

# **Assessment of Water and Sanitary Services**



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*Waimate 2020*

## Assessment of Water and Sanitary Services

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## 1.0 Introduction

The Local Government Act 2002 places a specific requirement on local authorities to make assessments of water and sanitary services available to communities within the District under jurisdiction.

The Act requires that the assessment shall provide the following information in respect of water services:-

- A description of the means by which drinking water is obtained by residents, including the extent by which the authority or any other person provides the water supply and the treatment processes
- A description by which sewage is disposed of within the District, including the extent by which the authority or any other person provides sewerage and sewage treatment facilities
- A description by which storm water is disposed of within the District, including the extent by which the authority or any other person provides drainage works
- An assessment of any risks to the community relating to the absence of a water supply or reticulated sewerage network
- An assessment of the quality and adequacy of supply of drinking water available for each community within the District
- An assessment of the quality and quantity of waste water discharged from reticulated sewerage or sewage treatment systems within the District
- A statement of current and estimated future demands for water and waste water services and a statement of any issues relating to the quality and adequacy of supply of drinking water for each community and the health and environmental impacts of discharges of stormwater and sewage arising from future demands
- A statement of the options available to meet the current and future demands and an assessment of the suitability of each option for the District and each community within it
- A statement of the local authorities intended role in meeting the current and future demands

- A statement of the local authority's proposals in meeting the current and future demands including proposals for any new or replacement infrastructure.

The Act requires that the assessment shall provide the following information in respect of sanitary services:-

- A description of the sanitary services provided within the District for each community
- A forecast of future demands for sanitary services within the District and each community within it
- A statement of options available to meet the forecast demands and an assessment of the suitability of each option for the District and each community within it
- A statement of the local authorities intended role in meeting the forecast demands
- A statement of the local authority's proposals in meeting the forecast demands including proposals for any new or replacement infrastructure.
- A statement about the extent to which the proposals will ensure that public health is adequately protected

'Sanitary Services' is defined in accordance with the description of 'Sanitary Works' as per the Health Act 1956 and thus includes drainage works, sewerage works (and works for the disposal of sewage), waterworks, works for the collection of refuse, public conveniences, swimming baths, dressing sheds, cemeteries, crematoria, disinfection and cleansing stations.

The Act recognises the extent to which information is provided is determined by the local authority in consideration of the significance of the information, the cost of and difficulty in obtaining the information including the resources available to the local authority.

## 2.0 Overview of the Main Services Provided in the District

### 2.1 Location

The Waimate District is located between the Waitaki and Pareora Rivers to the south and north respectively, the mountains of Mackenzie District to the West and the Pacific Ocean to the East

The main centre of population is the town of Waimate itself, a town housing a population of some 2700 people. This represents over a third of the total population of the District of around 7000. Other centres of population include the coastal townships of Glenavy, Willowbridge, Makikihi and St Andrews.

### 2.2 Water supplies

Council operated reticulated water schemes cover part of the less sparsely populated areas of the District, these incorporate outlying townships such as Glenavy and Willowbridge and are discussed individually later in this report. There remain many farms and settlements outside these areas however, these source water from privately managed water schemes, (such as the Hakataramea and Cattle Creek water supply schemes) private bores or watercourses. Indeed there are many dwellings within council managed scheme boundaries which are not served by these managed community networks either, this due to schemes being closed by Council due to considered insufficient capacity within the scheme or by personal preference.

All rural water supplies are sourced from surface water courses, each is provided with disinfection by chlorination in one form or another. The schemes were set up under the Water Race Bylaws in the 1960's and their general condition in some areas is a reflection of their age.

The township of Waimate itself is served by two deep wells, the only such wells in the District. Both wells could be expected to achieve 'secure' source status under current guidelines. Well pumps deliver water direct into the urban network which dates back to the early 20th century with flows in excess of instantaneous demand being conveyed to a reservoir above the township.

Council managed schemes are administered at the main council offices in Queen Street, Waimate and operated and managed by the Council's Utilities Services Unit (USU) now located at Michael Street nearby. The urban scheme is provided with two operating staff under USU, who are also responsible for the operation of the town sewerage network and waste water treatment facility including specific ground maintenance as well as other duties including the upkeep and maintenance of the town swimming pool.

Two field staff are appointed to operate and maintain the rural water scheme plant fixing leaks etc as generally advised by the public. Specific controlled records of mains repairs are now kept on the Bizeasset data management system, management plans for the schemes are being developed and operation and maintenance manuals are being produced.

Council staff monitor and log post treatment residual chlorine levels weekly (or fortnightly for the smaller schemes). Water is sent to laboratories for bacteriological testing once a week.

### 2.3 Sewerage and sewage treatment

Only the township of Waimate itself is provided with a reticulated sewerage network delivering flows to a waste water treatment plant. The rest of the District is reliant on individual (or in some cases communal) septic tanks, the administration of which in terms of the treatment process lies beyond the remit of the District council.

The sewerage reticulation network within the township of Waimate itself dates back to the 1920s. The pipelines comprising the network are constructed of differing materials including earthenware, cast iron and PVC.

The sewerage network conveys flows to a treatment plant constructed on the outskirts of the township adjacent to a public park. Flows are directed to the base of a deep pit constructed within an oxidation pond. Solids settle within the pit as the effluent rises to the aeration basin where two mechanical aerators assist the natural oxidation processes, as required.

Effluent from the oxidation ponds flow under gravity and are stored in maturation ponds awaiting periodic discharge to land via border dyke irrigation.

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Operation and maintenance manuals for the system are being evolved.

## **2.4 Other Sanitary Services**

Most of the District is covered by a Waste Management Plan. Wheelie bins or bags are available for all urban residents and wheelie bins are available and may be collected in some rural areas. A recycling collection has been introduced, serving Waimate. Refuse is collected weekly and is transferred to a landfill site at Timaru.

The Council now operates a Recycling Centre at the Resource Recovery Park and also a collection for recyclables on the outskirts of the urban area.

Many rural properties, even those within the refuse collection areas continue to use offal pits which require a resource consent from the regional authority.

A separate comprehensive report has been prepared to cover refuse disposal and is included at Appendix C.

Other sanitary services are discussed in Section 11.

## 3.0 Waimate Township Water Supply

### 3.1 Overview

Water is delivered to the township of Waimate from two sources. One is a borehole located to the northeast of the town off SH 82 (Timaru Road) at 27m above sea level, the other a borehole located adjacent to Manchester Road to the east at 28m above sea level. Both sources pump water direct to the township (average level 57m above sea level) with water in excess of instantaneous demand flowing to storage in a 2600 m<sup>3</sup> reservoir located at Mill Rd above the township at 125m above sea level.

There are connections to the Hook Waituna Rural Water supply scheme at two locations, the intention being to boost the supply to that rural scheme.

The town supply is also used to provide stock water at several sites on the periphery of the township. Fixtures such as troughs are coupled directly to the high pressure mains.

Operation and Maintenance Manuals are available for the three main sites.

Opus Consulting Engineers produced an Asset Management Plan for the urban water supply scheme in the year 2000. An updated plan was completed in 2005. No specific controlled maintenance, leak detection or mains flushing programmes are in place.

### 3.2 Operational Regime

The reservoir at Mill Rd serves three functions. The first is to provide pump control levels, the second to provide a body of stored water, the third to stabilise and provide mains pressure across the network.

Supervisory Control and Data Acquisition (SCADA) is afforded to the main elements of the plant, with the nerve centre being located at the Local Government Offices on Queen Street in Waimate. MMI (man machine interface) functionality is also provided at each site.

The Timaru Rd bore is capable of delivering approximately 40 l/s to the township.

The Manchesters Rd bore delivers some 20 l/s. Given that town demand is usually below 20 l/s the Manchesters Rd bore is set as the primary water source for the township. The pumping regime is such that when the level in the reservoir drops to a predetermined level, the Manchesters Rd plant starts and delivers water to the network. Any excess is delivered to the reservoir which fills in this instance and the pump stops when the reservoir has filled to a predetermined level. When demand continues to outstrip the pumped supply however the water level continues to be drawn down from the reservoir as flows reverse towards the town under gravity. When the reservoir reaches a further predetermined low level, the pump at Timaru Rd starts to boost the supply and replenish the reservoir. When the reservoir is sufficiently full the Timaru Rd pump stops leaving the Manchesters Rd pump to continue pumping until a higher set point is reached.

### 3.3 Timaru Road Bore

In 1999 a bore pump was commissioned in an existing unused bore off SH 82 (Timaru Rd). Initially the groundwater was gas chlorinated and pumped direct to a rising main constructed to deliver flows to the township. Soluble iron contamination levels led to complaints however and an iron removal plant was installed in mitigation. The present day upgraded treatment plant was commissioned in 2002.

A low head borehole pump delivers ground water to storage tanks via a filtration plant which is designed to remove iron using chlorine as an oxidation agent/coagulant. The chlorine dosing system also provides for residual levels of chlorine within the treated water for disinfection purposes. The original bore pump was shrouded and located in the storage tanks from which water is pumped through the rising main to the township and potentially the reservoir. A lime dosing facility is also available should pH adjustment be required.

The filter backwashes periodically into a purpose built settling pond and soak hole.

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Timaru Road Bore data
<b>ECan data</b>
Resource Consent No:- CRC 992171 dated 9 Dec 2002
Bore:- Ref J40/0250, depth 110m, dia 250mm
Consent max extract rate combined with Manchester Road – 65 l/s, 4320m <sup>3</sup> /day.
Max extract rate (limited by pipeline):- 45 l/s
<b>Other Data</b>
MoH 2004 community drinking water supplies register 2004 data
Community Code:-WAI033
Source code:- GO 1525
Treatment plant code:- not given
Distribution network/zone code;- WA1033WA
Population served:- 3000 (MoH)
*Zone grade:- e
*Treatment plant grade:- E
<small>*Revisited late 2005</small>

Disinfection is provided by liquid chlorine injection to the rising main. The dosing plant is housed within a wooden shed. The borehead is outside the building in a shallow pit.

Manchester Road Bore data
<b>ECan data</b>
Resource Consent No:- CRC 992171 dated 9 Dec 2002
Bore:- Ref J40/0022, depth 81m, dia 200mm
Consent max extract rate combined with Timaru Road – 65 l/s, 4320m <sup>3</sup> /day.
Max extract rate:- 25 l/s
<b>Other Data</b>
MoH 2004 community drinking water supplies register 2004 data
Community Code:-WAI033
Treatment plant code:- TP 00492
Distribution network/zone code;- WA1033WA
Population served:- 3000
*Zone grade:- e
*Treatment plant grade:- E
<small>*Revisited late 2005</small>

## 3.4 Manchesters Road Bore

The constituents of the raw ground water delivered from the Manchester Rd bore is such that filtration to remove iron is not required. The bore pump therefore delivers flows direct to the rising main, town reticulation network, and ultimately the reservoir. The delivery rate exceeds demand for all but the driest months of the year and therefore this bore is set to provide the primary base flows for the township.

## 3.5 Pipeline Network

A Plan describing the water scheme is given at Appendix E. Generally speaking the pipeline network comprises pipes up to 225 mm dia constructed of Cast Iron, asbestos cement and some PVC.

## 3.6 Catchment Description

The water supply for Waimate used to be sourced from the Waimate Creek to the north and west of the town at Kelcey's Bush. This supply was abandoned some time ago following the commissioning of the Manchesters Rd bore. The Water Supply Protection Area as described by the current District Plan covers the Kelceys Bush area only however and the bores are therefore located outside such an area.

The immediate vicinity of the Timaru Rd bore is fenced for protection against stock but the Manchester Rd bore is not afforded such protection. The reservoir is protected by intruder fencing.

## 3.7 Risk to supply and quality

The following risks to supply and/or quality are identified:-

Chlorinator failure
Lowering of ground water levels
Loss of/exhaustion of Chlorine
Single point failures – critical pipelines
Power failure
Backflow, particularly from connections to troughs etc.
Mechanical damage to plant from vehicles and stock at Manchesters Rd bore
Illegal connections/tampering
Vandalism
Seismic activity
Lack of investment, poor maintenance

These are considered further in Section 7.

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## 4.0 Rural Water Supplies

### 4.1 General

There are a number of rural water supply schemes within the District. Six of these are operated and administered by the Council as follows:-

- Cannington-Motukaika rural water supply scheme
- Hook Waituna rural water supply scheme
- Lower Waihao rural water supply scheme
- Otaio – Makikihi rural water supply scheme
- Waihaorunga rural water supply scheme
- Waikakahi rural water supply scheme

These schemes are discussed in more detail at 4.2 – 4.7 below.

There are also four small water supply schemes which serve camping grounds. These are generally owned by LINZ but are administered and maintained by the Council's parks dept, these as follows:-

- Te Akatarawa Camping Ground
- Waitangi Reserve Camp Ground
- Fisherman's Bend Camp Site
- Brairs Gully Camp Site

These schemes are discussed further at 4.8 below.

There are two further privately owned schemes within the District which are administered but not operated by the Council. These as follows:-

- Hakataramea valley rural water supply scheme
- Cattle Creek (also known as Upper Waihao) rural water supply scheme

These schemes are discussed further at 4.9 below.

Part of the Downlands rural water supply scheme which is operated by Timaru District Council serves properties within the Waimate District. Waimate District Council has a 14% stake holding in the scheme but has no direct involvement in the scheme apart from for the collection of water rates on those properties within its District.

The above schemes are described by an overview drawing at Appendix A and described in more detail below.

There are now Asset Management Plans but as yet no Operation and Maintenance Manuals for any of the rural water supply schemes. Drawings of approximate pipeline reticulations are available on GIS. Computer generated electronic drawings have been produced over the last 18 months however but these were produced from old, dated plans. These drawings remain in draft form subject to detailed ongoing checks by operators with local knowledge. The pipeline networks are superimposed over aerial photographs with data on pipe sizes and tanks available within the database.

Limited SCADA control is afforded to the Otaio, Lower Waihao and the Waikakahi Rural water schemes only.

Council operated rural water supplies are governed by rules quite different to those of the urban supply. The general modus operandi and the main rules include:-

- that water is delivered to a reception tank or any number of tanks located on any given property
- that the reception tank is sized to store no less than 3 days normal supply
- that water delivered to any property may not serve any fixture on any other property
- that no connection to any fixture on the property may be made to the high pressure side on the tank delivery pipeline
- that no other water supply may be or may be able to be connected to the reception tank

The above rules have not been followed consistently across the District.

Water entering consumer's tanks is controlled by a ballcock and this represents the separation between the Council and the landowner's respective responsibilities. The volume of water delivered to each tank is dependant on the landowner's water allocation for which water rates are charged, and the supply is regulated by an orifice plug located within a restrictor unit upstream of the ballcock.

All plant upstream of and including the ballcock is the property of and the responsibility of the Council to maintain. The tank itself and all downstream (domestic) plant including pipelines are the property of, and the responsibility of the landowner. Rules still apply to domestic reticulation however, and these include that the domestic reticulation shall serve fixtures located on that property only, and that no wastage shall be permitted.

The rules are set to eliminate the possibility of contamination of the public water supply. Negative pressures can and do occur in pipeline systems and the possibility of syphoning flows from farm fixtures into the public water supply is very real in the event that the rules are not followed.

Each water scheme is considered below, information given under the General Data heading has been sourced from the MoH Register of Community Water Supplies 2004, and from ECan consent data. The disinfection process agent is also identified.

## 4.2 Cannington/Motukaika Rural Water Supply Scheme

### 4.2.1 General Data

Community Code:- CAN001
Source:- Mount Nimrod Stream, map ref J40:400-391
Register Source Code:- S00307
Treatment Plant code:- TP 00485
Distribution network/zone code;- CAN001CM

Population served:- 120
Current MoH zone grade:- Ee
Current MoH Treatment Plant grade:- E
Consent No:- SCY760105
Max consented flow rate:- 5.5 l/s
Max consented water take:- 3325 m3/week
Disinfection:- Liquid chlorine (derived from Sodium Hypochlorite powder)

### 4.2.2 Overview

Water intake is from a weir constructed in the bed of the White Rock River (also referred to as Mount Nimrod Stream). The weir diverts flows into a covered channel which diverts flows to a single perforated pipe located within a covered gravel filter. Excess water spills over the channel back into the river.

The water flowing through the filter into the perforated pipe is then conveyed under gravity to a storage tank approximately 2 km away. Water enters this tank via a stainless steel mesh filter. Flows to the tank are controlled by a conventional ballcock arrangement.

Chlorination is by way of liquid chlorine injection into the pipeline immediately upstream of the storage reservoir. The rate of chlorination is determined by manually setting the pump stroke and rate. The chlorinator is activated by a flow switch which senses flows of a given operator input flow rate. Flows less than this value will therefore not be chlorinated and the system control does not take account of the delivery rate of water to the network. Power for the disinfection process is provided by batteries charged by roof mounted solar panels.

The land rises towards the Southern end of the scheme. Here a booster pump lifts volumes of treated water from 290m Above Ordnance Datum (AOD)

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to a reservoir at 440m Above Ordnance Datum (AOD) through a 50mm PVC water main. Flows gravitate to dwellings from this point or are coupled directly to the rising main.

There is no standby plant installed and there is no electronic supervision or control of the system.

There is no fencing provided at the intake, the booster pump station or either of the reservoirs.

## 4.2.3 Pipeline network

A plan describing the water scheme is given at Appendix F. Generally speaking the pipeline network comprises small bore pipe work of up to 150 mm dia. A consideration of the pipes and their sizes is given below:-

Pipeline Diameter (mm)	Pipeline material	Pipeline Length (m)
150	Asbestos Cement	2,290
100	Asbestos Cement	1,910
25	Polythene	7,550
20	Polythene	8,855
15	Polythene	2,980
80	PVC	5,280
50	PVC	7,820
40	PVC	4,030
32	PVC	8,615
25	PVC	4,300

The pipeline lengths listed above have been extracted from computer generated plans following the production of electronic drawings over the last 18 months. The electronic drawings are being produced from old baseline drawings and local knowledge.

Information regarding pipeline ages and condition is available in a valuation study carried out by Council in 2004, but given the foregoing and that pipeline renewals have not been accurately recorded over the years, that some condition ratings are best estimates and that pipeline classes are assumed, this information is considered approximate.

## 4.2.4 Catchment description

The catchment area is listed in the District Plan as a Water Supply Protection Area for which rules governing land use are written. The land, owned by the Conservation Department and dominated by Mount Nimrod is generally forested/bushland. The Hunters Hills area is subject to possum control from time to time.

The watershed serving the stream is a significant area adjoining the Timaru Water Supply Protection Area some 4300m to the West. A plan of the water supply protection areas for all schemes is given at Appendix E. Water test results are available.

## 4.2.5 Supply and quality Risks

Risks are identified below, more detailed consideration is given in Section 7

Heavy rain leading to contamination from the catchment
Algal blooms
Animal infestation, dead animals from possum control, hunting etc in water source
Contamination within the catchment
Chlorinator failure
Loss of/exhaustion of Chlorine

Pipeline failures, critical pipelines such as 150mm Main from intake to reservoir, White Rocks crossing, 100mm main at creek Motukaika River crossing at Motukaika Rd
Farmers/contractors damaging pipes.
Booster pump failure
Power failure, chlorinator runs off battery powered by solar panel
Low flow periods – no chlorination
Illegal connections/tampering
Mechanical damage – vehicular impact, animals
Vandalism
Seismic activity, no geological faults shown on drawings
Lack of investment, poor maintenance

## 4.3 Hook/Waituna Rural Water Supply Scheme

### 4.3.1 General Data

Community Code:- HOO001
Source:- Hook River, map ref J40:492-160
Source code:- S00308
Treatment Plant code:- TP 00486
Distribution network/zone code;- HOO001HW
Population served:- 1200
Zone grade:- Ed

Treatment plant grade:- E
Disinfection:- Liquid Chlorine (derived from Sodium Hypochlorite powder)
Max consented flow rate:- 20 l/s
Max consented water take:- 1728 m <sup>3</sup> /day

### 4.3.2 Overview

Twin perforated pipes are laid in the gravel bed of the Hook River behind a weir constructed of rock filled gabion baskets. Water flows by gravity into the pipeline and flows to a tank located some 250 m downstream. Flow into the tank is controlled by a ballcock. Flow out of the tank is determined by demand. A stainless steel mesh filter is installed at the tank inlet.

The tank serves as a mixing tank for chlorination as well as a holding/balancing tank. Chlorine is injected only when flows enter the tank, controlled by a flow switch on the intake. When running, the chlorine pump injects chlorine at an operator input set rate irrespective of the actual flow into the tank.

During peak demand, a pump located immediately downstream of the holding tank can be manually operated to boost supplies but the success of this operation is limited by the small capacity of the tank. There are 4 other manually or pressure regulated pump facilities located around the scheme, these at Brownleas Rd, Triangle Rd, Waituna School Rd and Garlands Rd.

The Hook Waituna scheme extends to Willowbridge settlement, some 20 km away (as the crow flies) and also encircles the township of Waimate. The urban water supply network and the Hook Waituna network cross at numerous locations. At two such points the supplies are connected. This has the effect of boosting the supply into the rural water scheme network. There remains the possibility that water from the Hook Waituna scheme may ingress the town reticulation network on occasion.

The plant generally is old and suffers badly from a lack of investment on maintenance over the years.

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There is no standby plant installed anywhere except for a boxed spare at one of the booster pump stations and there is no electronic supervision or control of the system.

## 4.3.3 Pipeline network

Several break tanks and pressure reducing valves are located at strategic points within the system to reduce pressures and protect the pipelines. The latest plans describing the water scheme are provided at Appendix F. Generally speaking the pipeline network comprises of small bore pipework of up to 150 mm dia. A consideration of the pipes and their sizes is given below:-

Pipeline Diameter (mm)	Pipeline material	Pipeline Length (m)
150	Asbestos Cement	8,395
100	Asbestos Cement	2,890
25	HDPE	1,140
20	HDPE	827
50	Polythene	12,211
40	Polythene	779
32	Polythene	2,321
25	Polythene	36,051
20	Polythene	62,627
15	Polythene	41,172
100	PVC	760
80	PVC	11,631
50	PVC	12,185
40	PVC	26,312
32	PVC	14,005
25	PVC	2,993

20	PVC	280
15	PVC	160
Unknown	Unknown	970

The pipeline lengths listed above have been extracted from computer generated plans following the production of electronic drawings over the last 18 months. The electronic drawings are being produced from old baseline drawings and local knowledge and there is some debate as to their accuracy. This information must be considered approximate.

Information regarding pipeline ages and condition is available in a valuation study carried out by Council in 2004, but given the foregoing and that pipeline renewals have not been accurately recorded over the years, that some condition ratings are best estimates and that pipeline classes are assumed, this information is considered approximate.

## 4.3.4 Catchment Description

The catchment area is listed in the District Plan as a Water Supply Protection Area for which rules governing land use are written. The area extends to the crest of the Hunters Hills some 5000m to the west and is essentially a mixture of bushland and farmland. The land is either privately owned farmland or smaller residential properties or is owned by the Conservation Department. Sheep farming activities continue within the catchment and the Hunters Hills area is subject to possum control from time to time.

A plan of the water supply protection areas for all schemes is given at Appendix E.

## 4.3.5 Supply and Quality Risks

Risks are identified below, a more detailed consideration is given in Section 7

Heavy rain leading to contamination from the catchment
Algal blooms
Animal infestation, dead animals from possum control, hunting etc in water source
Contamination within the catchment
Chlorinator failure
Loss of/exhaustion of Chlorine
Pipeline failures, critical pipelines such as Gap Creek Crossing, Hook River crossings, Waimate Creek crossings. Crossings comprise AC, poly, PVC or steel pipes in varying conditions
Farmers/contractors damaging pipes.
Booster pumps failure
Power failure, mains power available at all sites. The chlorinator runs off a battery constantly trickle fed by a charger so if power goes down, the battery is charged 24 hrs/day.
Low flow periods – no chlorination
Illegal connections/tampering
Mechanical damage – vehicular impact, animals
Vandalism
Seismic activity, no geological faults shown on drawings
Lack of investment, poor maintenance

## 4.4 Lower Waihao Rural Water Supply Scheme

### 4.4.1 General data

Community Code:- LOW002
Source:- Lower Waihao Bore, map ref J41:5401-8678
Source Code:- G00317
Treatment Plant code:- TP00487
Distribution network/zone code;- LOW002LO
Population served:- 430
Zone grade:- De
Treatment plant grade:- D
Disinfection:- Gaseous chlorine (supplied in tanks)
Consent No:-CRC940846
Max consented flow rate:-18.9 l/s
Max consented water take:- 1633 m3/day

### 4.4.2 Overview

The source of water for the Lower Waihao Scheme is a shallow (5m deep) well constructed some 200 m from the banks of the Waitaki River at Ferry Rd, Glenavy.

The well is located outside the confines of a pump shed. Neither the well nor the pump shed is fenced. Cattle are often found grazing the roadside.

The plant is generally old and has suffered from a lack of expenditure on maintenance and renewals over the years.

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Water is pumped from the well to a reservoir located at an elevation of 110m Above Ordnance Datum (AOD) some 4.5 km. A duty/standby pumping arrangement is provided for this purpose located within a pump house adjacent to the well. The initiation of the standby pump is by manual intervention at the site. To boost the supply a single on-line booster pump is stationed within a pump house 4.0 km downstream of the main pumps but prior to the final 50 m of lift. Provision is made in the pipework arrangement for the installation of a standby pump but this has not been provided. The booster pump house is protected by fencing.

The pumping regime is controlled by SCADA. The main and booster pump operational programme is initiated by level detection in the reservoir which relays a signal via telemetry to the motor starters.

Recently a gaseous chemical chlorination system has been introduced, with SCADA monitoring of chlorination.

Mains power is provided at both pump houses but the controlling reservoir is reliant on a battery charged by a solar panel.

## 4.4.3 Pipeline network

The scheme is located within a low lying coastal strip. Whilst there are a few laterals connected directly to the pumped main, the vast majority of consumers are supplied by gravity from the reservoir. There are no booster pump arrangements within the distribution network.

The main delivery pipeline passes directly beneath a dairy effluent pond and a silage pit. The pipeline is old and is constructed of asbestos cement materials.

A plan describing the water scheme is given at Appendix F. Generally speaking, the pipeline network comprises of small bore pipework of up to 150 mm dia. A consideration of the pipes and their sizes is given below:-

Pipeline Diameter (mm)	Pipeline material	Pipeline Length (m)
150	Asbestos Cement	9,650

100	Asbestos Cement	5,185
50	Polythene	230
40	Polythene	452
32	Polythene	4,272
25	Polythene	24,111
20	Polythene	21,045
15	Polythene	2,472
100	PVC	2,160
80	PVC	13,330
50	PVC	12,693
40	PVC	8,196
32	PVC	13,595
25	PVC	3,275
20	PVC	270
15	PVC	280
Unknown	Unknown	4,997

The pipeline lengths listed above have been extracted from computer generated plans following the production of electronic drawings over the last 18 months. The electronic drawings are being produced from old baseline drawings and local knowledge and there is some debate as to their accuracy. This information must be considered approximate.

Information regarding pipeline ages and condition is available in a valuation study carried out by Council in 2004, but given the foregoing and that pipeline renewals have not been accurately recorded over the years, that some condition ratings are best estimates and that pipeline classes are assumed, this information is considered approximate.

## 4.4.4 Catchment Description

The catchment area is listed in the District Plan as a Water Supply Protection Area for which rules governing land use are written. The area extends north for approximately 2 Km to the Tawai Ikawai Rd and a similar distance to the west of Ferry Rd.

The land is almost entirely used for dairy farming under private ownership. A large dairy effluent holding pond was located some 200m north of the intake within the protection area and above the main delivery pipeline but is no longer in use. This pond was known to leak and abatement notices had been applied by ECan and the pond is now disused. Silage pits have also been constructed over the same pipeline immediately south of the effluent ponds. A border dyke irrigation area is set aside immediately to the north and east of the intake. Whilst the area immediately east of the pump house is outside the water supply protection area irrigation races which may be used to convey dairy effluent from the ponds pass within metres of the well.

A surface water stream flows through the farmland across the catchment. The stream flows from the north-east and passes 100m to the north of the well.

It is understood that there was no bacteriological contamination in this water source in the past. Bacteria are now known to be present in the source water.

A plan of the water supply protection areas for all schemes is given at Appendix E.

Dead animals in catchment
Chlorinator failure
Loss of/exhaustion of Chlorine
Pipeline failures, critical pipelines such as the pumping mains, particularly the section below the silage pits and the effluent pond.
Farmers/contractors damaging pipes.
Booster pump failure
Power failure
Illegal connections/tampering
Mechanical damage – vehicular impact, animals
Vandalism
Seismic activity
Lack of investment, poor maintenance
Flooding at intake

These are considered further at Section 7.

## 4.4.5 Supply and quality Risks

Risks are listed below, a more detailed consideration is given in Section 7

Contamination from the catchment due to farming activities, especially effluent ponds, silage pits etc.
Direct contamination at the well from animal infestation

## 4.5 Otaio/Makikihi Rural Water Supply Scheme

### 4.5.1 General data

Community Code:-OTA005
Source:- Otaio River
Source Code:- S00309
Treatment Plant code:- TP00488

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Distribution network/zone code;- OTA005OM
Population served:- 400
Current zone grade:- Dd
Current treatment plant grade:- D
Disinfection:- Liquid chlorine (derived from Sodium Hypochlorite powder)
Consent No:- CRC981876
Max consented flow rate:- 15 l/s
Max consented water take:- 4500 m3/week

## 4.5.2 Overview

Water is sourced from an intake infiltration gallery consisting of a single perforated pipe located in the bed of the Otaio River. From the gallery the water enters a shallow well on the north bank of the river within which a bore pump is housed within a shroud.

The pump delivers water back across the river at a constant rate to a reservoir located some 5.5 km away at 220m Above Ordnance Datum (AOD). From here water gravitates into the distribution network. There are no booster pumps anywhere within the system. The pump is controlled by sensors located within the reservoir. The control system is linked to SCADA and all inputs are powered by mains electricity. Low level protection for the main pump is provided.

Disinfection is by way of chlorine injection directly into the pumped main. The chlorinator pump operates at an operator input set rate whenever the delivery pump is running.

The intake and the pumping arrangement was constructed in 1999 and remains in relatively good condition.

## 4.5.3 Pipeline network

A Plan describing the water scheme is given at Appendix F. Generally speaking the pipeline network comprises of small bore pipework of up to 150 mm dia. A consideration of the pipes and their sizes is given below:-

Pipeline Diameter (mm)	Pipeline material	Pipeline Length (m)
150	Asbestos Cement	1,770
100	Asbestos Cement	5,720
80	Asbestos Cement	6,884
100	Polythene	9,028
40	Polythene	1,542
32	Polythene	9,724
25	Polythene	15,805
20	Polythene	26,420
15	Polythene	24,494
150	PVC	5,330
80	PVC	80
50	PVC	18,032
40	PVC	7,850
32	PVC	8,041
25	PVC	70
20	PVC	1,670
Unknown	Unknown	442

The pipeline lengths listed above have been extracted from computer generated plans following the production of electronic drawings over the last 18 months. The electronic drawings are being produced from old baseline drawings and local knowledge and there is some debate as to their accuracy. This information must be considered approximate.

Information regarding pipeline ages and condition is available in a valuation study carried out by Council in 2004, but given the foregoing and that pipeline renewals have not been accurately recorded over the years, that some condition ratings are best estimates and that pipeline classes are assumed, this information is considered approximate.

#### 4.5.4 Catchment Description

The catchment area given in the District Plan 2001 as a Water Supply Protection Area for the scheme is dated, being relevant to the site of an old intake located some 4.5 km downstream. Whilst the new intake remains within that protection area, the area extends upstream for only some 100m.

The catchment itself will extend far up into the Otaio Gorge which is a conservation area and into surrounding farmland.

A plan of the water supply protection areas for all schemes is given at Appendix E.

#### 4.5.5 Supply and quality Risks

Risks are listed below, a more detailed consideration is given in Section 7

Contamination from the catchment due to farming activities
Direct contamination at the well from animal infestation
Dead animals in catchment
Chlorinator failure
Loss of/exhaustion of Chlorine
Pipeline failures, critical pipelines such as the pumping mains, particularly the section below the silage pits and the effluent pond.
Farmers/contractors damaging pipes.
Main pump failure

Booster pump failure
Power failure
Illegal connections/tampering
Mechanical damage – vehicular impact, animals
Vandalism
Seismic activity
Lack of investment, poor maintenance
Flooding at intake

## 4.6 Waihoarunga Rural Water Supply Scheme

### 4.6.1 General data

Source:- Waihoarunga Stream, map ref J40:3150-0528
Secondary Source:- Taverndales Rd, map ref J40:316-080
Community Code:-WAI031
Source Code:- S00310 (Waihoarunga Stream)
Secondary Source Code:- S00888 (Taverndales)
Treatment Plant code:- TP00489 (Waihoarunga given only)
Distribution network/zone code;- WA1031WA
Population served:- 150
Disinfection:- Liquid chlorine (derived from Sodium Hypochlorite powder)
Zone grade:- ue
Treatment plant grade:- u

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Consent No:- CRC981876
Max consented flow rate:- 5.3 l/s from Waihaorunga Stream intake, 1.4 l/s from Tavendales
Max consented water take:- 3185 m3/week and 847 m3/week respectfully.

## 4.6.2 Overview

The Waihaorunga Rural Water Supply Scheme has two sources of water. The main water source is the Waihaorunga Creek near the juncture of Hursts Rd and Waitaki Valley Rd.

This intake comprises a twin perforated pipe intake galley located in the bed of the creek behind a small rock weir. Water flows from the gallery into a pump well where two submersible pumps are located in a duty/standby arrangement. The duty pump delivers flows to a reservoir some 2.6 km away from where the system runs under gravity to consumers.

Disinfection is provided at the pump site by chlorine injection into the rising main. The chlorinator operates at an operator input set rate whenever the duty delivery pump is running. Control of the system is by manual intervention only.

A second source of water is located high in the hills above Taverndales Rd, this source is known to dry up during hot summer months. The intake comprises a single perforated pipe located in the bed of a tributary of the Waihaorunga Creek behind a sandbag weir. Water is gravity fed from the intake to a treatment and booster pump shed at Taverndales Rd, some 1.7 km away. Here a chlorinator injects chlorine at an operator set rate downstream of the pumps which deliver flows to a booster reservoir to the north.

There are two further pumping arrangements within the reticulation network. The Tara Hill Rd booster station pump comprises a single on line booster pump which encourages flows to the East, and a second, at Zig Zag Rd pumps the supply up to a reservoir at 600m Above Ordnance Datum (AOD) to enable supplies to the West.

All pumps are located within pump sheds but none of these are protected.

## 4.6.3 Pipeline network

A Plan describing the water scheme is given at Appendix F. Generally speaking the pipeline network comprises of small bore pipework of up to 100 mm dia. A consideration of the pipes and their sizes is given below:-

Pipeline Diameter (mm)	Pipeline material	Pipeline Length (m)
100	Asbestos Cement	3,180
25	Polythene	9,315
20	Polythene	19,540
15	Polythene	4,856
50	PVC	9,280
40	PVC	6,290
32	PVC	10,685
25	PVC	2,323

The pipeline lengths listed above have been extracted from computer generated plans following the production of electronic drawings over the last 18 months. The electronic drawings are being produced from old baseline drawings and local knowledge and there is some debate as to their accuracy. This information must be considered approximate.

Information regarding pipeline ages and condition is available in a valuation study carried out by Council in 2004, but given the foregoing and that pipeline renewals have not been accurately recorded over the years, that some condition ratings are best estimates and that pipeline classes are assumed, this information is considered approximate.

## 4.6.4 Catchment Description

Catchment areas for both sources are defined as Water Supply Protection Areas in the District Plan. Both these areas are relatively small representing only a small proportion of the catchment area, the lower reaches of which are farmed. Cattle are known to frequent the Waihaorunga Creek immediately upstream of the intake.

A plan of the water supply protection areas for all schemes is given at Appendix E.

Seismic activity
Lack of investment, poor maintenance

## 4.6.5 Supply and quality Risks

Risks are listed below, a more detailed consideration is given in Section 7

Contamination from the catchment due to farming activities
Direct contamination at the source from animal infestation
Dead animals in catchment
Chlorinator failure
Loss of/exhaustion of Chlorine
Pipeline failures, critical pipelines such as the pumping mains.
Farmers/contractors damaging pipes.
Main pump failure
Booster pump failure
Power failure
Illegal connections/tampering
Mechanical damage – vehicular impact, animals
Vandalism

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## 4.7 Waikakahi Rural Water Supply Scheme

### 4.7.1 General data

Community Code:- WAI032
Source:- Waitaki River at Waikakahi (tributary), map ref J40:432-916
Source Code:- S00311
CPH Treatment plant code:- TP00490
CPH Distribution network/zone code;- WAI032WA
Population served:- 450
Disinfection:- Chlorine gas. (delivered in liquid form in 70 kg bottles)
Zone grade:- Ed
Treatment plant grade:- E
Max consented flow rate:- 17 l/s
Max consented water take:- none

### 4.7.2 Overview

Water is sourced for the Waikakahi Rural Water Supply Scheme from a tributary of the Waitaki River at a location known as 'The Stone Wall' on State Highway 82 between Glenavy and Kurow. Here, an intake pipe is located within a slow moving stream behind a gravel dam. The end of the pipe is protected with a coarse fish screen. Water flows from the intake into a screening chamber where two further mesh screens filter the water before it enters a well housed within a pump shed.

The pumping arrangement comprises a submersible pump which delivers flows to a duty/standby dry well pumping arrangement. A series of timers on the pump starters provide the means for dry run protection.

The main duty pump delivers flows to a reservoir some 3 km to the north at an elevation of 300m Above Ordnance Datum (AOD). From the reservoir flows gravitate through the reticulation network to all consumers towards the west and the central part of the scheme.

A booster pump lifts flows to an additional reservoir on the east side of the scheme from where consumers to the east are fed by gravity mains.

One of the main pumps is relatively new, having been installed in 2003, but the rest of the equipment is old. The main electrical boards and switchgear for example are approaching 30 years of age and are in need of replacement, which is the subject of a current tender call.

Disinfection is provided by Chlorine gas injection into the suction side of pump. Injection is initiated by main pump start. The dosage rate is set manually.

There is currently a study underway to enhance the volume of water available to the scheme.

### 4.7.3 Pipeline network

A Plan describing the water scheme is given at Appendix F. Generally speaking the pipeline network comprises small bore pipework of up to 150 mm dia. A consideration of the pipes and their sizes is given below:-

Pipeline Diameter (mm)	Pipeline material	Pipeline Length (m)
150	Asbestos Cement	7,635
100	Asbestos Cement	1,100
32	HDPE	850
32	Polythene	11,770
25	Polythene	28,860
20	Polythene	35,483
15	Polythene	146

25	MDPE	700
150	PVC	2,494
100	PVC	3,375
80	PVC	12,418
60	PVC	4,220
50	PVC	12,040
40	PVC	11,880
32	PVC	22,746
25	PVC	230
150	Steel	350
Unknown	Unknown	360

The pipeline lengths listed above have been extracted from computer generated plans following the production of electronic drawings over the last 18 months. The electronic drawings are being produced from old baseline drawings and local knowledge and there is some debate as to their accuracy. This information must be considered approximate.

Information regarding pipeline ages and condition is available in a valuation study carried out by Council in 2004, but given the foregoing and that pipeline renewals have not been accurately recorded over the years, that some condition ratings are best estimates and that pipeline classes are assumed, this information is considered approximate.

#### 4.7.4 Catchment Description

The catchment area given in the District Plan as a Water Supply Protection Area comprises a narrow strip of land between the Waimate-Kurow Highway and the Waitaki River. This section of land is farmed.

The catchment itself extends west along the banks of the Waitaki and north across farmland to the hills beyond.

A plan of the water supply protection areas for all schemes is given at Appendix E.

#### 4.7.5 Supply and quality Risks

Risks are listed below, a more detailed consideration is given in Section 7

Contamination from the catchment due to farming activities
Animal infestation, dead animals from possum control, hunting etc in water supply
Chlorinator failure
Loss of/exhaustion of Chlorine
Pipeline failures, critical pipelines such as the pumping mains.
Farmers/contractors damaging pipes.
Main pump failure
Booster pump failure
Power failure
Vandalism
Heavy rain – contamination
Algal blooms
Solar panel failure at reservoir
Tampering/theft/Illegal connections
Mechanical damage – vehicular impact, animals
Seismic activity
Lack of maintenance
Contractors/farmers digging pipes up.

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## 4.8 Parks and Reserves Schemes

The water supply to the main camping grounds operated by the Council and served with water sourced from schemes other than those already described elsewhere in this report are listed below.

Other small water supplies within the District serve camp sites at Gunns Bush which is built to house over 100 people (Community Code GUN001) and run by the Methodist Church, and the Lindisfarne camp (Community Code LIN007) which caters for a capacity of 60, and is operated by the Presbyterian Church.

The pipelines used for the conveyance of water to the campsites are generally small bore poly pipes. There is no disinfection of the raw water and it is Council policy to affix boil water notices to stand pipes etc, and within ablution blocks.

Risks to the supply and quality of the water are similar for each scheme and include raw water contamination, pipeline failures, critical pipelines such as the pumping mains, main pump failure and power failure.

The catchments are typical high country mountainous areas. The groundwater aquifer from which the water is pumped will be replenished by rainfall within the surrounding countryside and retained by water levels in the dams.

### 4.8.1 Te Akatarawa Camping Ground

#### 4.8.1.1 General Data

Community Code:- TEA008
Source:- Te Akatarawa Stream (given previously in 2003 as Te Akatarawa Camp Well) .
Source Code:- S00886 (given previously in 2003 as G00974)
Treatment Plant code:- TP01678
Distribution network/zone code;-TEA008TE

Population served:- 10 (previously given in 2003 as 10 – 3000)
Zone grade:- u
Treatment plant grade:- u
Disinfection:- Not disinfected
No consent data provided.

#### 4.8.1.2 Overview

A submersible pump is located within a shallow (5m to 6m) well. The pump delivers flows to the camping ground with surplus fed to a 3000 gallon concrete tank. The pump is operated by a float switch.

Two houses are also supplied with water from the well, these are immediately adjacent to the camp site.

### 4.8.2 Waitangi Reserve Camp Ground

#### 4.8.2.1 General data

Community Code:- WAI120
Source:- Waitangi Reserve Water Race (given previously in 2003 as Waitangi Reserve Camp Well).
Source Code:- S00887 (given previously in 2003 as G00975)
Treatment plant code:- TP01679
Distribution network/zone code;- WAI120WA
Population served:- 10 to 3000
Disinfection:- Not disinfected

Zone grade:- u
Treatment plant grade:- u
No Consent data provided.

#### 4.8.2.2 Overview

A submersible pump is located within a shallow (5m to 6m) well. The pump delivers flows to the camping ground with surplus fed to a 3000 gallon concrete tank. The pump is operated by a float switch.

#### 4.8.3 Fisherman's Bend Camp Site

Fisherman's Bend Camp Site is located at the Lake Waitaki dam wall. A water supply is sourced from a pipe located within the dam wall adjacent to the spillway.

There is no disinfection process and there is no official register of this water supply. Toilet blocks, and stand pipes are supplied by the scheme.

#### 4.8.4 Brairs Gully Camp Site

##### 4.8.4.1 General Data

Community Code:- WAI120
Source:- Lake Aviemore Briars Gully.
Source Code:- S00875
Treatment plant code:- TP02377
Distribution network/zone code;- BRI004BR
Population served:- 200

Disinfection:- Not disinfected
Zone grade:- u
Treatment plant grade:- u
No Consent data provided.

#### 4.8.4.2 Overview

The Camp Site is located at the head of Lake Aviemore. The water supply is sourced from the Benmore Dam.

There is no disinfection process. Toilet blocks, and stand pipes are supplied by the scheme.

### 4.9 Privately Operated Schemes Located Within the District

#### 4.9.1 Hakataramea

##### 4.9.1.1 General data

Source:- Driscoll Race, Kirkliston
Source Code:- S00306
Treatment plant code:- TP 00484
Distribution network/zone code;- HAK002HA
Population served:- 265
Zone grade:- Ee
Treatment plant grade:- E
No consent details available.

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## 4.9.1.2 Overview

The Hakataramea rural water supply scheme is run by a society. Council involvement is limited to the collection of rates.

The intake is located at an altitude of some 600m on the slopes of Mt Milne. There is no disinfection and the pipeline reticulation is entirely gravity operated.

## 4.9.1.3 Catchment Description

The catchment area is listed in the District Plan as a Water Supply Protection Area for which rules governing land use are written. The land, owned by the Conservation Department and dominated by Mt Milne of the Kirkliston Range is generally high country bushland with limited activity.

A plan of the water supply protection areas for all schemes is given at Appendix E.

## 4.9.1.4 Supply and quality risks

Risks are listed below, a more detailed consideration is given in Section 7

Contamination from the catchment
Pipeline failures
Farmers/contractors damaging pipes.
Vandalism
Heavy rain – contamination
Tampering/theft/Illegal connections
Mechanical damage – vehicular impact, animals
Seismic activity
Lack of maintenance

## 4.9.2 Cattle Creek (also known as Upper Waihao).

### 4.9.2.1 General data

Community Code:- CAT001
Source:- Cattle Creek.
Source Code:- S00607
Treatment plant code:- TP01507
Distribution network/zone code;- CAT001CA
Population served:- 20
Zone grade:- u
Treatment plant grade:- u
Disinfection:- none
Consent No:- CRC940845
Max consented flow rate:- 1.6 l/s
Max consented water take:- 138 m <sup>3</sup> /day

There appears to be some confusion with the registration of this scheme. There were two separate schemes, one of which may have been abandoned and the incorrect intake deleted by MoH. Previous (2003) data given below.

Source:- Cattle Creek	Source:- Upper Waihao
Source Code:- S00607	Source Code:- S00609
CPH Treatment plant code:- TP01507	CPH Treatment plant code:- TP01510

CPH Distribution network/zone code;- CAT001CA	CPH Distribution network/zone code;- UPP004UP
Population served:- 20	Population served:- 20
Disinfection:- Not disinfected	Disinfection:- Not disinfected
Current zone grade:- u	Current zone grade:- u
Current treatment plant grade:- u	Current treatment plant grade:- u

#### 4.9.2.2 Overview

The source of water for the scheme is a tributary of the North Branch of the Waihao River. The intake comprises a 1m length of slotted pipe located in the river bed.

There is no treatment of the raw water.

#### 4.9.2.3 Pipeline network

The reticulation system is small bore pipe work gravity fed from the intake.

#### 4.9.2.4 Catchment Description

The catchment area is listed in the District Plan as a Water Supply Protection Area for which rules governing land use are written. The land is dominated by Mount Nimrod to the east and is generally forested/ bushland with sheep farming activities. The Hunters Hills area is subject to possum control from time to time.

The watershed serving the stream is a significant area adjoining the Timaru Water Supply Protection Area to the north. A plan of the water supply protection areas for all schemes is given at Appendix E.

#### 4.9.2.5 Supply and quality risks

Risks are listed below, a more detailed consideration is given in Section 7

Contamination from the catchment
Pipeline failures
Farmers/contractors damaging pipes.
Vandalism
Heavy rain – contamination
Tampering/theft/Illegal connections
Mechanical damage – vehicular impact, animals
Seismic activity
Lack of maintenance

#### 4.10 Schemes Administered by other Authorities within the District

Timaru District Council operates and maintains the Downlands Water Supply Scheme. 14 % of this scheme supply area lies within the boundaries of the Waimate District. This element of the scheme serves the township of St Andrews.

Waimate District Council collects the rates and passes these on as appropriate.

The assessment of the scheme has been carried out by Timaru District Council and is contained in Appendix K.

The Timaru Water Supply Protection Area extends into the Waimate District to the Cannington and Cattle Creek protection areas.

General data for the scheme given as follows:-

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Source:- Pareora River at Springbrook (for St Andrews)
Source Code:-S00608
Treatment Plant code:- TP01509
Distribution network/zone code:- STA004ST
Population served:- 240
Zone grade:- u
Treatment plant grade:- u

## 5.0 Sewage Disposal

The majority of the sewage generated within the District is discharged to septic tanks, the effluent and sludges from these systems being disposed of under the jurisdiction and control of the Regional Council. It is known that sludges from septic tanks are often discharged to farmland.

The township of Waimate is the only settlement in the District provided with a sewerage network. Much of the network, which serves the majority of the urban area was constructed in the early 20th Century. There remains peripheral areas of town which are not sewered, dwellings in these areas dispose of waste water via septic tanks. Some of these properties are relatively small.

The Waimate sewerage network ultimately discharges to a waste water treatment plant located on the edge of town adjacent to a public park. The plant has no cess reception facilities and essentially incorporates an anaerobic sludge digester comprising a deep pit located within and below the base of an oxidation pond. This digestion facility was designed such that desludging will not be required for 30 years, this based on the theory that a prolonged digestion period will mineralise the sludges received.

Waste water is introduced to the plant at the base of the sludge pit, some 3.5m below the main pond floor. Flows rise from the pit, leaving the settleable fraction behind in the anaerobic environment of the pit to digest. The effluent rises into the main pond where aerobic bacteria consume the remaining solids releasing Carbon Dioxide as they do so. The Oxygen required by the bacteria to live is provided by algae which populate the pond, thriving on the abundance of Carbon Dioxide and sunlight. Thus the balance of nature cleanses the effluent.

The effluent flows out of the main ponds to a secondary pond via a rock filter. Bacteria populate the rocks providing additional treatment with the passage of flows. As flows enter this section of the plant flows of equal volumes are displaced over a weir to three maturation ponds below.

The effluent is held in the maturation ponds to allow a period of consolidation and disinfection by ultraviolet rays prior to being discharged to land. A series of 49 border dykes are provided with 2 valves each to permit the controlled irrigation of

pastures set aside for the purpose. The remaining nutrients and the abundance of water encourage the pastures to proliferate, the pastures are grazed and thus the treated effluent is returned to nature's cycle.