

Ohau Village Water Supply

Issues and Options Report

August 2018



www.fluentsolutions.co.nz





Ohau Village Water Supply Issues and Options Report

Task	Responsibility	Signature	
Project Manager:	Melanie Stevenson	Ma A	
Prepared By:	Melanie Stevenson	1 thing	
Reviewed By (WDC):	Michael Goldingham	M O Goldingh	

Issue Date	Revision No.	Author	Checked	Approved
10 August 2018	A	MKS	MKS	MKS
21 November 2018	В	MKS	MG	MG

Prepared By: Fluent Infrastructure Solutions Ltd 2nd Floor, Burns House 10 George Street PO Box 5240 Dunedin 9058 Telephone: + 64 3 929 1263 Email: office@fluentsolutions.co.nz Web: www.fluentsolutions.co.nz

Job No.: Date: Reference: 000442 10 August 2018 RP 18-08-10 MKS 000442(RevB)

© Fluent Infrastructure Solutions Ltd

The information contained in this document is intended solely for the use of the client named for the purpose for which it has been prepared and no representation is made or is to be implied as being made to any third party. Other than for the exclusive use of the named client, no part of this report may be reproduced, stored in a retrieval system or transmitted in any form or by any means.





Ohau Village Water Supply Issues and Options Report

EXECUT	IVE SUMMARY	.1
1.0	Introduction	.1
2.0	Existing Supply	. 1
2.1	Overview of existing System	. 1
2.2	Identified Issues	. 3
2.2.1	Source	. 3
2.2.2	Treatment	.4
2.2.3	Storage	.4
2.2.4	Distribution	.4
2.2.5	Drinking Water Legislation	. 5
2.2.6	Other Issues	.5
3.0	Drinking Water Regulations	
3.1	Health (Drinking Water) Amendment Act 2007	
3.2	Drinking Water Standards for New Zealand	. 6
3.3	Possible Changes to Regulations Since the Havelock North Enquiry	.6
4.0	Water Demand Assessment	.7
4.0 4.1	Water Demand Assessment	.7 .7
4.0 4.1 4.2	Water Demand Assessment General Current Demand	.7 .7 .7
4.0 4.1 4.2 4.3	Water Demand Assessment General Current Demand Future Demand	.7 .7 .7 .8
4.0 4.1 4.2	Water Demand Assessment General Current Demand	.7 .7 .7 .8
4.0 4.1 4.2 4.3	Water Demand Assessment General Current Demand Future Demand	.7 .7 .8 .8
4.0 4.1 4.2 4.3 4.4	Water Demand Assessment	.7 .7 .8 .8
4.0 4.1 4.2 4.3 4.4 5.0	Water Demand Assessment	.7 .7 .8 .8
4.0 4.1 4.2 4.3 4.4 5.0 5.1	Water Demand Assessment	.7 .7 .8 .8 .9 .9
4.0 4.1 4.2 4.3 4.4 5.0 5.1 5.2	Water Demand Assessment General Current Demand Future Demand Design Flows Upgrade Options General Source	.7 .7 .8 .9 .9
4.0 4.1 4.2 4.3 4.4 5.0 5.1 5.2 5.2.1	Water Demand Assessment	.7 .7 .8 .9 .9 .9
4.0 4.1 4.2 4.3 4.4 5.0 5.1 5.2 5.2.1 5.2.2	Water Demand Assessment	.7 .7 .8 .9 .9 .9 .9
4.0 4.1 4.2 4.3 4.4 5.0 5.1 5.2 5.2.1 5.2.2 5.2.3	Water Demand Assessment General Current Demand Future Demand Design Flows Upgrade Options General Source General Bore Location Community Drinking-water Protection Zone	.7 .7 .8 .9 .9 .9 .9



5.3.2	Comparison of Treatment Technologies	12
5.3.3	Proposed Treatment for Ohau Village Water Supply	17
5.3.4	WTP Location	17
5.4	Storage	18
5.4.1	General	18
5.4.2	Storage Volume Calculations	18
5.4.3	Reservoir Location	18
5.5	Reticulation	19
5.6	Fire Fighting	19
6.0	Concept Design and Cost Estimates	19
6.1	General	19
6.2	Design Assumptions	20
6.3	Option 1: New Bores plus Treatment and New Storage at existing Location	21
6.3.1	Description	21
6.3.2	Cost Estimate	24
6.3.3	Pros and Cons	24
6.4	Option 2: New Bores plus Treatment, New Storage and Reticulation Pumps that Pump Directly to Reticulation	25
6.4.1	Description	
6.4.2	Cost Estimate	
6.4.3	Pros and Cons	
6.5	Summary of Options	
0.0	Summary of Options	28
7.0	Discussion	30
8.0	Recommendations	.31

APPENDIX 1

Process Flow Diagrams

APPENDIX 2

Detailed Cost Estimates



EXECUTIVE SUMMARY

The Ohau Village Water Supply services Ohau Village which is a 136 lot alpine subdivision adjacent Lake Ohau, in the McKenzie Basin. Currently there are 60 houses connected to the water supply which are a combination of on-demand and restricted connections to both permanent and holiday houses.

Key issues identified with the existing water supply are:

- The water source experiences drought and is unlikely to meet future demands from the village.
- The source water experiences high levels of E.coli contamination and is untreated.
- The community is reliant on boiling their own water and there is a high risk that holiday makers are not aware of the boil water notice and drink unsafe water.
- The intake and storage is on private land with uncertainty over future access.
- The system has been designed as a restricted supply but there are currently a mixture of on-demand connections and restricted supplies. Restricted units are 600L/day and is not considered to be an adequate volume for most households.
- Drinking water regulations are expected to change in the near future with chlorine disinfection becoming mandatory.

Description	Unit	Current	Fi	uture
		On-demand	Restricted	On-demand
Average daily flow	m³/day	47	116	123
Peak daily flow	m³/day	110	184	390
Instantaneous flow	L/sec	7	2.2	12.1

Upgrade options have been identified to provide a water supply that will meet the Health (Drinking Water) Amendment Act 2007 and that meets future demand with either restricted or on-demand connections.

There are two main options that have been developed. These are:

Option 1: New bore supply with new treatment plant treatment and storage located at existing storage site.

Option 2: New bore supply with new treatment plant treatment, storage and reticulation pumps.



Each option has sub options which are:

- With chlorine and without chlorine
- Restricted and On-demand flow

Both options involve the development of a new bore supply. The most viable option is considered to be adjacent Lake Ohau, in WDC reserve land.

The most cost effective treatment process is considered to be cartridge filtration followed by UV disinfection, with chlorine disinfection (to be added now or later). Cartridge filtration will rely on high quality water from the bore supply to ensure rapid fouling of the cartridge does not occur. The water treatment would be located adjacent bores, also in WDC reserve land.

Storage can be located at the existing site (private property) (Option1) or adjacent the water treatment plant, which requires additional reticulation pumping and power generation (Option 2).

Costs Estimates for the various options range from \$919,000 for a restricted unchlorinated supply, to \$1,250,000 for an on-demand, chlorinated supply.

Option	Description	Chlorine	Flow Type	Capital (\$)
		Disinfect		
	New bores and water	No	Restricted	919,900
1	treatment plant adjacent	No	On-demand	1,045,700
	lake. Elevated storage in	Yes	Restricted	1,119,500
	current location.	Yes	On-demand	1,250,900
	New bores, water	No	Restricted	964,000
2	treatment plant and	No	On-demand	1,089,600
2	storage with reticulation	Yes	Restricted	1,044,800
	pumps adjacent lake.	Yes	On-demand	1,172,800

It is recommended that Council:

- develops funding options to make upgrade affordable to the community
- present options to the Community Board to confirm preference:
 - o for restricted or on-demand flow
 - o for chlorine now or chlorine later
 - o to maintain location of existing storage or construct new storage
 - for location for bores
- engages a hydrogeologist to confirm best location for bores and extent of community drinking-water protection zone
- following confirmation of preference, discuss changes with landowner
- water quality of Lake Ohau should be tested for particle size, turbidity and UV transmittance to get an idea of possible worst case scenarios for the bore



1.0 Introduction

Ohau Village is a small primarily holiday community located near the western edge of Lake Ohau in the Mackenzie Basin. The water is supplied to the village from an adjacent mountain catchment which is untreated. The Ohau Village water supply does not meet the current drinking water legislation.

Fluent Solutions has been engaged by the Waitaki District Council to investigate and report on issues and options to upgrade the Ohau Village Water Supply to meet current drinking water regulations and meet current and future demands of the community.

The results of the investigation are presented in this report.

2.0 Existing Supply

2.1 Overview of existing System

The Ohau Village Water Supply services Ohau Village as shown in Figure 2.1 and 2.2 below.

The Ohau Village Water Supply draws water from a shallow infiltration gallery that is sourced from an un-named stream that is assumed to be a minor branch of the Freehold Creek, approximately 2km west of Ohau Village. The water is then gravity fed from the infiltration gallery to a series of eight concrete storage tanks (total storage 180m³) from where it is supplied by gravity to the township.

The Ohau Water Supply was designed as a restricted supply, however, there are a number of on-demand connections within the village.

Customers on **restricted supply** have individual storage tanks and restrictors that allow the customer to receive a maximum allocated volume (600L) of water over each day. The customer is responsible for a minimum of 3 days storage and a pump system that provides flow and pressure to the house. During power outages water supply cannot be provided to the houses unless they have their own power generator.

On-demand customers receive water directly from the water supply mains in an uncontrolled and unmetered manner. The pressure in the reticulation provides the house with the flow it needs without the need for additional pumps. Water can be supplied to the customer during power outages.

The reticulation around the village is primarily through a looped DN 100 PVC main. Fire fighting protection is provided by a number of fire hydrants and fire hoses housed in cabinets spread around the village.



The water supply system was constructed during the development of the village in 1981. There is no treatment and there is a permanent boil water notice in place.

Waitaki District Council holds a water take consent for the Ohau Village Water Supply:

- **CRC001915** to take water from the unnamed creek for public water supply at a maximum of 2.2L/s. The consent expires on 21 June 2035.
- It is noted that an extraction rate of 2.2L/s is equivalent to a maximum daily volume of 190m³/day.

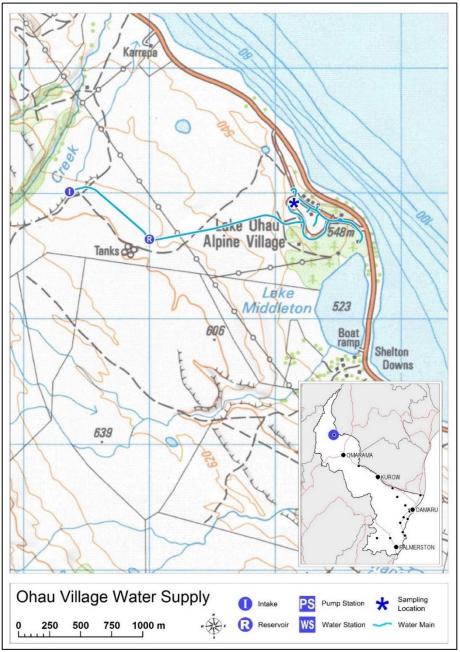


Figure 2.1: Map of Supply Area



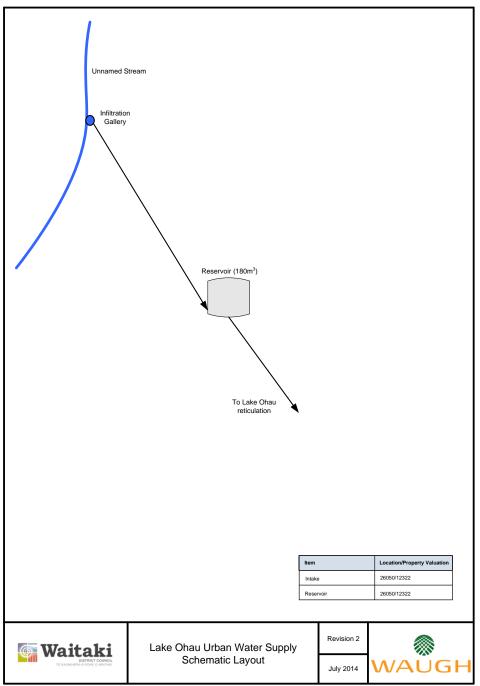


Figure 2.2: Schematic of Water Supply System

2.2 Identified Issues

The key identified issues for the Ohau Village Water Supply are:

2.2.1 Source

- The existing water source is remote and on private land with 4WD access only.
- Access to the intake is through private land with uncertainty over future access.



- The intake is within a community water supply protection zone and therefore requires all grazing stock to be excluded from waterways and banks within a142 Ha zone. No stock holding areas can be established within the zone.
- The water source experiences drought and is unlikely to meet future demands from the village.
- The resource consent is for a maximum of 2.2L/sec which is unable to meet future demands from the village.
- The source water is of variable quality.
 - E.coli averages 10 MPN/100ml with recorded counts of 580 MPN/100ml¹
 - Measured turbidities show that turbidity varies from 0.1NTU to 56 NTU².
- The catchment may become more contaminated due to an increase in farming or more tourists using the Alps to the Ocean track.

2.2.2 Treatment

- There is currently no treatment of the water. The community is reliant on boiling their own water or having their own point of use treatment.
- There is a high risk that holiday makers are not aware of the boil water notice and drink unsafe water.

2.2.3 Storage

- The existing storage tanks are on private land with access by 4WD only.
- There is no way of measuring level in the storage tanks.
- The tanks are 35 years old and are showing signs of deterioration. To meet best
 practice standards for holding treated water, the tanks require upgrading to ensure
 they are adequately sealed from vermin, runoff and that they are secured.

2.2.4 Distribution

- The system has been designed as a restricted supply, however there are still a number of on-demand connections.
- Restricted connections are able to take 600L/day over 24 hours. 600L/day is less than standard design guidelines for domestic demand (which is a minimum of 250L/person/day – NZS4404:2010 – 1,000L/connection based on 4 people per house).
- Restricted connections are unable to obtain water during power black outs unless they have their own power generator.

¹ Drinking Water Standards require E.coli to be <1MPN/100ml

² Turbidity should be stable at <1NTU for effectiveness of disinfection processes such as chlorination and UV disinfection.



- On-demand connections take water in an uncontrolled manner. On-demand systems require water infrastructure to meet peak instantaneous flow rates, which are typically 2.5 to 3 times the flow of restricted systems.
- 2.2.5 Drinking Water Legislation
 - The current water supply does not meet current drinking water legislation. Namely:
 - Drinking Water Standards for New Zealand 2005 (revised 2008)
 - Health (Drinking Water) Amendment Act (2007)
 - An inquiry into the 2016 Havelock North gastroenteritis outbreak, has resulted in a number of recommendations for changes to the drinking water regulations which will likely make treatment requirements more stringent than current standards.

2.2.6 Other Issues

- Ohau Village is remote from operational staff whom are based in Oamaru.
 Currently Ohau is visited 3 monthly. A new treatment plant would need to be automated, and remotely monitored and visited on a weekly basis.
- The topography of the land is such that there are limited sites that are adequately elevated to provide gravity supply. The location of the existing storage tanks is best.
- Ohau village experiences variable power quality (brown outs) which can affect the performance of some water treatment equipment (e.g. UV disinfection). The village also experiences power black outs that can last for up to a week.

3.0 Drinking Water Regulations

3.1 Health (Drinking Water) Amendment Act 2007

The Health (Drinking Water) Amendment Act 2007 (the Act) was passed in October 2007 and took effect from 1 July 2008. The Act imposes a range of duties on drinking water suppliers, the three most important duties being:

- Monitor drinking water; and
- Take all practicable steps to comply with the drinking-water standards; and
- Implement water safety plans for supplies serving greater than 500 people.

These requirements are mandatory for water suppliers and are legally enforceable with heavy penalties prescribed in the Act for non-compliance.



In the Health (Drinking Water) Amendment Act 2007, the Ohau Supply is defined as a Neighbourhood Supply³. The date for compliance with the Act was 1 July 2016. Compliance with the drinking water standards has not occurred.

3.2 Drinking Water Standards for New Zealand

The quality of drinking water in New Zealand is currently measured against the Drinking Water Standards for New Zealand 2005 (Revised 2008) [referred in this report as DWSNZ2005(Rev2008)]. Drinking water standards detail how to assess the quality and safety of drinking water using water quality standards and compliance criteria. The standards are applicable to water intended for drinking irrespective of its source, treatment or distribution.

There are two key areas of compliance criteria for a water supply; namely bacterial compliance and protozoal compliance.

Bacterial compliance criteria relates to the protection against human pathogens. The DWSNZ (2008) stipulate a range of monitoring and operational requirements in order to minimise risk of contamination against human pathogens. Bacteria can be removed by treatment with processes such as chlorination and UV disinfection.

Protozoal compliance criteria relates to the protection against protozoa such as Cryptosporidium and Giardia. Their (oo)cysts are found in the faeces of humans and animals. To determine compliance with the standards the DWSNZ2005(rev2008) first require that Protozoal Log Credit Requirements are determined. This assessment determines the amount of protozoa removal log credits required for the treatment process. To achieve the log credits, the treatment process must meet certain operational and monitoring criteria as set out in the DWSNZ2005(rev2008).

The DWSNZ2005(rev2008) also have chemical compliance criteria which can include chemical determinants introduced to the water by treatment chemicals or those that may be in the raw water, disinfection by-products and cyanotoxins. Monitoring of these determinants is established by the Ministry of Health following identification of risk to the supply.

3.3 Possible Changes to Regulations Since the Havelock North Enquiry

In August 2016, there was a widespread outbreak of gastroenteritis in Havelock North during which more than 5000 people were estimated to have fallen ill, with up to four deaths associated with the outbreak.

An inquiry into the outbreak resulted in 51 recommendations to improve the safety of our drinking-water. Major changes to the drinking water regulations are now being considered.

³ **neighborhood drinking-water supply** means a drinking-water supply that is used to supply drinking water to between 25 and 100 people (inclusive) for at least 60 days per year.



These are:

- all water supplies are to be treated, including with a residual disinfectant in the reticulation. A letter from the Ministry of Health has requested Council investigate this now.
- compliance with the Drinking-water Standards to be mandatory (not only taking all practical steps)
- a dedicated drinking-water regulator to be established
- dedicated water suppliers to be aggregated

One of the key impacts that the above proposed changes to the drinking water legislation will have on the upgrade to the Ohau water supply is that the level of treatment required may become more stringent than current drinking water standards and that provision of the chlorination is likely to become mandatory.

4.0 Water Demand Assessment

4.1 General

In order to size the infrastructure associated with a water supply, it is imperative that a thorough analysis of both current and future water use is completed. A description of the analysis and resulting water demand used in the preliminary designs of the water supply components is presented below.

Peak daily demand calculations are usually the most critical when designing water treatment processes, while instantaneous flows are used to help design treated water storage and pipework leaving reservoirs and in the reticulation.

4.2 Current Demand

Water demand for the Ohau Village Water supply is based on actual flows taken from the flowmeter sited at the outlet of the storage tanks.

Flow data covers the period 1 May 2016 to 30 April 2017. Results indicate:

- Average daily flow is 47m³/day
- Peak daily demand is 110m³/day (occurred over New Year 2016/17)
- Peak instantaneous flow has been recorded as 7L/s (30 December 2016).

As assessment of flow usage during off peak periods when the village primarily comprises of permanent residents on on-demand connections, indicate that water consumption is around 1,100L/day. This is almost double the volume from a restricted take (600L/day).



4.3 Future Demand

The future demand assessment assumes two different supply scenarios:

- 1. All restricted connections with a supply of 1,000L/day⁴ per connection
- 2. All on-demand connections

The number of future connections assumes:

- All available136 Lots are connected to the water supply comprising 50 permanent residents and 86 holiday makers
- The DoC camping ground maintains its existing connection
- 20 additional restricted connections are made in the future (outside village boundary)
- Leakage and flow to the oxidation pond has a constant supply to it of 0.25L/sec (21.6m³/day) [current night time flows]
- The average daily demand from the on-demand connection is 1,100m³/day

Future demand calculations result in the following:

Description	Unit	Connection Type	
		Restricted	On-demand
Average daily flow	m³/day	116	123
Peak daily flow	m³/day	184	390
Instantaneous flow	L/sec	2.2	12.1

Table 4.1: Future Demand Flows

As shown in Table 4.1 above, the water use on average is similar for both restricted and ondemand, however, during peak conditions, the on-demand flow is substantially greater. This impacts the sizing of infrastructure.

4.4 Design Flows

For the purposes of developing options, the design flows are the assessed future demand for fully restricted and full on-demand connections as shown in Table 4.1 above.

⁴ 1,000L/day is considered a reasonable allocation for Ohau based on the current average ondemand usage and design standards of 250L/day per person assuming a 4 people per household.



5.0 Upgrade Options

5.1 General

Currently the water source is of variable quality and quantity and there is no treatment in place to address contamination issues. The water supply system does not comply with the Health (Drinking Water) Amendment Act 2007.

The following section discusses options for upgrading the supply to meet the Health (Drinking Water) Amendment Act 2007 and provides cost estimates for a supply that meets future demand with either restricted or on-demand connections.

5.2 Source

5.2.1 General

As discussed in Section 2.2.1, the existing source has several issues associated with it, making the source not favoured for further development as part of the upgraded system. The main issues are related to:

- the variable quality of the water resulting in the need for a more complex and expensive treatment process.
- Remote site with likely future access issues due to private land ownership.
- Limited flow during drought conditions to meet both current and future demand.

Alternative options are:

- A new Lake Ohau intake
- A new take from Freehold Creek
- Bore supply

An initial assessment of alternative sources determined that the most cost effective option for further development are the bore supplies. A bore supply typically has a more consistent water quality that is easier to treat and is less affected by drought conditions.

5.2.2 Bore Location

Two areas have been identified for locating bores. These are:

- adjacent Lake Ohau (in WDC reserve land to the north east of the village)
- adjacent Lake Middleton (in the Lake Middleton Recreation Reserve managed by DoC to the south of the village)

Possible bore locations are indicated in Figure 5.1 below.





Figure 5.1: Possible Bore Location



Initial desk top investigations to assess feasibility (carried out by Environmental Associates Ltd) indicate that bores located within 100-200m from the lakes would provide the estimated future demand of the community (4-6L/sec), with around 80% of the flow being drawn through the groundwater from the adjacent lakes.

With the adjacent lake water likely to be a large portion of recharge water, the quality of the lake water needs to be taken into consideration. A review of 3-monthly water quality data from Lake Ohau and Lake Middleton (obtained from Environment Canterbury) shows that Lake Ohau has low levels of nutrients (TN <0.1mg/L), chlorophyll (<0.002mg/L) with the maximum turbidity <10NTU. Lake Middleton on the other hand, is more susceptible to higher nutrient loadings (TN 0.2-0.5mg/L), chlorophyll (up to 6.8 mg/L) and has experienced cyanobacteria algae growth (*Draft Lake Middleton Catchment Report*⁵). Lake Middleton, however, has lower levels of turbidity recorded; most likely due to it being more sheltered than Lake Ohau.

While the gravels will provide treatment of the lake water through filtration and bacteria die off, the site adjacent Lake Ohau is considered as the preferred option for development due to a lower risk of contamination from nutrient loading, cyanobacteria and any e.coli that may be in the lake water.

It should be noted however that the proposed site for the Lake Ohau bores are 500-800m away from the Ohau Oxidation Pond. While the groundwater flow from the oxidation pond should be away from the bores, a defined recharge zone needs to the confirmed with the hydrogeologist.

5.2.3 Community Drinking-water Protection Zone

Development of a new water source will require the establishment of a Community Drinkingwater Protection Zone. This limits the discharge of contaminants from such things as wastewater, stormwater, and farming practices in the protection zone. This is managed through the consenting process.

The area of the protection zone is determined by a number of factors, including:

- Aquifer confinement
- Direction of groundwater flow
- Level of treatment
- Rate of take

It is recommended that the Community Drinking-water Protection Zone be well defined prior to finalising the bore location.

⁵ Department of Conservation December 2014



5.2.4 Log Credit Assessment for Proposed New Source

Due to the proximity of the lake and the new groundwater source being drawn from an unconfined aquifer 10 to 30m deep, it is considered appropriate that a **4 log protozoal treatment** is designed for. This may be able to be reduced to a 3 log credit with a detailed catchment risk assessment and consideration of groundwater flow.

5.3 Treatment

5.3.1 General

The key requirements for a water treatment system at Ohau are considered to be:

- compliance with DWSNZ2005 (Rev 2008) which is provision of 4 log protozoal treatment plus bacterial treatment
- provide a system that is upgradable with likely future changes to the Drinking Water Standards and Regulations
- provides preventative measures that address high potential risk to public health
- has sufficient capacity to meet current and future demands
- provide redundancy and flexibility in design to allow demands to be met when maintenance is being undertaken
- provide a treatment system that is both cost effective to construct and to operate and maintain
- provide a treatment process that is reliable and can consistently provide good quality water

5.3.2 Comparison of Treatment Technologies

Water treatment plants vary in type and extent, from those providing only basic screening and disinfection to sophisticated systems designed to reliably provide potable water of high quality, that is safe to drink and pleasant to the taste.

Different treatment methods target different stages of the treatment process. Broadly speaking these processes fall into one of two categories:

- 1. The removal of particulate and dissolved materials to achieve water of high clarity, chemical safety and acceptable taste; and
- 2. Disinfection to kill pathogenic bacteria, viruses and protozoa such as Cryptosporidium and Giardia.

Disinfection can be achieved through physical removal of fine particulate matter, as well as by chemical means, and thus some processes target both categories.

The treatment options that are potentially available to Ohau to address a 4 log credit protozoa removal and provide bacterial compliance are summarised and discussed below. It should be noted that some treatment systems can be combined to achieve higher protozoa log credit removal ratings.



Table 5.1: Treatment Processes

Treatment Option	Protozoal Log Credits	Bacterial Compliance	Pros and Cons	Comment
Coagulation plus Sand Filtration Description: addition of coagulant, followed by flocculation and then filtration though sand media	Up to 3.5	None	 Pros Able to treat highly turbid and coloured water Cons Backwash water with chemical discharge High operator input Complex 	Not considered for Ohau as costly to construct and operate and associated chemical discharge difficult to manage.
Direct filtration with Back-washable Filter Description: pressure vessel with media which is used to filter out particles in the water down to 3 um	Up to 2 log (if approved by MoH)	None	 Pros Backwashable so no need for replacement of cartridges etc Cons Backwash water which needs management High Capital Cost Break through of dirt can occur when overloaded 	Not considered for Ohau as costly to install and associated discharge difficult to manage.
Membrane Filtration Description: membrane allows water to pass through tiny pores in the membrane fibre wall (usually below 0.2 microns) while leaving bacteria and protozoa on the outside of the fibre.	Up to 4 log	None	 Pros Absolute barrier to protozoa Cons Backwash water which needs management Very High Capital Cost High operational cost 	Not considered for Ohau as very costly to install and operate and associated discharge difficult to manage.



Treatment Option	Protozoal Log Credits	Bacterial Compliance	Pros and Cons	Comment
Cartridge Filtration Description: cartridge filters consist of cylinders through which water flows from the outside of the filter to a central collection duct. The aperture size of the material determines the size of the particles removed. Aperture sizes vary from 500 microns to 1 micron and smaller depending on the stage of the treatment process that the cartridge filters are employed.	0-3 log credit depending on pore size and whether using Section 5 or Section 10 (Small Water Supplies) of the DWSNZ.	None	 Pros No backwash requirements Low capital cost Compact with small footprint Cons When cartridge fouls up the cartridge needs replacement. If the raw water is dirty this can occur quickly Not suitable for dirty water – Turbidity >2NTU 	This is considered as part of a cost effective upgrade solution for Ohau and is considered in the upgrades. The pore size of the cartridges will depend on the water quality from the bores and the other treatment processes employed. As cartridges can be prone to blocking up with dirty water, space should be allowed for the addition of bag filters upstream as a lower cost sacrificial filter to keep operational cost down.
Bag Filtration Description: bag filters consist of a porous bag through which water flows from the inside to the outside. The pore size determines the size of the particles removed.	0-1 log credit depending on pore size and stage in the process.	None	 Pros No backwash requirements Bag replacement is significantly lower than cartridge Compact with small footprint Cons Not very robust Not suitable for dirty water – Turbidity >2NTU 	Bag filtration can be used as a sacrificial pre-filter to cartridges as they are lower cost than cartridges. Space should be allowed for the addition of bag filters upstream of the cartridges.
Ultraviolet Disinfection Description: water passes through a reactor which consists of UV lamps inside quartz sleeves. The UV rays act to inactivate protozoa and bacteria by affecting the DNA so they cannot replicate and affect a subsequent host.	Up to 3 log if turbidity < 1 NTU or <u><</u> 5um cartridge filter upstream and turbidity <2 NTU.	Yes – if dosed at 40mJ/cm ²	 Pros A cost effective treatment system for both protozoa and bacterial compliance Simple to operate Cons Can be effected by power brown outs Water quality needs to be highly consistent and good quality water for UV to be effective Does not provide residual disinfection 	This is considered a cost effective upgrade solution for Ohau and is considered in the upgrades. UV lamps can be affected by poor quality power and therefore requires a UPS system to be installed with it.



Treatment Option	Protozoal Log	Bacterial	Pros and Cons	Comment
	Credits	Compliance		
Chlorine Disinfection Description: chlorine is added to the water protection against harmful bacteria and viruses. Chlorine can be dosed as a gas or as a liquid (for example sodium hypochlorite) and provides a long lasting disinfecting residual in the reticulation system.	None	Yes	 Pros Provides long lasting disinfection residual in reticulation Cons High Capital Cost compared with UV disinfection 	This is considered as part of the upgrade solution for Ohau. Chlorine disinfection is not mandatory as part of the DWSNZ2005(2008) however new regulations may require chlorine to be added. Chlorine also treats for viruses which are likely to be part of future drinking water standards.
Ozone Disinfection Description: ozone is a colourless, poisonous gas generated on-site using proprietary generators. It is a strong disinfectant, and an effective oxidant of many organic chemicals and organic colour. Ozone is also often used to help control taste and odours.	Up to 3 Log Credits	Yes	 Pros Can provide protection against protozoa and bacteria Can be used to treat taste and odours Cons Hazardous gas Does not provide residual disinfection 	Not considered for Ohau due to management of hazardous gas and costs.



Treatment Option	Protozoal Log Credits	Bacterial Compliance	Pros and Cons	Comment
Point of Use Treatment Description: point of use treatment is treatment at the connection to the household. It usually comprises of cartridge filtration followed by UV disinfection.	NA	NA	 Pros Capital cost for Ohau likely to be less expensive than a full upgrade Cons Reliant on customers to ensure system is working High operational costs as Council would need to check and maintain system at all connections Does not work during power outage Not compliant with drinking water standards 	Not considered for Ohau due to ongoing operational cost and unable to meet drinking water legislation.



5.3.3 Proposed Treatment for Ohau Village Water Supply

Bacterial compliance and a 4-log protozoal treatment process is the proposed level of treatment for a new bore water at Ohau for compliance with the DWSNZ2005(Rev 2008) and the Health (Drinking Water) Amendment Act 2007 (see Section 3.0).

Protozoal compliance can be met with a number of the discussed treatment processes, however cartridge and UV disinfection is considered to be the most cost effective treatment process for Ohau. Both of these systems are relatively easy to install and operate and has a small footprint in comparison to other technologies.

Bacterial compliance can be achieved with UV disinfection or chlorine disinfection. If UV disinfection is installed then no additional treatment system is required to meet the current standards, provided a 40mJ/cm² dose is dosed. If however, a residual disinfection is required or that changes to the drinking water regulations are made that make chlorine disinfection mandatory, then chlorine will need to be installed.

The treatment proposed for Ohau are:

- Cartridge Filtration 1um to provide 2-3 log credits (with allowance to add bag filtration in the future should cartridge fouling become an issue)
- UV Disinfection to provide dose of 40mJ/cm² that provides 3 log credit and bacterial compliance
- Chlorine gas disinfection 2 x 70kg cylinders with dosing equipment for bacterial compliance, provision of a residual disinfectant and future proofing.

There is the option of staging works. This would involve the installation of the cartridge and UV disinfection initially with design consideration given to adding chlorine at a later time, if required. Upgrade options with and without chlorine are presented in section 6.0.

5.3.4 WTP Location

It is proposed that the water treatment plant building be constructed nearby the bores, on reserve land and away from houses. If chlorine gas is installed on site then there is a risk, albeit very small, of chlorine leakage. It is therefore recommended that chlorine gas is installed downhill and away from houses.

The preferred site for the WTP is adjacent Lake Ohau Road as indicated in the Figure 6.1 and 6.2. This site can be easily viewed by passers by and given the scenic and natural environment, the WTP and associated infrastructure will need to be a sympathetic design with appropriate landscaping to fit within the environment.



5.4 Storage

5.4.1 General

Treated water reservoir storage is required for several reasons:

- Operating Storage
 - to supply water during peak demands in excess of treatment plant flow (diurnal peaks). This allows the treatment plant capacity to be reduced to cover peak daily flow rather than peak hourly demand.
 - taken as 6 hours at peak instantaneous demand.
- Emergency Storage
 - to supply stored water in case of source or treatment plant breakdown or power outage.
 - taken as 24 hours at average daily flow.
- Fire fighting Storage
 - to supply stored water for fighting fires.
 - Taken as 45m³ Fire Risk Classification FW2 (SNZ PAS 4509:2008).
- Chlorine Contact Time
 - o 30 minute at peak treated water design flow.

5.4.2 Storage Volume Calculations

Storage volume calculations have been completed to estimate the volume of storage required. The resulting storage is presented in Table 5.3 below:

Connection Type	Chlorine Contact Time – 30min (m ³)	Operational Storage (m³)	Emergency Storage (m³)	Fire Storage (m³)	Total Storage (m ³)	No. of 30m ³ tanks
Restricted	4.6	1	116	45	166	6
On Demand	9.8	164	123	45	342	12

Table 5.3: Storage Requirements for Ohau Village (Future Flows)

5.4.3 Reservoir Location

Two main locations have been identified to storage location.

Option 1 is locating the reservoirs at the current site. This is at an elevation of around 580m, some 35m above the village reticulation. At this site, the reservoirs would act as a balance tank connected by the existing watermain that would act as a rising falling main. Given the condition of the existing reservoirs, full reservoir replacement is recommended.

Option 2 is locating the reservoirs adjacent the water treatment plant. The reservoirs would store treated water from the adjacent WTP. As the reservoirs will be below the elevation of



the village reticulation, reticulation pumps will be needed to provide flow and pressure to the water. A power generator would be required to maintain flow and pressure during power outages for this option.

5.5 Reticulation

There are no major changes proposed for the existing reticulation which is a 100mm diameter ringmain around the village. However, as there is a combination of on-demand and restricted flow connections, changes will need to be made to make these consistent, depending upon what option is chosen.

5.6 Fire Fighting

As discussed in section 2.1, fire fighting protection is provided by a number of fire hydrants and fire hoses housed in cabinets spread around the village. Following discussions with the Otago Rural Fire Service (pers. comm Graham Still), the fire hoses are for immediate use by residents for small controlled fires. Under the current system, these 41mm hoses are expected to be able to discharge about 10L/sec.

The installed fire hydrants would be utilised by fire appliances that would come from Twizel and Omarama within about 15-20min. With the existing system, these should be able to provide 25L/sec from up to 2 hydrants. The fire service could also obtain water from Lake Ohau or Lake Middleton and they also arrive on site with 2,200L in each fire appliance.

Helicopters are also sent to a fire callout and can arrive within 15 minutes from Twizel.

For the purposes of this options report, it is assumed that the current fire fighting protection remains. Where the storage is adjacent the WTP (Option 2), there will need to be a fire pump and larger generator to provide the same level of service for fire protection as is currently in place.

6.0 Concept Design and Cost Estimates

6.1 General

This section outlines the concept design and cost estimates for upgrading the Ohau Village water supply.

There are two main options that have been developed. The main options are as follows:

Option 1: New bore supply with new treatment plant treatment and storage located at existing storage site.

Option 2: New bore supply with new treatment plant treatment, storage and reticulation pumps.



Each option has sub options which are:

- With chlorine and without chlorine
- Restricted and On-demand flow

The location of the bore pumps and treatment plant is assumed the preferred option adjacent Lake Ohau (discussed in Section 5.0). If Lake Middleton bore option is developed the costs will be similar.

Option	Description	Treatment	Flow Type	Option Ref
Option	Description	Treatment	гюм туре	Option Rei
1	New bores plus	Cartridge/UV Disinfection	Restricted	1a-R
	treatment and	Cartridge/UV Disinfection	On Demand	1a-OD
	new storage at	Cartridge/UV Disinfection	Restricted	1b-R
	existing location	plus Chlorination		
		Cartridge/UV Disinfection	On Demand	1b-OD
		plus Chlorination		
2	New bores plus	Cartridge/UV Disinfection	Restricted	2a-R
	treatment, New	Cartridge/UV Disinfection	On Demand	2a-OD
	storage and	Cartridge/UV Disinfection	Restricted	2b-R
	reticulation	plus Chlorination		
	pumps (adjacent	Cartridge/UV Disinfection	On Demand	2b-OD
	bores)	plus Chlorination		

Table 6.1 below summarises the key identified options.

Overall location plans for each option are shown in Figure 6.1 and 6.2 and process flow diagrams for each option are presented in the appendices.

6.2 Design Assumptions

The following design assumptions have been made:

- For the restricted flow option the design flows are:
 - Treatment plant and bore design peak daily over 20 hours = 2.6L/sec
 - Reticulation design instantaneous flow is based on all connections taking restricted flow simultaneously
- For the on-demand flow option the design flows are:
 - Treatment plant and bore design peak daily over 20 hours = 5.4L/sec
 - Reticulation design instantaneous flow is based on Probable Simultaneous Demand calculations from ASNZS 3500:2015 for all connections
- The water quality from the bore supply has:
 - UV transmittance <u>>85%</u>
 - Turbidity <2 NTU
- 2 bores are installed in a duty/assist operation for peak flow and duty/standby at average flow



- The cartridge design allows for duty/standby for peak flow
- The UV reactors are designed as duty/assist at peak flow but will operate as duty/standby for average flow
- The UV system requires UPS (uninterruptible power supply) to address brown out power conditions which can make UV unreliable
- Back-up generators are required for on-demand flow scenarios and for option 2, where storage is adjacent water treatment plant
- All options allow for the installation of chlorine gas disinfection (either at the time of construction or at a later date)
- The target pressure for restricted flow is 15m and for on-demand flow is 25m
- The fire flow requirements are based around:
 - A water supply classification of FW2 requiring 45m³ storage
 - The reticulation is to have a capacity for 60% of peak flow plus 25L/sec SNZ PAS 4509:2008
- The reticulation pumps are hydrovars with at least 2 pumps to operate as a duty/assist.

6.3 Option 1: New Bores plus Treatment and New Storage at existing Location

6.3.1 Description

This option is for the construction of 2 new bores, a new treatment plant and new storage tanks to replace the existing tanks at the current location.

The bores will pump water through the treatment process directly into the reticulation and up to the storage tanks, elevated about 35m above the village. The storage tanks will act as a balance tank to provide flow for peak instantaneous demand, emergency storage, and fire storage. To ensure adequate turn-over of the storage tanks, the pipework will have to allow for a separate inlet and outlet and have level monitored with telemetry to communicate with the bore pumps to turn on/off.

Given the condition of the existing storage tanks, demolition of these tanks plus new replacement tanks have been allowed for.

The minimum proposed treatment system to meet DWSNZ 2005(Rev 2008) is a 1um cartridge filter with UV reactors. This would be housed in a small (10m²) water treatment plant building.

An additional treatment barrier is the installation of chlorine gas dosing for disinfection. This would also be housed within the treatment plant building but would require the addition of 30 minutes contact time. This could be provided by installing a pressurised chlorine tank or a length of large diameter pipework.



This option can be constructed to supply either restricted and on-demand flow connections. For on-demand flow, a power generator has been allowed as 1day of storage is not considered adequate to arrange the delivery and connection of a plug in back up generator.

An overall site plan for Option 1 is shown in Figure 6.1 below and a process flow diagram Option 1 is provided in the appendices.





Figure 6.1: Option 1 Site Plan



6.3.2 Cost Estimate

Estimated costs for Option 1 scenarios are provided in the table below. More detailed costing is provided in the Appendices.

Table 6.2: Preliminary Cost Estimates for Option 1, with and without chlorine disinfection, and for Restricted and On-demand flow scenarios.

Description		nent (cartridge, UV) and in current location	Bore supply, treatment (cartridge, UV and CHLORINE) and new storage in current location		
	Restricted On Demand		Restricted	On Demand	
	Option 1 a -R	Option 1 a - OD	Option 1 b-R	Option 1 b - OD	
Source	165,500	166,500	165,500	166,500	
Treatment	255,700	265,800	402,300	412,300	
Reticulation	37,600	37,600	37,600	37,600	
Storage	185,600	238,800	181,600	238,800	
Fire Protection	12,600	12,600	12,600	12,600	
Generator		25,600	-	25,600	
P&G, Design and Contingency	262,800	298,776	319,900	357,400	
Capital cost	919,900	1,045,700	1,119,500	1,250,900	
Annual Cost	38,200	38,200	38,400	38,400	
NPV 20 years at 8%	1,294,900	1,420,700	1,496,500	1,627,900	

Operating Costs are based on average flows and include labour charges for weekly visits from Oamaru (with sharing travel costs with other Waitaki Valley supplies).

An assessment of the preliminary costs indicate that, as expected, the least capital expenditure is associated with a restricted connection without chlorine. Increasing the level of service to on-demand connections adds a further \$125,800 and adding chlorine will increase costs by another \$205,000.

Please note that fire protection is as currently provided. Costs associated with the Fire Protection in Table 6.2 above, are related to 45m³ storage.

6.3.3 Pros and Cons

Pros and Cons for Option 1 are:

Pros

- Elevated storage provides supply during power outage without the need for a generator.
- A smaller footprint is required adjacent the lake as storage is at the existing site.
 This results in reduced landscaping and screening requirements.
- This existing storage could be maintained if it was preferred to stage the works (replace the tanks at a later time).
- Able to abandon intake and associated pipework to storage tanks.
- The private land owner is able to utilise land around intake.



Cons

- The storage is on a remote site so there will be additional operational cost with travel time to site.
- Due to the location of storage, there are also likely to be more issues with the communication between the storage and the pumps resulting in addition maintenance.
- Future access issues are likely due to private land ownership.

6.4 Option 2: New Bores plus Treatment, New Storage and Reticulation Pumps that Pump Directly to Reticulation

6.4.1 Description

This option is for the construction of 2 new bores, a new treatment plant and new storage tanks connected to reticulation pumps that pump directly into the Village reticulation. The bore pumps, water treatment plant and storage would all be located adjacent the lake edge.

The bores will pump water through the treatment process directly into storage tanks. The storage tanks will feed reticulation pumps that are controlled to maintain a set pressure in the village reticulation. The size of the pumps and the pressure set point would depend upon whether the flow scenario is for restricted or on-demand connections.

The storage tanks will be of capacity to provide flow for operational demand, emergency storage, and fire storage. The level in the storage tanks control the operation of the bore pumps.

As in Option 1, the proposed treatment system to meet DWSNZ 2005(revised 2008) is a 1um cartridge filter with UV reactors with chlorine gas used for disinfection. Contact time (30minutes) can be provided with a small polyethylene tank.

Restricted and on-demand flow scenario options have been developed and are presented.

An overall site plan for Option 2 is shown in Figure 6.2 below and a process flow diagram Option 2 is provided in the appendices.





Figure 6.2: Option 2 Site Plan



6.4.2 Cost Estimate

Estimated costs for Option 2 scenarios are provided in the table below. More detailed costing is provided in the Appendices.

Table 6.3: Preliminary Cost Estimates for Option 2 (with and without chlorine disinfection) for Restricted and On-demand flow scenarios.

Description		nt (cartridge, UV), new I reticulation pumps	Bore supply, treatment (cartridge, UV and CHLORINE), new storage at WTP and reticulation pumps		
	Restricted	On Demand	Restricted	On Demand	
	Option 2 a -R	Option 2 a - OD	Option 2 b-R	Option 2 b - OD	
Source	164,200	166,500	164,200	166,500	
Treatment	340,900	380,100	398,500	439,500	
Reticulation	56,700	59,800	56,700	59,800	
Storage	33,750	75,000	33,750	75,000	
Fire Protection	67,500	71,300	67,500	71,300	
Generator	25,600	25,600	25,600	25,600	
P&G, Design and					
Contingency	275,400	311,300	298,500	335,100	
Capital cost	964,000	1,089,600	1,044,800	1,172,800	
Annual Cost	33,000	36,400	33,200	36,500	
NPV 20 years at 8%	1,288,000	1,447,000	1,370,800	1,531,200	

Operating Costs are based on average flows and include labour charges for weekly visits from Oamaru (with sharing travel costs with other Waitaki Valley supplies). Further detail is provided in the Appendices.

An assessment of the preliminary costs indicate that Option 2 has a higher capital expenditure than Option 1 with the differential without chlorine being in the order of \$200,000 and with chlorine being around \$70-80,000. The smaller differential for chlorine is related to the 30 minute contact time which requires a pressure cylinder or pipe for Option 1 but only a small contact tank for Option 2.

Costs associated with the Fire Protection in Table 6.3 above, are related to 45m³ volume of storage tanks, a fire pump (20L/sec) and the additional cost associated with a larger backup generator.

6.4.3 Pros and Cons

Pros and Cons for Option 2 are:

Pros

- The water bores, water treatment plant and storage will be in WDC reserve land with easy access.
- The water intake, storage and associated pipework can be abandoned.
- The private land owner is able to utilise land around intake and storage.
- It is easier to upgrade this option to include chlorine disinfection in the future (if and when required).



• Fire protection is provided with an in-line fire pump, storage and generator.

Cons

- Storage is lower than the village and will require reticulation pumps to meet demand. A generator is required to provide supply during power outage.
- Landscaping and screening will be required to hide water treatment plant and storage adjacent lake. The storage requirements are significant for on-demand flows but these could be reduced by increasing the capacity of the bores and treatment.

6.5 Summary of Options

Table 6.4 summarises the options for Lake Ohau Village Water Supply, the associated costs for each option.



Table 6.4: Summary of Options and Costs

Option	Description	Option	Chlorine	Flow Type	Cost			Comment
		Code	Disinfect		Capital	Operational	NPV	
1	New bores and water treatment plant adjacent lake. Elevated storage in current location.	1a-R	No	Restricted	919,900	38,200	1,294,900	 Able to meet current drinking water standards but not future proofed for anticipated changes to drinking water regulations No need for back up power generator Infrastructure on private land with likely future access issues Cannot provide water supply to houses during black out
		1a-OD	No	On-demand	1,045,700	38,200	1,420,700	 Able to meet current drinking water standards but not future proofed for anticipated changes to drinking water regulations Houses can take more than restricted allocation day when required Can provide water supply to houses during black out. A generator would provide protection against black outs lasting more than 1 day Infrastructure on private land with likely future access issues
		1b-R	Yes	Restricted	1,119,500	38,400	1,496,500	 Same as option 1a-R however, this is a more robust treatment that is future proofed for anticipated changes to drinking water regulations
		1b-OD	Yes	On-demand	1,250,900	38,400	1,627,900	 Same as option 1a-OD however, this is a more robust treatment that is future proofed for anticipated changes to drinking water regulations
2	New bores, water treatment plant and storage with reticulation pumps adjacent lake.	2a-R	No	Restricted	964,000	33,000	1,288,000	 Able to meet current drinking water standards but not future proofed for anticipated changes to drinking water regulations Back-up power generator required as low level storage and reticulation pumps Water intake, WTP and storage all in close proximity to each other making operation easier Key water infrastructure out of private land and in reserve area Cannot provide water supply to houses during black out
		2a-OD	No	On-demand	1,089,600	36,400	1,447,000	 Able to meet current drinking water standards but not future proofed for anticipated changes to drinking water regulations Houses can take more than restricted allocation day when required. Can provide water supply to houses during black out with a generator Water intake, WTP and storage all in close proximity to each other making operation easier Key water infrastructure out of private land and in reserve area
		2b-R	Yes	Restricted	1,044,800	33,200	1,370,800	 Same as option 2a-R however, this is a more robust treatment that is future proofed for anticipated changes to drinking water regulations
		2b-OD	Yes	On-demand	1,172,800	36,500	1,531,200	 Same as option 2a-OD however, this is a more robust treatment that is future proofed for anticipated changes to drinking water regulations



7.0 Discussion

The existing source water is not considered as an option for development for the upgrade to the Ohau Village water supply is recommended that 2 bores be developed for supplying the village. The new bores will provide the community with a more reliable water source, that is out of private land, and that can meet the future demands of the community.

The preferred location of the bores is adjacent Lake Ohau which is considered to be at less risk from contamination than the alternative location adjacent Lake Middleton. However, prior to finalising the location of the bores, the extent of the recharge zone, the resulting community drinking-water protection zone and any potential risk of contamination from the oxidation pond needs to be defined.

A new treatment plant is necessary to provide safe drinking water water to the community and comply with drinking-water standards. It is recommended that this provides 4 log protozoa treatment plus bacterial treatment. The most cost effective treatment option is cartridge filtration and UV disinfection. 1 um cartridge filtration can provide up to 3 log credits (for small supplies) with UV disinfection providing a further 3 log credits. Depending on the quality of the bore water, it may be necessary to add a bag filter prior to the cartridge to reduce operational costs of replacement cartridges. The final design of the treatment plant should allow for adding bag filtration in the future.

Chlorine disinfection is proposed for Ohau as it provides a residual disinfectant in the water. This means that any contamination that enters the water supply system after the treatment plant can be treated. This is particularly important for water that is sitting around in storage tanks.

Chlorine is also likely to become mandatory following the impending changes to drinking water regulations and therefore, at a minimum, allowance should be provided in the design to add chlorine at a later stage.

The lowest capital cost option for the storage and associated reticulation is Option 1. This option maintains storage at the existing location and provides 1 day back up storage without the need for power generator. It also maintains the existing fire protection without the need for additional infrastructure. However, the most significant issue with Option 1 is the addition of chlorine contact time. This would need to be a pressurised tank or pipeline to enable the bore pumps to pump directly to the storage tanks. This option also has higher operational costs and a higher NPV due to additional operations and maintenance associated with the remote location of the storage.

Option 2 has storage and reticulation pumps at the WTP which requires a power generator. This option simplifies operation as the main infrastructure is in one place, however the quantity of storage on site requires significant landscaping to camouflage the site from passers by. This is a particular issue for on-demand flow. Storage could however be reduced by increasing the capacity of the bore and treatment plant.



Provision of restricted or on-demand flow has an impact on the cost of the upgrade, with ondemand connection options being more expensive for the upgrade. However, on demand connections negate the need for residents to supply, install and maintain storage tanks and domestic pumps and it allows houses to receive water during power outages.

8.0 Recommendations

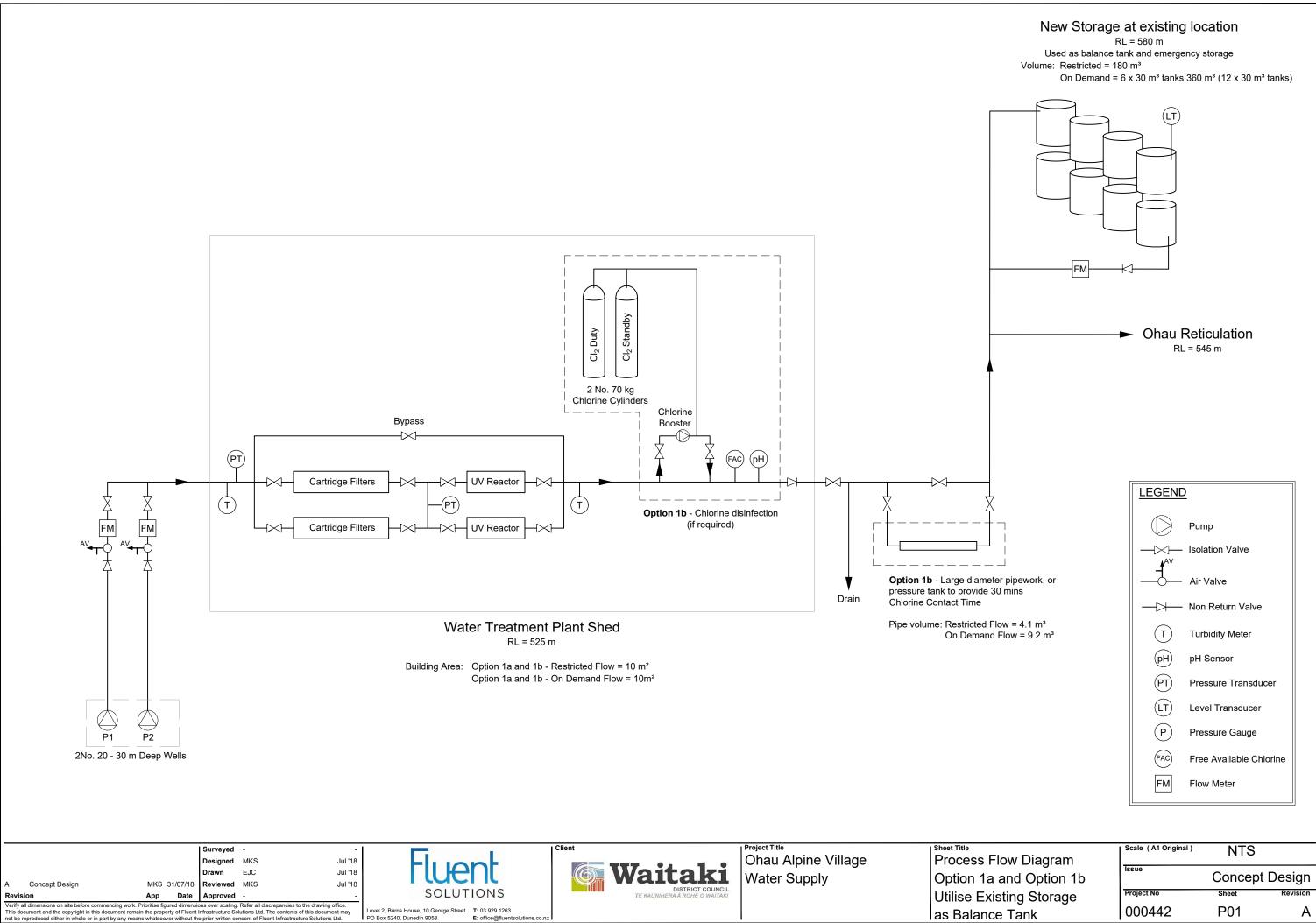
It is recommended that Council:

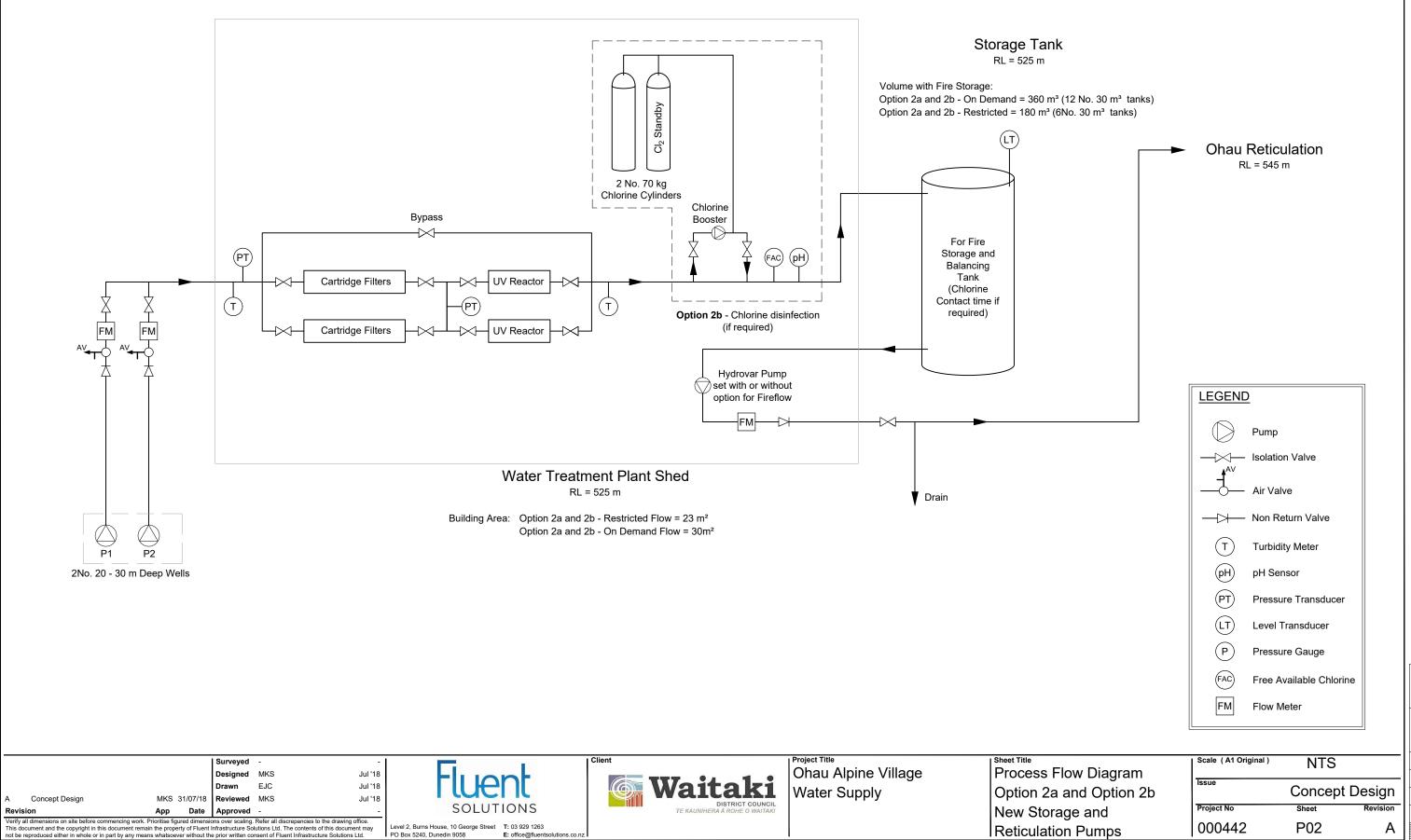
- develops funding options to make upgrade affordable to the community
- present options to the Community Board to confirm preference:
 - for restricted or on-demand flow
 - for chlorine now or chlorine later
 - o to maintain location of existing storage or construct new storage
 - for location for bores
- engages a hydrogeologist to confirm best location for bores and extent of community drinking-water protection zone
- following confirmation of preference, discuss changes with landowner
- water quality of Lake Ohau should be tested for particle size, turbidity and UV transmittance to get an idea of possible worst case scenarios for the bore



APPENDIX 1

Process Flow Diagrams





E: office@fluentsolutions.co.n

А

not be re

uced either in whole or in part by any m

ans whatsoever without the prior written consent of Fluent Infrastructure Solutions Ltd.

			LE
Scale (A1 Original)	NTS		
Issue	Concept	Design	-5
Project No	Sheet	Revision	
000442	P02	А	1 mm
	Issue Project No	Issue Concept Project No Sheet	Issue Concept Design Project No Sheet Revision



APPENDIX 2

Detailed Cost Estimates

Option 1 a OD- New	w bores, WTP, Storage in Existing Loc	ation - ON DEM	IAN	D FLOW		
Description	Unit	Quantity		Rate		Cost
Source Water						
Application to work in reserve	With WDC	1	\$	5,000	\$	5,000
ECAN Consent	consent to take groundwater	1	\$	25,000	\$	25,000
Bores drilling and headworks		2	\$	30,000	\$	60,000
Bore Pumps	2.8 L/sec at up to 90m allowed for	2	\$	2,500	\$	5,000
VFD	VFD for pumps	2	\$	3,500	\$	7,000
Raw water turbidimeter	Hach 1720E	1	\$	7,000	\$	7,000
Flow meter	DN80 yokogawa mag flowmeter	2	\$	4,600	\$	9,200
Electrical and Control	level switches electrical cabinet, install	1	\$	15,000	\$	15,000
Installation and Construction		25%	\$	133,200	\$ \$	33,300
SUBTOTAL Water Treatment					ş	166,500
Filtration, UV, Building, Civil						
Cartridge	1 HF40H304 (duty/standby) 1 um	2	\$	8,250	\$	16,500
-	nominal - will treat up to 5 L/sec UV Pro 50 (up to 3.15 L/sec) Duty					
Ultraviolet Disinfection	UPS - for management of brown outs	2	\$	10,000	\$	20,000
UPS for UV	30min	1	\$	3,000	\$	3,000
Pressure Transducer	For monitoring pressure across cartridges	3	\$	500	\$	1,500
Turbiditmeter	For treated water	1	\$	7,000	\$	7,000
Flow meter Pipes, valves and fittings	DN80 yokogawa mag flowmeter 50 to 100 mm	1	\$ \$	4,600 10,000	\$ \$	4,600 10.000
		1				.,
Water Treatment Plant Building	Alpine style m2	10	\$	4,000	\$	40,000
Landscaping/Access	Landscaping/ Access Road	1	\$	30,000	\$	30,000
Telemetry	RTU and Aerial, programming etc	1	\$	20,000	\$	20,000
Electrical and Switchboard		1	\$	40,000	\$	40,000
Power Upgrade	Upgrade to provide service fuse box on boundary of 13 Ohau Drive		\$	20,000	\$	20,000
		1				
Installation and Construction SUBTOTAL		25%	\$	212,600	\$ \$	53,150 265,750
Reticulation						
Flow meter Bores to WTP	DN80 yokogawa mag flowmeter DN100 PVC/PE	1 90	\$ \$	4,600 150	\$ \$	4,600 13,500
WTP to Retic	DN100 PVC/PE	80	\$	150	\$	12,000
Installation and Construction		25%	\$	30,100	\$ \$	7,525
SUBTOTAL Storage					\$	37,625
Replacement of existing tanks						
Demolition of tanks	Demolition of existing tanks (20%	20%	\$	130,000	\$	26,000
Telemetry (to talk to pumps and provide		1	\$	15,000	\$	15,000
data, alarms) New Flow meter	battery and repeater DN80 yokogawa mag flowmeter	1	\$	4,600	\$	4,600
New tanks	24 Hours emergency storage, operational storage = 287m3	10	\$	6,000	\$	60,000
Access Road Improvements	alowance for improvement to access	1	\$	50,000	\$	50,000
Pipework	road Allowance for pipework	1	\$	15,000	\$	15,000
Installation and Construction		40%	\$	170,600	\$	68,240
SUBTOTAL Fire Protection						238,840
Fire Tanks	30,000 L tanks with fittings (45m3)		¢	6 000	\$	0.000
riie Talliks	30,000 L tanks with fittings (45m3)	1.5	\$	6,000	Э	9,000
Installation and Construction		40%	\$	9,000	\$	3,600
SUBTOTAL		40%	L		L	12,600
Add- ons						
Generator	30 KVA generator	1		20,500	\$	20,500
Installation and Construction SUBTOTAL		25%	\$	20,500	\$	5,125 25,625
SUBTOTAL			L		L	25,625 746,940
Preliminary and General		10%				74,694
Design		20%				149,388
Contingency		10%	_		_	74,694
Total Estimated Capital Cost:			_	-	_	1,045,700
Annual Operational Costs	assumed average daily flow (m3/day)	50				
Compliance and Management	per hour (5.5 hours monthly) extra	66		180		11,880
	1.5 hours as reservoir on private land per hour (weekly visits for 5 hours)					
Labour	plus additional 4 hours /monthly to address issues with storage	308		70		21,560
UV Disinfection	kWhr (assumes 0.23 kw operating 24 hours per day)	2014.8		0.4		806
Lamp Replacement	Assumes yearly reaplacement of 1	1.0		433.0		433
Cartridges	lamp (1 lamp per unti) per cartridge (assume quarterly)	3		433.0 500		1,500
Electricity for Bore Pumps	kWhr (assumes 2kw pump operating at 2 L/sec)	5,069		0.4		2,028
SUBTOTAL	ai 2 L/SEU)	5,009		0.4	s	38,206.70
Total Estimated Annual Operational			-			
Costs					\$	38,200
NPV of Operating Costs (20 yr @ 8%)					\$	375,000
NPV Capital plus Operating Costs					\$	1,420,700

Option	n 1 a R - New bores, WTP, Storage in Existi	ng Location - RE	STRI	CTED FLOW		
Description	Unit	Quantity		Rate		Cost
Source Water						
Application to work in reserve	With WDC	1	\$	5,000	\$	5,000
ECAN Consent	consent to take groundwater	1	\$	25,000	\$	25,000
Bores drilling and headworks		2	\$	30,000	\$	60,000
Bore Pumps	1.3L/sec at up to 90m allowed for	2	\$	2,100	\$	4,200
VFD	VFD for pumps	2	\$	3,500	\$	7,000
Raw water turbidimeter	Hach 1720E	1	\$	7,000	\$	7,000
Flow meter	DN80 yokogawa mag flowmeter	2	\$	4,600	\$	9,200
Electrical and Control	level switches electrical cabinet, install	1	\$	15,000	\$	15,000
Installation and Construction SUBTOTAL		25%	\$	132,400	\$ \$	33,100 165,500
Water Treatment						
Filtration, UV, Building, Civil						
Cartridge	1 HF40H304 (duty/standby) 1 um nominal - will treat up to 5 L/sec	2	\$	8,250	\$	16,500
Ultraviolet Disinfection	UV Pro 30 (up to 1.89 L/sec) (Duty Assist)	2	\$	5,990	\$	11,980
UPS for UV	UPS - for management of brown outs 30min	1	\$	3,000	\$	3,000
Pressure Transducer	For monitoring pressure across cartridges		\$	500	\$	1,500
Turbiditmeter	For treated water	3 1	\$	7,000	\$	7,000
Flow meter	DN80 yokogawa mag flowmeter	1	\$	4,600	\$	4,600
Pipes, valves and fittings	50 to 100 mm	1	\$	10,000	\$	10,000
Water Treatment Plant Building	Alpine style m2	10	\$	4,000	\$	40,000
Landscaping/Access	Landscaping/ Access Road	1	\$	30,000	\$	30,000
Telemetry	RTU and Aerial, programming etc	1	\$	20,000	\$	20,000
Electrical and Switchboard		1	\$	40,000	\$	40,000
Power Upgrade	Upgrade to provide service fuse box on		\$	20,000	\$	20,000
	boundary of 13 Ohau Drive					
		1	_			
Installation and Construction SUBTOTAL Treatment		25%	\$	204,580	\$ \$	51,145 255,725
Reticulation						
Flow meter Bores to WTP	DN80 yokogawa mag flowmeter DN100 PVC/PE	1 90	\$ \$	4,600 150	\$ \$	4,600 13,500
WTP to Retic	DN100 PVC/PE	80	\$	150	\$	12,000
Installation and Construction		25%	\$	30,100	\$	7,525
SUBTOTAL Storage					\$	37,625
Replacement of existing tanks						
Demolition of tanks	Demolition of existing tanks (20%	20%	s	130,000	\$	26,000
Telemetry (to talk to pumps	replacement cost) RTU and aerial, pole, solar panel, battery	1	\$	15,000	\$	15,000
and provide data, alarms) New Flow meter	and repeater DN80 yokogawa mag flowmeter	1	\$ \$	4,600	\$	4,600
New tanks	24 Hours emergency storage = 116m3	4.5	\$	6,000	\$	27,000
Access Road Improvements	alowance for improvement to access road	1	\$	50,000	\$	50,000
Pipework valving		1	\$	10,000	\$	10,000
Installation and Construction		40%	\$	132,600	\$	53,040
SUBTOTAL Fire Protection						185,640
Fire Tanks	30,000 L tanks with fittings (45m3)		\$	6.000	\$	9,000
File Tanks	30,000 E tanks with hitings (45113)	1.5	φ	0,000	φ	5,000
Installation and Construction		40%	\$	9,000	\$	3,600
SUBTOTAL		1070				12,600
Add- ons	Not required for restricted flow - allow to				-	
Generator	bring in plug in generator				<u> </u>	077 07 -
SUBTOTAL Preliminary and General		10%			-	657,090 65,709
Design		20%				131,418
Contingency		10%				65,709
Total Estimated Capital Cost:	annumed august and detter detter de la detter de	50		-		919,900
Annual Operational Costs	assumed average daily flow (m3/day) per hour (5.5 hours monthly) extra 1.5	50 66		180		11,880
Compliance and Management	hours as reservoir on private land per hour (weekly visits for 5 hours) plus	00		180		11,880
Labour	additional 4 hours /monthly to address issues with storage	308		70		21,560
UV Disinfection	kWhr (assumes 0.23 kw operating 24 hours per day)	2014.8		0.4		806
Lamp Replacement	Assumes yearly reaplacement of 1 lamp (1	1.0				433
Cartridges	lamp per unti) per cartridge (assume quarterly)	3		433.0		1,500
	kWhr (assumes 2kw pump operating at	-		500		
Electricity for Dans 12		5,069		0.4	l I	2,028
Electricity for Bore Pumps	2L/sec)				2	28 206 70
SUBTOTAL Total Estimated Annual	2L/sec)				\$ \$	38,206.70 38,200
SUBTOTAL Total Estimated Annual Operational Costs NPV of Operating Costs (20	2L/sec)				\$	38,200
SUBTOTAL Total Estimated Annual Operational Costs	2L/sec)					

Option 1 b OD - New bor	es, WTP with Chlorine, Storage in exisit	ing location - O	N DE	MAND FLC	w	
Description	Unit	Quantity		Rate		Cost
Source Water						
Application to work in reserve	With WDC	1	\$	5,000	\$	5,000
ECAN Consent	consent to take groundwater	1	\$	25,000	\$	25,000
Bores drilling and headworks		2	\$	30,000	\$	60,000
Dava Diverse		2		2 500	s	5 000
Bore Pumps	2.8 L/sec at up to 90m allowed for		\$	2,500		5,000
VFD Raw water turbidimeter	VFD for pumps Hach 1720E	2	\$ \$	3,500 7,000	s s	7,000 7,000
Flow meter	DN80 yokogawa mag flowmeter	2	\$	4,600	\$	9,200
Electrical and Control	level switches electrical cabinet, install	1	\$	15,000	\$	15,000
Installation and Construction SUBTOTAL		25%	\$	133,200	\$ \$	33,300 166,500
Water Treatment						
Filtration, UV, Building, Civil						
Cartridge	1 HF40H304 (duty/standby) 5 um nominal - will treat up to 5 L/sec	2	\$	8,250	\$	16,500
Ultraviolet Disinfection	UV Pro 50 (up to 3.15 L/sec) Duty	2	\$	10,000	\$	20,000
UPS for UV	assist UPS - for management of brown outs	1	ŝ	3,000	\$	3,000
	30min For monitoring pressure across					
Pressure Transducer	cartridges	3	\$	500	\$	1,500
Turbiditmeter Flow meter	For treated water DN80 yokogawa mag flowmeter	1	\$ \$	7,000 4,600	\$ \$	7,000 4,600
Pipes, valves and fittings	50 to 100 mm	1	э \$	10,000	۰ ۶	10,000
Water Treatment Plant Building	Alpine style m2	10	\$	4,000	\$	40,000
		10				
Landscaping/Access	Landscaping/ Access Road	1	\$	30,000	\$	30,000
Telemetry Electrical and Switchboard	RTU and Aerial, programming etc	1	\$ \$	20,000 40,000	\$ \$	20,000 40,000
Power Upgrade	Upgrade to provide service fuse box on		\$	20,000	\$	20,000
	boundary of 13 Ohau Drive	1 25%			ŝ	
Installation and Construction SUBTOTAL		25%	\$	212,600	A (A)	53,150 265,750
Chlorine Disinfection, Contact Time						
Chlorine Gas Dosing	Gas Cylinders and Dosing -	1	\$	72,735	\$	72,735
Carry water Pump Chlorine Analyser	Carry water Pump MFC with Depolox 5	1	\$ \$	2,000 25,000	\$ \$	2,000 25,000
Chlorine Contact Time 30 min	DN450 pipeline added length of pipeline (4.1 m3)	25	\$	700	\$	17,500
Installation and Construction	(4.1 m3)	25%	\$	117,235	\$	29,309
SUBTOTAL SUBTOTAL Treatment					\$ \$	146,544
Reticulation					ş	412,294
Flow meter	DN80 yokogawa mag flowmeter	1 90	\$ \$	4,600	\$	4,600
Bores to WTP WTP to Retic	DN100 PVC/PE DN100 PVC/PE	90 80	\$ \$	150 150	\$ \$	13,500 12,000
Installation and Construction		25%	\$	30,100	\$	7,525
SUBTOTAL Storage					\$	37,625
Replacement of existing tanks						
Demolition of tanks	Demolition of existing tanks (20%	20%	s	130,000	s	26.000
Telemetry (to talk to pumps and provide	replacement cost) RTU and aerial, pole, solar panel, battery					
data, alarms)	and repeater	1	\$	15,000	\$	15,000
New Flow meter	DN80 yokogawa mag flowmeter 24 Hours emergency storage,	1	\$	4,600	\$	4,600
New tanks	operational storage 287 m3 alowance for improvement to access	10	\$	6,000	\$	60,000
Access Road Improvements	road	1	\$	50,000	\$	50,000
Pipework Installation and Construction	Allowance for pipework	1 40%	\$ \$	15,000 170,600	\$ \$	15,000 68,240
SUBTOTAL			Ĺ	.,	Ĺ	238,840
Fire Protection Fire Tanks	30,000 L tanks with fittings (45m3)	1.5	\$	6,000	\$	9,000
Installation and Construction		40%	\$	9,000	\$	3,600
SUBTOTAL Add- ons						12,600
Generator	30 KVA generator	1		20,500	\$	20,500
Installation and Construction	, , , , , , , , , , , , , , , , , , ,	25%	\$	20,500	\$	5,125
SUBTOTAL SUBTOTAL						25,625
Preliminary and General		10%			_	893,484 89,348
Design		20%				178,697
Contingency		10%				89,348
Total Estimated Capital Cost:				-		1,250,900
Annual Operational Costs	assumed average daily flow (m3/day)	50				
	per hour (5.5 hours monthly) extra 1.5	~~				44 000
Compliance and Management	hours as reservoir on private land per hour (weekly visits for 5 hours)	66		180		11,880
Labour	plus additional 4 hours /monthly to address issues with storage	308		70		21,560
UV Disinfection	kWhr (assumes 0.23 kw operating 24	2014.8		0.4		806
Lamp Replacement	hours per day) Assumes yearly reaplacement of 1 lamp	1.0		433.0		433
	(1 lamp per unti)					
Cartridges	per cartridge (assume quarterly) per kg (based on 70kg cylinder assume	3 27.4		500		1,500
Chlorine Dosing	1.5g/m3 kWhr (assumes 2kw pump operating	27.4		5		145
Electricity for Bore Pumps	at 2 L/sec)	5,069		0.4		2,028
SUBTOTAL					\$	38,351.79
Total Estimated Annual Operational Costs			L		\$	38,400
NPV of Operating Costs (20 yr @ 8%)					\$	377,000
			-		\$	1,627,900

	- New bores, WTP with Chlorine, Storage in	Existing Locati	on - R	ESTRICTED F	LOW	1
Description	Unit	Quantity		Rate		Cost
Source Water						
Application to work in reserve	With WDC	1	\$	5,000	\$	5,000
ECAN Consent	consent to take groundwater	1	\$	25,000	\$	25,000
Bores drilling and headworks		2	\$	30,000	\$	60,000
Bore Pumps	1.3L/sec at up to 90m allowed for	2	\$	2,100	\$	4,200
VFD	VFD for pumps	2	s s	3,500	s s	7,000
Raw water turbidimeter	Hach 1720E	1	\$	7,000	\$	7,000
Flow meter	DN80 yokogawa mag flowmeter	2	\$	4,600	\$	9,200
Electrical and Control	level switches electrical cabinet, install	1	\$	15.000	\$	15.000
Installation and Construction		25%	\$	132,400	s	33.100
SUBTOTAL			Ť	,	\$	165,500
Water Treatment Filtration, UV, Building, Civil						
	1 HF40H304 (duty/standby) 5 um nominal -					
Cartridge	will treat up to 5 L/sec	2	\$	8,250	\$	16,500
Ultraviolet Disinfection	UV Pro 30 (up to 1.89 L/sec) (Duty Assist)	2	\$	5,990	\$	11,980
UPS for UV	UPS - for management of brown outs 30min	1	\$	3,000	\$	3,000
Pressure Transducer	For monitoring pressure across cartridges	3	\$	500	\$	1,500
Turbiditmeter	For treated water	1	\$	7,000	\$	7,000
Flow meter Pipes, valves and fittings	DN80 yokogawa mag flowmeter 50 to 100 mm	1	\$ \$	4,600 10,000	\$ \$	4,600 10,000
Water Treatment Plant Building	Alpine style m2	I	s s	4,000	s	40,000
water freatment Plant Building	Alpine style m2	10	ð	4,000	ð	40,000
Landscaping/Access	Landscaping/ Access Road	1	\$	30,000	\$	30,000
Telemetry	RTU and Aerial, programming etc	1	\$	20,000	\$	20,000
Electrical and Switchboard	Upgrade to provide service fuse box on	1	\$	40,000	\$	40,000
Power Upgrade	boundary of 13 Ohau Drive	1	\$	20,000	\$	20,000
Installation and Construction		25%	\$	204,580	\$ \$	51,145 255,725
Chlorine Disinfection,					ş	200,720
Contact Time Chlorine Gas Dosing	Gas Cylinders and Dosing -	1	\$	72,735	\$	72,735
Carry water Pump	Carry water Pump	1	\$	2,000	\$	2,000
Chlorine Analyser Chlorine Contact Time 30 min	MFC with Depolox 5 DN450 pipeline added length of pipeline (4.1	1 25	\$ \$	25,000 700	\$ \$	25,000 17,500
Installation and Construction	m3)	25	э \$	117,235	э \$	29,309
SUBTOTAL		2570	Ť	,====	\$	146,544
SUBTOTAL Treatment Reticulation					\$	402,269
Flow meter	DN80 yokogawa mag flowmeter	1	\$	4,600	\$	4,600
Bores to WTP WTP to Retic	DN100 PVC/PE DN100 PVC/PE	90 80	\$ \$	150 150	\$ \$	13,500 12,000
Installation and Construction	BINIOUTE	25%	\$	30,100	\$	7,525
SUBTOTAL Storage					\$	37,625
Replacement of existing tanks						
Demolition of tanks	Demolition of existing tanks (20%	20%	\$	130,000	\$	26.000
Telemetry (to talk to pumps	replacement cost)	2070	Ŷ	100,000	Ŷ	20,000
and provide data, alarms)	RTU and aerial, pole, solar panel, battery and repeater	1	\$	15,000	\$	15,000
New Flow meter	DN80 yokogawa mag flowmeter	1	\$	4,600	\$	4,600
New tanks	24 Hours emergency storage = 116m3	4.5	\$	6,000	\$	27,000
Access Road Improvements	alowance for improvement to access road	1	\$	50,000	\$	50,000
Pipework valving Installation and Construction		1 40%	\$ \$	10,000 122,600	\$ \$	10,000 49,040
			۲.	,000	Ľ.	
SUBTOTAL						181,640
Fire Protection	30,000 L tanks with fittings (45m3)	15	\$	6 000	\$	
Fire Protection Fire Tanks Installation and Construction	30,000 L tanks with fittings (45m3)	1.5 40%	\$ \$	6,000 9,000	\$	9,000 3,600
Fire Protection Fire Tanks Installation and Construction SUBTOTAL	30,000 L tanks with fittings (45m3)					9,000
Fire Protection Fire Tanks Installation and Construction	Not required for restricted flow - allow to					9,000 3,600
Fire Protection Fire Tanks Installation and Construction SUBTOTAL Add- ons						9,000 3,600
Fire Protection Fire Tanks Installation and Construction SUBTOTAL Add-ons Generator SUBTOTAL Preliminary and General	Not required for restricted flow - allow to	40%				9,000 3,600 12,600 799,634 79,963
Fire Protection Fire Tanks Installation and Construction SUBTOTAL Generator SUBTOTAL	Not required for restricted flow - allow to	40%				9,000 3,600 12,600 799,634
Fire Protection Fire Tanks Installation and Construction SUBTOTAL Add-ons Generator SUBTOTAL Preliminary and General Design	Not required for restricted flow - allow to	40% 10% 20%				9,000 3,600 12,600 799,634 79,963 159,927
Fire Protection Fire Tanks Installation and Construction SUBTOTAL Add-ons Generator SUBTOTAL Preliminary and General Design Contingency	Not required for restricted flow - allow to bring in plug in generator assumed average daily flow (m3/day)	40% 10% 20%		9,000		9,000 3,600 12,600 799,634 79,963 159,927 79,963
Eire Protection Fire Tanks Installation and Construction SUBTOTAL Add- ons Generator SUBTOTAL Preliminary and General Design Contingency Total Estimated Capital Cost:	Not required for restricted flow - allow to bring in plug in generator assumed average daily flow (m3/day) per hour (5.5 hours monthly) extra 1.5 hours as reservoir on private land	40% 10% 20% 10%		9,000		9,000 3,600 12,600 799,634 79,963 159,927 79,963
Eire Protection Fire Tanks Installation and Construction SUBTOTAL Add- ons. Generator SUBTOTAL Preliminary and General Design Contingency Total Estimated Capital Costs:	Not required for restricted flow - allow to bring in plug in generator assumed average daily flow (m3/day) per hour (5.5 hours month) extra 1.5 hours as reservoir on private land per hour (wekly visits for 5 hours) plus additional 4 hours /monthy to address	40% 10% 20% 10% 50		9,000		9,000 3,600 12,600 799,634 79,963 159,927 79,963 1,119,500
Fire Protection Fire Tarks Installation and Construction SUBTOTAL Add-ons Generator SUBTOTAL Preliminary and General Design Contingency Total Estimated Capital Cost: Annual Operational Costs Compliance and Management Labour	Not required for restricted flow - allow to bring in plug in generator assumed average daily flow (m3/day) per hour (5.5 hours monthly) extra 1.5 hours as reservoir on private land per hour (weekly visits for 5 hours) plus	40% 10% 20% 10% 50 66 308		9,000 - 180 70		9,000 3,600 12,600 799,634 79,963 159,927 79,963 1,119,500 11,880 21,560
Eire Protection Fire Tanks Installation and Construction SUBTOTAL Add-ons Generator SUBTOTAL Preliminary and General Design Contingency Total Estimated Capital Costs: Annual Operational Costs Compliance and Management	Ant required for restricted flow - allow to bring in plug in generator assumed average daily flow (m3/day) per hour (5.5 hours monthly) extra 1.5 hours as reservoir on private land per hour (weekly visits for 5 hours) plus additional 4 hours /monthly to address issues with storage kWhr (assumes 0.23 kw operating 24 hours per day)	40% 10% 20% 10% 50 66		9,000		9,000 3,600 12,600 799,634 79,963 159,927 79,963 1,119,500 11,880
Fire Protection Fire Tarks Installation and Construction SUBTOTAL Add-ons Generator SUBTOTAL Preliminary and General Design Contingency Total Estimated Capital Cost: Annual Operational Costs Compliance and Management Labour	Not required for restricted flow - allow to bring in plug in generator assumed average daily flow (m3/day) per hour (5.5 hours monthy) extra 1.5 hours as reservoir on private land per hour (weekly visits for 5 hours) plus additional + hours /monthy to address issues with storage kWhr (assumes 0.23 kw operating 24	40% 10% 20% 10% 50 66 308		9,000 - 180 70		9,000 3,600 12,600 799,634 79,963 159,927 79,963 1,119,500 11,880 21,560
Fire Protection Fire Tanks Installation and Construction SUBTOTAL Add-ons Generator SUBTOTAL Preliminary and General Design Contingency Total Estimated Capital Cost: Annual Operational Costs Compliance and Management Labour UV Disinfection	Not required for restricted flow - allow to bring in plug in generator assumed average daily flow (m3/day) per hour (5.5 hours monthy) extra 1.5 hours as reservoir on private land per hour (weekly visits for 5 hours) plus additional 4 hours /monthy to address issues with storage kWhr (assumes 0.23 kw operating 24 hours per day) Assumes yearly reaplacement of 1 lamp (1	40% 10% 20% 10% 50 66 308 2014.8		9,000 - - 180 70 0.4		9,000 3,600 12,600 799,634 79,963 159,927 79,963 1,119,500 11,880 21,560 806
Fire Protection Fire Tanks Installation and Construction SUBTOTAL Add-ons Generator SUBTOTAL Preliminary and General Design Contingency Total Estimated Capital Cost: Annual Operational Costs Compliance and Management Labour UV Disinfection Lamp Replacement	Not required for restricted flow - allow to bring in plug in generator assumed average daily flow (m3/day) per hour (5.5 hours monthly) extra 1.5 hours as reservoir on private land per hour (weekly visits for 5 hours) plus additional 4 hours /monthly to address issues with storage kWhr (assumes 0.23 kw operating 24 hours per day) Assumes yearly reaplacement of 1 lamp (1 lamp per unti) per catritidge (assume quarterly) per kg (based on 70kg cylinder assume	40% 10% 20% 10% 50 66 308 2014.8 1.0		9,000 - - 180 70 0.4 433.0 500		9,000 3,600 12,600 799,634 79,963 159,927 79,963 1,119,500 11,880 21,560 806 433
Fire Protection Fire Tarks Installation and Construction SUBTOTAL Add-ons Generator SUBTOTAL Preliminary and General Design Contingency Total Estimated Capital Cost: Annual Operational Costs Compliance and Management Labour UV Disinfection Lamp Replacement Cartridges Chlorine Dosing	Not required for restricted flow - allow to bring in plug in generator assumed average daily flow (m3/day) per hour (5.5 hours month)) extra 1.5 hours as reservoir on private land per hour (weekly visits for 5 hours) plus additional 4 hours /monthly to address issues with storage kWhr (assumes 0.23 kw operating 24 hours per day) Assumes yearly reaplacement of 1 lamp (1 lamp per unit) per cartridge (assume quarterly) per kg (based on 70kg cylinder assume 1.5gm3	40% 10% 20% 10% 50 66 308 2014.8 1.0 3 27.4		9,000 		9,000 3,600 12,600 799,634 79,963 159,927 79,963 1,119,500 11,880 21,560 806 433 1,500 145
Fire Protection Fire Tarks Installation and Construction SUBTOTAL Add-ons Generator SUBTOTAL Preliminary and General Design Contingency Total Estimated Capital Cost: Annual Operational Costs Compliance and Management Labour UV Disinfection Lamp Replacement Cartridges Chlorine Dosing Electricity for Bore Pumps	Not required for restricted flow - allow to bring in plug in generator assumed average daily flow (m3/day) per hour (5.5 hours monthy) extra 1.5 hours as reservoir on private land per hour (weekly visits for 5 hours) plus additional 4 hours information and the storage kWhr (assumes 0.23 kw operating 24 hours per day) Assumes yearly reaplacement of 1 lamp (1 lamp per unti) per cartridge (assume quarterly) per kg (based on 70kg cylinder assume 1.5g/m3	40% 10% 20% 10% 50 66 308 2014.8 1.0 3		9,000 - - 180 70 0.4 433.0 500	↔	9,000 3,600 12,600 799,634 79,963 159,927 79,963 1,119,500 11,880 21,560 806 433 1,500 145 2,028
Fire Protection Fire Tarks Installation and Construction SUBTOTAL Add-ons Generator SUBTOTAL Preliminary and General Design Contingency Total Estimated Capital Cost: Annual Operational Costs Compliance and Management Labour UV Disinfection Lamp Replacement Cartridges Chlorine Dosing	Not required for restricted flow - allow to bring in plug in generator assumed average daily flow (m3/day) per hour (5.5 hours month)) extra 1.5 hours as reservoir on private land per hour (weekly visits for 5 hours) plus additional 4 hours /monthly to address issues with storage kWhr (assumes 0.23 kw operating 24 hours per day) Assumes yearly reaplacement of 1 lamp (1 lamp per unit) per cartridge (assume quarterly) per kg (based on 70kg cylinder assume 1.5gm3	40% 10% 20% 10% 50 66 308 2014.8 1.0 3 27.4		9,000 	\$	9,000 3,600 12,600 799,634 79,963 159,927 79,963 1,119,500 11,880 21,560 806 433 1,500 145 2,028 38,351.79
Fire Protection Fire Tarks Installation and Construction SUBTOTAL Add-ons Generator SUBTOTAL Preliminary and General Design Contingency Total Estimated Capital Cost: Annual Operational Costs Compliance and Management Labour UV Disinfection Lamp Replacement Cartridges Chlorine Dosing Electricity for Bore Pumps SUBTOTAL Total Estimated Annual Operational Costs	Not required for restricted flow - allow to bring in plug in generator assumed average daily flow (m3/day) per hour (5.5 hours month)) extra 1.5 hours as reservoir on private land per hour (weekly visits for 5 hours) plus additional 4 hours /monthly to address issues with storage kWhr (assumes 0.23 kw operating 24 hours per day) Assumes yearly reaplacement of 1 lamp (1 lamp per unit) per cartridge (assume quarterly) per kg (based on 70kg cylinder assume 1.5gm3	40% 10% 20% 10% 50 66 308 2014.8 1.0 3 27.4		9,000 	\$ S \$	9,000 3,600 12,600 79,963 159,927 79,963 1,119,500 11,880 21,560 806 433 1,500 145 2,028 38,351.79 38,400
Fire Protection Fire Tanks Installation and Construction SUBTOTAL Add-ons Generator SUBTOTAL Preliminary and General Design Contingency Total Estimated Capital Cost: Annual Operational Costs Compliance and Management Labour UV Disinfection Lamp Replacement Cartridges Chlorine Dosing Electricity for Bore Pumps SUBTOTAL Total Estimated Annual	Not required for restricted flow - allow to bring in plug in generator assumed average daily flow (m3/day) per hour (5.5 hours month)) extra 1.5 hours as reservoir on private land per hour (weekly visits for 5 hours) plus additional 4 hours /monthly to address issues with storage kWhr (assumes 0.23 kw operating 24 hours per day) Assumes yearly reaplacement of 1 lamp (1 lamp per unit) per cartridge (assume quarterly) per kg (based on 70kg cylinder assume 1.5gm3	40% 10% 20% 10% 50 66 308 2014.8 1.0 3 27.4		9,000 	\$	9,000 3,600 12,600 799,634 79,963 159,927 79,963 1,119,500 11,880 21,560 806 433 1,500 145 2,028 38,351.79

Ontion 2 a OD	- New bores, WTP, Storage, Reticulation pumps (adjace	nt lake) - ON-DEN		FLOW		
Description	Unit	Quantity		Rate		Cost
Source Water		······ · ,				
Application to work in reserve	With WDC	1	\$	5,000	\$	5,000
ECAN Consent	consent to take groundwater	1	\$	25,000	\$	25,000
Bores drilling and headworks		2	\$	30,000	\$	60,000
Bore Pumps	2.75L/sec at up to 55 m allowed for	2	\$	2,500	\$	5,000
VFD	VFD for pumps	2	\$	3,500	\$	7,000
Raw water turbidimeter	Hach 1720E	1	\$	7,000	\$	7,000
Flow meter Electrical and Control	DN80 yokogawa mag flowmeter level switches electrical cabinet, install	2 1	\$ \$	4,600 15,000	\$ \$	9,200 15,000
Installation and Construction	level switches electrical cabinet, install	25%	Տ	133,200	э \$	33,300
		2370	Ψ	100,200		
SUBTOTAL					\$	166,500
Water Treatment						
Cartridge	1 HF40H304 1 um - will treat up to 5 L/sec (Duty assist)	2	\$	8,250	\$	16,500
Ultraviolet Disinfection	UV Pro 50 (up to 3.15 L/sec) Duty assist	2	\$	10,000	\$	20,000
UPS for UV	UPS - for management of brown outs 30min	1	\$	3,000	\$	3,000
Pressure Transducer	For monitoring pressure across cartridges	6	\$	500	\$	3,000
Turbiditmeter	For treated water	1	\$	7,000	\$	7,000
Flow meter	DN80 yokogawa mag flowmeter 50 to 100 mm	1 1	\$ \$	4,600 10,000	\$ \$	4,600
Pipes, valves and fittings				-		10,000
Water Treatment Plant Building Building Consent	Alpine style m2 Building consent for WTP	25 1	\$ \$	4,000 10,000	\$ \$	100,000 10,000
Landscaping/Access	Landscaping/ Access Road	1	э \$	50,000	э \$	50,000
Telemetry	RTU and Aerial, programming etc	1	э \$	20,000	э \$	20,000
	rero ana richai, programming ete					
Electrical and Switchboard		1	\$	40,000	\$	40,000
Power Upgrade	Upgrade to provide service fuse box on boundary of 13	1	\$	20,000	\$	20,000
	Ohau Drive		-	004.400		
Installation and Construction		25%	\$	304,100	\$	76,025
SUBTOTAL					\$	380,125
Reticulation						
Hydrovar Pump set (12 L/sec at 50m)	Lowara Twin Pac Dual 15SV06F055T5.5 KW	1	\$	11,000	\$	11,000
Flow meter	DN80 yokogawa mag flowmeter	1	\$	4,600	\$	4,600
Bores to WTP	DN100 PVC/PE	90	\$	150	\$	13,500
WTP to Storage	DN100 PVC/PE	5	\$	150	\$	750
Storage to Retic	DN150 PVC/PE	100	\$	180	\$	18,000
Installation and Construction		25%	\$	47,850	\$	11,963
SUBTOTAL					\$	59,813
Storage						
Storage (operational and emergency)	30,000 L tanks with fittings (operational and emergency - 287m3)	10	\$	6,000	\$	60,000
Installation and Construction	201110)	25%	\$	60,000	\$	15,000
SUBTOTAL						75,000
Fire Protection						
Fire Tanks	30,000 L tanks with fittings	2	\$	6,000	\$	12,000
Added building space		5	\$	4,000	\$	20,000
Additional Generator Cost	increase in size of generaotr for Fire pump	1	\$	6,000	\$	6,000
Fire Pump		1		19,000	\$	19,000
Installation and Construction		25%	\$	57,000	\$	14,250
SUBTOTAL						71,250
Add- ons Generator	30 KVA generator	1		20,500	\$	20,500
Installation and Construction	SU KVA generator	25%	\$	20,500	\$	5,125
SUBTOTAL		2370	Ψ	20,000	Ŷ	25,625
SUBTOTAL						778,313
Preliminary and General		10%				77,831
Design		20%				155,663
Contingency		10%				77,831
Total Estimated Capital Cost:				-		1,089,638
Annual Operational Costs	assumed average daily flow (m3/day)	50				
Compliance and Management	per hour (4 hours monthly)	48		180		8,640
Labour	per hour (weekly visits for 5 hours)	260		70		18,200
UV Disinfection	kWhr (assumes 0.23 kw operating 24 hours per day)	2014.8		0.4		806
Lamp Replacement	Assumes yearly reaplacement of 1 lamp (1 lamp per unti)	1.0		433.0		433
Cartridges	per cartridge (assume quarterly)	3		500		1,500
Electricity for Bore Pumps	kWhr (assumes 2kw pump operating at 2L/sec for about					1,521
	7 hours per day) kWbr. (assumes4kw.pump.operating.at 1.5 L/sec for 12	5,069		0.3		
Electricity for Reticulation Pumps	kWhr (assumes4kw pump operating at 1.5 L/sec for 12 hours per day)	17,520		0.3		5,256
SUBTOTAL			L		\$	36,355.75
Total Estimated Annual Operational					\$	36,400
Costs NPV of Operating Costs (20 yr @					<u> </u>	
8%)			L		\$	357,400
NPV Capital plus Operating Costs					\$	1,447,038
pine epsialing oosta			I		1	.,,

	Option 2 a R - New bores, WTP, Storage, Reticulation pum	os (adjacent lake) - RESTRICTED	FLOW		
Description	Unit	Quantity	Rate	(Cost
Source Water		·			
Application to work in reserve	With WDC	1	\$ 5,000	\$	5,000
ECAN Consent	consent to take groundwater	1	\$ 25,000	\$	25,000
Bores drilling and headworks		2	\$ 30,000	\$	60,000
Bore Pumps	2 x 1.3L/sec at up to 55 m allowed for	2	\$ 1,580	\$	3,160
VFD	VFD for pumps	2	\$ 3,500	\$	7,000
Raw water turbidimeter	Hach 1720E	1	\$ 7,000	\$	7,000
Flow meter	DN80 yokogawa mag flowmeter	2	\$ 4,600	\$	9,200
Electrical and Control	level switches electrical cabinet, install	1	\$ 15,000	\$	15,000
Installation and Construction		25%	\$ 131,360	\$	32,840
SUBTOTAL				\$	164,200
Water Treatment					
Cartridge	1 HF40H304 (duty/standby only) 5 um - will treat up to 5 L/sec	2	\$ 8,250	\$	16,500
Ultraviolet Disinfection	UV Pro 30 (up to 2 L/sec) Duty Standby	2	\$ 5,990	\$	11,980
UPS for UV	UPS - for management of brown outs 30min	1	\$ 3,000	\$	3,000
Pressure Transducer	For monitoring pressure across cartridges	6	\$ 500	\$	3,000
Turbiditmeter	For treated water	1	\$ 7,000	\$	7,000
Flow meter	DN80 yokogawa mag flowmeter	2	\$ 4,600	\$	9,200
Pipes, valves and fittings	50 to 100 mm	- 1	\$ 10,000	\$	10,000
					72,000
Water Treatment Plant Building	Alpine style m2	18		\$ ¢	
Building Consent	Building consent for WTP	1	\$ 10,000	\$	10,000
Landscaping/Access	Landscaping/ Access Road	1	\$ 50,000	\$	50,000
Telemetry	RTU and Aerial, programming etc	1	\$ 20,000	\$	20,000
Electrical and Switchboard		1	\$ 40,000	\$	40,000
Power Upgrade	Upgrade to provide service fuse box on boundary of 13 Ohau Drive	1	\$ 20,000	\$	20,000
Installation and Construction		25%	\$ 272,680	\$	68,170
SUBTOTAL				\$	340,850
Reticulation					
Hydrovar Pump set	6L/sec at 40m	1	\$ 8,500	\$	8,500
Flam mater	DN00 uslasseus mas flaumatas	4	¢ 4.000	¢	4 000
Flow meter	DN80 yokogawa mag flowmeter	1	\$ 4,600	\$	4,600
Bores to WTP	DN100 PVC/PE	90	\$ 150	\$	13,500
WTP to Storage	DN100 PVC/PE	5	\$ 150	\$	750
Storage to Retic	DN150 PVC/PE	100	\$ 180	\$	18,000
Installation and Construction		25%	\$ 45,350	\$	11,338
SUBTOTAL Storage				\$	56,700
-		4.5	• • • • • • •	<u>,</u>	07.000
Storage (femergency)	30,000 L tanks with fittings (116m3)	4.5	\$ 6,000	\$	27,000
Installation and Construction		25%	\$ 27,000	\$	6,750
SUBTOTAL					33,750
Fire Protection					
Fire Tanks	30,000 L tanks with fittings	1.5	\$ 6,000	\$	9,000
Added building space		5	\$ 4,000	\$	20,000
Additional Generator Cost	increase in size of generaotr for Fire pump	1	\$ 6,000	\$	6,000
Fire Pump	18.5KW in line fire pumps	1	19,000	\$	19,000
Installation and Construction		25%	\$ 54,000	\$	13,500
SUBTOTAL					67,500
Generator					
Generator	30 KVA generator	1	20,500	\$	20,500
Installation and Construction	-	25%	\$ 20,500	\$	5,125
SUBTOTAL					25,625
SUBTOTAL			h		688,600
Preliminary and General		10%			68,860
Design		20%			137,720
Contingency		10%			68,860
		10 /0	-		964,000
Total Estimated Capital Cost: Annual Operational Costs	wold wold average daily flow (m2/day)	50	-		304,000
	assumed average daily flow (m3/day)		100		0.040
Compliance and Management	per hour (4 hours monthly)	48	180		8,640
Labour	per hour (weekly visits for 5 hours)	260	70		18,200
UV Disinfection	kWhr (assumes 0.23 kw operating 24 hours per day)	2014.8	0.4		806
Lamp Replacement	Assumes yearly reaplacement of 1 lamp (1 lamp per unti)	1.0	433.0		433
Cartridges	per cartridge (assume quarterly)	3	500		1,500
-	kWhr (assumes 2kw pump operating at 2L/sec for about 7	-			
Electricity for Bore Pumps	hours per day)	5,069	0.3		1,521
Electricity for Reticulation Pumps	kWhr (assumes1.1kw pump operating at 1L/sec for 16 hours	o /or			1,927
	per day)	6,424	0.3	¢	
SUBTOTAL				\$	33,026.95
Total Estimated Annual Operational Costs				\$	33,000
NPV of Operating Costs (20 yr				-	
@ 8%)				\$	324,000
NPV Capital plus Operating Costs				\$	1,288,000
00010	1		l	l	

EAN Consent and the bits graundmater 1 S 20000 S 200000 S 200000 <td< th=""><th>Option 2 b OD</th><th>- New bores,WTP with Chlorine,Storage and reticulation</th><th>pumps - ON DEM</th><th>IAND</th><th>FLOW</th><th></th><th></th></td<>	Option 2 b OD	- New bores,WTP with Chlorine,Storage and reticulation	pumps - ON DEM	IAND	FLOW		
Application was in rearrer WW NUC 1 5 5.000 5 5.000 5 5.000 5 5.000 5 5.000 5 5.000 5 5.000 5 5.000 5 5.000 5 5.0000 5 5.0000 5 5.000 5<	Description	Unit	Quantity		Rate		Cost
Control User providenser 1 S 2.50.0 S 5.00.00 Bore Plungs 2.78.1.cer up to Sin allowed for 2 S 2.50.0 S 5.00.00 Nortin WTD orungin 2 S 2.50.0 S 7.00.0 New wear traditions of Construction User semiground cabinet, intell 1 S 1.50.0 S 5.00.0 S 5.			· · ·				
Bores offinge 1/2/Lister at pre 5 on allowed far VFD for pumps 2 5 0.000 5 0.000 WD for pumps 2 5 0.000 5 0.000 5 0.000 Row mader Uterholmer 1000 5 0.0000 5 0.000	Application to work in reserve	With WDC	1	\$	5,000	\$	5,000
Sport Purp Purp Sport Purp Purp Sport Purp Sport Purp Sport Purp Sport Purp	ECAN Consent	consent to take groundwater	1	-			25,000
VTD or parties 2 8 3.5.0 5 7.000 Rew mater Attributes 1 8 7.000 5 7.000 Rew mater Attributes 2 5 7.000 5 7.000 Rew mater Attributes 1 1 8 7.000 5 3.3.200 Exected and Control 1 1 1.000 1.000 1.000 1.000 1.000 5 3.3.200 SUBTORAL 1 1.000 1.000 5 3.00000 5 3.0000	0		-	-			,
Baye water Underwater Heart Profil 1 S TOO TOO S TOO S TOO S TOO S TOO TOO S TOO TOO TOO TOO TOO TOO TOO TOO TOO TOO </td <td></td> <td>-</td> <td></td> <td>-</td> <td></td> <td></td> <td></td>		-		-			
Prometer DMB syndpace and ploameter 2 8 4.60 5 9.200 Exacted and Control lead austhese decisital cabriel, install 1 8 15000 5 15000 SURPTORAL Interfeder Interfeder Interfeder 5 16620 SURPTORAL Interfeder Interfeder 5 16620 5 16620 UP is for management of bream atta 2000 into 15 15 Used Duby seads 2 5 16600 5 30000 UP is for management of bream atta 2000 into 15 15 Used Duby seads 2 5 10000 5 00000 Pace mater Promoter 1 5 10000 5 00000 1 5 00000 1 5 00000 1 5 00000 1 5 00000 1 5 00000 1 5 00000 1 5 00000 1 5 00000 1 5 00000 1 5 00000 1 5 00000 1 <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>							
Bedital and Control iewel awitches destinat action at hissiliton 1 \$ 15,000 \$ 15,000 Mather Trashmedt 25% \$ 13,000 \$ 13,000 Carlinging 1 H#42H340.4 1 un - will read up to 5 Lines (Duly usaid) 2 \$ 4,000 \$ 20,000 Univoide Branchison UV Pro 50 (up to 3.5 Lines) Duly seardit 2 \$ 1,000 \$ 20,000 \$ 3,000 \$ 20,000 \$ 5,000 \$ 20,000 \$ 5,000 \$ 20,000 \$ 5,000 \$ 20,000 \$ 5,000 \$ 10,000 \$ 5,000 \$ 10,000 \$ 5,000 \$ 10,000 \$ 10,000 \$ 10,000 \$ 10,000 \$ 10,000 \$ 10,000 \$ 10,000 \$ 10,000 \$ 10,000 \$ 10,000 \$ 10,000 \$ 10,000 \$ 10,000 \$ 10,000 \$ 10,000 \$<			-	-			
Installation and Construction 22% \$ 133,200 3 33,300 OWNOTAL Intel-OHD0A 1 unit will breat up to 5 Lines (Doty assist) 2 \$ 8,200 \$ 166,200 UPS for UN UDFs 50 (up to 3.15 Lines) (Doty assist) 2 \$ 8,200 \$ 9,200 \$ 3,0000 \$ <t< td=""><td>Flow meter</td><td>DN80 yokogawa mag nowmeter</td><td>2</td><td>Э</td><td>4,600</td><td>ф</td><td>9,200</td></t<>	Flow meter	DN80 yokogawa mag nowmeter	2	Э	4,600	ф	9,200
SUPTOTAL Image: Supersonance in the set of the Supersonance in the Supersonance	Electrical and Control	level switches electrical cabinet, install	1	\$	15,000	\$	15,000
Wate Treatment I HF40H304 1 um - will text up to 5 Lize (Duy assist) 2 5 6.20 5 10.000 UPs for UV UPs to 0 (up to 3.15 Lize) Duy assist 2 5 10.000 5 30.000 UPs for UV UPs - to management of brave on 30.000 in 1 5 30.000 5 30.000 Den mater 1 5 7.000 5 30.000 5 30.000 Turiddimeer 1 5 4.000 5 10.000 5 0.000 DNM processe mig lowneer 1 5 4.0000 5 0.0000 <td>Installation and Construction</td> <td></td> <td>25%</td> <td>\$</td> <td>133,200</td> <td>\$</td> <td>33,300</td>	Installation and Construction		25%	\$	133,200	\$	33,300
Carriage 11 HF40H304 1 um - will teat up b 5 Lines (Daty sealed) 2 \$ 6.100 5 10000 UPS for U/Pro 50 (up to 3.15 Line) Daty assist 2 \$ 1000 (s 5 32000 5 32000 UPS for U/Pro 50 (up to 3.15 Line) Daty assist 1 \$ 5 3000 (s 5 32000 Protein Prioring 1 \$ 4.000 (s 5 3000 (s 3 3000 (s 3000 (s 3 3000 (s 30000 (s 30000 (s 300	SUBTOTAL					\$	166,500
Carriage 11 HF40H304 1 um - will teat up b 5 Lines (Daty sealed) 2 \$ 6.100 5 10000 UPS for U/Pro 50 (up to 3.15 Line) Daty assist 2 \$ 1000 (s 5 32000 5 32000 UPS for U/Pro 50 (up to 3.15 Line) Daty assist 1 \$ 5 3000 (s 5 32000 Protein Prioring 1 \$ 4.000 (s 5 3000 (s 3 3000 (s 3000 (s 3 3000 (s 30000 (s 30000 (s 300	Water Treetment						
Ultravidet Diarkection UV Pro 50 (pp to 315 Leed Duty statet 2 \$ 10000 \$ 20000 UPS (ur UV) UPS-tor meanagement of brow noti. 30min 1 \$ 3.000 \$ 3.000 Presume Transducer For meanagement of brow noti. 30min 1 \$ 4.000 \$ 3.000 Prom meter DND0 yockgame and store attravious 1 \$ 4.000 \$ 1.000 Prom meter DND0 yockgame ming fourmeter 1 \$ 4.000 \$ 1.0000 Applies with m22 DS to 100 mm 1 \$ 1.0000 \$ 1.0000 \$ 1.00000 \$ 1.00000 \$ 1.00000 \$ 1.00000 \$ 1.00000 \$ 1.00000 \$ 1.00000 \$ 1.00000 \$ 1.00000 \$ 1.00000 \$ 1.00000 \$ 1.00000 \$ 1.00000 \$ 1.00000 \$ 1.00000 \$ 1.00000 \$ 1.00000 \$ 1.00000 \$ 1.00000<	water freatment						
Ultravidet Diarkection UV Pro 50 (pp to 315 Leed Duty statet 2 \$ 10000 \$ 20000 UPS (ur UV) UPS-tor meanagement of brow noti. 30min 1 \$ 3.000 \$ 3.000 Presume Transducer For meanagement of brow noti. 30min 1 \$ 4.000 \$ 3.000 Prom meter DND0 yockgame and store attravious 1 \$ 4.000 \$ 1.000 Prom meter DND0 yockgame ming fourmeter 1 \$ 4.000 \$ 1.0000 Applies with m22 DS to 100 mm 1 \$ 1.0000 \$ 1.0000 \$ 1.00000 \$ 1.00000 \$ 1.00000 \$ 1.00000 \$ 1.00000 \$ 1.00000 \$ 1.00000 \$ 1.00000 \$ 1.00000 \$ 1.00000 \$ 1.00000 \$ 1.00000 \$ 1.00000 \$ 1.00000 \$ 1.00000 \$ 1.00000 \$ 1.00000 \$ 1.00000 \$ 1.00000<							
UPS for UV UPS - for management of brown outs 30min 1 \$ 3,000 \$ 3,000 Pressue Transluter For moning pressue across contridges 6 \$ 7,000 \$ 7,000 Piew meter DNB yelogame mag formenter 1 \$ 4,000 \$ 4,000 Piew neter DBB yelogame mag formenter 1 \$ 4,000 \$ 100,000 Builing Consent 1 \$ 5 100,000 \$ 100,000 Builing Consent for VTP Builing Consent for VTP \$ 20,000 \$ 20,000 \$ 20,000 \$ 20,000 \$ 20,000 \$ 7000 Tower Lugrade Upgrade to provide service fue box on boundary of 13 \$ 20,000 \$ 70000 \$ 70000 Tower Lugrade Upgrade to provide service fue box on boundary of 13 \$ 1 \$ 100,000 </td <td>Cartridge</td> <td>1 HF40H304 1 um - will treat up to 5 L/sec (Duty assist)</td> <td>2</td> <td>\$</td> <td>8,250</td> <td>\$</td> <td>16,500</td>	Cartridge	1 HF40H304 1 um - will treat up to 5 L/sec (Duty assist)	2	\$	8,250	\$	16,500
Pressure Transducer For motioning pressure across caridges 6 8 7000 5 70000 Pior meter Pior meter Pior meter Pior meter 1 8 70000 5 70000 Pior meter Pior meter Pior meter 1 8 70000 5 70000 Pior meter Pior meter 1 8 70000 5 700000 5 700000 5 700000 5 700000 5 700000 5 700000 5 700000 5 700000 5 700000 5 700000 5 700000 5 700000 5 700000 5 700000 5 7000000 7000000000000000000000000000000000000	Ultraviolet Disinfection	UV Pro 50 (up to 3.15 L/sec) Duty assist	2	\$	10,000	\$	20,000
Pressure Transducer For motioning pressure across caridges 6 8 7000 5 70000 Pior meter Pior meter Pior meter Pior meter 1 8 70000 5 70000 Pior meter Pior meter Pior meter 1 8 70000 5 70000 Pior meter Pior meter 1 8 70000 5 700000 5 700000 5 700000 5 700000 5 700000 5 700000 5 700000 5 700000 5 700000 5 700000 5 700000 5 700000 5 700000 5 700000 5 7000000 7000000000000000000000000000000000000		LIDE for monogoment of brown outs 20min	1	¢	2 000	¢	2 000
Turbelmater For meter Piew meter		-		-			
Figure mater DNND yukagawa magi flavmeter 1 S 4.000 5 4.000 5 4.000 S 4.000			•	-			
Pipes. where and fittings			-				
Water Treatment Plane Building Building Consers for WTP 1 5 1.00.00 5 1.00.00 Landscaping/Access RTU and Areal, programming atc 1 S 2.00.00 S 0.00.00 Tailementy RTU and Areal, programming atc 1 S 2.00.00 S 0.00.00 Power Lipprade Upgrade to provide service fuse tox on boundary of 3 Chau Dive 1 S 2.00.00 S 7.00.00 SUBTOTAL Carry water Pump 1 S 2.0.00 S 7.0.00 Control Construction Carry water Pump 1 S 2.0.00 S 7.0.00 Control Construction Carry water Pump 1 S 2.0.00 S 7.0.00 SUBTOTAL Carry water Pump 1 S 3.0.00 S 1.0.00 SUBTOTAL Carry water Pump 1 S 4.0.00 S 1.0.00 SUBTOTAL Contract tank 10.000 Contract tank S 1.0.00 S 1.0.00 SUBTOTAL				-			
Building consent on VTP 1 S 10.000 S 10.000 Landscapping Access Road 1 S 90.000			-				
Landscapeng/Access Road 1 \$ 60,000 \$ 90,000 <td>-</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>10,000</td>	-						10,000
Telemetry RTU and Aerial, programming etc. 1 S 20,000 S 20,000 Electrical and Switchboard Upgrade to provide service tuse box on boundary of 13 Onau Drive 1 S 40,000 S 40,000 Installation and Construction 25% S 304,100 S 75,202 SUBTOTAL 25% S 304,100 S 72,002 Choirne Obinitication, Contact Time Choirne Obinitication, Contact Time Choirne Obinitication, and Construction S 30,249 20,000 S 20,000 S <t< td=""><td>=</td><td>0</td><td>-</td><td>-</td><td></td><td></td><td>50,000</td></t<>	=	0	-	-			50,000
Electrical and Switchboard Upgrade Upgrade to provide service fuse box on boundary of 13 Chau Drive 1 S 40,000 S 40,000 Power Upgrade Upgrade to provide service fuse box on boundary of 13 Chau Drive 1 S 20,000 S 20,000 Chorne Drainfection, Contact Time Chorne GasDoaig Cass Cylinders and Doaing- Carry water Pump 1 S 30,748 S 30,749							
Power Upgrade Upgrade to provide service hase box on boundary of 13 Chau Drive 1 5 20,000 5 20,000 Installation and Construction 25% 5 304,100 5 76,000 Choine Gas Doring Gas Cylinders and Dosing - Carry water Pump 1 \$ 30,749 \$ 30,749 Construction MC with Depolox 5 1 \$ 11,300 \$ 11,000 \$ 11,000 \$ 11,000 \$ 11,000 \$ <td< td=""><td>reiellieuy</td><td>R I O anu Aeriai, programming etc</td><td>1</td><td>Ģ</td><td>20,000</td><td>φ</td><td>20,000</td></td<>	reiellieuy	R I O anu Aeriai, programming etc	1	Ģ	20,000	φ	20,000
Power Upgrade Upgrade to provide service hase box on boundary of 13 Chau Drive 1 5 20,000 5 20,000 Installation and Construction 25% 5 304,100 5 76,000 Choine Gas Doring Gas Cylinders and Dosing - Carry water Pump 1 \$ 30,749 \$ 30,749 Construction MC with Depolox 5 1 \$ 11,300 \$ 11,000 \$ 11,000 \$ 11,000 \$ 11,000 \$ <td< td=""><td>Electrical and Switchboard</td><td></td><td>4</td><td>\$</td><td>40,000</td><td>\$</td><td>40,000</td></td<>	Electrical and Switchboard		4	\$	40,000	\$	40,000
One of plante 1 S 2.000 S 2.000 SUBTOTAL 25% \$ 304.100 \$ 308.022 Chroine Dialneticino, Contact Time Gas Cylindern and Dosing - 1 \$ 30.021 Chroine Star Dosing Gas Cylindern and Dosing - 1 \$ 30.042 \$ Chroine Star Dosing Gas Cylindern and Dosing - 1 \$ 30.043 \$ 3.000 Chroine Analyser MFC with Depolot S 1 \$ 1.000 \$			1				
Installation and Construction 25% \$ 304.100 \$ 76.203 300.704. \$ 300.704. \$ 300.704	Power Upgrade			\$	20,000	\$	20,000
SUBTOTAL	Installation and O	Ondu Drivo	-	¢	204.405	¢	70 005
Chlorine Disinfection, Contact Time Chlorine Disinfection, Contact Time Chlorine Gas Dosing Carary water Pump 1 \$ 30.749 \$ 30.749 Chlorine Das Dosing Carary water Pump 1 \$ 30.700 \$ 30.700 Chlorine Analyser 1 \$ 1.300 \$ 31.300 Contract tank installation and Construction 10000L 1 \$ 3.360 SUBTOTAL 25% \$ 47.862 \$ 3.89.072 SUBTOTAL DN00 pVc/pet 90 \$ 11.000 \$ 11.000 DN100 PVC/PE 90 \$ 10.00 \$ 11.000 \$ 11.000 \$ 10.00 \$ 11.000 \$ 11.000 \$ 11.000 \$ 11.000 \$ 11.000 \$ 11.000 \$ 11.000 \$ 10.00 \$ 10.00 \$ 10.00 \$ 10.00 \$ 10.00 \$ 10.00 \$ 10.00 \$ 10.00 \$ 10.000 \$ 10.000			25%	\$	304,100		
Chlorine Gas Dosing Instruction S 30,749 S S </td <td></td> <td></td> <td></td> <td></td> <td></td> <td>\$</td> <td>380,125</td>						\$	380,125
Carry water Pump 1 S 2.000 S 2.000 Chlorine Analyser MFC with Depolox 5 1 S 11,300 S 11,300 Contact Link 10000L 1 S 3.000 S 3.000 Installation and Construction 25% S 4.75.49 S 11,300 SUBTOTAL Treatment Ediculation 1 S 4.99.225 Reticulation DN00 pVologaw mag flowmeter 1 S 4.900 S 4.99.225 Reticulation DN100 PVC/PE 90 S 150 S 13.000 Storage to Retic DN100 PVC/PE 100 S 6.000 S 10.00 S 10.00 S 10.00 S 10.00 S 6.000 S 10.00 S 10.00 S 10.00 S 6.000 S 10.00 S 6.000 S 10.00 S 6.000 S 10.000 S 6.0000 S 10.000	Chlorine Disinfection, Contact Time						
Chorne Analyser MFC with Depolox 5 1 S 11300 S 11300 S 11300 S 13300 S 11300 S 11300 S 13300 S 11300 S 113000 S 113000 S	Chlorine Gas Dosing	Gas Cylinders and Dosing -	1	\$	30,749	\$	30,749
Contact task 10000L 1 S 3.500 S 3.800 S 3.8000 S 1.800 S 3.8000 S 1.800 S 3.8000 S	Carry water Pump	Carry water Pump	1	\$	2,000	\$	2,000
Installation and Construction 25% S 47,540 S 11,887 SUBTOTAL		-	1	-			11,300
SUBTOTAL s 59.400 SUBTOTAL Treatment s 499.225 Reliculation 1 \$ 490.225 Hydrovar Pump set (12 L/sec at 50m) DN00 pkogawa mag flowmeter 1 \$ 4,600 \$ 4,600 Sores to WTP DN100 PVC/PE 90 \$ 150 \$ 1000 \$ 1000 \$ 1000 \$ 1000 \$ 1000 \$ 1000 \$ 1000 \$ 1000 \$ 1000 \$ 1000 \$ 6,0000 \$ 1000 \$ 6,000 \$ 10,000 \$ 6,0000 \$ 10,000 \$ 6,000 \$ 10,000 \$ 6,000 \$ 10,000 \$ 6,000 \$ 10,000 \$ 6,000 \$ 10,000 \$ 6,000 \$ 10,000 \$ 6,000 \$ 10,000 \$ 6,000 \$ 10,000 \$ 10,000 \$ 10,000 \$ 10,000		10000L					
SUBTOTAL Treatment \$ 439,225 Reticulation Hydrowar Pump set (12 L/sec at 50m) Flow meter Lowara Twin Pac Dual 15SV06F055T5.5 KW 1 \$ 11,000 \$ 11,000 Bores to WTP DN00 yokogawa mag flowmeter DN100 FVC/PE 90 \$ 150 \$ 13,000 Storage to Retic DN10 PVC/PE 90 \$ 150 \$ 18,000 Installation and Construction SUGTOTAL 25% \$ 4000 \$ 18,000 Storage (operational and emergency) 30,000 L tanks with fittings (0perational and emergency) 10 \$ 6,000 \$ 15,000 SUBTOTAL 25% \$ 60,000 \$ 15,000 \$ 15,000 \$ 15,000 SUBTOTAL 25% \$ 60,000 \$ 15,000 \$ 5,9473 \$ 5,9473 Storage (operational and emergency) 25% \$ 60,000 \$ 15,000 \$ 15,000 SUBTOTAL 25% \$ 60,000 \$ 15,000 \$ 12,000 \$ 12,000 SUBTOTAL 25% \$ 0,000 \$ 14,250 \$ 14,250 \$ 14,250 SUBTOTAL 25% \$ 7,000 \$ 14,250 \$ 20,500 \$ 5,12,600			25%	\$	47,549		
Baticulation Hydroxer Pump set (12 L/sec at 50m) Lowara Twin Pac Dual 15SV06F055T.5.KW 1 \$ 11,000 \$ 11,000 \$ 11,000 \$ 11,000 \$ 14,000 \$ 11,000 \$ 14,000 \$ 11,000 \$ 14,000						,	
Hydrovar Pump set (12 L/sec at 50m) Lowara Twin Pac Dual 15SV06F05T5.5 KW 1 \$ 11,000 \$ 11,000 \$ 11,000 \$ 11,000 \$ 11,000 \$ 11,000 \$ 11,000 \$ 11,000 \$ 11,000 \$ 11,000 \$ 11,000 \$ 11,000 \$ 11,000 \$ 11,000 \$ 14,000 \$ 14,000 \$ 14,000 \$ 14,000 \$ 14,000 \$ 14,000 \$ 14,000 \$ 14,000 \$ 14,000 \$ 14,000 \$ 14,000 \$ 14,000 \$ 14,000 \$ 14,000 \$ 14,000 \$ 14,000 \$ 14,000 \$ 16,000 \$ 16,000 \$ 16,000 \$ 16,000 \$ 16,000 \$ 16,000 \$ 16,000 \$ 16,000 \$ 16,000 \$ 16,000 \$ 16,000 \$ 16,000 \$ 16,000						\$	439,525
Flow meter DN80 yokogawa mag flowmeter 1 \$ 4,600 \$ 4,600 Bores to WTP DN100 PVC/PE 90 \$ 150 \$ 13,500 Storage to Retic DN150 PVC/PE 100 \$ 1800 \$ 18,000 Installation and Construction SUBTOTAL 25% \$ 47,850 \$ 60,000 \$ 60,000 \$ 60,000 \$ 60,000 \$ 60,000 \$ 75,000 75,000 \$ 75,000 \$ 10,000 \$ 60,000 \$ 10,000 \$ 60,000 \$ 10,000 \$ 10,000 \$ 10,000 \$ 10,000 \$ 10,000 \$ 10,000 \$ 10,000 \$ 10,000 \$ 10,000 \$ 10,000 \$ 10,000 \$ 10,000 \$ 10,000 \$ 10,000 \$ 10,000 \$ 10,000 \$ 10,000 \$ 12,000 \$ 12,0000 \$							
Bores to WTP DN100 PVC/PE 90 \$ 150 \$ 13,500 Storage to Retic DN100 PVC/PE 5 \$ 150 \$ 18,000 Installation and Construction 25% \$ 47,850 \$ 18,000 Storage to Retic DN150 PVC/PE 10 \$ 6,000 \$ 5 5,9247 Storage to perational and emergency- 287m3) 30,000 L tanks with fittings (operational and emergency- 287m3) 10 \$ 6,000 \$ 10,000 \$ 60,000 \$ 10,000 \$ 60,000 \$ 10,000 \$ 60,000 \$ 10,000 \$ 60,000 \$ 10,000 \$ 60,000 \$ 10,000 \$ 60,000 \$ 10,000 \$ 60,000 \$ 10,000 \$ 10,000 \$ 10,000 \$ 10,000 \$ 10,000 \$ 10,000 \$ 10,000 \$ 10,000 \$ 10,000 \$ 10,000 \$ 10,000 <	Hydrovar Pump set (12 L/sec at 50m)	Lowara Twin Pac Dual 15SV06F055T5.5 KW	1	\$	11,000	\$	11,000
WTP to Storage DN100 PVC/PE 5 \$ 150 \$ 750 Storage to Retic Installation and Construction DN150 PVC/PE 100 \$ 180 \$ 18,000 SUBTOTAL 25% \$ 47,850 \$ 19,803 \$ 59,813 Storage (operational and emergency) 10 \$ 6,000 \$ 60,000 \$ 16,000 \$ 60,000 \$ 60,000 \$ 15,000 \$ 60,000 \$ 15,000 \$ 60,000 \$ 12,000 \$ 16,000 \$ 60,000 \$ 12,000	Flow meter	DN80 yokogawa mag flowmeter	1	\$	4,600	\$	4,600
Storage to Retic DN150 PVC/PE 100 \$ 180 \$ 18,000 Installation and Construction 25% \$ 47,080 \$ 11,080 Storage Storage (operational and emergency) 30,000 L tanks with fittings (operational and emergency- 2287m3) 10 \$ 6,000 \$ 60,000 Installation and Construction 225% \$ 60,000 \$ 10.00 \$ 6,000 \$ 60,000 \$ 60,000 \$ 60,000 \$ 60,000 \$ 60,000 \$ 60,000 \$ 60,000 \$ 60,000 \$ 60,000 \$ 60,000 \$ 10.00 \$ 60,000 \$ 11,000 \$ 10,000 \$ 11,000 \$ 11,000 \$ 11,000 \$ 11,000 \$ 11,000 \$ 11,000 \$ 11,000 \$ 11,000 \$ 11,000 \$ 11,000 \$ 11,000 \$ 2,0500 \$ 5,125 20,5000 <td< td=""><td>Bores to WTP</td><td>DN100 PVC/PE</td><td>90</td><td>\$</td><td>150</td><td>\$</td><td>13,500</td></td<>	Bores to WTP	DN100 PVC/PE	90	\$	150	\$	13,500
Instalation and Construction 25% \$ 47,850 \$ 11,963 Storage 30,000 L tanks with fittings (operational and emergency - 287m3) 10 \$ 6,000 \$ 6,000 SUBTOTAL 30,000 L tanks with fittings (operational and emergency - 287m3) 10 \$ 6,000 \$ 15,000 Installation and Construction SUBTOTAL 25% \$ 60,000 \$ 15,000 File Protection. File Protection 5 \$ 4,000 \$ 12,000 Adde building space Adde building space 5 \$ 4,000 \$ 12,000 Installation and Construction 25% \$ 57,000 \$ 14,200 SUBTOTAL 25% \$ 57,000 \$ 14,200 Installation and Construction 25% \$ 20,500 \$ 5,122 SUBTOTAL 25% \$ 20,500 \$ 5,122 SUBTOTAL 25% \$ 20,500 \$ 5,122 SUBTOTAL 25% \$ 20,500 \$ 5,125 SUBTOTAL 25% \$ 20,500 \$ 5,125 SUBTOTAL 25% \$ 20,500 \$ 5,125 SUBTOTAL 1	_		5		150		750
SUBTOTAL S 59,813 Storage 30,000 L tanks with fittings (operational and emergency- 287m3) 10 \$ 6,000 \$ 60,000 SUBTOTAL 25% \$ 60,000 \$ 15,000 \$ 15,000 \$ 60,000 \$ 15,000 \$ 15,000 \$ 15,000 \$ 15,000 \$ 15,000 \$ 15,000 \$ 12,000 \$ 12,000 \$ 12,000 \$ 12,000 \$ 12,000 \$ 12,000 \$ 14,250 \$ 14,250 \$ 14,250 \$ 20,500 \$ 14,250 \$ 20,500 \$ 14,250 \$ 20,500 \$ 5,125 \$ 20,500 \$ 5,125 \$ 20,500 \$ 5,125 \$ 20,500 \$ 5,125 \$ 20,500 \$ 5,125 \$ 20,500 \$ 5,125 \$ 20,500 \$ 5,125 \$ 20,500 \$ 5,125		DN150 PVC/PE					18,000
Storage 30,000 L tanks with fittings (operational and emergency- 287m3) 10 \$ 6,000 \$ 60,000 Installation and Construction SUBTOTAL 25% \$ 60,000 \$ 15,000 File Protection 25% \$ 60,000 \$ 12,000 Added building space 30,000 L tanks with fittings 2 \$ 6,000 \$ 12,000 Added building space Additional Generator Cost increase in size of generator for Fire pump 1 \$ 6,000 \$ 19,000 \$ 19,000 \$ 19,000 \$ 19,000 \$ 14,250 \$ 2,56,225 \$ 5 \$ 0,000 \$ 1,2000 \$ 14,250 \$ 2,56,225 \$ 5 \$ 2,56,000 \$ \$ 5,51,225 \$ 2,500 \$ \$ 5,51,225 \$ 5,51,225 \$ 5,51,225 \$ 5,51,225 \$ 5,51,225 \$ 5,51,225 \$ 5,51,225 \$ 5,51,225 \$ </td <td></td> <td></td> <td>25%</td> <td>\$</td> <td>47,850</td> <td></td> <td>11,963</td>			25%	\$	47,850		11,963
Storage (operational and emergency- 287m3) 10 \$ 6.000 \$ 60,000 Installation and Construction 25% \$ 60,000 \$ 15,000 SUBTOTAL 25% \$ 60,000 \$ 15,000 SUBTOTAL 25% \$ 60,000 \$ 15,000 SUBTOTAL 30,000 L tanks with fittings 2 \$ 6,000 \$ 12,000 Adde building space 30,000 L tanks with fittings 2 \$ 6,000 \$ 12,000 Installation and Construction increase in size of generator Fire pump 1 \$ 6,000 \$ 14,250 SUBTOTAL 25% \$ 57,000 \$ 14,250 SUBTOTAL 20,500 \$ 5,51,250 \$ 20,500 \$ 5,51,250 SUBTOTAL 20% \$ 20,500 \$ 5,51,250 \$ 5,51,250 SUBTOTAL 20% \$ 5,20,500 \$ 5,51,250 \$ 5,51,250						\$	59,813
Close of Construction 287m3) 10 0 0 0000 15 0000 15 0000 15 0000 15 0000 15 0000 15 0000 15 0000 15 0000 15 0000 15 0000 15 0000 15 0000 15 0000 15 0000 15 0000 15 0000 15 0000 15 0000 15 0000 12,000 0000 12,000 0000 12,000 0000 12,000 0000 11	Storage	30,000 L tanks with fittings, (operational and operange)					
Installation and Construction 25% \$ 60,000 \$ 15,000 SUBTOTAL - - 75,000 75,000 75,000 75,000 75,000 75,000 75,000 75,000 75,000 75,000 75,000 75,000 75,000 75,000 75,000 75,000 75,000 71,000 <td>Storage (operational and emergency)</td> <td>287m3)</td> <td>10</td> <td>\$</td> <td>6,000</td> <td>\$</td> <td>60,000</td>	Storage (operational and emergency)	287m3)	10	\$	6,000	\$	60,000
Fire Protection. 30,000 L tanks with fittings 2 \$ 6,000 \$ 12,000 Added building space addional Generator Cost increase in size of generaotr for Fire pump 1 \$ 6,000 \$ 20,000 Fire Pump 1 \$ 6,000 \$ 20,000 Installation and Construction 25% \$ 57,000 \$ 14,250 SUBTOTAL 25% \$ 57,000 \$ 14,250 Add-ons 25% \$ 20,500 \$ 25,125 SUBTOTAL 30 KVA generator 1 20,500 \$ 25,522 SUBTOTAL 30 KVA generator 1 20,500 \$ 25,522 SUBTOTAL 10% 83,771 83,771 38,3771 36,500 \$ 36,500 Soningency 20% 10% 83,771 20% 14,250 36,400 83,771 Total Estimated Capital Cost: assumed average daily flow (m3/day) 50 - 1,172,798 Anual Operational Costs assumed average daily flow (m3/day) 50 - 1,172,798	Installation and Construction		25%	\$	60,000	\$	15,000
Fire Tanks 30,000 L tanks with fittings 2 \$ 6,000 \$ 12,000 Added building space increase in size of generator for Fire pump 1 \$ 6,000 \$ 19,000 \$ 19,000 \$ 19,000 \$ 14,250 77,256 \$ 5 \$ 4,000 \$ 14,250 77,256 \$ 20,500 \$ 14,250 77,256 \$ 20,500 \$ 5,125 \$ 20,500 \$ 5,125 \$ 20,500 \$ 5,125 \$ 26,622 \$ 25,622 \$ 20,500 \$ 5,125 \$ 26,622 \$ 30,713 \$ 16,7543 \$ 20,500 \$ 5,125 \$ 26,622 \$ 30,711 \$ 16,7543 \$ 30,711 \$ 16,7543 \$ 30,711 \$ 16,7543 \$ 30,711 \$ \$ 30,711 \$ \$ 30,711 \$ \$ 30,711 \$ \$ 3	SUBTOTAL						75,000
Added building space 5 \$ 4,000 \$ 20,000 Additional Generator Cost increase in size of generaotr for Fire pump 1 \$ 6,000 \$ 6,000 \$ 19,000 \$ 19,000 \$ 19,000 \$ 19,000 \$ 19,000 \$ 19,000 \$ 19,000 \$ 19,000 \$ 19,000 \$ 14,250 \$ 20,500 \$ 14,250 \$ 20,500 \$ 5,5125 \$ 20,500 \$ 5,5125 \$ 20,500 \$ 5,5125 \$ 20,500 \$ 5,5125 \$ 20,500 \$ 5,5125 \$ 20,500 \$ 5,5125 \$ 20,500 \$ 5,5125 \$ 20,500 \$ 5,5125 \$ 20,500 \$ 5,5125 \$ 20,500 \$ 5,5125 \$ 5,5125 \$ 20,500 \$ 5,5125 \$ 5,5125 \$ 5,5125 \$ 5,5125 \$ 5,	Fire Protection						
Additional Generator Cost increase in size of generator for Fire pump 1 \$ 6,000 \$ 6,000 Fire Pump 1 \$ 6,000 1 1,000 \$ 19,000 \$ 19,000 \$ 19,000 \$ 19,000 \$ 19,000 \$ 19,000 \$ 19,000 \$ 14,250 \$ 14,250 \$ 14,250 \$ 77,256 \$ 20,500 \$ 20,500 \$ 20,500 \$ 5,152 5,152 \$ 25,502 \$ 20,500 \$ 5,152 \$ 25,502 \$ 25,502 \$ 5,152 \$ 25,502 \$ 5,152 \$ 25,502 \$ 5,152 \$ 25,502 \$ 5,152 \$ 25,502 \$ 5,152 \$ 25,502 \$ 5,152 \$ 25,502 \$ 5,152 \$ 25,502 \$ 5,152 \$ 25,502 \$ 5,152 \$ 25,502 \$ 5,152 \$ 25,502 \$ 5,172 \$ \$ 3,771 3 \$		30,000 L tanks with fittings					12,000
Fire Pump 1 19,000 \$ 19,000 \$ 19,000 \$ 19,000 \$ 19,000 \$ 19,000 \$ 19,000 \$ 19,000 \$ 19,000 \$ 19,000 \$ 19,000 \$ 14,250 \$ 57,000 \$ 14,250 77,250 \$ 77,250 \$ 77,250 \$ 77,250 \$ 20,500 \$ 14,250 \$ 20,500 \$ 51,255 25,007 \$ 20,500 \$ 51,255 25,020 \$ 51,255 25,020 \$ 51,255 25,020 \$ 51,255 25,020 \$ 33,771 20,500 \$ 33,771 33,771 30 20,000 33,771 33,771 33,771 33,771 33,771 33,771 33,771 33,771 33,771 33,771 33,771 34,844 3400 33,771 35,000 34,844 34,00 33,771 35,000 34,3771 35,000 34,33,01 34,33,01 34				-			20,000
Installation and Construction SUBTOTAL 25% \$ 57,00 \$ 14,250 Add-ons. Generator 30 KVA generator 1 20,500 \$ 20,500 Installation and Construction 30 KVA generator 1 20,500 \$ 5,125 SUBTOTAL 25% \$ 20,500 \$ 5,125 \$ 20,500 \$ 5,125 SUBTOTAL 25% \$ 20,500 \$ 5,125 \$ 837,713 Preliminary and General 10% 20% \$ 83,771 Design 10% 20% 11,72,798 Annual Operational Costs assumed average daily flow (m3/day) 50 11,172,798 Compliance and Management per hour (4 hours monthly) 48 180 8,640 Labour per hour (weekly visits for 5 hours) 260 70 18,200 UV Disinfection kWhr (assumes 0.23 kw operating 24 hours per day) 27.4 5 145 Lamp Replacement Assumes yearly replacement of 1 lamp (1 lamp per unti) 1.0 433.0 433 Cartridges per cartridge (assume quarterly) 3 500 1,500		increase in size of generaotr for Fire pump		\$			6,000
SUBTOTAL 71,250 Add-ons. 30 KVA generator 1 20,500 \$ 20,500 Installation and Construction 25% \$ 20,500 \$ 5,125 SUBTOTAL 25% \$ 20,500 \$ 5,252 SUBTOTAL 10% 837,713 Preliminary and General 10% 837,771 Design 10% 837,771 Contingency 10% 83,771 Total Estimated Capital Cost:							
Add- ons. Generator 30 KVA generator 1 20,500 \$ 20,500 Installation and Construction SUBTOTAL 25% \$ 20,500 \$ 5,625 SUBTOTAL 10% 83,771 20% 167,543 Preliminary and General Design 10% 83,771 20% 167,543 Contingency 10% 83,771 20% 167,543 Contingency 10% 83,771 20% 167,543 Compliance and Management per hour (4 hours monthly) 48 180 8,640 Labour per hour (weekly visits for 5 hours) 260 70 18,200 UV Disinfection kWhr (assumes 0.23 kw operating 24 hours per day) 2014.8 0.4 806 Chlorine Dosing per kg (based on 70kg cylinder assume 1.5g/m3 27.4 5 145 Lamp Replacement Assumes yearly reaplacement of 1 lamp per day) 1.0 433.0 433 Cartridges per cartridge (assume quarterly) 3 500 1,524 Electricity for Reticulation Pumps kWhr (assumes4kw pump operating at 1.5 L/sec for 12 hours per day) 17,520 0.3 5,256 SUBTOTAL \$ 36,500.84 \$ 36,500.84 36,500.84 NPV of Operating Costs (2			25%	\$	57,000	\$	
Generator 30 KVA generator 1 20,500 \$ 20,500 Installation and Construction 25% \$ 20,500 \$ 5,125 SUBTOTAL 25% \$ 20,500 \$ 5,125 SUBTOTAL 25% \$ 20,500 \$ 5,125 SUBTOTAL 10% 25% \$ 20,500 \$ 5,252 SUBTOTAL 10% 837,71 20% 167,543 Design 20% 10% 83,771 Total Estimated Capital Cost: - 1,172,798 Annual Operational Costs assumed average daily flow (m3/day) 50 Compliance and Management per hour (4 hours monthy) 48 180 8,640 Labour per hour (weekly visits for 5 hours) 260 70 18,200 UV Disinfection kWhr (assumes 0.23 kw operating 24 hours per day) 27.4 5 145 Lamp Replacement Assumes yearly reaplacement of lamp (1 lamp per unit) 1.0 433.0 433 Cartridges per cartridge (assume quarterly) 3 500 1,500 Electricity							11,200
Installation and Construction SUBTOTAL 25% \$ 20,500 \$ 5,125 SUBTOTAL 25% \$ 20,500 \$ 5,125 SUBTOTAL 20,500 \$ 25,625 SUBTOTAL 20,500 \$ 25,625 SUBTOTAL 20,500 \$ 25,625 SUBTOTAL 10% 283,771 Dreigin 20% 167,543 Contingency 10% 20% 83,771 Total Estimated Capital Cost: assumed average daily flow (m3/day) 50 11,772,798 Annual Operational Costs assumed average daily flow (m3/day) 50 18,200 Compliance and Management per hour (4 hours monthly) 48 180 8,640 Labour per hour (weekly visits for 5 hours) 260 70 18,200 UV Disinfection kWhr (assumes 0.23 kw operating 24 hours per day) 2014.8 0.4 806 Chorine Dosing per kg (based on 70kg cylinder assume 1.5g/m3 27.4 5 145 Lamp Replacement Assumes yearly reaplacement of 11amp (1 lamp per unit) 1.0 433.0 1,520		30 KVA generator	1		20 500	\$	20 500
SUBTOTAL 25,625 SUBTOTAL 10% 837,713 Preliminary and General 10% 837,713 Design 10% 837,713 Contingency 10% 837,713 Total Estimated Capital Cost: - 1,172,798 Annual Operational Costs assumed average daily flow (m3/day) 50 Compliance and Management per hour (4 hours monthly) 48 180 Labour per hour (weekly visits for 5 hours) 260 70 18,200 UV Disinfection kWhr (assumes 0.23 kw operating 24 hours per day) 2014.8 0.4 866 Chlorine Dosing per kg (based on 70kg cylinder assume 1.5g/m3 27.4 5 145 Lamp Replacement Assumes yearly repalacement of 1 lamp (1 lamp per unt) 1.0 433.0 433 Cartridges per cartridge (assume quarterly) 3 500 1,521 Electricity for Reticulation Pumps kWhr (assumes4kw pump operating at 1.5 L/sec for 12 hours per day) 5,669 0.3 5,256 SUBTOTAL \$ 36,500 \$ <		co revergenerator		s			
SUBTOTAL 837,713 Preliminary and General 10% Design 20% Contingency 10% Total Estimated Capital Cost: - Annual Operational Costs assumed average daily flow (m3/day) Compliance and Management per hour (4 hours monthly) Labour 9er hour (weekly visits for 5 hours) Coloringency 260 Compliance and Management per hour (weekly visits for 5 hours) Labour 0.4 UV Disinfection kWhr (assumes 0.23 kw operating 24 hours per day) Chlorine Dosing per kg (based on 70kg cylinder assume 1.5g/m3 Lamp Replacement 1.0 Cartridges 433.0 Electricity for Bore Pumps KWhr (assumes 2kw pump operating at 2L/sec for about 7 hours per day) KWhr (assumes4kw pump operating at 1.5 L/sec for 12 hours per day) 5,069 0.3 5.069 SUBTOTAL \$ Total Estimated Annual Operational Costs (20 yr @ 8%) \$			2370	Ĩ	20,000	*	25,625
Preliminary and General 10% 83,771 Design 20% 167,543 Contingency 10% 83,771 Total Estimated Capital Cost: - 1,172,798 Annual Operational Costs assumed average daily flow (m3/day) 50 Compliance and Management per hour (4 hours monthly) 48 180 8,640 Labour per hour (weekly visits for 5 hours) 260 70 18,200 UV Disinfection kWhr (assumes 0.23 kw operating 24 hours per day) 2014.8 0.4 806 Chlorine Dosing per kour (4 hours monthly) 43 10 433.0 433 Lamp Replacement Assumes yearly reaplacement of 1 lamp per unti) 1.0 433.0 433 Cartridges per cartridge (assume quarterly) 3 500 1,500 Electricity for Bore Pumps KWhr (assumes4kw pump operating at 2L/sec for about 7 hours per day) 5,069 0.3 5,256 SUBTOTAL S 36,500 \$ 3 5,00.8 Total Estimated Annual Operational Costs (20 yr @ \$ \$ 358,400							837,713
Design20%167,543Contingency10%83,771Total Estimated Capital Cost:-1,172,798Annual Operational Costsassumed average daily flow (m3/day)50Compliance and Managementper hour (4 hours monthly)481808,640Labourper hour (weekly visits for 5 hours)2607018,200UV DisinfectionkWhr (assumes 0.23 kw operating 24 hours per day)2014.80.4806Chorine Dosingper kg (based on 70kg cylinder assume 1.5g/m327.45145Lamp ReplacementAssumes yearly reaplacement ont)1.0433.0433433Cartridgesper cartridge (assume quarterly)35001,500Electricity for Bore PumpskWhr (assumes4kw pump operating at 2L/sec for about 7 hours per day)5,0690.31,521SUBTOTAL\$36,500\$35001,521New Yor Operating Costs (20 yr @ 8%)\$\$ 358,400			10%				83,771
Configency 10% 83,771 Total Estimated Capital Cost: - 1,172,798 Annual Operational Costs. assumed average daily flow (m3/day) 50 - Compliance and Management per hour (4 hours monthly) 48 180 8,640 Labour per hour (weekly visits for 5 hours) 260 70 18,200 UV Disinfection kWhr (assumes 0.23 kw operating 24 hours per day) 2014.8 0.4 806 Chlorine Dosing per kg (based on 70kg cylinder assume 1.5g/m3 27.4 5 145 Lamp Replacement Assumes yearly reaplacement of 1 lamp (1 lamp per unti) 1.0 433.0 433 Cartridges per cartridge (assume quarterly) 3 500 1,520 Electricity for Bore Pumps kWhr (assumes 2kw pump operating at 1.5 L/sec for about T hours per day) 5,069 0.3 5,256 SUBTOTAL \$ 36,500 \$ 3 5,000 NPV of Operating Costs (20 yr @ \$ 358,400 \$ 358,400							167,543
Annual Operational Costs assumed average daily flow (m3/day) 50 Compliance and Management per hour (4 hours monthly) 48 180 8,640 Labour per hour (4 hours monthly) 48 180 8,640 UV Disinfection kWhr (assumes 0.23 kw operating 24 hours per day) 2014.8 0.4 806 Chlorine Dosing per kg (based on 70kg cylinder assume 1.5g/m3 27.4 5 145 Lamp Replacement Assumes yearly reaplacement of 1 lamp per unti) 1.0 433.0 433 Cartridges per cartridge (assume quarterly) 3 500 1,500 Electricity for Bore Pumps kWhr (assumes 2kw pump operating at 2L/sec for about 7 hours per day) 5,069 0.3 1,521 SUBTOTAL thours per day) kWhr (assumes4kw pump operating at 1.5 L/sec for 12 hours per day) 3 36,500.84 \$ 36,500 NV of Operating Costs (20 yr @ s 358,400 \$ 358,400 \$ 358,400	-		10%				83,771
Compliance and Management Labourper hour (4 hours monthly)481808,640Labourper hour (weekly visits for 5 hours)2607018,200UV DisinfectionKWhr (assumes 0.23 kw operating 24 hours per day)2014.80.4806Chlorine Dosingper kg (based on 70kg cylinder assume 1.5g/m327.45145Lamp ReplacementAssumes yearly reaplacement of 1 lamp (1 lamp per unti)1.0433.0433Cartridgesper cartridge (assume quarterly)35001,500Electricity for Bore PumpsKWhr (assumes 2kw pump operating at 2L/sec for about 7 hours per day)5,0690.35,256SUBTOTALkWhr (assumes4kw pump operating at 1.5 L/sec for 12 hours per day)17,5200.35,256SUBTOTALs36,500836,500NPV of Operating Costs (20 yr @ 8%)Lame Leader Lead					-		1,172,798
Labour per hour (weekly visits for 5 hours) 260 70 18,200 UV Disinfection kWhr (assumes 0.23 kw operating 24 hours per day) 2014.8 0.4 806 Chlorine Dosing per kg (based on 70kg cylinder assume 1.5g/m3 27.4 5 145 Lamp Replacement Assumes yearly reaplacement of 1 lamp (1 lamp per unit) 1.0 433.0 433.0 Cartridges per cartridge (assume quarterly) 3 500 1,500 Electricity for Bore Pumps kWhr (assumes4kw pump operating at 1.5 L/sec for about 7 hours per day) 5,069 0.3 5,256 SUBTOTAL s 36,500 \$ 36,500 \$ 36,500 NeV of Operating Costs (20 yr @ s 358,400 \$ \$ 358,400	Annual Operational Costs						
UV Disinfection kWhr (assumes 0.23 kw operating 24 hours per day) 2014.8 0.4 806 Chlorine Dosing per kg (based on 70kg cylinder assume 1.5g/m3 27.4 5 145 Lamp Replacement Assumes yearly reaplacement of 1 lamp (1 lamp per unti) 1.0 433.0 433 Cartridges per cartridge (assume quarterly) 3 500 1,500 Electricity for Bore Pumps kWhr (assumes 2kw pump operating at 1.5 L/sec for about 7 hours per day) 5,069 0.3 1,521 SUBTOTAL s 36,500 8 36,500 8 36,500 NPV of Operating Costs (20 yr @ s 358,400 s 358,400							8,640
Chorine Dosing per kg (based on 70kg cy/linder assume 1.5g/m3) 27.4 5 145 Lamp Replacement Assumes yearly reaplacement of 1 lamp (1 lamp per unti) 1.0 433.0 433 Cartridges per cartridge (assume quarterly) 3 500 1,500 Electricity for Bore Pumps kWhr (assumes 2kw pump operating at 2L/sec for about 7 hours per day) 5,069 0.3 1,521 Electricity for Reticulation Pumps kWhr (assumes4kw pump operating at 1.5 L/sec for 12 hours per day) 17,520 0.3 5,256 SUBTOTAL s 36,500 36,500 36,500 NPV of Operating Costs (20 yr @ s 358,400 358,400							18,200
Lamp Replacement Assumes yearly reaplacement of 1 lamp (1 lamp per unti) 1.0 433.0 433 Cartridges per cartridge (assume quarterly) 3 500 1,500 Electricity for Bore Pumps kWhr (assumes 2kw pump operating at 2L/sec for about 7 hours per day) 5,069 0.3 1,521 Electricity for Reticulation Pumps kWhr (assumes4kw pump operating at 1.5 L/sec for 12 hours per day) 17,520 0.3 5,256 SUBTOTAL s 36,500 36,500 36,500 NPV of Operating Costs (20 yr @ 8%) e e s 358,400							806
Lamp Replacement until) 1.0 433.0 433.0 Cartridges per cartridge (assume quarterly) 3 500 1,500 Electricity for Bore Pumps kWhr (assumes 2kw pump operating at 2L/sec for about 7 hours per day) 3 500 1,521 Electricity for Reticulation Pumps kWhr (assumes4kw pump operating at 1.5 L/sec for 12 hours per day) 17,520 0.3 5,256 SUBTOTAL 3 36,500.84 5 36,500.84 Total Estimated Annual Operational Costs S 36,500 \$ 36,500 NV of Operating Costs (20 yr @ 8%) 6 6 5	Chlorine Dosing		27.4		5		145
Cartridges per cartridge (assume quarterly) 3 500 1,500 Electricity for Bore Pumps kWhr (assumes 2kw pump operating at 2L/sec for about 7 hours per day) 5,069 0.3 1,521 Electricity for Reticulation Pumps kWhr (assumes4kw pump operating at 1.5 L/sec for 12 hours per day) 17,520 0.3 5,069 SUBTOTAL s 36,500.84 Total Estimated Annual Operational Costs s 36,500 RV of Operating Costs (20 yr @ 8%) s 36,500	Lamp Replacement		1.0		433.0		433
Electricity for Bore Pumps kWhr (assumes 2kw pump operating at 2L/sec for about 7 hours per day) 5,069 0.3 1,521 Electricity for Reticulation Pumps kWhr (assumes 4kw pump operating at 1.5 L/sec for 12 hours per day) 17,520 0.3 5,256 SUBTOTAL s 36,500 \$ 36,500 \$ 36,500 \$ 36,500 NPV of Operating Costs (20 yr @ 8%) s 358,400 \$ 358,400	Cartridges		3				1,500
Electricity for Bole Pullips 7 hours per day) 5,069 0.3 1,321 Electricity for Reticulation Pumps kWhr (assumes4kw pump operating at 1.5 L/sec for 12 hours per day) 17,520 0.3 5,256 SUBTOTAL \$ 36,500 \$ 36,500 \$ 36,500 NPV of Operating Costs (20 yr @ 8%) \$ 358,400	-	kWhr (assumes 2kw pump operating at 2L/sec for about	-				
Electricity for Reliculation Pumps hours per day) 17,520 0.3 5,250 SUBTOTAL \$ 36,500.84 Total Estimated Annual Operational Costs \$ 36,500 NPV of Operating Costs (20 yr @ 8%) \$ 358,400	Electricity for Dore Fullips	7 hours per day)	5,069		0.3		1,521
SUBTOTAL \$ 36,500.84 Total Estimated Annual Operational Costs \$ 36,500 NPV of Operating Costs (20 yr @ 8%) \$ 358,400	Electricity for Reticulation Pumps		17.520		0.3		5,256
Total Estimated Annual Operational Costs \$ 36,500 NPV of Operating Costs (20 yr @ 8%) \$ 358,400	SUBTOTAL		.,0		2.0	\$	36,500.84
Costs	Total Estimated Annual Operational					-	
8%) \$356,400				L		φ	30,300
						\$	358,400
NPV Capital plus Operating Costs \$ 1,531,198				-		~	1 504 100
	NPV Capital plus Operating Costs					\$	1,531,198

	Option 2 b R - New bores,WTP with Chlorine,Storage and re	eticulation pumps - RESTRICTED	FLOW	
Description	Unit	Quantity	Rate	Cost
Source Water				
Application to work in reserve	With WDC	1	\$ 5,000	\$ 5,000
ECAN Consent	consent to take groundwater	1	\$ 25,000	\$ 25,000
Bores drilling and headworks	~	2	\$ 30,000	\$ 60,000
Bore Pumps	2 x 1.3L/sec at up to 55 m allowed for	2	\$ 1,580	\$ 3,160
VFD	VFD for pumps	2	\$ 3,500	\$ 7,000
Raw water turbidimeter	Hach 1720E	1	\$ 7,000	\$ 7,000
Flow meter	DN80 yokogawa mag flowmeter	2	\$ 4,600	\$ 9,200
Electrical and Control	level switches electrical cabinet, install	1	\$ 15,000	\$ 15,000
Liectical and control	level switches electrical cabillet, install	I		
Installation and Construction		25%	\$ 131,360	\$ 32,840
SUBTOTAL				\$ 164,200
Water Treatment				
Filtration plus UV Civil				
Cartridge	1 HF40H304 (duty/standby only) 1 um - will treat up to 5 L/sec	2	\$ 8,250	\$ 16,500
Ultraviolet Disinfection	UV Pro 30 (up to 2 L/sec) Duty Standby	2	\$ 5,990	\$ 11,980
UPS for UV	UPS - for management of brown outs 30min	1	\$ 3,000	\$ 3,000
Pressure Transducer	For monitoring pressure across cartridges	6	\$ 500	\$ 3,000
Turbiditmeter	For treated water	1	\$ 7,000	\$ 7,000
Flow meter	DN80 yokogawa mag flowmeter	2	\$ 4,600	\$ 9,200
Pipes, valves and fittings	50 to 100 mm	1	\$ 10,000	\$ 10,000
Water Treatment Plant Building	Alpine style m2	18	\$ 4,000	\$ 72,000
Building Consent	Building consent for WTP	1	\$ 10,000	\$ 10,000
Landscaping/Access	Landscaping/ Access Road	1	\$ 50,000	\$ 50,000
Telemetry	RTU and Aerial, programming etc		\$ 20,000	\$ 20,000
		1		
Electrical and Switchboard		1	\$ 40,000	\$ 40,000
	Ungrado to provide position from how or how to 110 ft	•		
Power Upgrade	Upgrade to provide service fuse box on boundary of 13 Ohau Drive		\$ 20,000	\$ 20,000
Installation and Count of		1	¢ 070.000	¢ 00.470
Installation and Construction SUBTOTAL		25%	\$ 272,680	\$ 68,170 \$ 340,900
SUBTOTAL Chlorine Disinfection, Contact				φ 340,900
Time				
Chlorine Gas Dosing	Gas Cylinders and Dosing -	1	\$ 30,749	\$ 30,749
Carry water Pump	Carry water Pump	1	\$ 2,000	\$ 2,000
Chlorine Analyser	MFC with Depolox 5	1	\$ 11,300	\$ 11,300
Contact tank	5000L	1	\$ 2,000	\$ 2,000
Installation and Construction		25%	\$ 46,049	\$ 11,512
SUBTOTAL				\$ 57,600
SUBTOTAL Treatment				\$ 398,500
Reticulation				
Hydrovar Pump set	Retic pumps 6 L/sec @40m	1	\$ 8,500	\$ 8,500
Flow meter	DN80 yokogawa mag flowmeter DN100 PVC/PE	1 90	\$ 4,600 \$ 150	\$ 4,600 \$ 13,500
Bores to WTP	DN100 PVC/PE	90 5	\$ 150 \$ 150	\$ 13,500 \$ 750
WTP to Storage	DN100 PVC/PE DN150 PVC/PE			\$ 750 \$ 18,000
Storage to Retic Installation and Construction	DN150 FVC/FE	100	\$ 180 \$ 45,350	\$ 11,338
SUBTOTAL		25%	φ 45,550	\$ 56,700
Storage				φ 30,700
Storage (femergency)	30,000 L tanks with fittings	4.5	\$ 6,000	\$ 27,000
Installation and Construction		25%	\$ 27,000	\$ 6,750
SUBTOTAL				33,750
Fire Protection				
Fire Tanks	30,000 L tanks with fittings	1.5	\$ 6,000	\$ 9,000
Added building space		5	\$ 4,000	\$ 20,000
Additional Generator Cost	increase in size of generaotr for Fire pump	1	\$ 6,000	\$ 6,000
Fire Pump	18.5KW in line fire pumps	1	19,000	\$ 19,000
Installation and Construction		25%	\$ 54,000	\$ 13,500
SUBTOTAL				67,500
Generator_				
Generator	30 KVA generator	1	20,500	\$ 20,500
Installation and Construction		25%	\$ 20,500	\$ 5,125
SUBTOTAL				25,625
SUBTOTAL				746,300
Preliminary and General		10%		74,630
Design		20%		149,260
Contingency		10%		74,630
Total Estimated Capital Cost:			-	1,044,800
Annual Operational Costs	assumed average daily flow (m3/day)	50		
Compliance and Management	per hour (4 hours monthly)	48	180	8,640
Labour	per hour (weekly visits for 5 hours)	260	70	18,200
UV Disinfection	kWhr (assumes 0.23 kw operating 24 hours per day)	2014.8	0.4	806
Lamp Replacement	Assumes yearly reaplacement of 1 lamp (1 lamp per unti)	1.0	433.0	433
Cartridges	per cartridge (assume quarterly)	3	500	1,500
Chlorine Dosing	per kg (based on 70kg cylinder assume 1.5g/m3	27.4	5	145
-	kWhr (assumes 2kw pump operating at 2L/sec for about 7	21.4	5	
Electricity for Bore Pumps	hours per day)	5,069	0.3	1,521
Electricity for Reticulation Pumps	kWhr (assumes1.1kw pump operating at 1L/sec for 16 hours	6,424	0.3	1,927
SUBTOTAL	per day)	0,424	0.3	\$ 33,172.04
Total Estimated Annual				
Operational Costs				\$ 33,200
NPV of Operating Costs (20 yr @				\$ 326,000
8%) NBV Capital plus Operating				
NPV Capital plus Operating Costs				\$ 1,370,800