Wide Bay Water Case Study

Reusing sewage protects a World Heritage site and develops new revenue streams

Wide Bay Water's reuse scheme is an example of wastewater being recycled and reused to avoid environmental pollution. During the past 23 years since the scheme's inception, federal and state government grants have helped to fund its expansion.

The recycled water is being used for irrigating cane farms as well as the utility's own hardwood plantations in a bid to create revenue streams. However, irrigation demand is affected by climate, payback on plantation wood is long term and operating costs present an ongoing burden.

This study is funded by the Australian Water Recycling Centre of Excellence under the Commonwealth's Water for the Future Initiative

WIDE BAY WATER

The Hervey Bay Water recycling scheme is located in the Fraser Coast Region in Queensland and comprises three sewage treatment plants.

ELI CREEK

CAPACITY	CLASS OF WATER
4.5 ML/d	B

TYPE
Activated sludge/trickling filter

USAGE
Golf course, cane farms, plantations

PULGUL CREEK

CAPACITY	CLASS OF WATER
5.0 ML/d	B

TYPE
Activated sludge plus intermittently decanted extended aeration

USAGE
Cane farms, plantations, sporting fields, airport

NIKENBAH

CAPACITY	CLASS OF WATER
4.8 ML/d	A

TYPE
MBR with biological nutrient removal

USAGE
Cane farms, plantations

ABOUT THE PROJECT

This national collaborative research project entitled "Building industry capability to make recycled water investment decisions" sought to fill significant gaps in the Australian water sector's knowledge by investigating and reporting on actual costs, benefits and risks of water recycling **as they are experienced in practice.**

This project was undertaken with the support of the Australian Water Recycling Centre of Excellence by the Institute for Sustainable Futures (ISF) at the University of Technology Sydney (UTS), in collaboration with 12 partner organisations representing diverse interests, roles and responsibilities in water recycling. ISF is grateful for the generous cash and in-kind support from these partners: UTS, Sydney Water Corporation, Yarra Valley Water, Ku-ring-gai Council, NSW Office of Water, Lend Lease, Independent Pricing and Regulatory Tribunal (IPART), QLD Department Environment & Resource Management, Siemens, WJP Solutions, Sydney Coastal Councils Group, and Water Services Association of Australia (WSAA).

ISF also wishes to acknowledge the generous contributions of the project's research participants – approximately 80 key informants from our 12 project partners and 30 other participating organisations.

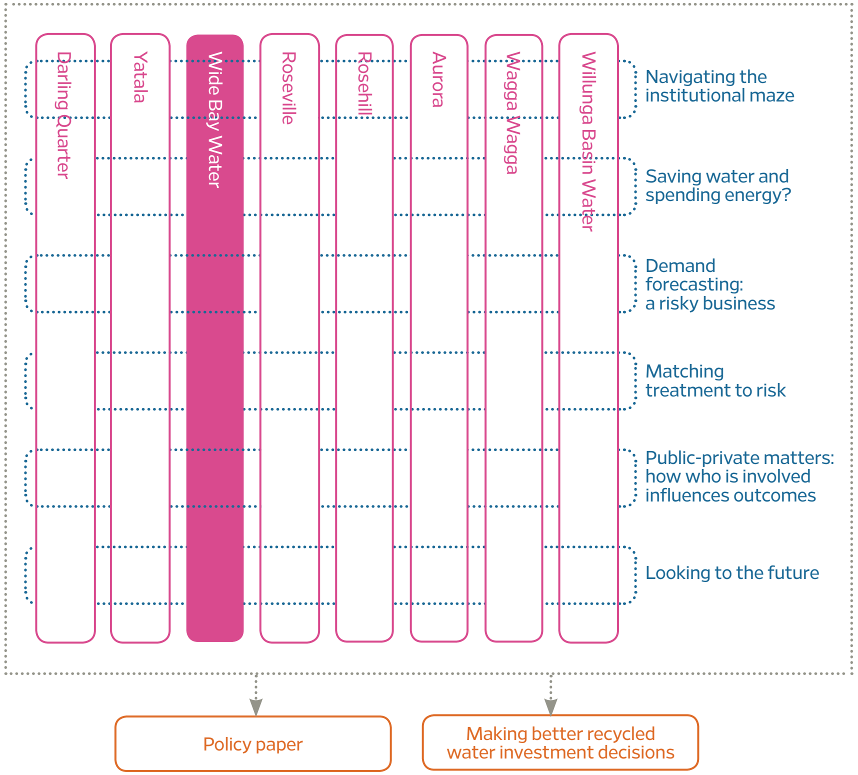
Eight diverse water recycling schemes from across Australia were selected for detailed investigation via a participatory process with project partners. The depth of the case studies is complemented by six papers exploring cross-cutting themes that emerged from the detailed case studies, complemented by insights from outside the water sector.

For each case study and theme, data collection included semi-structured interviews with representatives of all key parties (e.g., regulators, owners/investors, operators, customers, etc) and document review. These inputs were analysed and documented in a case study narrative. In accordance with UTS ethics processes, research participants agreed to participate, and provided feedback on drafts and permission to release outputs. The specific details of the case studies and themes were then integrated into two synthesis documents targeting two distinct groups: policy makers and investors/planners.

The outcomes of the project include this paper and are documented in a suite of practical, accessible resources:

- 8 Case Studies
- 6 Cross-cutting Themes
- Policy Paper, and
- Investment Guide.

For more information about the project, and to access the other resources visit www.waterrecyclinginvestment.com



ABOUT THE AUTHORS

The Institute for Sustainable Futures (ISF) is a flagship research institute at the University of Technology, Sydney. ISF's mission is to create change toward sustainable futures through independent, project-based research with government, industry and community. For further information visit www.isf.uts.edu.au

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DISCLAIMER

Summary

The original driver for water recycling at Hervey Bay was that it offered a cheaper and more acceptable option for dealing with wastewater from the growing population than the alternative of an ocean outfall. The anticipated cost of infrastructure and treatment that would have been required to discharge to high quality environmental areas was re-directed into creating a valuable product, rather than an expensive waste stream.

Since the development of the scheme, Wide Bay Water Corporation (WBWC) has been very successful in securing State and Federal government subsidies for many of the capital investments, which reduced the costs to customers. WBWC signed up some of the irrigating cane farmers in the region on retainers to take recycled water, which is very valuable to them during dry years, although no dryland farmers were convinced to shift to irrigation. WBWC also invested in water reuse to produce hardwood on consignment to the energy sector for power poles, with the land as an appreciating asset.

However, a changing regulatory and organisational context means that drivers are changing, and the future operation and expansion of water recycling in the region is less clear.

The short story

Protecting the unique wetland ecosystems of the Great Sandy Strait Ramsar site is a major driver for recycling effluent from the Hervey Bay area.

Hervey Bay is a coastal town located at the mouth of the Great Sandy Strait, a sand passage estuary between the mainland and the World Heritage-listed Fraser Island. The region's mangroves and wetlands support biodiverse ecosystems and the area holds significant cultural and spiritual importance to Indigenous peoples. Residents and visitors highly value the commercial fishing, recreational fishing, swimming, boating and tourism-related activities supported by the natural environment (Department of the Environment 2011).

The Hervey Bay effluent reuse scheme was established in response to population growth, fear of sewage debris on the beach, and cost-saving considerations.

As one of the fastest-growing areas in Queensland, throughout the 1980s increasing volumes of effluent was a growing concern for the then Hervey Bay City Council.

At the same time, the declining health of coastal and riverine waters in urban areas was also one of several factors driving the implementation of recycling schemes nationwide (WME Magazine n.d.). A particular influence was the frequent incidence of sewage debris and high coliform counts on Bondi Beach, a problem which played a major role in convincing the Hervey Bay community and Council that the region should choose reuse rather than an ocean outfall. The initial capital cost for the reuse scheme was also estimated at less than the cost of an ocean outfall.

Since the commencement of the scheme in 1989, Australian and Queensland Government subsidies and rebates have supported the financial viability of scheme expansion.

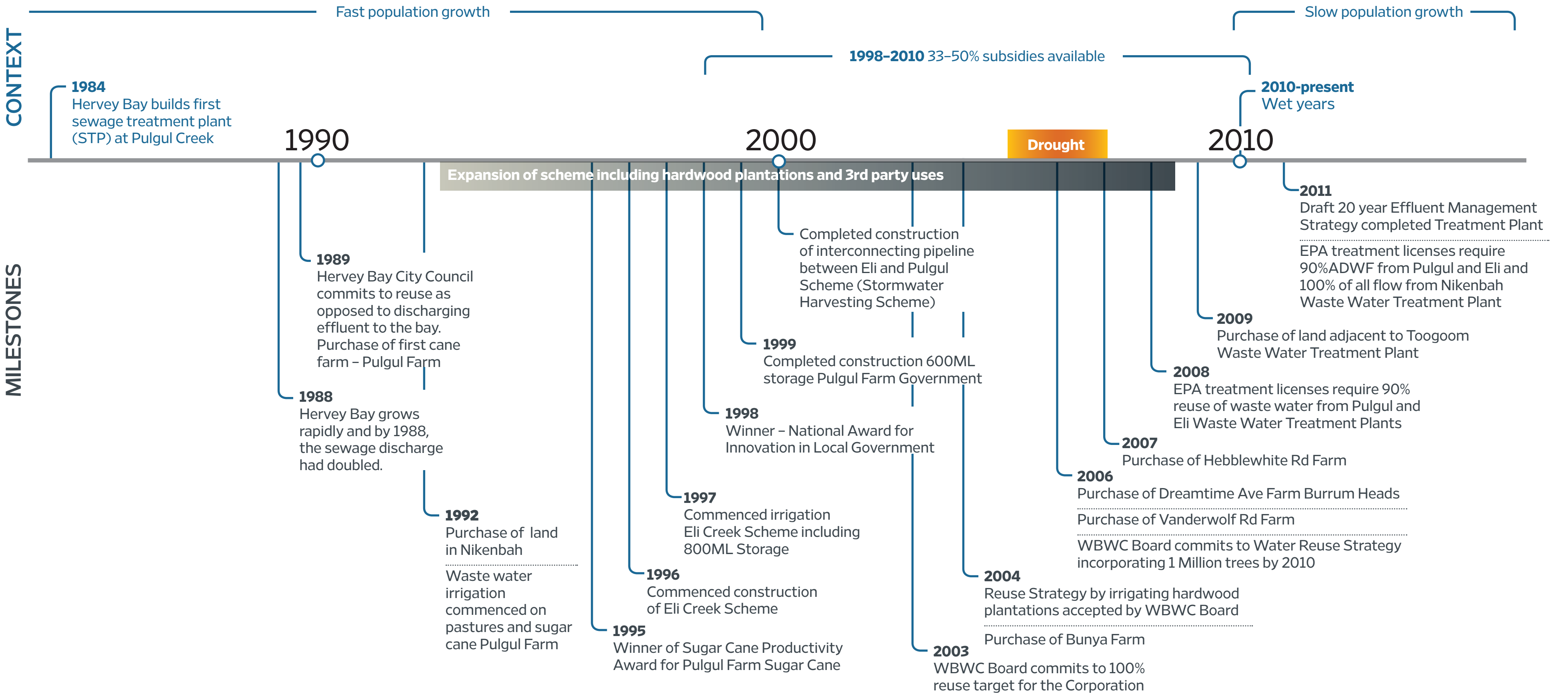
> "The quick budget estimate at the time for a 3-kilometre ocean outfall was $3 million 1988 dollars... The Council Mayor threw it back in their face and said, I'm not facing the population of Hervey Bay to tell them our biggest single capital works expenditure for next year is to build an ocean outfall when the front page headline is *Turds on Bondi Beach*."

Innovative irrigation-based reuses aim to create value for the community, but their rainfall dependency poses challenges.

The reuse scheme initially focussed on providing irrigation water for cane farms. However, reuse was limited by the seasonal nature of cane irrigation and lower than expected uptake. Wide Bay Water Corporation subsequently extended its reuse operations by developing native hardwood plantations. This helped balance demand throughout the year and will provide a potential revenue stream for the local community through sales of plantation products. However, opportunities to reuse recycled water on plantations are limited overall by naturally high salt levels in local soils and in wet seasons by reduced demand. The greater need to discharge during wet seasons has resulted in mass pollutant loads that have breached environmental licence conditions.

The subsidies available in the past for establishing and expanding recycling schemes are unlikely to be available in at least the near future. Further, WBWC is currently undergoing a period of structural and organisational change, transitioning from being an independent water corporation to a unit within Council. Within this context, WBWC is currently grappling with decisions about whether and how to continue with water reuse as a means of managing effluent in the future. Systematic consideration of costs, benefits and risks across diverse stakeholders will determine whether and in what form recycling will represent a value proposition for the local community in the future. This case study highlights gaps in information on costs, benefits and risks of the Hervey Bay recycling scheme.

Timeline



The reuse scheme

Wide Bay Water Corporation's network comprises eight wastewater treatment plants of which seven service the Hervey Bay region. The Maryborough WWTP was added when Hervey Bay and Maryborough water services were amalgamated in 2010 (Wide Bay Water Corporation 2011a).

Eli Creek, Pulgul and Nikenbah are the three main sewage treatment plants (STPS), treating sewage to B, B and A class respectively. Water from Nikenbah is mixed with Eli Creek water, so all reuse water produced from the scheme is classified as B. There is no outfall from the Nikenbah plant, but it is networked to Eli Creek and Pulgul plant which discharge via small creeks. These three STPS have a combined design capacity of 14 ML/day and provide reuse water for cane farms, WBWC native hardwood plantations, a golf course, sporting fields and airport dual reticulation. There are also several lower-volume reuses linked to other smaller STPs in the area.

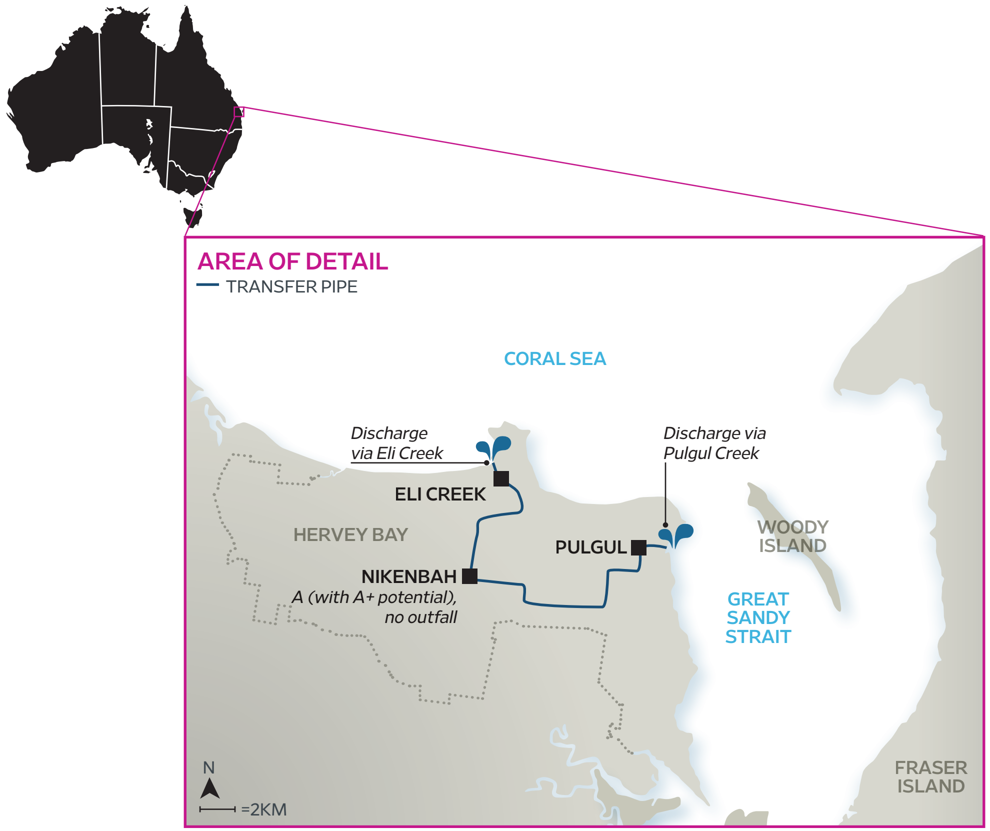
Introducing the stakeholders

The natural environment in Hervey Bay benefits local, national and global communities

The significance of the natural environment in the Hervey Bay region is recognised locally, nationally and internationally. Interviewees noted that the natural environment benefits not only Hervey Bay, but is important to wider Australian as well as global communities.

> "The cost (of recycling) borne by a local community is actually offsetting an impact on a World Heritage area. So it's a local cost for a common good. Which is not necessarily fair to the local community."

Hervey Bay wastewater treatment plants



ELI CREEK	PULGUL CREEK	NIKENBAH
Capacity 4.5 (ML/d)	**Design capacity** 5.0 (ML/d)	**Design capacity** 4.8 (ML/d)
Class B	**Class** B	**Class** A
Type Activated sludge/ trickling filter	**Type** Activated sludge plus intermittently decanted extended aeration	**Type** MBR with biological nutrient removal
Usage Golf course, cane farms, plantations	**Usage** Cane farms, plantations, sporting fields, airport	**Usage** Cane farms, plantations

The Hervey Bay community faces economic constraints

The local community of approximately 55,000 people are heavily dependent on the major local industries of sugar cane growing and milling, and tourism. The area was identified by interviewees as a lower socioeconomic area, consistent with the ABS's SEIFA index which ranks one part of the Hervey Bay SLA in the lowest decile in both Australia and Queensland. Compared to the Australian average, greater proportions of the community in the Fraser Coast region/statistical division/SLA are unemployed or retired. The Wide Bay-Burnett Region has been identified by the ABS as having one of the highest rates of long-term unemployment in the country, at 3.4% (ABS 2003).

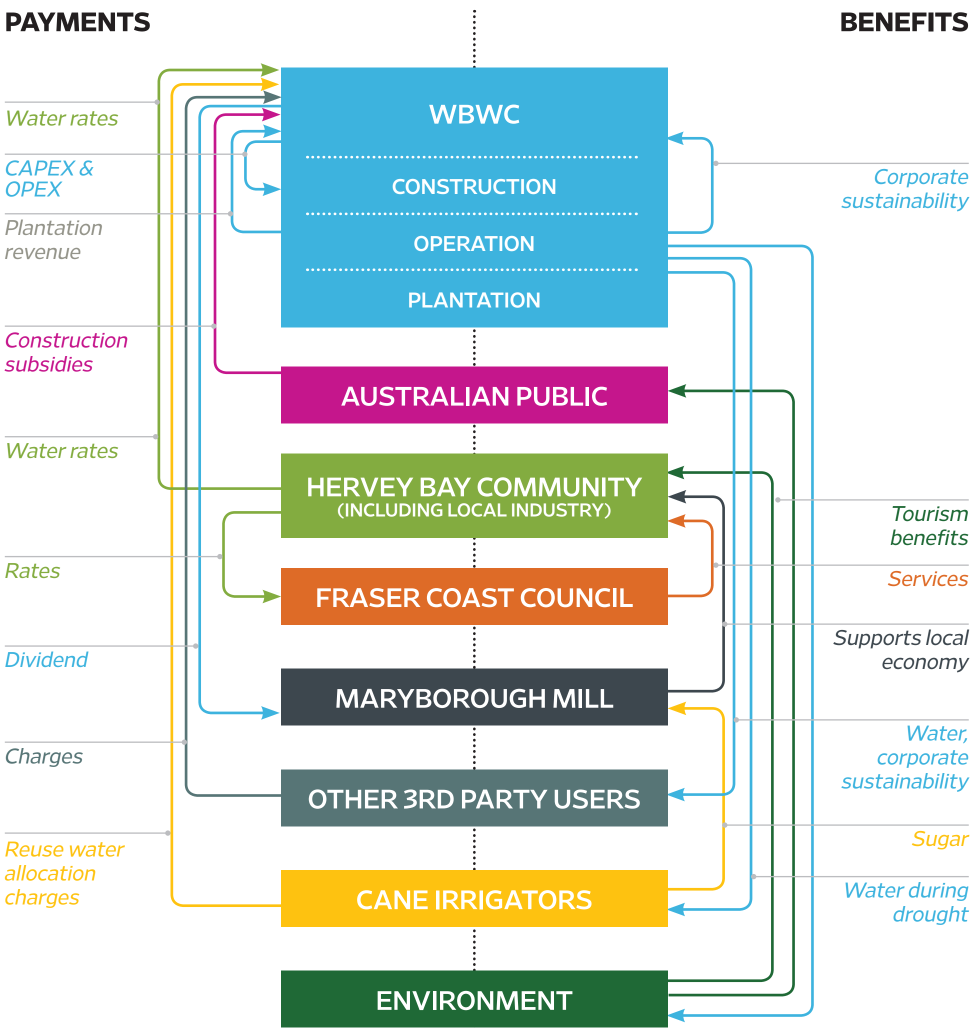
Hervey Bay has experienced a slowing in economic activity and population growth, which has raised concerns about the community's current and future ability to absorb the costs of recycling schemes.

The local sugar industry is predominantly based on dryland farming, with some irrigation

Cane growing is a major agricultural industry in the Hervey Bay area. Taken together, the agriculture, forestry and fishing industries are the largest employer in the regions and they employ approximately 18% of the workforce. The predominant form of agriculture is dryland rather than irrigation. Whilst irrigation does significantly improve production, it also involves cost and significantly more work. Also, some of those who do irrigate do not utilise as much water as they could because of concerns about their soil quality being put at risk - the naturally sodic coastal soils are quite susceptible to structural damage from the higher salinity levels of recycled water. However, one interviewee indicated that analysis of the

> Irrigation is hard work... Some guys are nearly 80 and they've still got the farm. They've got this water but they just don't need to use it... For others, hobby farmers and part-timers, it is just a lifestyle thing... they just choose not to [irrigate]."

Payments and benefits of water recycling



soils that have been irrigated by wastewater for the longest period has shown productivity improvements, with higher soil carbon, neutral pH and better drainage characteristics, indicating that the impact on soils can also be positive.

Wide Bay Water Corporation (WBWC) is undergoing significant structural and organisational change

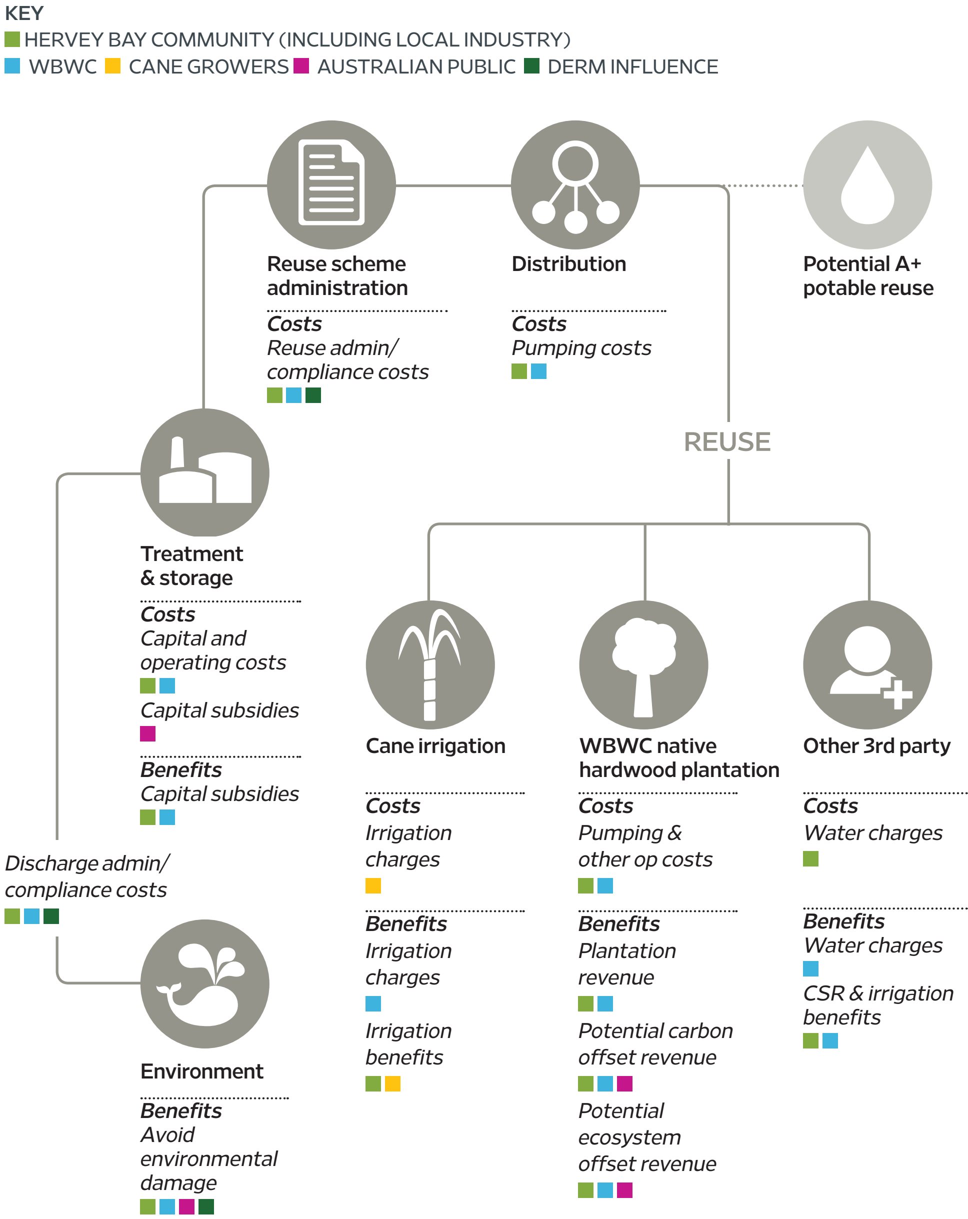
Wide Bay Water employs more than 200 people and is wholly owned by the Fraser Coast Regional Council. WBWC sets its own tariffs that are approved by Council on a year-to-year basis, in contrast to the 5-year price path strategy adopted by most regulated metropolitan utilities (Marchment Hill Consulting 201). For the year 2010/11, a total dividend of $3.8m was paid by WBWC to the Fraser Coast Regional Council (Wide Bay Water Corporation 2011b).

Throughout the 2000s, the then CEO, Board members and senior employees were instrumental in driving the development of the reuse scheme and other water supply and efficiency projects. In recent years, WBWC has been undergoing a period of significant change. A new CEO and several new board members were appointed, and across the organisation increasing emphasis has been placed on examining the costs of the WBWC operations. In July 2012, the Fraser Coast Regional Council commenced a Public Benefit Assessment of alternative business model options for Wide Bay Water Corporation. Following public consultation, the Council decided to dissolve the WBW Corporation in late 2012 and shift the water and wastewater services to a commercialised business unit within Council.

The Queensland Government's Department of Environmental Heritage and Protection (previously DERM) imposes strict regulatory regimes on both discharge and recycled water quality

The Queensland Department of Environmental Heritage and Protection (EHP) regulates two main aspects of WBWC's operations: firstly, through discharge licence conditions on WBWC's DA for its operations under the *Environmental Protection Act 1994* and the *Environmental Protection (Water) Policy 2009* and secondly, through regulation of WBWC's recycled management, including that of third parties, under the *Water Supply and Safety Reliability (WSSR) Act 2008*.

Stakeholder interest and influences in scheme components



Costs, benefits and risks

Wide Bay Water Corporation interviewees held diverse views and perceptions on the costs, benefits, and risks of recycling - and on the extent to which recycling as a whole will represent value for the community in the future.

> "There were some good grants [for Nikenbah]... At some point we expect to take that water through and actually use it as a drinking water supply. But that would require a huge shift in public perception. So whether or not that will happen in my lifetime depends on how many more droughts we have."

What started as a relative saving in capital costs became a substantial investment in treatment and storage infrastructure over time

In addition to regulatory, community and political opposition to damaging the natural environment, avoided infrastructure capital costs were also a driver for establishing the scheme in 1988, even before subsidies were considered.

Whilst WBWC was enormously successful in securing subsidies, substantial additional investments were required to continue to expand the scheme. Over the period 1998-2010, WBWC accessed almost $14 million of State and Federal government subsidies for reuse construction and land purchase. These subsidies were sought with a range of goals in mind, including nutrient removal, sugar industry reform, and reuse. These subsidies substantially offset the construction and in some cases land costs to WBWC and the community, ranging from one-third to one-half of total costs. The remainder of the reuse capital costs including construction and excavation costs have been borne by WBWC and local ratepayers.

The development of the Nikenbah WWTP, and the subsidies obtained for it, are a key example of the influence on investment decisions by WBWC of drought and associated general policy direction. Nikenbah, which is linked to the overall reuse scheme, was deliberately designed with the potential to be upgraded to supply A+ class potable water during drought as this enabled it to attract a substantial reuse subsidy. According to interviewees the alignment with the then State government policy agenda driving potable reuse was influential in securing the subsidy. Since then, however, the reuse water produced from Nikenbah is mixed with B class water from the other treatment plants and used for irrigation.

Comparative data on the treatment costs for reuse purposes compared to ocean outfall were not available for this case study. However, some interviewees were of the view that no additional *treatment* costs are incurred for Pulgul and Eli treatment plants from implementing the reuse scheme, and the upgrading of those plants to include tertiary treatment could have been avoided.

GRANTS AND SUBSIDIES PAID 1998–2009	VALUE ($ '000)	GOV'T	YEAR OF FINAL PAYMENT
Vanderwolf Reuse	2,448	State	2009
Eli Reuse	2,247	State	1998
Burrum Heads Reuse	1,984	State	2010
Pulgul North and South Reuse	1,649	State	2006
Bunya Reuse	1,529	State	2007
Eli Reuse SIIP Contribution	1,500	Federal	1998
Stormwater Harvest/ Interconnecting Pipe	1,150	Federal	2001
Pulgul East Reuse	935	State	2010
Extra Subsidy due to Reuse (Nikenbah STP)	477	State	2010
Wastewater Fill Stations	150	State	2008
Howard Reuse	103	State	2006
TOTAL	**$14,172**		

> "We started this process of 'we're all going to drink recycled water in South East Queensland'. They brought in some very, very strong rules in terms of water quality..."

The regulatory framework for recycled water management was introduced during a period of rapid change. Subsequent experience demonstrates that there is potential for streamlining regulatory processes and requirements.

The management and administration costs of the reuse scheme relate to operations and customer management as well as compliance with regulations. In the process of developing its Recycled Water Management Plan, WBWC is currently grappling with the requirements of the WSSR Act. WBWC participants noted that the water quality standards may be overly restrictive. For example, the regulations require A+ class for car wash use, but the WBWC reuse system supplies class B, and hence a potential developer was deterred from establishing a car wash at Hervey Bay's airport industrial estate.

In addition, monitoring and reporting requirements are onerous and relatively inflexible. Complying with these requirements creates substantial ongoing administration costs - around one or two people full-time for WBWC.

> "The legislation was put in place pretty quickly to coincide with the development of the Western Corridor... too quick. What has been implemented isn't actually working; it's deterring a lot of councils and water authorities... Toowoomba Regional Council actually shut down recycling schemes ... the regime of testing and all the other paperwork, it is not viable for them."

According to interviewees, public health outcomes could be met with a more flexible system: the current level of rigidity is not required to ensure public health outcomes, and is actually discouraging other small Queensland utilities from pursuing recycling.

Cane farmers are the major third party recycled water user

Cane irrigators comprise approximately 90% of all water reused by third parties. They are the major beneficiaries of the reuse scheme, particularly during drought. Although not all cane growers utilise irrigation water to its full potential, for the one-third of growers in the region who do aim to maximise production, reuse water is key to maintaining cane yields throughout periods of drought. This results in benefits in terms of production for the local sugar mill, and the local economy.

> "A decision not to recycle water would mean that our third party users in a drought have no water. Which means they then can't grow cane. Which then means there's not enough cane to keep the mill open in Maryborough. They have a set tonnage that they need to put through the plant to make it viable. So what happens then? Then the mill shuts down? Then we don't have any cane farming in the region?"

Cane farmers pay approximately $26/ML for their allocation of reuse water and a further $8.75/ML for the water they actually use. WBWC interviewees noted that the revenue from charges offsets the power costs of the reuse system, which are about $34/ML. However, electricity costs have soared recently and WBW have indicated that they will need to increase water prices for farmers to help recover their increased energy costs.

From the cane farmer perspective, health risks are not perceived to be a problem with using recycled water, but there are limits to how much reuse water they can apply due to the risk of soil salinisation - in practice, regular soil

"I think effluent water always needs to be cheaper than scheme water because you're taking on...environmental risks."

monitoring is required. This in part influences irrigators' views that effluent water should be priced lower than potable mains water. However, where regular monitoring of soils has occurred, it has not revealed changes in soil structure due to reuse water application on cane farms.

In addition to agricultural use, other third party users include the council for open space, golf courses, Hervey Bay airport and dust suppression.

There are administration costs involved with managing the third party reuse element of the scheme. These are in addition to the legislative compliance costs outlined above, and for WBWC, they mainly involve negotiating and establishing contracts and billing arrangements.

WBWC Native hardwood plantations have large, long-term land requirements. That means high up-front costs but also significant long-term benefits because the land is an appreciating asset.

WBWC currently holds 1300 ha of land, which includes 550 ha for reusing treated effluent on hardwood plantations. The cost of land for plantations is of key interest and contention amongst WBWC interviewees. In the past, subsidies were available for the purchase of some of this land. Some interviewees noted that the now higher cost of land and the absence of subsidies going forward as key factors that should influence decisions about whether to extend the land-based reuses of the scheme. Others argued that as land is an appreciating investment for the local community, increasing property prices are a financial argument for, not against, extending the scheme. The land for the Pulgul Reuse scheme cost Council $1m in 1989 and is now worth $2.4m according to a recent valuation. In contrast, the same investment in plant and equipment would have depreciated to be worth almost nothing over the same time period.

"You could buy land in Hervey Bay. It was cheap. There was a 50 per cent rebate. You could get a funding from the Government... None of those things exist anymore.... there's no subsidy for buying the land. The land itself is both very expensive and much further away."

"When you procure land, it's not a purchase that's written off. It's an investment and it appreciates.... As the old adage goes, if it appreciates, buy it. If it depreciates, rent it... If you take the whole life cost on reuse, and you put all the things that you should put into the NPV equation. Then it stands on its own two feet as being a viable option."

The plantation operating costs include pumping and other energy costs, personnel, and the cost of chemicals. Interviewees estimated that the total operating costs amounted to about $2100 per hectare per year. This includes $94/ML for electricity.

Several interviewees raised concerns about risks associated with WBWC plantations, specifically the risk of pests, storm damage, fire damage, and soil sodicity. Insurance against storm, fire and pest damage offset some of these risks but also add to the operating costs - around $66,000 per year. Storm damage was experienced in 2008 possibly due to overwatering during drought, but changes in watering practices since then have reduced that risk.

In terms of soil sodicity, some interviewees viewed the demand risk of the scheme - where irrigators do not take water during wet seasons - as shifting the risk to WBWC land, where over-watering could cause salinisation. However, other interviewees involved in the management of the plantations noted that watering rates are calculated to minimise risk, and a regular soil monitoring programme has not revealed any changes to soil sodicity or structure due to irrigation.

WBWC currently has a contract with Ergon Energy to supply power poles. Interviewees noted that the terms of the contract specifying timing are somewhat flexible from the perspective of WBWC, with Ergon agreeing to take poles earlier or later depending on when they mature, due to an overall shortage of pole supply in the market. It is expected that the plantation revenue stream from pole sales as well as other wood products will be approximately $53,000 per hectare over an 18-year cycle.

Some interviewees also noted other potential revenue streams from biodiversity offset and carbon offset values that had not yet been assessed. These are in addition to the possible intangible benefits of providing habitat to native species.

> " So continuing the reuse scheme is still adding a monetary value to the community, because it's an asset in a way. It's not a depreciating asset. There is an end product."

There is contention about the scale of water recycling's contribution to improved local ecological outcomes. While there is agreement about the importance of the environmental, recreational and cultural values of the region, a major point of contention amongst WBWC interviewees was the extent to which the reuse scheme prevented ecological damage.

Some interviewees noted that the Eli Creek and Pulgul discharge points were already located in areas classified as having "Low Environmental Value", and that hence the impact would be negligible. In contrast, others argued that the Eli Creek and Pulgul discharge points are close to recreational swimming and boating areas, and that even localised damage to seagrasses would have significant adverse impact on environmental values.

A few noted that advances in treatment technology mean that the cost of treating wastewater to a quality suitable for discharge is now much lower than when the original decision to develop land-based reuses was made. However others recognised that future increases in mass loads are unlikely to be approved by the environmental regulator.

Amongst the differing views, what is clear is that there is a gap in scientific monitoring and modelling of the water quality and ecological impacts of Hervey Bay sewage discharge, relative to impacts from pollutants discharged via the Mary River. Some studies have noted that the ability of

WBWC'S EXPERIENCE OF CHANGING DISCHARGE LICENCE CONDITIONS

The 90% reuse was originally set by WBWC as an aspirational target. During the development of WBWC's operating licence (DA), WBWC and DERM included the same target as a condition of licence.

In earlier days with a lower population, meeting this target was feasible. However, as population and wastewater treatment volumes grew, this target became increasingly difficult to meet. It also became apparent that as the condition was based on average years, it did not reflect the level of environmental impact which differed greatly between wet and dry years.

> "The targets in the DA were really proposed by Wide Bay Water. They were [...aspirational] targets and we put them in.
> When the EPA came to talk to us about getting our new licence under the Environment Protection Act 1994, they said well here are your choices. You either go to reuse or we make it really hard for you to discharge."

In recent years this target was amended by DERM to 90% of Average Dry Weather Flow in acknowledgement of the increased inflow during wet conditions, reduced opportunities for land-based reuse, and the lower marginal environmental impact of effluent discharge during wet conditions.

Separate licence conditions are also set for each of the two main, interconnected treatment plants with discharge points, Pulgul and Eli. WBWC and DERM are also currently negotiating a bubble licensing arrangement, to improve the flexibility for managing discharge from the treatment plants.

> "It's a bit different with the Mary... because it is a real tidal system... where it comes out it goes into the Sandy Straits, but it's not a high recreational area. Whereas the WWTP discharge points are to small creeks... the problem is they're right near swimming and recreational areas."

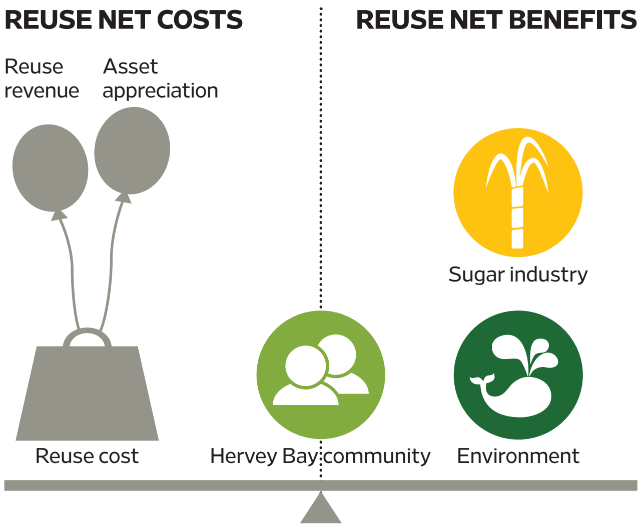
> "There is the natural load, then there is the unnatural load of which our discharge is a part… I don't think the two things should be confused. There should be a limit, which is not for us to prescribe, but for DERM [the environmental regulator] to set."

the wetlands to recover from contamination damage during storms depends on levels of stress between storm events. WBWC has currently commissioned an ecological study to assess the relative impacts. This information will be vital to underpinning any future community consultation about how much the Hervey Bay community values protecting the local environment and what they are willing to trade off.

> "We wouldn't get that approval [for an ocean outfall] in our area… because it's all sorts of green zones, it's all Ramsar Wetlands, so you know, World Heritage List – Fraser Island… It's not particularly an option."

Key learnings

Past decisions to pursue reuse were substantially influenced by the availability of subsidies. Looking to the future, more detailed information is required to systematically weigh up costs, benefits and risks.
WBWC is in the process of examining ongoing operating costs of the scheme, and is also considering whether further expansion of the scheme would be viable in the absence of further subsidies. To determine options for ensuring the ongoing financial viability of the scheme, they are pursuing additional information and more systematic analysis is required to better understand the net financial costs of the scheme, and to compare these costs to the environmental and local economy benefits.



Understanding the actual impacts of effluent discharge on the bay, and how the community values protecting the environment, is critical to scheme operation and to decisions about future reuse.
As the main driver for irrigation-based reuse is the desire to avoid damage to the receiving environment, the lack

of detailed monitoring and modelling of the impacts of discharge has hampered effective decision-making regarding reuse. In recognition of this, WBWC has commissioned studies to shed light on this issue. The exact nature of ecological impacts will depend on the characteristics of the event, and modelling is by definition limited in the extent to which it can exactly predict harm. WBWC and DERM are continuing to discuss how elements of an adaptive management approach can inform licensing conditions.

Introducing flexibility to licensing requirements could substantially reduce the costs of scheme administration and management

WBWC is pursuing negotiations and discussions with the environmental regulator, EHP, to introduce flexibility into two regulated elements of its operations.

Firstly, under a bubble licensing arrangement WBWC operators would be able to manage their discharges as an integrated network, rather than as individual plants.

Secondly, WBWC is currently navigating the process of developing and implementing a Recycled Water Management Plan. They have noted that the legislative requirements introduce substantial administration costs and complexities to operating the reuse scheme, but without additional public health risk reduction benefits. WBWC notes that EHP has welcomed discussions on this matter. Reducing compliance costs in this area could have a substantial impact on the net costs of the reuse scheme.

In wet conditions, which result in low demand for reuse water for cane irrigation, WBWC is largely insured contractually against demand risk. However, if reuse water cannot be disposed of on land, attention and potential risks shift onto the discharge to the bay.

As irrigators pay for 75% of their allocations of reuse water irrespective of the volume they use, there is a "revenue floor" for WBWC irrespective of rainfall conditions. However, when third-party users do not take their allocations, greater management is required to balance the disposal of reuse water on WBWC plantations in a way that avoids soil salinisation and an increase in discharge to the bay which could result in a breach of licence conditions.

Future decisions about recycling need to be directly informed by community perspectives on the value of environmental and local economy benefits.

WBWC interviewees shared a strong sense of responsibility for and pride in providing services to the local community according to the community's needs and preferences. Many believed that although the community highly valued the natural environment, the emerging sentiment was that the financial costs outweighed the benefits of recycling. When engaging with the community to determine its attitudes and perspectives, key topics to focus on are: ecological values; risk of sugar industry impacts during drought; long-term prospects of selling land for development; and appropriate timeframes for decision-making.

> "There should be total community engagement so that people know what benefits they're going to be paying for."

Assessing the costs, benefits and risks of recycling, the changes over time and future prospects, are genuinely complex, but critical, tasks for WBWC.

As illustrated throughout this case study, recycling schemes can come with many interrelated costs, benefits and risks. Due to unexpected weather and demand conditions and expected conditions do not always eventuate on a year to year basis - and there are constraints on what historical and current data is available for assessing whole-of-scheme net impacts over a longer period, and for comparing them to expectations.

As WBWC contemplates whether and how to continue and further implement the recycling scheme within its effluent management strategy, the main challenge is how to assess costs, benefits and risks when the future is by definition uncertain - population growth, demand and climate conditions are all uncertain factors. Scenario analyses might provide a risk-weighted picture of how the costs and benefits will result in different circumstances.

> "Forecasting is probably one of the hardest areas… I just haven't got an average year over the last four or five years because of drought and rain and all the rest of it. And what's the population doing? Every set of numbers you see coming out of OESR are different."

The 'baseline context' for making decisions about investing in recycling is also shifting, with external influences of regulation and organisational structure changing.

In terms of regulation, impact-based environmental regulation (of discharge quality to the Bay) may help introduce flexibility in how the recycling scheme is managed to help avoid land-based risks (as well as minimise costs). The water quality management plan requirements may currently add significant administration costs, but these are expected to be streamlined soon and hence these costs may decrease.

In terms of organisational influences, what is and isn't considered within the scope of utility activities may change as WBWC is reintegrated back within Council. In particular, the equation for costs, benefits and risks - and the equation for determining how and when the community will benefit from and pay for the scheme - will change substantially if the management of reuse is no longer considered part of WBWC operations.

Summary of costs and benefits

WBWC				
Costs				
	When	**Transferred to or from**	**Details including value where available**	**Key influences**
Land purchase for reuse scheme, net of subsidies	Past cost	To Hervey Bay Council	$1.6 million (spent 1989–92) $6.6 million (spent 2004–11)	Subsidised (spent over time – estimate)
Reuse scheme operating costs including management and administration	Net present value (NPV) over 20 years	To Hervey Bay Council	NPV $15 million[1]	Including management, admin, labour, plantation and irrigation maintenance
Benefits				
Revenue from third party recycled water charges	NPV over 20 years	From third party recyclers	NPV $1.2 million[1]	
Revenue from plantation product sales	NPV over 20 years	To Hervey Bay Council	NPV $6.7 million[1]	Based on future projected sales NPV $5.8 million is already secured. Note, prior to 2013, revenue was $3000/year.
Revenue from carbon credits	Future potential benefit, if participate in scheme	To Hervey Bay Council	N/A	

Summary of costs and benefits (cont.)

HERVEY BAY COMMUNITY				
Costs				
	When	Transferred to or from	Details including value where available	Key influences
Reuse scheme operating costs (via water charges)	Ongoing cost	From WBWC	NPV $10.8 million[1] (in 2012 dollars)	Legislative compliance adds administration costs; these may be streamlined and reduced.
Reuse scheme capital costs for irrigation system and planting (via water charges)	Past cost	From WBWC	$4.8 million (spent 2006–2011)	Substantially subsidised throughout 1990s.
Reuse scheme capital costs for land	Past costs	From WBWC	$1.6 million (spent 1989–92) $6.6 million (spent 2004–11)	Subsidised
Benefits				
Viable local sugar industry throughout drought	Past benefit and also realised periodically during future drought.		Has not been quantified	
Potential A+ potable water from Nikenbah	Potential future benefit		Has not been quantified	
Land value appreciation	Ongoing benefit, potentially realised in future	From WBWC	Land bought in 1989–90, has appreciated by $1.7 million (by 2012 estimates)	Potential risk of soil sodicity
Revenue from plantation product sales	Future ongoing benefit once thinning commences in 2016.	From WBWC	NPV $6.7 million[1] projected, of which NPV $975k is yet to be secured by contract	Potential risk of pests, storm or fire damage (management approaches and insurance in place)
Revenue from carbon credits	Future potential benefit, if participate in scheme	From WBWC	N/A	90 ha have been surveyed and registered with the Greenhouse gas office
Avoided damage to ecological, recreational, cultural and tourism values of receiving environment	Ongoing benefit		Has not been quantified[2]	

Summary of costs and benefits (cont.)

LOCAL CANE GROWERS

Costs	When	Transferred to or from	Details including value where available	Key influences
Recycled water charges	Ongoing benefit	To WBWC	$75,014 p/a	Based on consumption average over life of scheme
Benefits				
Irrigation through drought	Past benefit and also realised in future periodically during drought		Avoided loss of 30% production	Potential risk of soil sodicity

AUSTRALIAN AND GLOBAL COMMUNITY

Benefits	When	Transferred to or from	Details including value where available	Key influences
Avoided damage to ecological, recreational, cultural and tourism values	Ongoing benefit	To WBWC	Has not been quantified, ecological studies currently underway[2]	

Notes

1. Net Present Value (NPV) calculations based on a 20 year timeframe, using 2012 prices with a 7% discount rate.
2. Total Recycled Water Used on Land (1994-2013) = 37,488.785ML Total Nitrogen and Phosphorus saved from entering receiving waters and have been applied on land as Class B recycled water for agricultural purposes equals to 835,190.15kg and 112,466.36kg, respectively.

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