DEVELOPING A CULTURALLY ACCEPTABLE WATER SUPPLY - A MAORI PERSPECTIVE

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ABSTRACT

The Torere community, located in the Bay of Plenty and within the tribal boundaries of Ngaitai Iwi had historically used untreated surface water and rainwater collected and consumed in individual dwellings, for water supply. Risks to public health and the opportunity to obtain Ministry of Health funding led Ngaitai Iwi Authority to investigate the possibility of establishing a new community water supply scheme.

A source was identified, however high levels of iron and manganese meant that the water would require treatment before consumption. The Torere community also had specific requirements of the new water supply system, including:

- Meeting cultural requirements regarding treatment, particularly, the use of chemicals.
- Involvement, as much as possible, of the community in the construction and operation of the water supply scheme.

The paper discusses:

- MoH funding – its adequacy, obtaining this funding, and its application to capital as opposed to operational costs.
- Challenges in the design of the treatment system and how community views and design constraints were resolved to provide an optimal solution.
- Finding bicultural solutions that satisfy the requirements of drinking water standards whilst recognising Maori cultural beliefs regarding water.
- Benefits to the community resulting from the scheme.

KEYWORDS

Water, Maori, Community, treatment, groundwater, iron, manganese, Ministry of Health.

NOMENCLATURE

CAP	Capital Assistance Programme
DWAP	Drinking-water Assistance Programme
DWSNZ	Drinking-water Standards for New Zealand
GV	Guideline Value
HDWAA	Health (Drinking Water) Amendment Act
MAV	Maximum Acceptable Value
MoH	Ministry of Health
NIA	Ngaitai Iwi Authority
PHRMP	Public Health Risk Management Plan

TAP	Technical Assistance Programme
WTP	Water Treatment Plant

1 INTRODUCTION

The Torere community is located in the Bay of Plenty, approximately 20 km west of Opotiki. The community consists of approximately 180 households, a Marae, a church and small school. The local community is of predominantly Maori ethnicity. The Marae and local Maori in the area are within the tribal boundaries of the Ngaitai Iwi. The Iwi has established the Ngaitai Iwi Authority (NIA) to provide services in fisheries, education, health and housing for communities and local Maori within the tribal boundaries.

The Community established a Water Committee and associated water scheme approximately 10 years ago to provide water for part of the Torere community. The Water Committee supplies water to approximately 45% of the Torere community population, a total of around 120 people including the community school and the Marae. The present scheme sources its water from the Tunapahore Stream located to the east of the community. Although the school and Marae each have an independent UV treatment facility, the remaining population supplied by the Water Committee, receives untreated water direct from the Tunapahore Stream. The remainder of the community outside the scheme, including the community sports club, rely on untreated surface water from the river and rainwater harvesting from their roofs for water supply.

2 DRIVERS FOR ESTABLISHING NEW WATER SUPPLY

As with most rural communities, Torere is self-sufficient, and the water reticulation system was self-designed and implemented. It has served Torere well, but the scheme has little in the way of treatment, and the Tunapahore Stream is known to suffer contamination due to livestock in the catchment. As such, the potential for contamination and associated health risks were sufficient to warrant upgrade or replacement of the scheme.

Drinking water sourced in this manner and having little treatment, poses increased health risks as opposed to reticulated supplies administered by territorial authorities. This is due to an increased number of contamination pathways and insufficient protection barriers. Contamination in surface water supplies is commonly through the following:

- Bird and animal faecal matter falling within the catchment area of the river and being washed into the river during rainfall.
- High turbidity during rainfall events increasing the potential for a range of contaminants to be present.

These increased health risks can result in a range of direct and indirect, short and long-term health impacts on the community such as sickness, decreased life expectancy and absenteeism from work and school. There is also a potential cost to the taxpayer through increased medical costs and income support. The Ministry of Health (MoH) wishes to reduce these risks and associated costs by providing funding to small drinking water supplies to improve the quality of the water available to the community.

3 CAPITAL ASSISTANCE

In May 2005 the New Zealand Government launched the Drinking-water Assistance Programme (DWAP) to help improve drinking water supplies in New Zealand communities. The DWAP includes $117.8 million (exclusive of GST) over 10 years for a Capital Assistance Programme (CAP). To be eligible to receive CAP funding, the water suppliers must:

- Have participated in the MoH's Technical Assistance Programme (TAP) as part of the DWAP.
- Have an approved Public Health Risk Management Plan (PHRMP).
- Supply to a community with a population less than 5,000 people.
- Supply to a community with a deprivation index greater than 3.

(MoH, 2006)

Funding for operational costs is only available to communities with a deprivation index of 9 or greater for up to 3 years following commissioning of the supply development or upgrade. The funding decreases from year 1 to year 3 and is only available under exceptional circumstances.

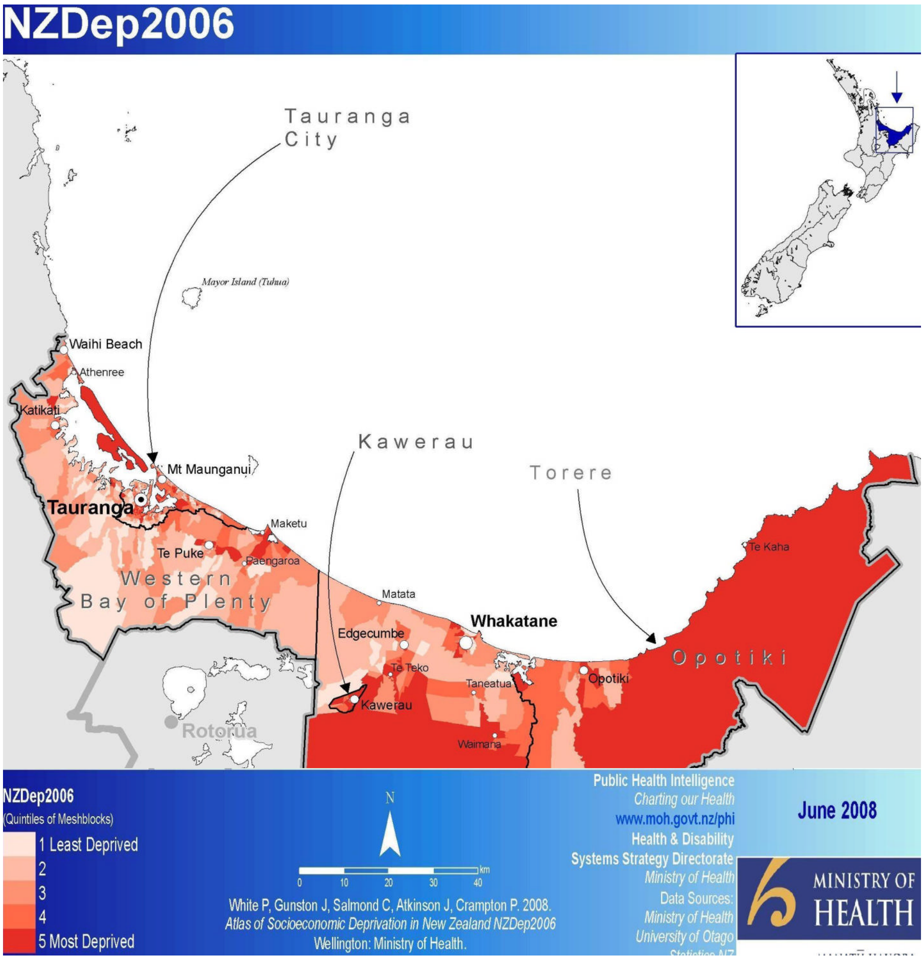
Capital funding is awarded as a percentage of the capital works cost, with this percentage dependant on:

- The size of community served (smaller communities get a greater percentage of funding).
- The social deprivation of the community (the higher the deprivation index the higher the percentage of funding).
- Demonstrating that the capital works for which funding is being applied for provides a reduction in public health risk and that the public health risk is significant.
- The ranking of the supply against others in the same funding round.

With the advent of the DWAP, NIA found it opportune to engage in the TAP training programme to procure funding to develop a better and healthier drinking water source for the community. It was determined at the early stages of the programme to source a water supply that was at least risk of contamination. The development of a bore was deemed to be the preferred method of extraction and supply and therefore less risk to outside contamination.

When it came to applying for CAP funding for the new water supply scheme the social deprivation of the community had a major impact. Unfortunately, the community, and a large proportion of the surrounding region are among some of the poorest and most deprived areas of the country. This is illustrated in Figure 1, which shows the socioeconomic deprivation in the Bay of Plenty area, based on the results of the 2006 census (Statistics New Zealand, 2006).

Figure 1: Social Deprivation – Bay of Plenty 2006.



(MoH, 2008)

The Social Deprivation index is derived from the census data shown in Table 1.

Table 1: Variables used in the calculation of Socioeconomic Deprivation.

Dimension of deprivation	**Variable description (in order of decreasing weight)**
Income	People aged 18-64 receiving a means tested benefit
Income	People living in equivalised* households with income below an income threshold
Owned home	People not living in own home
Support	People aged <65 living in a single parent family
Employment	People aged 18-64 unemployed
Qualifications	People aged 18-64 without any qualifications
Living space	People living in equivalised* households below a bedroom occupancy threshold
Communication	People with no access to a telephone
Transport	People with no access to a car
*Equivalisation: methods used to control for household composition.	

Salmond et al., 2007

The calculated Social Deprivation index results in a score from 1 to 10, 10 being the most deprived. In the 2006 census the Deprivation score of the Torere community was 9. With the proposed new scheme supplying to only 80 households, a Deprivation Index of 9 and an existing water supply scheme with a high public health risk, the Torere community was able to score highly against other funding applicants and so obtain a significant level of capital works funding from the MoH.

4 CULTURAL / COMMUNITY PERSPECTIVE

4.1 THE RELATIONSHIP OF MAORI WITH WATER

Wai, or water, is a taonga of paramount importance to Maori. Most, if not all Iwi will have reference to a body of water whether it is a river, a lake, sea or a spring. The Waitangi Tribunal in the Whanganui River Report (Wai 167,1999) stated:

> "Water, whether it comes in the form of rain, snow, the mists that fall upon the ground and leave the dew, or the spring that bursts from the earth, comes from the longing and loss in the separation of Rangi-o-te-ra and Papatuanuku in the primal myth. The tears that fall from the sky are the nourishment from the land itself. The life-giving water is founded upon a deep quality of sentiment that, to Maori, puts it beyond the realm of a mere usable commodity and places it on a spiritual plane."

Water has a mauri and as such must be kept in its natural state as far as it is possible to do so. Water as wai ora, the purest form of water, sustains, protects and enhances life. It is essential for the wellbeing and nourishment of all things whether it be in the physical or spiritual realm. It is avoided if it is unclean whether physically or spiritually and cannot be purified without effort. As such the protection of water is essential and as Ngaitai we have our own kaitiaki and taniwha to enforce such. This relationship with water is indivisible and as such cannot be viewed within the precepts of western ownership. Water is a taonga of paramount importance to Ngaitai as it forms an integral part of both the ecosystem and the cosmology of the environment.

4.2 IMPACTS OF THIS RELATIONSHIP ON THE USE AND TREATMENT OF WATER

As a reflection of the importance placed on water, there is always the debate over the treatment or otherwise of water. For Maori, the mauri of different water should not be mixed. If contact occurs, both are placed at risk and the balance of the ecosystem is disturbed. Iwi environmental concepts focus on the ethic of least interference to ensure that mauri are not mixed unnaturally. The use of chemicals therefore, is viewed as an unnatural interference, despite the rhetoric that all chemicals are viewed as natural. It is the synthesis of the chemical compounds that interferes with the balance of the nature, the mauri, of the wai that is deemed unnatural by Ngaitai.

Ngaitai Iwi and the community of Torere wanted no intervention. It was hoped that the water quality would not require any treatment whatsoever, but this was not to be and a solution for the treatment of the water supply with the least intervention was explored.

5 THE PROJECT

5.1 IDENTIFICATION OF NEW WATER SUPPLY

Once the decision to procure a new source via a bore had been made, a hydro-geologist was engaged to work with the NIA Project Manager. Consultation with Pakeke (elders) of the Iwi, determined the drilling sites for the bore. The first site was successful in striking water but there were concerns with the quality. A second site was drilled but in an area that the Pakeke stated had already been pot-holed with many attempts at putting down bores. Despite the advice of the Pakeke the hydro-geologist insisted on drilling at the second site, where subsequently, no water was found. As such, NIA decided to test the water from the first bore, and the results confirmed significant concentrations of iron and manganese were present. The drillers were engaged to return to screen test the first well and extract another sample with less turbidity. Three water samples were completed, all of them having significant concentrations of iron and manganese. The test results were sent to Harrison Grierson Consultants Limited to determine the type of treatment required. The response was that a treatment facility could be developed to ensure water quality achieved the health standards required by the MoH.

However, there was concern from NIA's support engineer over the volume of water available from the first bore and therefore the sustainability of the source. Two 24-hour draw-down tests were completed for the bore to determine it's sustainability and the resulting report was then peer reviewed. Based on the results, the decision was made to drill at a third site as the volume required to be drawn from Bore 1 was deemed unsustainable.

Whilst this was occurring, pipework for the reticulation system was being laid, including sections of the rising mains. A suitable elevated site for the water supply reservoir was also established. These tasks were fraught with their own set of issues, not least pipe sizing and site selection for the reservoir. These are not discussed in detail in this paper.

All of the above took place over a period of eight months. This became an exercise in patience and diplomacy, with significant challenges involved in the management of input and communication with a number of consultants and contractors. It was also necessary to regularly liaise with the MoH to satisfy the ongoing requirements of the CAP. NIA and the Torere community had a desire to see the project completed quickly with the minimum of fuss, at times finding the required paperwork and bureaucracy frustrating. Rural communities have a doctrine of their own of 'doing it does it', illustrating a desire to take a hands on approach and get things done sooner rather than later. This may not at times be the most efficient but it has proven to be the most effective for Torere in the past. Project management became a daily, time consuming exercise that was not included in the funding provided by the MoH through the CAP as small rural communities like Torere were expected to manage and pay for this themselves. As such, it was always an issue that was raised consistently with the MoH, who have subsequently included funding for project management as part of CAP funding for future applications.

The third bore proved more successful than Bores 1 and 2 with regard to sustainable volume and water quality and so it was decided to proceed with development of this bore to supply water for the scheme.

6 WATER QUALITY

Details of raw water quality obtained from each of the bores and comparison to the Drinking Water Standards for New Zealand (DWSNZ) 2005 (revised 2008) (MoH, 2008) are shown in Table 2. Those parameters exceeding DWSNZ 2005 (revised 2008) Maximum Acceptable Values (MAVs) or Guideline Values (GVs) are highlighted in grey.

Table 2 – Raw Water Quality

Bore		**1**	**3**	**DWSNZ 2005 (revised 2008)**	
Parameter	**Units**			**MAV**	**GV**
E. coli	cfu / 100 ml	-	< 1	< 1	-
pH	-	7.2	7.7	-	7.0 - 8.5
Turbidity	NTU	12	-	-	2.5
Total Alkalinity	mg$CaCO_3$/L	100	82	-	-
Transmittance (@ 254 nm)	%T, 1 cm cell	68	-	-	-
Total Hardness	mg$CaCO_3$/L	42	54	-	200
Total Dissolved Solids	mg/L	260	200	-	1000
Total Arsenic	mg/L	-	-	0.01	-
Total Boron	mg/L	0.04	0.17	1.4	-
Total Sodium	mg/L	64	41	-	200
Total Potassium	mg/L	2.9	3.1	-	-
Total Zinc	mg/L	0.43	0.037	-	1.5
Total Iron	mg/L	2.4	1.8	-	0.2
Total Manganese	mg/L	0.47	0.36	0.4	0.04
Chloride	mg/L	57	42	-	250
Sulphate	mg/L	4.9	13	-	250
Free Carbon Dioxide	mg/L at 25°C	13	3.3	-	-

As can be seen from Table 2 both of the bores had iron and manganese concentrations greater than the DWSNZ 2005 (revised 2008) GVs. In Bore 1 manganese concentrations were above the MAV. Turbidity was higher than the GV in Bore 1; Bore 3 not being tested for this parameter. Considering the DWSNZ 2005 (revised 2008) the key parameters of concern identified were:

- Total Iron – Elevated levels cause staining of laundry.
- Total Manganese – Elevated levels cause staining of laundry and metallic taste in water.
- pH – may require pH adjustment using chemicals such as caustic or sulphuric acid if close to the DWSNZ 2005 (revised 2008) range.

As discussed in Section 5.1, based on these key parameters and poor flowrates, Bore 1 was rejected in favour of Bore 3. Bore 3 had the following advantages over Bores 1:

- Lower iron concentration.
- Lower manganese concentration.
- pH comfortably within DWSNZ 2005 (revised 2008) GV.
- Sustainable flowrate greater than the demand.

Bore 3, although suitable for use as drinking water, would require specific treatment for iron and manganese.

7 LEGISLATIVE REQUIREMENTS

7.1 HEALTH (DRINKING WATER) AMENDMENT ACT (2007)

The Health (Drinking Water) Amendment Act (New Zealand Government, 2007) came into law in 2007 and aims to protect public health by improving the quality of drinking water. This act is mandatory for supplies serving 25 or more people and so is applicable to the Torere water supply scheme.

The Act defines the Torere water supply as a "small" supply, as it serves a population of between 101 – 500 people. Based on this definition Torere will have to comply with the Act from 1st July 2012.

From this date the Act will require the following of the Torere water supply:

1. Be registered on the Register of Community Drinking Water Supplies.
2. Undergo Public Health grading for the water supply and reticulation network.
3. Develop and implement a PHRMP.
4. Use MoH approved labs for water quality testing.
5. Take all "practicable" steps to comply with the DWSNZ 2005 (revised 2008).

A requirement of obtaining CAP funding is to have an approved PHRMP and as Torere has already obtained CAP funding they have satisfied Item 3. Items 1, 2 and 4 will be effective once the supply is established. Item 5 is somewhat detailed and impacts significantly on the design of the WTP. This is discussed separately in Section 7.2.

7.2 DWSNZ 2005 (REVISED 2008)

Following is a summary of the key information that the DWSNZ 2005 (revised 2008) details to water suppliers:

- MAVs and GVs for various contaminants that may be present in drinking water.
- Monitoring requirements – dependant on the population of the community supplied, likely contaminants and treatment processes used.
- Criteria for demonstrating compliance with DWSNZ 2005 (revised 2008).
- Actions to be taken in the event of non-compliance.

As a small water supply Torere has two options for demonstrating compliance with the DWSNZ 2005 (revised 2008):

1. Complying with the bacterial, protozoal, cyanotoxin, chemical and radioactive materials compliance criteria, as larger water supplies must do.
2. Following a PHRMP compliance criteria approach as a "participating supply".

As the supply had already developed a PHRMP as part of the process of obtaining CAP funding and the source is groundwater likely to be able to be proved "secure", Option 2 was preferable. Cyanotoxins are not found in groundwater so compliance for this criteria does not apply. To achieve compliance with the DWSNZ 2005 (revised 2008) the Torere water supply scheme must therefore:

- Demonstrate that the bore is secure – this eliminates the need for bacterial or protozoal treatment.
- Radiological testing must be carried out before connection of the supply to the reticulation.
- Iron and manganese must be treated to below the MAVs and GVs.

4.2.2.1 DEMONSTRATING BORE SECURITY

To demonstrate bore security the bore must meet several further criteria. Bore 3, to be used for the Torere water supply draws water from an unconfined aquifer at a depth of approximately 60 metres. Based on this information the criteria for demonstrating bore security are:

1. That the bore is not directly affected by surface or climatic influences. This can be achieved through demonstrating either:

- Residence time – that less than 0.005 percent of the water has been present in the aquifer for less than one year.
- Constant compositions – through testing conductivity, chloride and nitrate concentrations and showing their variability to be below various percentages, over a period of one to three years.
- Verified model – a hydrological model of the aquifer source showing no direct surface or climatic effects and independently peer reviewed by qualified persons.

2. The bore head and surrounds must be constructed to prevent:

- Ingress of water.
- Backflow.
- Animals from coming within 5 metres of the bore.

3. *E.coli* samples must be taken from the bore weekly for 12 months and no *E.coli* detected.

4.2.2.2 MONITORING

Provided the bore is proven to be secure, and the Torere water supply scheme gains "participating" status and compliance with the DWSNZ 2005 (revised 2008), the following ongoing monitoring will be required in order to maintain that compliance:

- Bacterial monitoring for *E.coli* at random points in the reticulation system. Initially this must be conducted at least once every three months.
- Chemical monitoring for manganese as this is present in the raw water at concentrations greater than 50% of its MAV. This must initially be monitored at least annually.
- Monitoring to demonstrate the three bore water security criteria listed in Section 4.2.2.1.

8 DESIGN

Design of the Torere Water Supply was carried out in two parts. The first part was the establishment of the reticulation system and was handled by another consultant. The second part was the design of:

- An approximately 850 metre raw water main from Bore 3 to the WTP.
- The WTP.
- An approximately 650 metre treated water main from the WTP to the water storage reservoirs.

The design of the water mains is not discussed within this paper. The basis for design of the WTP is detailed in Table 3.

Table 3 – Basis for Design of the WTP

Parameter	Value	Units
Average Daily Water Demand	80	m^3/day
Peak Flowrate (through WTP)	2	l/s
Peak Flowrate (from WTP to Reservoirs)	3	l/s
Treatment	Meet DWSNZ 2005 (revised 2008)	-

8.1 APPROACHES TO TREATMENT

The raw water requires treatment to reduce concentrations of iron and manganese. The following treatment processes are most commonly selected for this purpose:

- Catalytic filtration – for the removal of manganese, this involves pre-chlorination prior to filtration through a gravity media bed consisting of manganese coated media or manganese greensands.
- Ion Exchange – replaces iron and manganese ions with sodium ions which have little impact on water quality.
- Oxidation / filtration – oxidation is capable of iron and manganese removal and can be achieved by aeration, pre-chlorination, dosing with potassium permanganate or ozonation to precipitate the iron and manganese. Conventional filtration then removes the precipitates.

Advantages and disadvantages of each process are detailed in Section 8.2.

8.2 TREATMENT PROCESS

In addition to the design basis, the requirements of the Community also had to be considered and were the key to selection of the treatment process. Community requirements included:

- Satisfying cultural requirements through ensuring no interference with the water by chemicals.
- A simple control and operation system, able to be operated and maintained as much as possible by members of the community.
- The lowest possible operational cost throughout the life of the system.
- The lowest possible level of ongoing maintenance necessary.

Each of the options identified as suitable for treatment were assessed against the community requirements to identify the preferred option. Table 4 summarises the multi-criteria assessment. Each option is ranked from 1 – 3 as follows:

1 = Poor

2 = Adequate

3 = Preferable

Table 4: Assessment of Options for Treatment

Parameter	**Catalytic Filtration**	**Ion Exchang e**	**Aeration**	**Pre-chlorination**	**Potassium Permanganate**	**Ozonation**
Capital Cost	Moderate	Low	Low	Moderate	Moderate	High
	2	3	3	2	2	1
Operating Cost	Low	Low	Moderate	Moderate	Moderate	Moderate
	3	3	2	2	2	2
Chemical Use (Interference with the mauri of the water)	**Chlorine** – high level of interference. A powerful, chemical. Decreases the water's ability to sustain life, therefore reducing mauri.	**Salt, citric acid** – both naturally occurring and have a low impact on the water's ability to sustain life.	**None**, unless used for pH adjustment to improve aeration performance. No chemical use would leave the mauri of the water unchanged.	**Chlorine** – high level of interference. Powerful, and dangerous chemical. Decreases water's ability to sustain life, reducing mauri.	**Potassium Permanganate** – high level of interference. Powerful, and dangerous chemical. This would significantly reduce the mauri of the water.	**Ozone** produced – high level of interference. Powerful, chemical. Decreases water's ability to sustain life, therefore reducing mauri.
	1	2	3	1	1	1
Operational Complexity	Moderate - backwashing	Low – automated backwash	Low	Moderate - backwashing	High – potassium permanganate dosing must be carefully controlled.	High – obtaining correct dose is difficult. Can turn water pink. As such ozone not often used in this application.
	2	3	3	2	1	1
Maintenance / Servicing	Periodic media, chlorine changes	Regular top up of Salt, citric acid into brine tank	Infrequent	Periodic chlorine changes	Regular potassium permanganate make-up	Infrequent
	2	1	3	2	1	3
Treatment Performance	Good	Good	pH dependant – poor performance without pH correction	pH dependant – poor performance without pH correction	Good	Good, but this technology not often used for this purpose.
	2	2	1	1	2	2
Environmental Risk	Low	Minimal	None	Low	Moderate	Low
	2	3	3	2	1	2

Parameter	Catalytic Filtration	Ion Exchange	Aeration	Pre-chlorination	Potassium Permanganate	Ozonation
Health & Safety Risk	Moderate - Chlorine use / production can be dangerous	Low	Low	Moderate - Chlorine use / production can be dangerous	High - potassium permanganate handling is dangerous	Moderate
	1	2	2	1	1	1
Energy Consumption	Low	Minimal	Moderate	Low	Low	Moderate
	2	3	1	2	2	1
Ranking Total	17	22	21	15	13	14
Overall Rank	**3**	**1**	**2**	**4**	**6**	**5**

Based on the multi-criteria assessment, ion exchange was selected as the preferred option for treatment. The strongest factors influencing this outcome being:

- Low operating cost.
- Minimal interference with the mauri of the water while satisfying performance requirements.
- Low operating complexity.

Upon determining the most suitable treatment option, additional challenges to the design included:

- Re-use of existing infrastructure where possible.
- Redundancy features for emergency situations.
- Use of roof water from the WTP building for a community garden.
- Developing stormwater and waste brine disposal systems as there are no existing stormwater or sewer services at the site.

The most difficult of these to overcome was the stormwater and brine disposal. This was resolved by modifying standard soakpits, regularly used in Bay of Plenty areas without stormwater reticulation to receive stormwater and waste brine. The soakpit modifications included:

- A set depth of filtering sand to catch fine solids.
- Discharge sparges to maximise use of the soakage area and prevent scouring of the filtering sand.
- A geotextile at the base of the soak pit to prevent preferential flow and the passing of solids out of the soakage pit.

This ensured that the modified soakage pits allowed water to soak into the relatively free-draining soil while trapping solids in the filtering sand, which could be periodically removed and replaced. Dissolved salts in the waste brine were considered to be low risk to the soil due to the proximity of the site to the sea and probable naturally elevated salt levels in the soil.

9 MEETING PROJECT REQUIREMENTS

9.1 HOW THE PROJECT MEETS / DOES NOT MEET CULTURAL / COMMUNITY REQUIREMENTS

9.1.1 CHEMICAL USE

Sodium chloride (salt) and citric acid are the only chemicals required to be used in the treatment system. Although these are technically chemicals and therefore do not meet the Community's criteria for no chemical interference with the water, they are sourced from and based on naturally occurring substances and are not synthesized and produced by purely man-made processes. As such these chemicals result in minimal interference with the mauri of the water. The Pakeke and the community as a whole consider this to be satisfactory.

9.1.2 OPERATING COST

The operating cost for the Torere water supply scheme has been estimated at approximately $300 per household per year, all inclusive and is equivalent to approximately $0.82 per m^3 of water. This is well below the current rate charged by a number of territorial authorities and their water utilities. This expense is considered to meet the community requirement for lowest operational cost possible.

9.1.3 COMMUNITY INVOLVEMENT, OPERATION AND MAINTENANCE

From the commencement of the project the project management has been handled by a member of the Iwi. The project could not have been successful without consultation with and use of the knowledge of the Pakeke to identify suitable sites for bore exploration and provide counsel on cultural issues related to the development of the treatment system. The scheme has been and will continue to be constructed by local contractors and use locally sourced materials as much as possible. The water supply system uses a simple control philosophy based on levels in storage tanks starting and stopping pumps, and requires minimal operator supervision. Designated operators chosen from within the community will be responsible for day-to-day tasks including:

- Top-up of brine recharge tank with salt and citric acid.
- Water meter reading.
- Water quality sampling.
- Visual checks (e.g. pressure upstream and downstream of process units).

The control system is able to alert the system operators if more serious faults occur and the technology within the system is such that faults are able to be attended to by local contractors within the Opotiki, Whakatane area. Instrumentation has been selected with the priority on long-life and minimal maintenance requirements.

9.2 HOW THIS MEETS / DOES NOT MEET DWSNZ REQUIREMENTS

Provided the bore is able to obtain secure status, the treatment system will meet DWSNZ 2005 (revised 2008) requirements. If the bore is unable to achieve secure status, but still able to meet the criteria to be considered a "participating supply" then chlorine or UV disinfection would be necessary. As the community has a preference not to use chemicals, UV treatment would be likely to be selected and would provide bacterial and protozoal protection barriers. The treatment system is designed such that UV could easily be retrofitted, should this become necessary in the future.

10 OUTCOMES FOR THE COMMUNITY

Positive outcomes for the community are seen as threefold:

- Direct health benefits.
- Benefits of community ownership and involvement.
- Indirect socioeconomic benefits.

10.1 DIRECT HEALTH BENEFITS

The new Torere water supply scheme will provide direct health benefits to the community by reducing the health risks of consumption of contaminated water. This results in less illness from water-borne disease, and may also improve long-term health prospects.

10.2 BENEFITS OF COMMUNITY OWNERSHIP AND INVOLVEMENT

The community has been able to play an integral role in the development of the new water supply, not least through:

- Having a project manager from the Iwi.
- Consultation with and guidance from the Pakeke.

Once the supply scheme is established the Community will also operate and manage the system. These activities are likely to further strengthen the social network, cooperation and sense of togetherness that exists within the Community.

10.3 INDIRECT SOCIOECONOMIC BENEFITS

Having a substandard water supply with a higher risk of contamination not only increases direct short and long-term health impacts, but there are also a number of indirect impacts. The most significant of these being:

- Lost time from work – which may result in reduced income.
- Lost time from school – reducing learning opportunities for children, and long-term, the ability of gaining a qualification and ultimately employability as an adult.

Such indirect impacts are difficult to measure and place an economic value on. One way is through the socioeconomic deprivation index discussed in Section 3. Long-term, it may be possible to identify and measure some of the benefits to Torere and other communities who have received CAP funding through reductions in the social deprivation index score of those communities as measured from census information.

When assessing the success of the CAP it will be important to consider improvements to the socioeconomic status of funded communities and factor this into any cost benefit analysis.

11 CONCLUSIONS

The Torere community consists of approximately 180 households, of which approximately 45% are supplied by an existing surface water scheme operated by a Water Committee established by the Community. Although the existing system has served these members of the community well, health risks are such that the scheme requires upgrade or replacement. Sadly, the Torere community has a socioeconomic deprivation index of 9, based on 2006 census results, however this worked in favour of the community when CAP funding provided by the MoH was applied for. The application for funding was successful and the work of establishing a new community water supply through the input and organization of the NIA was begun.

The predominantly Maori community had a number of cultural and other requirements that the supply had to meet including:

- No use of chemicals, which would interfere with the mauri of the water.
- Having a simple control and operation system, able to be operated and maintained as much as possible by members of the community.
- Having the lowest possible operational cost throughout the life of the system.
- Having the lowest possible level of ongoing maintenance necessary.
- Re-use of existing infrastructure where possible.
- Redundancy features for emergency situations.

- Use of roof water from the WTP building for a community garden.

The development of a bore was deemed to be the preferred method of supply as there was considered to be less risk from outside contamination. Three exploration bores were drilled before a satisfactory bore was identified. Provided that the bore can obtain secure status, the raw water will require treatment for iron and manganese only.

Ion exchange was chosen as the preferred treatment option. This was preferred over other options due to:

- Low operating costs.
- Minimal interference with the mauri of the water while satisfying performance requirements.
- Low operating complexity.

The establishment of the Torere water supply will provide the following benefits to the community:

- Reduced instances of illness due to water-borne contaminants.
- Improved long-term health prospects.
- Further strengthening the social network, cooperation and sense of togetherness that exists within the community.
- Reductions in absenteeism from work and school.

Although difficult to measure, it may be possible in the long-term to identify the improvement to the drinking water supply as a factor in reducing the socioeconomic deprivation index score of the Community. This may occur as a result of indirect benefits such as increased qualification and employability levels, and ultimately increased incomes due to reductions in absenteeism from work and school.

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