Activity Completion Report: Northern Group Rainwater Harvesting Project

Summary

Activity information

Activity Title	Northern Group Rainwater Harvesting Project
Goal	To improve resilience against natural disasters and public health by providing a reliable and safe water supply for the islands of Pukapuka, Nassau, Penrhyn and Rakahanga
Intended outcomes	1. Increased capacity for rainwater storage and collection 2. Improved resilience on these islands to natural disasters (including drought proofing) 3. Strengthened disaster management capabilities 4. Sustainable growth of opportunities for employment, improved public health and well being 5. Promotion of environmentally sustainable economic development

Contract or grant information

Start and end dates	11 Feb 2011 – Dec 2013
Total cost	$2, 162,243.09
Reporting period	Feb 2006 – Dec 2013

Completion report preparation

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Version #:	10

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Date report submitted:	1 February 2014

In response to the 2004-2005 cyclone seasons and the infrastructure damage sustained by the Northern Island Group, the Cook Islands Government developed the Cyclone Recovery and Reconstruction Plan (CRRP). Cabinet approved the CRRP in July 2006 for a three year period, 2006-2009 (M06, 397). The CRRP listed the Northern Water Harvesting Project as a priority. The purpose of the project was to improve the resilience on the islands of Pukapuka, Nassau, Penrhyn, Manahiki and Rakahanga to natural disasters (including drought proofing) and to strengthen disaster management capabilities by increasing capacity for rainwater storage and collection. An important feature was to encourage sustainable growth of the selected islands with opportunities for employment, improved public health and well-being and to promote environmentally sustainable economic development.

Despite the project concept being initiated as early as 2006 (CRRP, p. 60), central government (CIG/NZ) led scoping and planning lasted five years. When interviewed about planning time, a former DCD Project Manager stated that it was not a priortized project even though CRRP and NZHC had prioritized it. In 2009, the NZ High Commission contracted Critical Path Consulting (Chris Manu) to produce a design document (April 2009). Funding approval in February 2010 provided resources to the Ministry of Infrastructure & Planning (MOIP) to mobilise the project assisted by a Steering Committee consisting of key stakeholders – New Zealand High Commission (NZHC), Development Corporation Division (DCD, formerly AMD), Cook Islands Red Cross, National Council of Women (NCW), Ministry of Health, Infrastructure Committee. MOIP also employed a CRRP Programme Coordinator to oversee the CRRP projects.

In December late 2010 Northern Group Cook Islanders and architect Romani Katoa of Romani Designs Ltd was awarded the Project Mangemena contract. This provided capacity to complete detailed design and run final tender processes resulting in appointment of Lead Contractor (May 2011) Keta Williams of RVK Contractors ltd (May 2011). From December 2010-July 2011 procurements were managed, on-island site supervisors secured, local labor contracted, and a new high-quality tank designed. The contractors secured MOUs with all Island Governments by July 2011, ordered materials and confirmed freight services. By October 2011, all labor and materials had arrived on four islands and simultaneous installation began. By December 2011, the repair of roofs, installation of domestic water tanks and new spouting, and training sessions in water safety and tank system maintenance were all completed. The contractors waited out the defects liability period in order to be paid their final payment. However, final engineering assessments were not started until May and August 2013, providing a positive report (see timeline in appendices). In the end, despite the project stalling in development and closure, the local private sector contractors delivered the project goal of improved water quality for the Northern Group in a timely manner and within budget.

Northern Water Project delivered 344 water tanks accross 4 islands in 2 months adding 1.78 million liters of water storage, replacing 10,000 lineal meters of roof and 2,900 lineal meters of fascia and spouting within the allocated 2.2 million budget. Overall, water security of all households was improved with increased water quality contributing to the goals of improved public health and resiliency to natural disasters.

At completion, the project set new norms for water delivery and for future development projects. These included:

- A minimum water service standard for rain water harvesting in the Cook Islands (Relevance/Impact)
- Holistic focus on roofs, tanks and gutters (Relevance)
- Adapting to the needs of individual household context (Relevance/Efficiency)
- Public-private partnerships (Effectiveness)
- Island Government involvement (Effectiveness)
- A higher standard of water tanks sold in the Cook Islands (Effectiveness)
- Burrying tanks (Effectiveness/Efficiency)
- The use of a measure and value contract (Efficency)
- First flush system (Impact)
- Simultaneous installation (Efficiency)
- Purpose-built pallets (Efficiency)
- Local on-island labor and management (Impact)
- On-island education and maintenance training (Impact)

The main challenge with this project resulted from poors relationship between the local and central levels due to what was basically a lack of shared understanding of the project expectations and the adaptive approach, highlighted by disputes over the use of innovation like the "measure and value" contract. Despite the many emails there was considerable "talking past each other" and reports to the Steering Committee in lthe later phases of the project did not focus on development issues. Due to falling level of trust, NZ/Australia funds originally committed for Northern Group community water tanks were reallocated to sanitation.

Final technical assessments from MOIP engineers (May and August 2013) support the position

that private sector contractors met obligations and were unfairly represented as failing in delivery. In November 2013, DCD engaged a lawyer in order to settle outstanding claims. Rarotonga government agencies failed to provide a timely response (e.g. 5 year design process) and exercise professional contract management (poor record keeping, biased communications). Overall the Northern Rainwater Harvesting Project used effective practices that adaptated to the needs of household contexts and achieved a near universal minimum water service standard of 6000 Liters per household.

Despite being a successful project by the standards of the community, final engineering assessments as well as the nine monthly reports from the Program Manager, the Northern Water Project was often labelled a failure in Rarotonga. This is largely due to disagreements that should be ancipated in any community development change process where local, national and international power relations are challenged. Overall, the Northern Water Project offers lessons in how to more successfully move forward with public-private-local partnerships to deliver projects witihin budget and in a timely manner.

Ongoing education, training and maintenance will rest with the Island Government as well as with individual householders. Island administrators will be encouraged to include water catchment and water storage issues as a priority within their community meetings and to encourage all householders to be looking at continuous improvement of harvesting water in order to sustain their families during the dry periods, provided that householders are trained in keeping the roof, collection guttering and piping clean and in maintaining the tank and fittings.

Report

Background and context

The five cyclones that hit the Cook Islands in 2005 caused major devastation across the island nation. Rarotonga and the Southern Group Islands suffered under Cyclones Meena, Nancy and Olaf; the Northern Group was targeted by Cyclone Percy; while Cyclone Rae, as a finale, created havoc across both the northern and southern groups. Total damage costs to the business community, mainly in the tourism sector, was estimated at $10 million with damage to government and community assets and private residences estimated at $10.5 million. Most of these costs were met by donor agencies, an ADB loan and the private sector (CRRP, 2006, p7)[1]. The Budget Policy Statement 2005-2006 identified economic recovery as one of its key policy goals in light of infrastructure recovery and reconstruction pressures. The policy saw the need for a plan to ensure that the recovery needs of islands damaged by cyclones were met. The Cyclone Recovery Reconstruction Plan (CRRP) 2006-2009 outlined the objectives and strategies for meeting urgent housing and infrastructure relief, reviving livelihoods and creating conditions for economic recovery (p7).

For the Northern Group Islands, the Cook Islands Government identified the repair and upgrade of the water supply as a priority. The key message from the Government was that recovery planning would reduce risk from future disasters. This was aligned with the national goal to strengthen national resilience to natural disasters, including the effects of climate change, sea level rise and climate variability.[2] Since some ground water had been contaminated by salt intrusion and seepage of pollutants from septic tanks and previous disasters, each island was identified as needing to increase its capacity for roof water catchments and to establish water bores (CRRP, p41).The CRRP water sector strategy for the Northern Group Islands was aimed at increasing reliability of quality water supply to all sectors and island populations; promoting and strengthening the use of water catchments to secure sustainable water supply for island populations; and providing alternative water supplies for island populations with limited access to fresh water during a natural disaster (p42). Following on from the Falkland visits (2001, 2005 and 2006), Critical Path Consulting Ltd (April 2009) was appointed to consolidate surveys and produce a project design document that would provide a reliable and sustainable source of potable water to the Northern Group Islands of Rakahanga, Pukapuka-Nassau, and Penrhyn. Funding did not include household level water tanks for Manihiki, becuase a separate project had equipped the island with micro shelters with household water tanks. Budgets had been identified to improve community water systems in all the Northern Group, including Manihiki, but this was not delivered to the extent invisaged due to a lack of funding.

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[1] *MFEM, Aid Management Division, Cyclone Recovery Committee (CRRP 2006-2009) December 2006.*
[2] *Northern Water Harvesting and Drought Proofing for Pukapuka, Nassau, Penrhyn, Cook Islands. Project Design Document prepared by Critical Path Consulting Ltd, April 2010.*

The household rain water approach is further strengthened by research[3] into the likely climate scenarios for the Cook Islands. The most likely change to climate patterns for the Northern Cook Islands are greater intensity of rainfall events but also increased lengths of drought periods. Increased frequency of more intense weather events can be expected to place higher stress on water infrastructure (household and community water systems) and increase the risk of sea water infiltration into the limited ground water reserves. Depleted or destroyed water storage systems could lead to over-pumping of limited and fragile ground water resources contaminating these for significant periods of time. Such increased pressure on drinking water resources in the Northern Cook Islands would negatively affect public health.

The Northen Water project goals, which set forth good development practice included:

- To foster local decision making. To place decisions about allocation between roof repairs and water tanks with Island Councils.
- To foster climate adaptation. Good roofs are essential for drinking water collection and to reduce cyclone damage. Tanks need to be positioned away from storm surges.
- To provide opportunities for inclusion and ownership. Ensure residents can contribute to improvements. Ensure non-resident owners are aware of project and option to pay contractor directly for water tank/roof repairs.
- To build local capacity for improved water management. Training must target key people including household elders, women, Island Councillors, water managers and village elders.

CRRP (2006, p60) originally established the cost of the programme for the four islands at $1,875.000. However, with changing climate change patterns in the Northern Cook Islands and the increased frequency of more intense weather events were also taken into consideration, additional funding took the project value to $2.2million (Project Approval Notification Sept 2010, signed by L. Te Puni, NZHC). During the 2006-2009 period, a series of visites to the Northern Group assessed options and surveyed needs. Conflciting survey numbers hampered project design and in May 2009 as a stop gap measure the New Zealand Armed forces installed 10 x 25,000 L tanks in Pukapuka and Nassau during a training mission there.

Although the concept of the project arose out of the CRRP, the project itself did not eventuate until reorganized as a public-private partnership in 2010. In October 2010, a project management contract was awarded to Romani Designs Ltd and in May 2011 the suply and isntallation contract was awarded to RVK Ltd.

[3] *http://www.pacificclimatechangescience.org/wp-content/uploads/2013/06/9_PCCSP_Cook_Islands_8pp.pdf*

Assessment against DAC evaluation criteria

Relevance

A high degree of relevance is demonstrated. The Northern Water Supply and Drought Proofing Proposal contributed to **a safe and reliable water supply** for the communities on four of the five target islands. Rain water harvesting systems is a relevant response to contamination of ground water by salt intrusion and pollutants from septic tanks. Equality was improved across island communities addressing poverty reduction by increasing compliance with a ''minimum water service standard''. The public health and hygiene benefits from safe and reliable access to drinking water benefit all community members, particularly women, children and the elderly. Greater household water supply decreases pressure on other sources of water that could be used for irrigation, therefore improving crop production. Water run off from the first flush system is put to such alternative uses

The use of a **minimum water service standard** for the Northern Group Islands of 6000 litres per household, which could be tailored to took into account roof quality and larger household was a relevant tool to allocate resources. This could be developed into a minimum standard relevant for all communities depending on rain water harvesting. The formula used was developed with World Heath Organisaiton and Red Cross assistance was based on 10L/per head/per day and a 3 month drought period and contingency[4]. From this it had been calculated that an 8m by 8m sloping roof would be adequate to supply a household of 5 with enough water to meet their daily needs (at 100L/person/day not just the 10L/person/day potable requirement).

The project adapted to the needs of **individual household contexts** in a number of ways. For example, priority was given to the most vulnerable residential houses in the communities. Installations were also adapted to cultural context. For example, where thatched (rau or kikau) roofs were in use, households were provided with an on-site catchment area to provide for water harvesting, either as a lean-to or a hip-roof (a.k.a. pyramid roof). In some rare cases, existing roofing structures that had suitable area to collect water were provided with a tank even if this seemed not logical in the first instance. For example, an elderly man requested that his water tank be connected to the newly constructed shelter for his wife's grave where he spent much of his time (PM Report #6). This decision was considered in light of the decision by the individual householder and the project goal of adapting to the household level context. Another example of adapting to individual household context was the measure of ordering 3000 liter tanks in addition to the 6000 liter tanks. This allowed homes with low-hanging roofs, which are cultural features in Pukapuka, to meet minimum water service standard by providing two 3000 liter tanks. These are some of many examples where the project adapted to individual household contexts.

The project emphaisized a holistic approach including tank, roofing and gutter. Despite some views like "this is not a re-roofing contract," (AMD Infrastrcuture Project Manager, August 16,

[4] *2376195-v1-Cooks_Northern_Water_harvesting_project_appraisal (MFAT)*

2011) key stakeholders emphasized the need to include roofing to meet the minimum water service standard as rusted roofs contaminate water and some gutters needed fixing.

Relevance was reduced to a certain extent by the community water component of the Northern Water Project not being fully completed, particularly on Manihiki. Climate change funding[5] earmarked for the community water tanks ($650,000) was not spent and eventually reallocated by MFAT to sanitation in 2013 due to uncertainty at central level as to the project success .

Overall, water infrastructure design, collection and construction approach proved relevant for the Northern Group. Relevance was diminished by delays in planning for project initiation and closure, and the loss of funding for community water tank improvements. Relevance was strengthened by moving the project to the private sector, providing jobs in local communities, adapting to individual household context and including roof repair and strengthening.

Effectiveness

Planning delays reduced project effectiveness. Emerging from 2005 cyclones, community benefits only became real in September 2011 when the first MOUs were signed with the Mayor and Island Secretaries of each of the four islands. Houses and householder needs were identified for the replacement of roofing iron, and the installation of water tanks. Effectiveness was further reduced between 2012-2013 failure to provide technical assessments within the defects and liability period and the contractors not receiving timely final payments. Effectiveness was also diminshed by the inability to complete the repair of the community water tanks due to the disputed outcomes and re-alloaction of New Zealand/Australian funding.

The **public-private partnership** proved effective in moving the project forward after stalling with various government agencies. Local contractors bought relevant knowledge of target communities, industry standards and provided a sense of urgency. Contractors delivered the project outcomes from tender to completion report within eighteen months, and completed the simultaneous installation in under three months. The project also emphasized Island Council involvement in the decision making process, providing community ownership for the project using a bottom-up development model. Effective income earning opportunities were created by the project Manager employing seven on-site island supervisors and the contractor employing 57 local on-island laborers.

The private contractors secured the MOU's with all island governments in July 2011. **Island Governments participated** in the project through making recommendations for changes during implementation and through purchasing and being gifted overstock materials. The Project Manager and Contractor, both with roots in the Northern Group, stated that the

[5] *International Climate change Adaptation Initiative, MFAT, November 2011.*

project had a "community feel." Island Council and homeowners reported directly to the Project Manager and the contractor of their satisfaction with the installation of water tanks to alleviate what in the past has been a difficult time for them during long periods without rain, and where local underground water sources did not offer sufficient potable supplies. Often, emergency water supplies were having to be shipped to them by Red Cross using whatever transport system might be available. Project Manager's Report #4 reports that steady rainfall over a two week period following the installation of the new roofing and water tanks on Pukapuka and Nassau had lifted the morale of the people who were very happy to have water tanks full of clean water. In Pukapuka, half the population left in 2006 after Cyclone Percy and some have since returned, expressing relief that their damaged home now has new roofing and a water tank. The robustly designed and heavier grade water tanks and the first flush diverters had received positive comments and wide approval for its simplicity and practicality. The Mayors and the Island Councils of Nassau and Pukapuka expressed their appreciation and "Atawai Wolo" to NZHC, MOIP, RVK Contractors and the PM team via celebratory feasts, gifts, oral and written reports and letters.

Effectiveness was improved to some extent by the construction team and project manager training of heads of households including and women in basic maintenance of new water systems. The effectiveness of this effrort was reduced to some extent by the fact that certain households have since removed first flush devices. The National Council of Women asked that women be consulted over the location of household tanks and that they also be trained in basic plumbing and maintenance procedures. Ongoing effectiveness of this aspect requires island water safety (Ministry of Heath) plans to integrate ongoing water and sanitation education and training.

A newly designed tank adaptd to the Northern Cook Islands has set **a higher norm for water tanks** now sold throughout the Cook Islands. This was in response to the problem of splitting tanks identified from previous works. Research showed water tanks had split in transport when a standard pallet was used (too small), in use due to heating of the concrete pads some tanks were placed on, and due to the widespread use of low-grade tanks. Even though the specifically designed tanks, the Northern water tanks were questioned by a compeitor who stated that the tanks were non-compliant[6] with minimum NZ standards[7]. The technical expert, however, did not evaluate the actual tank supplied. Measurements produced by Project Manager (Romani Designs, June 2011) refuted these claims, assuring that the tanks were suitable for the climatic conditions and had been appropriately strengthened to beyond compliance levels. There have been no problems with the tanks to date. MOIP final technical assessments further supported this claim (May and August 2013). Project research points to low tank quality due to consumer price pressure (downward), use of concrete pads and

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[6] *Letter from Gaye Whitta, General Manager, CITC to DonyeNuma, Acting Secretary MOIP 1 June 2011.*
[7] *NZ standard 4766:2006 (materials/design/manufacture), AS 2070:1999 (food contact) and AS 4020:2005 (potable water).*

designs not being suited to operation in high temperature environments as the principle cause of splitting.

Partial **burial of water tanks** was an effective technique to reduce cost, increase stability of tanks and adapt to households with low roof overhang. Proving more resilient over time engineers recommended burial of tanks rather than installation on a sandy base. Since the original installation of the tanks, overflowing water when there are great deluges of rain has destabilised some tanks on a sandy base. It has been recommended that the next time the tank is dry, that the householder digs a shallow pit in which to sit the tank. Some homeowners have already done this (RD Report).

Tank sunk into the ground (by owner)

Tank on gravel/sand in a timber frame (Rakahanga).

Effectiveness was diminished to smaller extent by the use of color steel to replace aluminum roofing due to perception of lack of value for money. MOIP engineers found in their final report some houses with evidence of rust though although this was well after the defects and liability period. Roof maintenance (rustkill and painting) will need to be at the cost of individual homeowners. In future, while allumium is more expensive, the longer term benefit should be taken into account especailly in remote and harsh environments found in the Cook Islands.

Efficiency

The project cut costs through innovations and continually adapting to the needs of household context. Examples include the locally appropriate first flush system, simultaneous installation, purpose-built pallets, and burrying tanks rather than expensive engineered concrete framed bases. The created household level assets that have low operating and maintenance costs.

Given the uncertainty, the effeciency was finally enabled by the use of the **measure and value contract**. Years of planning was essentially driven by trying to measure the unmeasureable. A high degree of variability exists in the needs of three hundred and fifty plus households sites located in four different islands. Multiple surveys lead to clashing statisitcs and project designs. Awarding a contract allowed the contractor to efficiently check measures with on island employees and informants and the measure and value form allowed adaption to household context as needed during the delivery process. Once awarded, the contract form enabled a timely, efficient and within budget impact.

Effeciency was further enhanced by the contractor being required to carry 15% additional spare parts and maintenance materials. This took into account the challenges of pre-planning for unforseen needs, adapting to household context, and transportation costs for any additional hard to get last-minute materials. This enabled additional materials to be bought and donated to the Island **providing resources for ongoing maintenance**. Efficiency was reduced to some extent by the lack of familiarity with the measure and value contract form of contract managers. Both government procurement agents and local contractors would benefit from training in the use of such industry standard forms which are particluarly adapted to some of the highly variable contexts found in development projects in the Pa Enua.

A new norm introduced by this project is the **first flush systems** which allows for salt, leaves and debris to be flushed off the roof and out of the pipes when it first starts to rain on the roof. After 10 minutes, the filter system can then be switched, allowing clean rainwater to be directed into the tanks. This first flush system actually used was a local innovation. Effeciency was achieved by a lower unit cost ($161 versus $75), lower maintenance resulting in better adaption to the context. While householders were trained in the use, management and maintenance of this simple and efficient system, efficiency was somewhat diminished in that some houses removed the first flush system after installation because of a lack of understanding of its value.

Effeciency was increased by **simultaneous installation** on all the islands with on-site supervisors. The Project Manager oversaw seven on-site island supervisors while the contractor had 57 local on-island laborers and 18 of his own workers from Rarotonga. Simultaneous installation proved beneficial for Northern Group project as it allowed for

timeliness and cost saving. Simultaneous installation would also likely prove efficient for large scale infrastructure projects in the Southern Group.

To address concerns regarding the splitting of tanks during transport, the project utilized **purpose built pallets**. It was discovered that the bottom water tank of a stack (up to 5) could be split/structurally damaged due to stress during transport by crane and lighters as the standard pallet is so small that it fits inside the tank base ridge. Along with purpose designed high-quality water tanks, the purpose built pallets worked well in that no tanks split during transport. This low cost local innovation would work well as the standard for transport of water tanks where lighterage is the norm. Efficiency was also enhanced by utilizing specifically designed water tanks to meet the harsh climates of the Northern Group for longevity and durability.

The **burying of tanks** also proved cost-effective ($850 as tendered engineered concrete base per versus 0) and reduced damage to the water tanks. The MOIP engineered design priced concrete bases would have costed $240,000 for the whole project. The project manager, contractor and other key stakeholders developed the the local innovation to bury the tanks or place them on sand bases, which had no cost as home owners could contribute this effort. This local on-site innovation avoided creating a situation that could lead to tanks splitting as had sometimes occurred in the past when water tanks were placed on expensive concrete slabs. The burying of water tanks is another new norm that can be utilized to lower the cost of future rainwater harvesting projects.

Overall, the efficiency of the project was enhanced by the speed in which the construction phase project was undertaken, low cost innovations, the use of local workforce and income generated locally to could sustain the projects outcomes. However, efficiency was significantly reduced by the time taken to scope and mobilise, the deteriorating quality of relationships in Rarotonga which exacerbated delays in the end of project assessments and final payments.

Impact

The Northern Group Rainwater Harvesting Project has contributed to keeping people on the islands and providing improved resiliency to natural disasters and climate change.

The Northern Water Rainwater Harvesting Project delivered 344 water tanks, providing 1.78 million liters of water over four islands. 260 homes received just over 10,000 sqm of new roofing and 2,908 lineal meters of new fascia and spouting. The project imporved water for 894 men, women and children on four islands within under the 2.2 million dollar budget. There has been no water crisis since a January 2012 in the Northern Group.

As a reult of this project, 287 households in the Northern Cook Islands meet a **minimum water service standard** which provides for their daily household drinking requirements for most of the year, and, with careful management, is sufficient to meet their drinking water requirements (10 litres/head/day) even during times of prolonged dry weather.

There were several significant impacts of this project on the Northern Group Islands. Firstly, 851 people (MFEM, 2011) in the Northern Group Islands now have a water system that provides householders with a higher quality and quantity water supply. Potential drought periods and natural disasters are expected to place higher stress on household water infrastructure so that the size of the tank for supplied for each dwelling has been calculated to meet the needs of its householders for up to 60 days of drought conditions. Secondly, the project emphasized bottom-up development, local decision making, local employment and homeowner maintenance.

The project had a major positive impact on the Northern Group Islands. The Project Manger's Report #3 states that while they were preparing their orders of equipment for their work on the Northern Group Islands, real concern was being transmitted from the Island Governments and Councillors about their islands not having had any heavy rain for seven months. They were surviving on community catchments that were also in need of refurbishment, and underwater supplies if these were available. Notification in 2011 that the tanks were on their way was met with much relief given that this project had been in the government pipeline since 2005.

Developing new building skills and opportunities for future employability were additional benefits for the island residents when **locals were employed** by the contractor to reconstruct dilapidated roofing structures, lay roofing iron and install the tanks, spouting, pipes and first flush filtering systems that were part of the construction activity on each island. This knowledge among the local community will

prove invaluable for maintaining the new systems over the long term, providing there is sufficient equipment and materials on hand to do the necessary repairs when required.

The project utilized local knowledge and trained on-site laborers for future development projects further increasing impact. Upon completion of the project, the contractor even offered jobs to some of the local laborers. On-island locals learned new relevant and transportable skills associated with water harvesting, roof construction and plumbing installation with which they could create work for themselves on their own island and elsewhere. The impact of any development project, particularly in the Pa Enua, is enhanced by the use of local labor, management and training.

Householder training, education, and maintenance was provided by the project team at the conclusion of the building activities to ensure that householders were aware of the maintenance needs of the system. Those locals who were employed by the contractor to be part of the roofing and tank installation teams would beconsidered the local experts and would be expected to pass this information on. They could also earn some income on the island by providing for any repairs required of the system using the additional spare parts that were also purchased or gifted as part of the project contract. Water, sanitation and hygiene education and training of the public was undertaken, including components on managing and maintaining the new water gathering system. Essential topics included: how to repair and maintain the roof catchment; keeping the collection system clean and free of debris; minimising the opportunity for birds and animals to get onto the roof; and the importance of conserving water as drought approaches. This project was proposed as a low operating cost way of providing convenient access to potable water to households in the targeted communities. However, the sustainability of the outcomes of this project depends on two criteria.

Firstly, on the associated community education programme equipping community members with the knowledge and skills to manage the supply well, and keep their supply system clean and properly maintained. Basic training was provided on each of the islands by the construction team or the local supervisor who was left behind to tidy up the project outputs on their respective islands. This included basic water safety and plumbing knowledge so that homeowners could make basic maintenance repairs as required. Island Governments need to act to ensure additional and on-going

training for all householders (including women) to ensure that all members of the community are aware of the importance of this knowledge. It would be advised that householders use other water sources for purposes that do not require the use of drinking water, for example, gardens, washing clothes, etc. This would be an especially important practice when their tanks fall to half full. On the standard design this would mean households would have 3,000 litres available to meet the drinking-only requirements for a household of 5 for 60 days which should cover an extended drought period. Many households also have their own privately purchased low-quality tanks, which now get used for washing and bathing while the new water tanks get used for drinking water.

Secondly, sustainability relies on the availability of appropriate materials for repairs when they are required. Some of the overstock ($108,000) has been purchased from the contractor to increase storage reserves. Remaining overstock was donated by the contractor to each island (e.g. Pukapuka Niua School). The community, with the support of the Island Government, will need to invest to be able maintain and operate the water supply system for the foreseeable future. Although some people on Penryhn proposed a maintenace levy to be held by the Island Council, the norm is that future maintenance requriements remains with individual homeowners (e.g. rust proofing) and the island government (community water tanks).

Roofing replacement - Before

Roofing replacement - After

(Rakahanga)

Impact was also somewhat diminished by the public health officers not completing water safety plans, per Red Cross recommendation. Island governments need to facilitate water safety plans and coordinate resources for ongoing maintenance and education to sustain impact.

Impact was reduced to a smaller extent by the lack of uptake by non resident homeowners to the opportunity to request for systems to be installed on their houses on the basis that they

cover the costs of these installations. While this did provide an opportunity to benefit from bulk purchase and installation arrangements in place a lack of adequate communication with diaspora in NZ and Australia is most likely the cause. Despite intentions, no cases of these last two criteria were recorded. Relevance could have been strengthened by contacting ovrseas owners and encouraging them to pay for project water tanks and upgrades to their system.

Governance and Management Issues

Power relations between different levels, for example inter agency, between central government and local contractors, between central government and Island government officials, within island communities, proved to be more complex than anticipated in some cases where detrimental to timely decision making and professional contract management.

Despite the prioirity placed on access to potable water in 2006, the project stalled in development stages until 2010, when with NZHC intervention, the project moved forward as a public-private partnership. In October 2010, Romani Katoa of Romani Designs Ltd was appointed as the Project Manager to complete the procurement process, oversee construction on four islands and to provide monthly reports to MOIP. It was not forseen that the shift to using local private contractors would be seen as comptetion by some officials in government agencies nor that governments contract administrators would be unaware of the importance of managing contractor relations in a constructive manner. I addition a new contract form was selected after discussion with MFAT procurement planners advising the Cook Islands on the response to cyclone PAT,. Aitutaki 2010. The contract was a lump-sum "measure and value" contract adapted to the high variability and lack of access to additional supplies in the Northern islands:

> *Measure and value contracts start with a design and contract documentation that is considered reasonably complete, with the client paying the contractor the rate for a particular type of work for the measured quantity constructed. The quantities in the schedule of prices are provided for the purposes of tendering and can be taken as a reasonable assessment of the quantity for an item. Where the actual quantity is different to that shown in the schedule of prices, to such an extent that a contractor would use different methods or resources to construct that item and the rate being used is considered unreasonable, then the change in quantity is treated as a variation. Problems*

can arise where the engineer measures a different quantity to that being claimed by the contractor.[8]

In May 2011 following from a tender, Keta Williams of RVK Contractors ltd was awarded this contract. The Project Manager and the Contractor completed design and procurement of new water tanks, addressing roofing and freight considerations. In July 2011, Memorandums of Understanding with the individual island administrators, the Mayors and the Island Secretaries were negotiated by the project manager. Equipment was loaded on the 30th September 2011 onto the barge "SV Kusima" chartered from Fiji. The Project Manager's Report #3 states that work preparation and training first began on Pukapuka on the 10 September. The first boats arrived in Pukapuka one month later on the 10th October 2011. All the work on the islands were completed ten weeks later, with the final tank being installed on Penrhyn on the 23rd December 2011 with the Project Manager's final completion report submitted (RD Report #9).

In January 2012, the MOIP CRRP Programme Manager resigned and no replacement was appointed. The contractors awaited final technical assessments after completion but during the defects liability period, there was no engineering assessment even though Cook Islands government officials did visit the islands. Final payments could not be made without a project completion certificate, yet this certificate could not be produced until building inspectors visited the project islands - Penrhyn, Rakahanga, Pukapuka and Nassau. This was finally completed in May and August of 2013, well after the end of the defects liability period in July 2012.

MOIP engineers indicated satisfaction with the work carried out in accordance with project expectations. They identified some of the issues addressed in this report and reflected the community training and maintenance recomendations outlined in the original project design document.

To small extent the poor relations resulted from a lack of understanding of this contract form and to a larger extent by a lack of appreciation for the need for constructive management of private contractors. For example even though the Project Manager submitted a total of nine reports[9], the project was often represented in a negative light as "over budget". These regular monthly reports outlined details of: progress with regards to the project, contract processes (payments to date, and

[8] *From the NZ Contractors Federation, http://www.contrafedpublishing.co.nz/Technical/Your+contract+options.html*

[9] *http://www.mfem.gov.ck/component/content/article/57-development/development-programmes/372-northern-water-improvement-project*

details of next payment), construction matters, site supervision and contract administration matters, photographs, and detailed summary of work. During the compliation of this report neither MOIP, NZHC or MFEM were able to produce full copies from their Northern Water files indicating poor record keeping.

These findings suggest that improvements can be made by increasing access to training for government contract managers and local private contractors, especially on new contract forms and good procurement practices relevant to development projects in the Cook Islands.

The project goal emphasized local decision making and the involvement of the Island Councils. While central government had pre-approved works through the MOU's, as the project progressed the Project Manager and Contractor responded to requests of the Island Councils making minor improvements, reporting and including emerging issues in monthly reports. This on-the ground local decision making is not without issues[10] as power relations also exist between and within communities. These conflicting power relations (local, local-central, between public and private sector managers) throughout the process and at different levels contributed to poor governance particularly when the MOIP CRRP was not replaced and communications between central agencies deteriorated.

Lessons Identified

- Relevance: This project developed a minimum water service standard (6000 Liters per household) for rain water harvesting including first flush, guttering, new roofing, strengthening and tanks adapted to household context.

- Effectiveness: Local private sector and communities can deliver water infrastructure projects in a timely and cost effective manner. Public sector managers need to strengthen partnership, contract management skills and knowledge of contract forms to work more effectively with private and local partners. Community development projects need to responsive to local level needs in a timely manner, especially when responding to natural disasters and drought conditions.

- Efficiency: The project was innovative and provides a cse study for benefits of the measure and value contract with local private contractors making numerous

[10] *Some cases of Island officials requesting entitlements above criteria and taking possession of contractors materials were recorded and resolved locally.*

cost-saving adjustments using local innovations (e.g. first flush system, burying tanks). Contract flexibility allowed the project to adapt to the needs of individual household context. Future projects, especially in the Pa Enua, should consider adapting contract form to context (e.g. measure and value contract) and future water projects can learn from the specific cost-saving measures utilized.

- Impact: A minimum water service standard for rainwater harvesting is relevant to the Northern Cook Islands. Training and utilizing local on-island labor and management contributes to sustaining education and maintenance capacity in all community development projects. Future maintenance (e.g. rustkill, painting) needs to become an individual homeowners responsibility to sustain impact.

- Governance and Management: Power relationships are complex even in small in community development projects. Distance and values multiply risk of miscommunication between levels such as between central government, private contractors and even within local communities. Future development projects need more effort to sustain constructive communications channels in order to sustain public-private-local partnerships which enable decision making at community levels in manner which builds trust of all parties.

Overall judgement and critical issues

Overall, the community appreciated the installation of improved catchment of water to help them during difficult drought conditions. Their appreciation was forwarded to the Project Manager who recorded these in his reports, as well as directly to the NZ High Commissioner. The project raised the minimum water service standard for the Northern Group Islands.

The project's effectiveness suffered from a lack of effective accountability for timely action to populations affected by natural disasters. Oversight by central agencies suffered from a lack of common understanding of the new approaches set forward in the Northern Water Project. Poor record keeping, changes to staff, conflicting communications resulted in a failure to trust the public-private-community partnership.

The project goal was to emphasize local decision making placed at the level of households and Island Councils and the Project Manager and Contractor responded

making minor changes as needed. This on-the ground local decision making contributed to some of the friction between central government in Rarotonga and the Project Manager. Some reports by the MOIP Programme Manager to the Steering Committee tended to belabour the deteriorating relationship between the two parties rather than any successful outcomes of the project itself.

A major impact of these deteriorating relationships in Rarotonga was the withdrawl of funding previously committed by NZ for community water tank upgrades which have not been completed. In the final stages of the project, the Steering Committee did not maintain regular meetings to ensure information sharing and accountability for progress. The non-appointment of a CRRP coordinator effected the timeliness of engineering assessments required. In the end, $650,000 NZ/AU funding for community water tanks in the Northern Group was reallocated to sanitation and the contractors did not receive payments until December 2013.

Despite being a successful project by the standards of the community and by MOIP's final assessment report as well as the nine monthly reports from the Program Manager, the Northern Water Project was dubbed a failure in Rarotonga. This is largely due to unaddressed conflicts that should be ancipated in any community development change process where local, national and international power relations are challenged. Overall, the Northern Water Project offers lessons in how to more successfully move forward with public-private-local partnerships to deliver projects witihin budget and in a timely manner.

Final actual expenditure against budget

Output	Planned Expenditure	Actual Expenditure	Variation
I. **Contractor - RVK Contractors ltd.**	$1,876,799	$1,960,371.90	+4%
II. **Project Manager – Romanidesigns ltd**	$106,600	$110,128.99	+3%
III. **CIG technical assistance (MOIP/AMD/DCD)**	$60,000	$53,700.20	-10%
IV. **Community Water tanks**	$30,000.00	$28,525.00	-5%
V. **Project Design document**	$15,000	$9,517	-37%
VI. **Contigencies**	$156, 601	0	-100%
BUDGET	**$2,245,000.00**[11]	**$2,162,243.09**	**-4%**

The summary cost demonstrates that overall costs are within approved budgets.

Small variations exist for the construction phase mainly due to the variation approved by the Island Government of $108,189[12] was for 27, 6,000 litre tanks that remained at the conclusion of the construction works which were distributed by the Island Council and installed before demobilisation in December 2012 and compensation agreed for delay in project closure and making final payments.

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[11] *NZAID PAA dated 9/2/2010 approved by Amanda Ellis.*
[12] *Northern Waters Domestic Water Tank Project Reconciliation.pdf Joseph Akaruru, MOIP.*

Community water tank funding ermarked for community water tank renovations in Ocober 2011[13] was finally reallocated by NZ in 2012. This budget responsibility is now proposed to be delegated to each Island Government in the 2014/15 budget and be a priority for CI government funding. Scoping and designs developed should be relevant for planning purposes.

Minor costs remain to be paid for completion reporting and legal services from the TA budget line.

Appendices (checklist)

This report includes the following appendices:

- Appendix A: Miniumum water service standard
- Appendix B Timeline
- Appendix C: Results Framework
- Appendix D: Asset Register - showing where, how and why Activity assets have been disposed of, where relevant (please complete the table)
- Appendix E: Transition or Exit Planning (please complete the table)
- Appendix F: Reporting against the agreed workplan and budget

[13] *NSDC October 2011, AusAID emails of 5/8/11 and 7/10/11*

Appendix A: Minimum water service standard

The **minimum water service standard** a relevant tool to allocate resources to improving water security for communities dependant on rain water harvesting.

Developed for the Northern Group Islands in 2011 the standard is 6000 litres per household, can be tailored to take into account roof quality and larger households. The criteria was developed throughout the project.

For a home to receive a water tank and new roofing. This criteria included:

- Only homes which are currently being occupied.
- Homeowners who resides on the island.
- Applies to all homes that do not meet the rainwater standard.
- Minimum water service standard –developed with World Heath Organisaiton and Red Cross assistance was based on 10L/per head/per day drinking water and a 3 month drought period and contingency[14]. This was translated to 1000 litres per person formula for ease of use.
    - 6000 litres per household of up to 6 occupants
    - 9000 litres per household of up to 9 occupants = 2x 6,000 L tanks
    - 12000 litres per household of up to 12 occupants = 2 x 6,000 L tanks
- Water tanks complaint with NZ standard 4766:2006 (materials/design/manufacture), AS 2070:1999 (food contact) and AS 4020:2005 (potable water).
- Collection area adequate to supply a household of 5 with enough water to meet their daily needs (at 100L/person/day not just the 10L/person/day potable requirement) is 8m by 8m sloping roof.
- Ideal roofing quality should be alumium 0.7mm which does not rust and resists peeling effect in cyclone conditions. Roof structures should be strengthened with cyclone ties and replacement of frames to ensure structural integrity.
- All homes to to fitted with first flush system.
- Training provided to homeowners and women in basic maintenance and cleaning of water systems e.g. tanks annually, purpose of fisrt flish, cleaning gutters, boiling drinking water.
- Bases should not be concrete due to cost and contributing to weakening tank structure over time. Ideal installation burried at 50 cm.

[14] *2376195-v1-Cooks_Northern_Water_harvesting_project_appraisal (MFAT)*

Appendix B: Timeline

2005: Cyclone Percy

2006: NZ & AU Funding Committed

2006-2010: Central Government Planning/scoping

April 2010: Project Design Document contract awarded to Citical Path Consulting (Chris Manu).

January 2011: Program Manager Contract awarded to Romani Designs Ltd to conduct remaining procurement, implementation and reporting.

January 2011-May 2011: Detailed project design, planning and tendering for construction.

May 2011: Contract contract awarded to RVK ltd.

July 2011: MOUs secured with Island Governments

October 2011: Boats in North

October-December 2011: Simultaneous installation

December 2011: Phase I Project completed

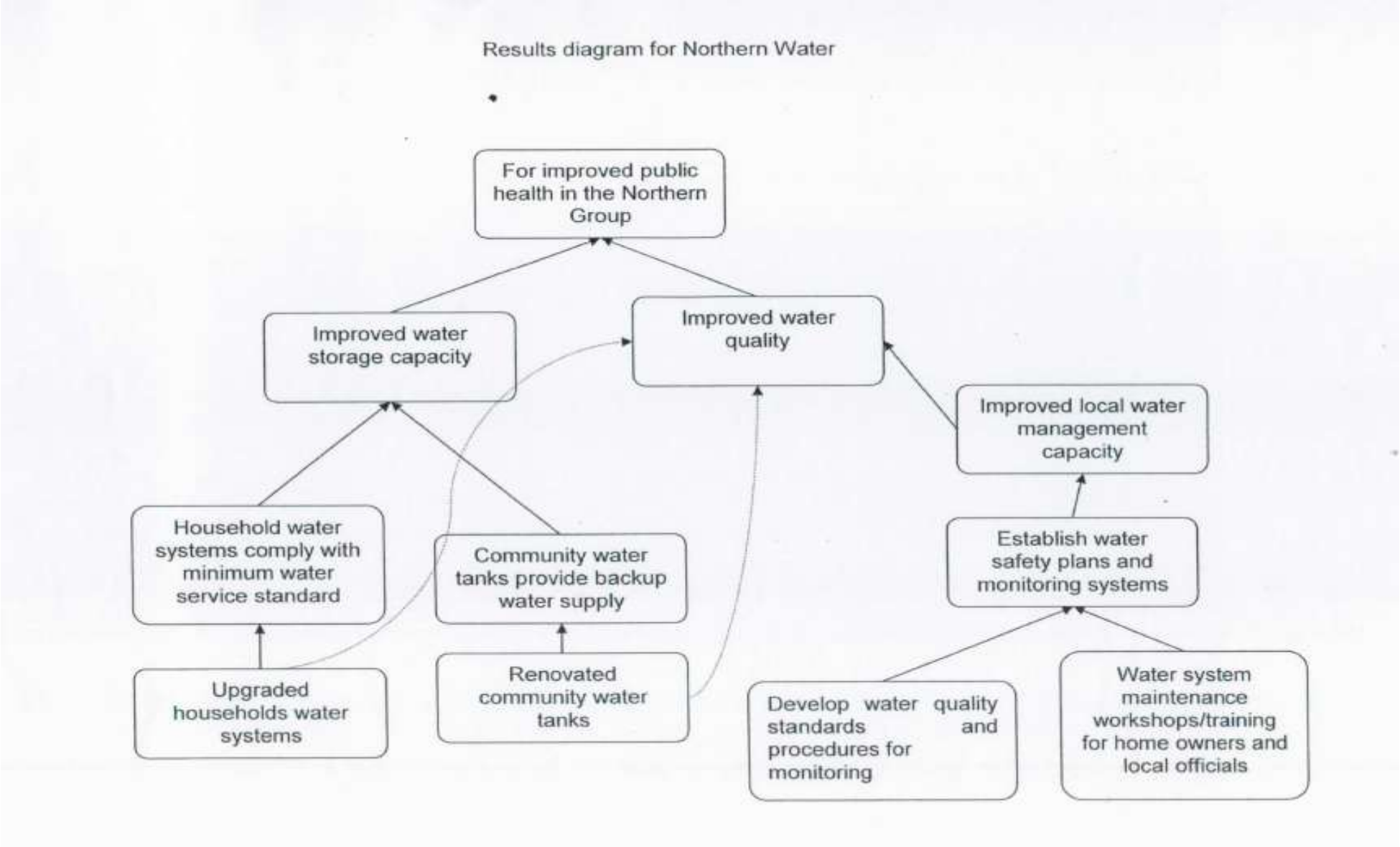
July 2012: End of defects and liability period.

July to August 2013: Assessments by building inspectors.

September to December 2013: Project Evaluation and activity completion report.

December 2013: Final settelements to contractors.

Appendix C: Results Framework



For all non-consumable capital items valued at NZ$1000 or more:

Asset Name	**Purchase Price**	**Date of Purchase**	**Location Held**	**Asset Disposed (where relevant)** Comment on where, how and why asset has been disposed of	**Date Disposed**
Community and household water tank improements. Community water tanks (Pukapuka and Nassau)	$1,960,371.90 $28,525	December 2011 May 2009	Pukapuka, Penrhyn, Nassau and Rakahanga	Household asset ownership transferred to homeowners. Community water asset ownership transferred to island governements.	July 2012 May 2009

Appendix E: Transition or Exit Planning

Task to be continued beyond Activity completion	Necessary inputs	Timeframe	Responsible organisation	Capacity development required to support responsible organisation
1) Repair of Community Water Tanks 2) Water Safety Plans 3) Maintenance of home installation	1) Budget, skilled trades people 2) Knowledge of locally relevant water safety practices 3) Materials and labor	1) 2014 2) Ongoing 3) Ongoing	1) Island Government. 2) Island Governments, Homeowners. 3) Homeowners	Review scope and plan works for renovations on each island. Resources from island government budget. Residents aware and capable of basic care of water systems at household levels. Island government capacity to maintain community water systems. Competent public health officers. Inspection and advice from public agencies.

Appendix F: Reporting Against the Agreed Workplan and Budget

SUMMARY OF CONSTRUCTION WORKS - from Project Manager's Final Completion Report

Island	Population in 2011/12	# Houses re-roofed	Roofing iron used – sqm	Fascia, spouting - lineal metres	First flush	Tanks installed	Additonal cost of 27 remaining tanks installed under variation	Total water storage - litres	Total measured value before viaration
Pukapuka - Yato	176	38	750.93	388.50	35	6kL/21, 3kL/36	$36,063	234,000	$248,728.95
Pukapuka - Roto	195	45	1,818.08	515.80	48	6kL/39, 3kL/22	$12,021	300,000	$326,495.75
Pukapuka - Ngake	148	36	1,282.00	450.20	35	6kL/28, 3kL/14		210,000	$224,547.15
Nassau	116	31	46.05	262.00	32	6kL/34		204,000	$208,474.08
Rakahanga	83	45	5574.80	582.17	45	6kL/48		288,000	$472,110.42
Penrhyn	176	65	57.00	709.50	65	6kL/55, 3kL/20	Tetautua $8,014 Omoka 16,028	390,000	$336.817.78
TOTALS	**894**	**260**	**10,028.86**	**2908.17**	260 +27 =**287**	6kL = 225 +27=252 3kL =92 **Total tanks 344**	Variation for remaining tanks approved by Island Gov/MOIP/MFEM. **$108,189.00**	1,626,000 +162,000 =**1,788,000**	$1,817,174.13 + 108,189 = **TOTAL CONTRACT PRICE 1,925,363.13**