REPORT

MINISTRY FOR THE ENVIRONMENT

Potential Demands for Waitaki Catchment Water (non Hydro, Irrigation or Stock)

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Report prepared by:

TONKIN & TAYLOR LTD

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Executive Summary

This report estimates the current peak flow and yearly demands for water from the Waitaki Catchment for community, private, commercial, industrial and recreation/tourism water supplies. It does not include estimates of water required for hydro-electricity generation, irrigation or stock water uses.

Mackenzie, Waimate and Waitaki District Councils preside over the Waitaki Catchment while Timaru District Council (east of the catchment) and Dunedin City Council (south of the catchment) are close enough to the Waitaki Catchment that some water supply may be possible in the future. Councils are generally concerned that a number of their communities are water short now, or are likely to be water short in the future.

The initial data collection phase indicated that some councils' data recording systems, although relatively basic, were effective in providing good quality water demand information. However some council systems are not metered and therefore demands had to be inferred.

The framework we have developed uses estimates of current water demand and then projects demands forward to account for reasonably expected growth over the future 10, 20 and 50-year period. Current water demands have been estimated by two parallel methods. Method 1 uses Environment Canterbury consent information as its basis and Method 2 uses recorded flow data and census population as its basis. Method 2 was required to estimate current demands outside the Waitaki Catchment where consent information was lacking.

Even with the two methods for estimating current demands there is still a proportion of potential demand that is not accounted for. An example is situations where landholdings are not connected to a community or rural supply and do not need a resource consent. By counting land parcels and assigning them a nominal demand we were able to account for this demand. This figure was then added to the results for Methods 1 and 2.

Three growth scenarios were developed (low, medium and high growth) from Statistics New Zealand national population growth figures and estimated economic growth data. When applied to the estimated current demands this gave us a range of peak flow and annual demand values. Due to the general nature of population and industry growth projection data used, the results should be regarded as approximate only.

Water demand for household uses arise primarily from community and rural water supply schemes. There are only a few industrial and large commercial operations presently drawing water from the Waitaki Catchment and most of this is used for meat processing. Snow making is the largest independent tourism-related water take in the Waitaki Catchment; most other tourism and recreation ventures are located in communities and hence the water is accounted for as a community demand.

Water demand for irrigation is not part of this report. However it is likely that on-farm secondary water demands could increase as a result of irrigation, as present dry land farming converts to dairy or horticulture.

The tables below show the results from the demand modelling for the various growth scenarios. Additional tables can be found in Section 5 and in the Appendices.

Table 5.4: Summary of peak flows from the Waitaki Catchment (high growth scenarios)

Location of demand	Current peak flow range (flows–consents) (l/s)	Projected 2011 peak flow range (flows–consents) (l/s)	Projected 2021 peak flow range (flows–consents) (l/s)	Projected 2051 peak flow range (flows–consents) (l/s)
Current Waitaki	613	725	770	915
Current out-of-catchment	236	266	293	352
Current total	**849–1172**	**991–1352**	**1063–1463**	**1266–1748**
Future out-of-catchment		699	730	863
Future out-of-catchment (including DCC)		103	110	131
Total	**849–1172**	**1793–2154**	**1903–2303**	**2261–2743**

Table 5.5: Summary by use type within Waitaki Catchment (high growth scenarios – consents data only)

Location of demand	Current peak flow range (flows–consents) (l/s)	Current annual range (flows–consents) (000 m^3/year)	Projected 2051 peak flow range (flows–consents) (l/s)	Projected 2051 annual range (flows–consents) (000 m^3/year)
Industrial/commercial	212.6	3589	317.0	5,352
Tourism	64.0	352	95.4	524
Community	810.0	9930	1208.0	14,808
Private potable	86.0	1081	128.0	1611
Total	**1172.6**	**14952**	**1748.4**	**22,295**

1 Introduction

1.1 Project objectives

In October 2004, Tonkin & Taylor was engaged by the Ministry for the Environment to develop an independent overview of potential demand for water from the Waitaki Catchment. This demand excludes water used for hydro-electricity, irrigation and stock drinking purposes; and includes consumptive water users in the following categories:

- community and domestic water supplies
- private potable water abstractions (whether existing or permitted under present planning rules)
- commercial and industrial (other than those arising within municipal supply areas)
- recreation and tourism.

Because the analysis is intended as a general overview, the majority of our estimates are at a sub-catchment level rather than assessment of all individual water takes. The estimate includes demands for Waitaki Catchment water arising from within and outside the physical catchment boundary. Where potential demands arise from outside the catchment we have commented on whether alternative sources of water have been considered or identified.

The majority of project data collected along with territorial local authority and regional council interviews were completed in a three-week period in October; however information has been received up to the time of writing.

To complete the project we made use of readily available information rather than researching for new information. Assumptions have been made from information provided at interviews with stakeholder territorial local authorities.

For major consumptive water users such as community water supplies, we have used recorded data where available. However, where recorded information has not been available demands have been inferred.

The framework we have developed projects demands forward to account for reasonably expected growth over the future 10, 20 and 50-year period. Due to the general nature of population and industry growth projection data used these figures should be regarded as approximate only. Of special note, there are two projects in progress that may provide further information supporting the conclusions and recommendations made in this report. The two projects are:

- Water and Sanitary Services Assessment of Council Water and Wastewater Assets, required under the Local Government Act 2002
- Effect of Irrigation on Economic Development in South Canterbury – Post Construction of Opuha Dam, to be commissioned by Aoraki Development Trust.

The specific terms of reference for this report are as follows:

i. **identify** potential demands for water from the Waitaki Catchment for:
   - drinking and town supply
   - commercial and industrial
   - tourism and recreation uses

ii. **provide** an estimate of the potential demands for each use over a 10, 20 and 50 year timescale and, where possible, provide approximate position(s) in the catchment

iii. **describe** whether demands are likely to be supplied via community infrastructure or on an individual basis

iv. **assess** the existing allocation to these uses and the extent to which efficiency and/or infrastructure improvements could meet future demand.

This report contains the project findings with respect to the terms of reference listed above using the information collected. A brief overview of the report format is provided below:

- Section 1 states the project objectives and gives a brief overview of the existing demand for water from the Waitaki Catchment.
- Section 2 describes the methodology and assumptions used for establishing the demands for Waitaki Catchment water, and the future demand growth possible.
- Section 3 summarises the interview notes taken from discussions with territorial local authorities, and industry and tourism/recreation groups.
- Section 4 briefly comments on the potential for water conservation, waste/loss minimisation and reuse.
- Section 5 discusses the project results and recommendations.

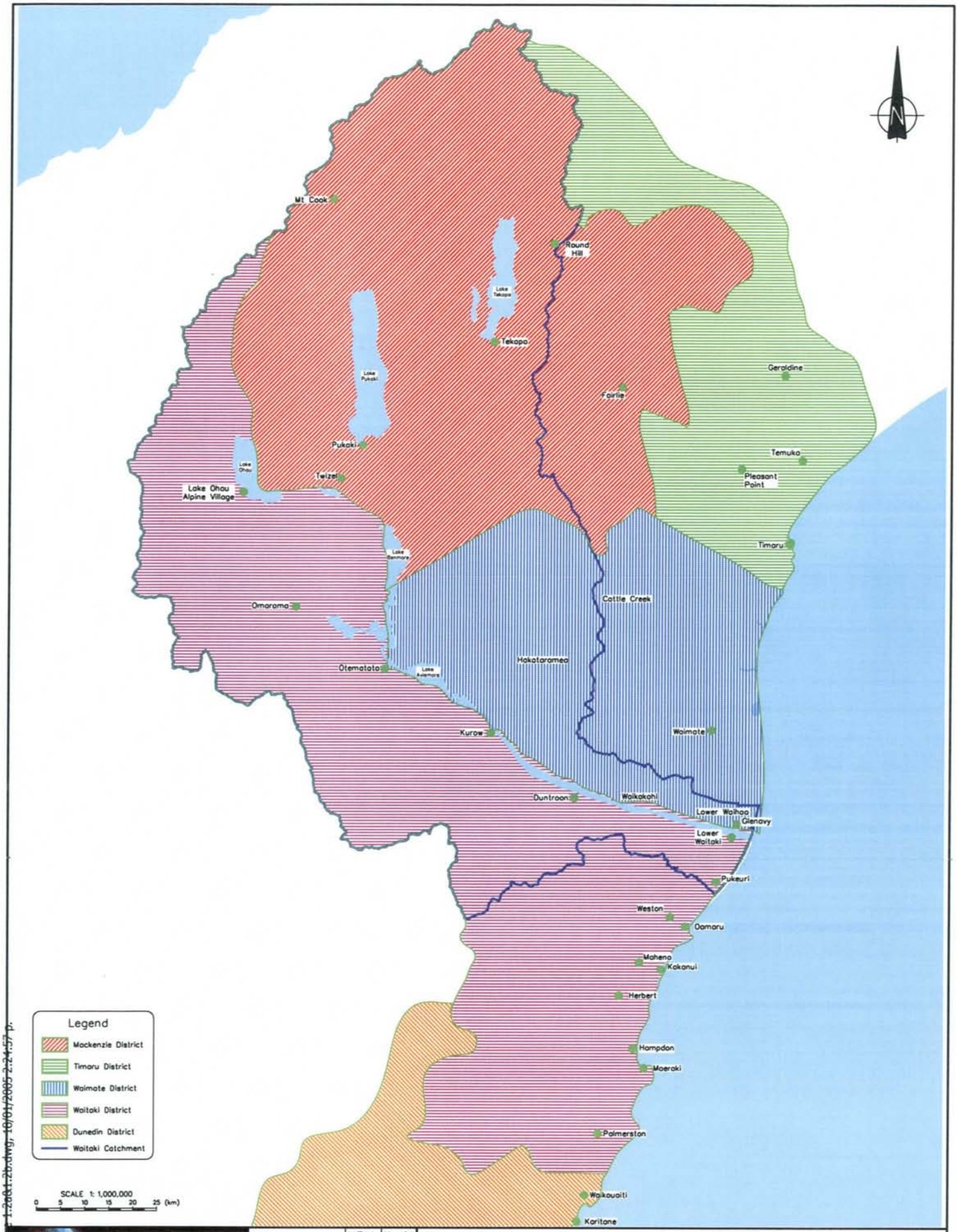
Additional supporting information is contained in Appendices A to G.

1.2 Brief overview of demand for Waitaki Catchment water

1.2.1 Overview of existing demands

The Waitaki Catchment provides water for a variety of in-stream values, community and domestic water supply, rural and stock water supply, irrigation, hydro-electricity, industrial and commercial uses, and recreation/tourism uses. Water and access to water support the region's social, cultural and environmental wellbeing. Water is also a vital ingredient to the economy. The benefits of water from the Waitaki Catchment are not limited to in-catchment users and the number of resource consent applications to move water out of the catchment is increasing.

Mackenzie, Waimate and Waitaki District Councils preside over the Waitaki Catchment and the approximate district boundaries are shown in Figure 1.2a. Interviews with these councils have revealed concerns that a number of the communities under their administration are water short presently, or are likely to be water short in the future. The majority of water supplied from council systems is for community supply and to a lesser extent, commercial, industrial and tourism. Councils are facing increased pressure to provide more water and ensure that existing supplies are secure.



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Waitaki, South Island NZ
Territorial Authority Plan

FIG. No. Figure 1.2a

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Catchment Locality Plan

FIG. No. Figure 1.2b

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Water demand for household uses arise from community, rural water supply schemes or from small private supplies. The larger community and rural supplies are indicated in Figure 1.2a. Small private supplies may occur where farms or rural residential properties are not connected to a community or rural supply.

Only a few industrial and large commercial operations are located within the Waitaki Catchment itself and most processing occurs on the Otago and Canterbury downlands, which are closer to the trade centres of Timaru and Oamaru. The Alliance Group freezing works located at Pukeuri near the catchment's southern boundary on State Highway 1 is the one exception to this rule.

Tourism and recreation ventures such as visitor accommodation and the service industries are primarily located in communities and hence the water is accounted as a community use. Snow making at the Ohau and Roundhill ski fields are the only other notable tourism demands.

Water demand for irrigation is not part of this report. However it is likely that on-farm secondary water uses could increase as a result of irrigation. Irrigation could possibly enable the conversion of present dry land farming to dairy farming or horticulture and in turn these on-farm industries will require additional water for processing and supporting industries to convert raw product into high value commodities.

1.2.2 Overview of potential demand

Much of the information collected for this report was from discussions and interviews with members of the various territorial local authorities. Generally summarised, the types of future growth predicted and concerns expressed fall under the following topic headings.

Subdivision development

Land subdivision development whether for new residential, commercial, industrial or tourism ventures were important discussion points with all of the district councils. Mackenzie District Council indicates that rapid subdivision growth is occurring in the upper catchment areas of Twizel, Lake Ruataniwha and Tekapo. Waitaki District Council has identified that growth outside the catchment in coastal areas is progressing. However, the council states that troubles gaining new water take resource consents and extending existing consents is slowing the overall rate of development.

Other economic development

With the prospect of increased land productivity it is likely that the major industries of meat processing and dairy will also increase their demands for water. Although meat processing is the only large industry currently served from the Waitaki Catchment, it is possible that new or expanding industries in or near the catchment could develop additional demand. Business factors such as the desire to centralise operations to the Waitaki are also possible, although this is difficult to predict.

Future light industry and commercial activities are expected to develop in support of the existing communities as they develop critical masses of population.

Vineyards and olive plantations have been promoted as possible development opportunities. Whether this occurs in boutique establishments similar to those occurring near Cromwell in Central Otago or in larger commercial plantations is yet to be seen. Councils have identified the flatter areas surrounding lakes Ohau and Pukaki in the Mackenzie Basin for these uses. Some commercial viticulture interest has also been reported in the Hakataramea Valley of Waimate District.

The development of forestry has been identified in some past council strategic plans. Discussions with the Mackenzie District Council, in particular, has identified that up to 3000 hectares of forestry is likely in the future. This will add to the proportion of water lost through evapotranspiration, but it is not a use of water assessed in this report.

Security of supply

Security of supply is a very important consideration for communities and rural schemes. This is especially in the low rainfall areas on the South Island's east coast and the Otago hinterland. Both the Canterbury and Otago regions suffer prolonged periods of hot and dry weather over summer, and water shortages occur. However, Canterbury has the advantage that water can be sourced from groundwater even during drought, albeit at reduced quantities. Otago, on the other hand, has very limited groundwater resources and a perceived over-allocation from many surface water sources. This is due in part to historical mining permits, the relatively low yield surface water tributaries and the flow sharing consenting regime adopted by Otago Regional Council.

As these issues are more relevant to coastal areas away from a secure supply of surface water, it is the districts outside the Waitaki Catchment that are primarily concerned such as Timaru, coastal Waitaki and Dunedin.

1.3 Acknowledgements

The primary contributors to this project were local and regional authorities; however a number of consultants to the Ministry for the Environment and industry representatives also made significant contributions. Tonkin & Taylor take this opportunity to thank all the organisations and individuals for their contribution to this project.

Territorial local authority and regional council contributors

Mr Ashley Harper, District Services Manager, Timaru District Council

Mr Murray Cleverley, CEO, Aoraki Development Trust

Mr Martin King, Manager Planning and Regulation, Mackenzie District Council

Mr Bernie Haar, Asset Manager, Mackenzie District Council

Mr John O'Connor, Operations, Mackenzie District Council

Mr Alan Porter, Water and Wastewater Engineer, Waimate District Council

Mr Brent Donaldson, Manager, Planning and Regulatory, Waimate District Council

Mr John Maxwell, General Manager, Waimate District Council

Mr Dean Sulzberger, Service Manager Water, Waitaki District Council

Mr Philip Bell, Assets Group Manager, Waitaki District Council

Mr Richard Mabon, Strategy Group Manager, Waitaki District Council
Mr Darrel Robinson, Water and Waste Services Manager, Dunedin City Council
Mr Gerard McCombie, Water Operations Team Leader, Dunedin City Council
Ms Tracey Morgan, Consents Officer, Dunedin City Council
Mr Graeme Martin, Chief Executive Officer, Otago Regional Council
Mr Darryl Lew, Water, Otago Regional Council
Mr John Weeber, Groundwater, Environment Canterbury
Mr John Talbot, Director, Policy and Planning, Environment Canterbury
Mr Malcolm Main, Regional Services – Timaru, Environment Canterbury

Tourism and recreation consultant

Mr Patrick O'Neill, Director, Leisure Matters Consultants

Industrial, commercial contributors and consultants

Mr Simon Harris, Resource Economist, Harris Consulting
Mr Justin O'Brian, Environmental Compliance Officer, Fonterra Clandeboye
Mr Danny Hailes, Plant Manager, Alliance Group Pukeuri Plant

2 Methodology

This project presents an overview of current and potential demands for water from the Waitaki Catchment excluding the water used for hydro-electricity, irrigation and stock. The report includes consumptive water demands in the following use type categories:

- community and domestic water supplies
- private potable water abstractions (whether existing or permitted under present planning rules)
- commercial and industrial (other than those arising within municipal supply areas)
- recreation and tourism.

The project requires an assessment of the demands arising from local in-catchment activities and also from out-of-catchment activities. By far, the majority of data available has been for demands arising from within the catchment and therefore we believe estimates of demand from outside the catchment will be less certain.

The data sources used for identifying the location, scale and nature of current demands were current consent database information, water supply records from district councils, Statistics New Zealand population data and land parcel information from the Land Information New Zealand Digital Cadastral Database (LINZ DCDB).

Where possible, demands have been assessed as:

- peak day demand flow rate[1] measured in litres/second (l/s)
- average annual demand volume measured in cubic metres per annum (m^3/year).

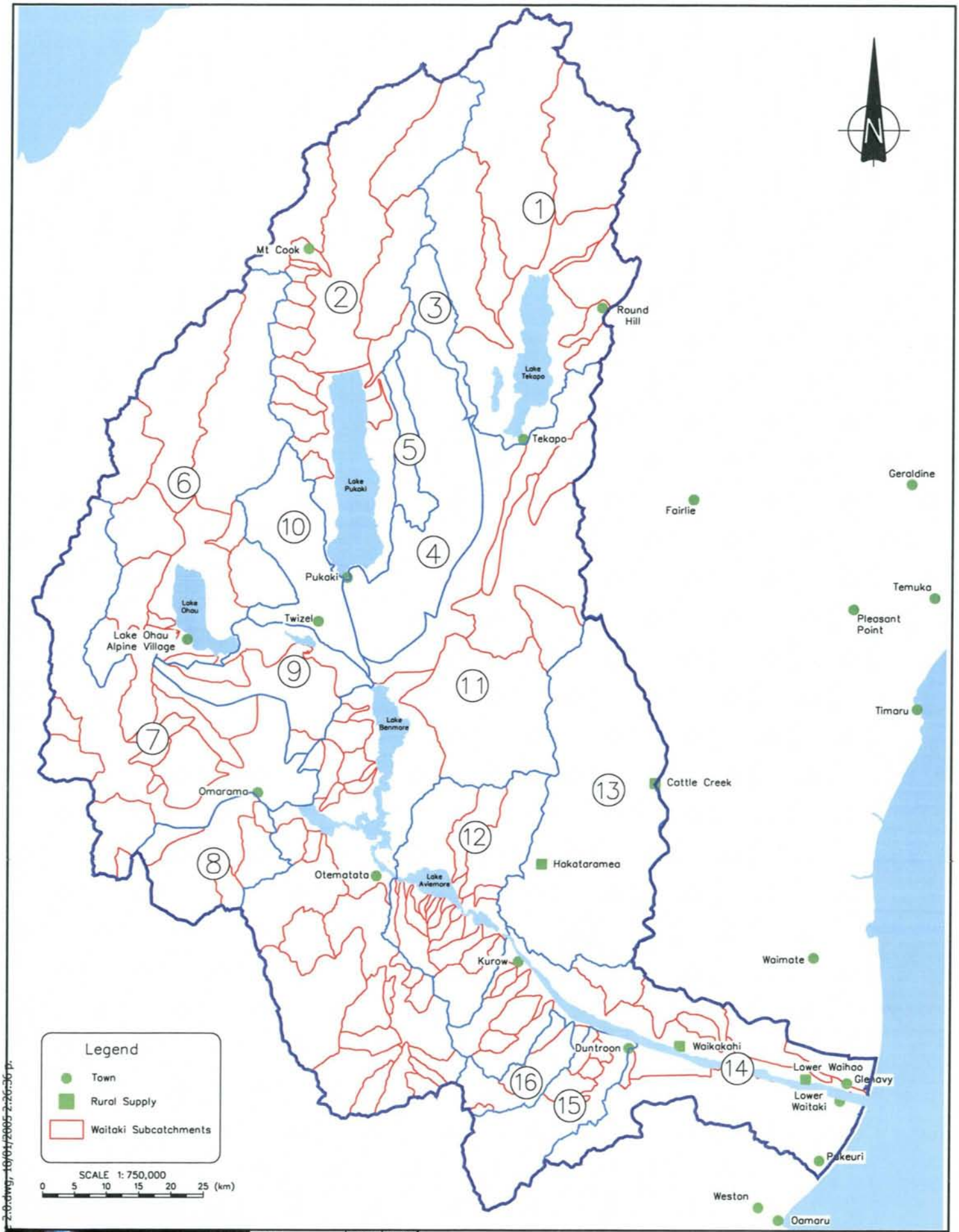
Our original proposal was to evaluate the current water takes from the Waitaki Catchment based on consents information, supported by an assessment of other unregistered water users. This method is referred to as Method 1: Assessment of resource consent data, in the flow chart presented as Figure 2.1.

However the original approach presented a number of problems and an alternative method was sought to act as a double check for peak flows and annual volumes and to fill in the gaps where consent information was not available. This method is based on recorded flow data and population and is referred to as Method 2: Assessment of population and recorded flow data, in the flow chart presented as Figure 2.1.

These two methods will be discussed in greater detail in sections 2.2.2.1 and 2.2.2.2.

The larger Waitaki Catchment has been divided into 16 smaller catchments. These 16 catchments represent clusters of sub-catchments defined in the ECan GIS database. These catchment boundaries have been based on criteria provided by the consultants completing the regional economic analysis.

[1] Where peak daily demand flow rates have been calculated, derived or inferred they are assumed to be a flow taken at constant rate over a 24-hour period. The instantaneous rate of take may be greater than the peak daily rate, but we have assumed consumers have on-site storage available to meet instantaneous peaks in demand.



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Waitaki, South Island NZ
Significant Analysis Catchments

FIG. No. Figure 2.0

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Figure 2.1 below presents the catchments of the significant catchment analysis.

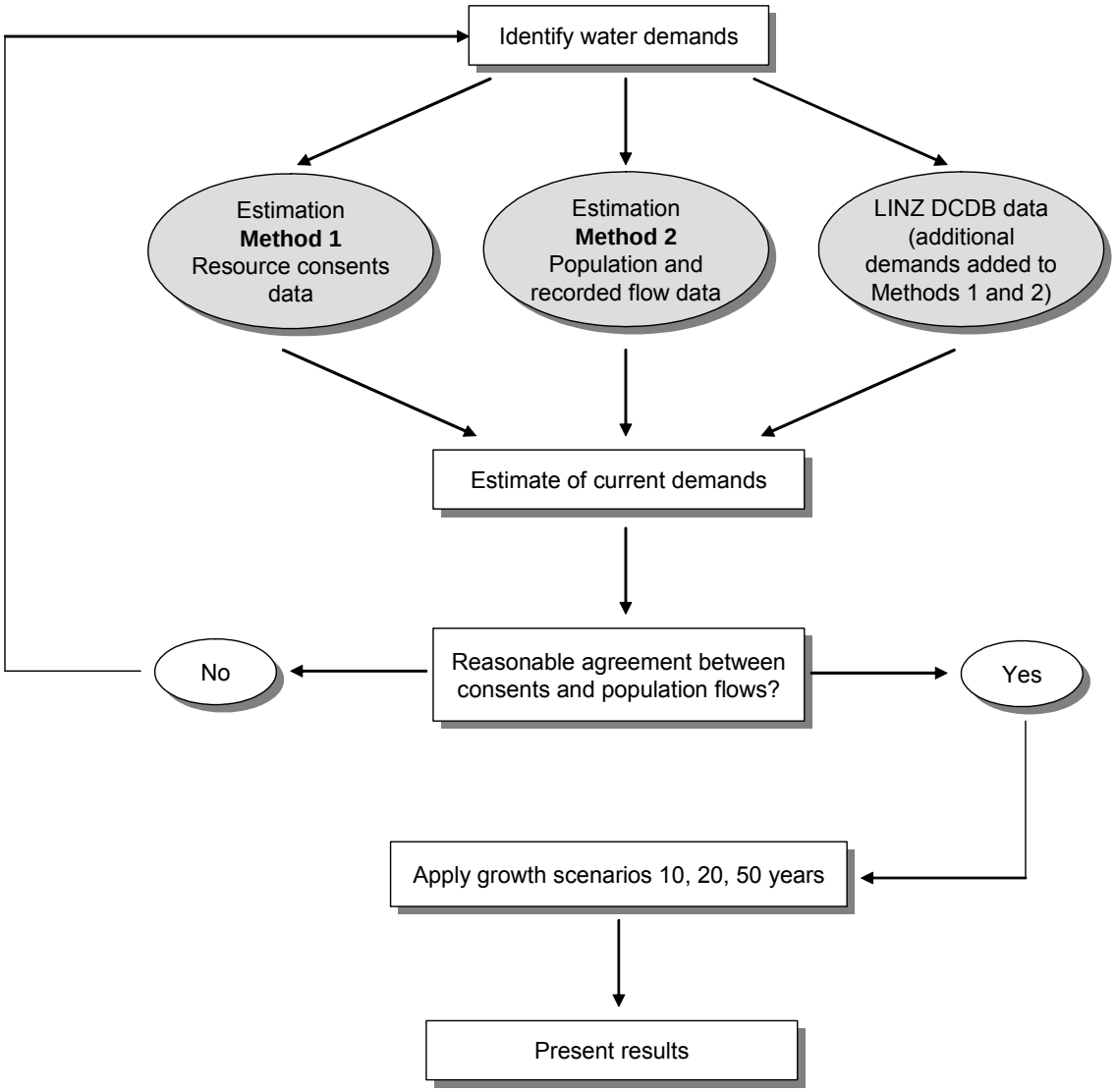
Interviews and discussions with local and regional authorities formed a significant part of this project and are outlined in Section 3.0.

Results summary tables and a brief discussion are included in Section 5.0, while detailed spreadsheets of results are included in Appendices A and B.

2.1 Methodology for demand modelling

The flow chart below outlines the overall approach to quantifying current and future demands included in the models. Two alternate methods were required to complete the demand assessment.

Figure 2.1: Specific processes for estimating current and future demand by two methods



Note: Method 1: Assessment of resource consent data. Method 2: Assessment of population and recorded flow data.

2.2 Assessment of current water demands

2.2.1 Current consumptive demands

As a brief introduction to the scale of water demands being considered in this project a number of charts are presented below. Data was sourced from Environment Canterbury consents using primary use codes.

When water take consents are issued they may contain allocations to a number of different uses. For example, a consent may be issued primarily for irrigation; however a smaller part may also be designated for rural farm supply (stock water) and an even smaller part may be designated for industrial cooling water. Hence this consent would have primary, secondary and tertiary allocations ranked in order of magnitude. The primary use will dominate the overall water use but the secondary use may be significant.

Figure 2.2.1a: Summary of consumptive demands from Waitaki Catchment for stock water, irrigation, community/domestic, industrial/commercial and recreation/tourism

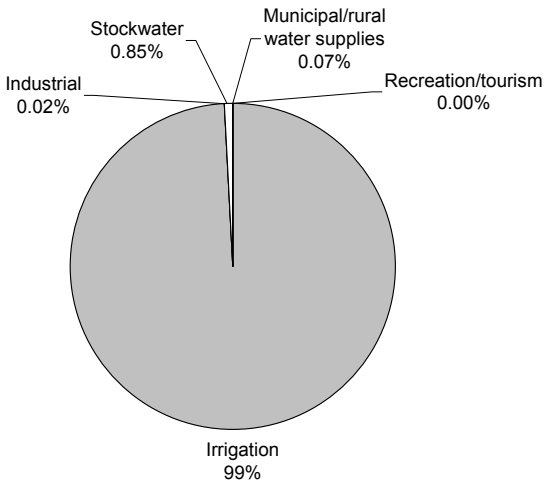


Figure 2.2.1b: Proportion of surface water takes vs groundwater takes in Waitaki Catchment – community/domestic, industrial/commercial and recreation/tourism

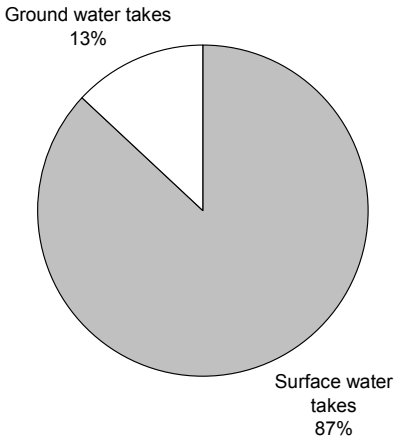
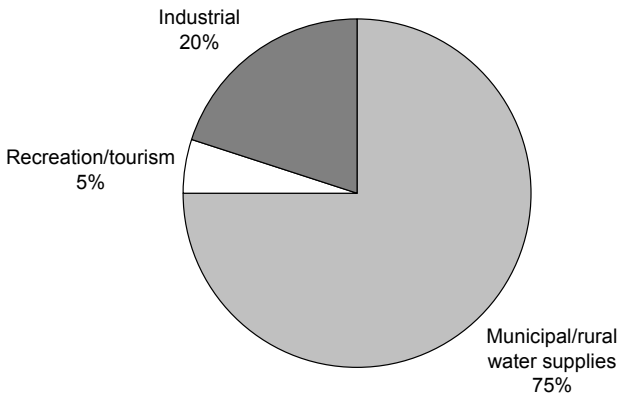


Figure 2.2.1c: Proportion of project use types (community/domestic, industrial/ commercial and recreation/tourism) by resource consent primary use codes



Note that the figures presented above have used resource consent data sorted by the consents primary use code (Use_1) with the exception of the estimated demand for the freezing works at Pukeuri.

Figure 2.2.1a illustrates the majority of consumptive water demands in existing resource consents are for irrigation and stock water, approximately 99.9 percent by daily flows. Thus our project is concerned with a relatively small proportion of the total water consented from the Waitaki Catchment.

As shown in Figures 2.2.1b and 2.2.1c, when considering consumptive water demands for the uses of water covered by this project they are primarily taken from surface water (87 percent) and primarily used for community and domestic water supply (75 percent). Industrial/ commercial and tourism/recreation have lesser proportions of 20 percent and 5 percent respectively. Although industrial uses appear to be significant, this is skewed somewhat by the presence of one major industry (the freezing works at Pukeuri) that accounts for approximately 75 percent of the consented industrial demand.

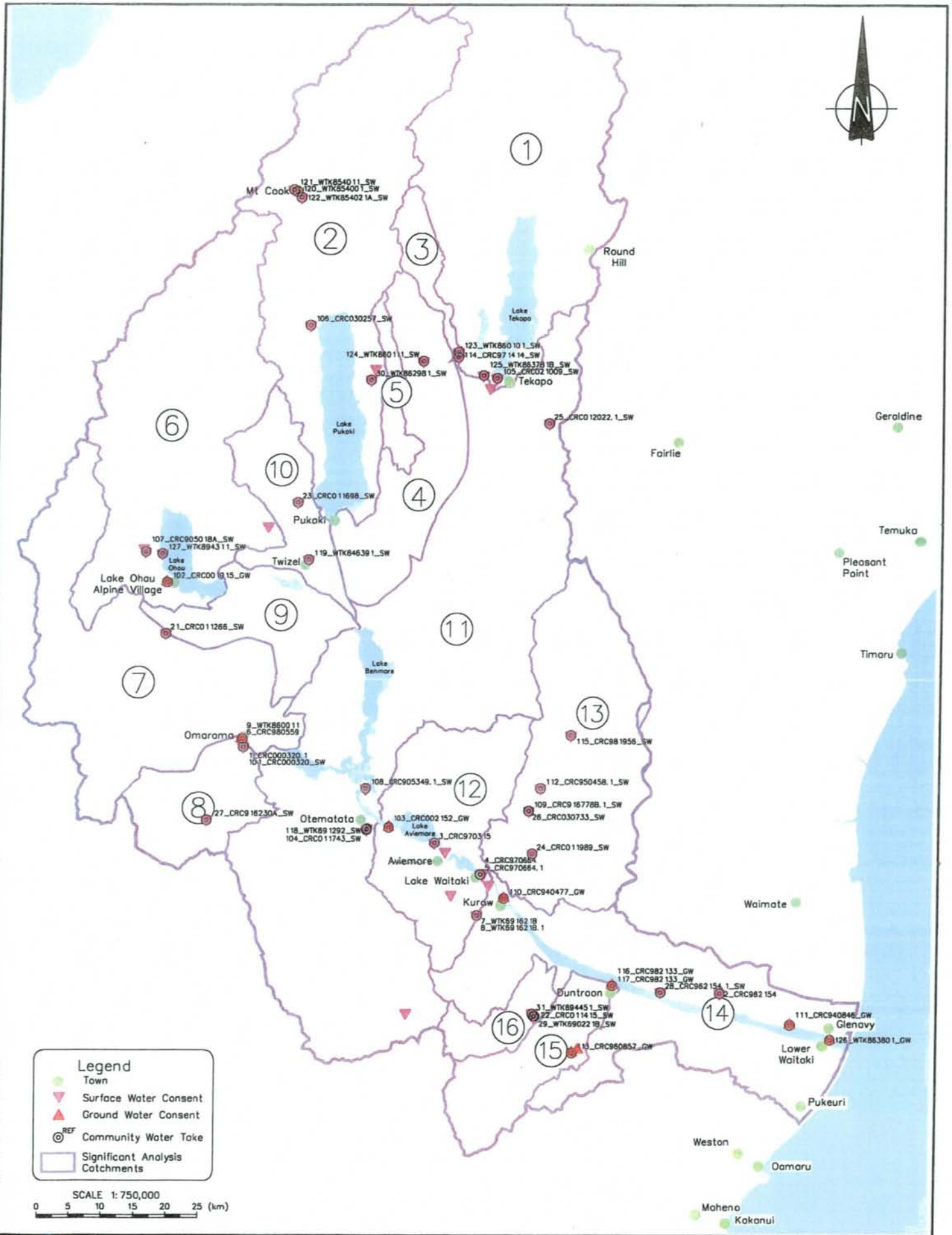
2.2.2 Current demand identification

The data sources used for identifying the location, scale and nature of current demands were current consent database information, water supply records from district councils, Statistics New Zealand population data and land parcel information from the Land Information New Zealand Digital Cadastral Database (LINZ DCDB).

Where possible, demands have been assessed as:

- peak day demand flow rate[2] measured in litres/second (l/s)
- average annual demand volume measured in cubic metres per annum (m^3/year).

[2] Where peak day demand flow rates have been calculated, derived or inferred they are assumed to be a flow taken at constant rate over a 24-hour period. White the instantaneous peak take can be higher, this approach assumes consumers have on-site storage available to meet the instantaneous peak in demand.



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Waitaki Catchment Water Study

Consent Location Plan

FIG. No. Figure 2.2.2

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Our original proposal was to evaluate the current water takes from the Waitaki Catchment based on consents information, supported by an assessment of other unregistered water users. However, this presented a number of problems and an alternative method was sought to act as a double check for peak flows and annual volumes and to fill in the gaps where consent information was not available. These two methods will be discussed in greater detail later in this section.

Figure 2.2.2 on the following page presents:

- catchments defined for the project
- location and type (surface or ground water) of consents used in Method 1: Assessment of resource consent data
- communities and other consented water takes used in Method 2: Assessment of population and recorded flow data

As community consents make up the bulk of consent flow information we have included individual consent references on the figure that can be linked to the spreadsheets in Appendix A.

2.2.2.1 Method 1: Assessment of resource consent data

Establishing consents to be included

Consents are issued for one or more uses, many of which are not water consuming. For the purpose of this project we have included only the consent codes that are specific to the use type categories in this project. A list of ECan GIS consent codes can be found in Appendix E.

For assessing demands from current consents we originally assumed the primary use code (Use_1) from the consent database was adequate to classify the water use in to the project use type categories (community/domestic, industrial/commercial and recreation/tourism). However the secondary use codes (Use_2) of resource consents may also contain significant allocations.

Issues with using only the primary use codes were noticeable in rural water supply schemes which are primarily for stock water but also secondly for domestic consumption. Similarly, schemes that are primarily allocated for irrigation may also have components for community and other uses. An example of this is the Lower Waitaki Irrigation Company scheme supplying the community of Oamaru and the freezing works at Pukeuri.

As a result we endeavoured to incorporate the community and domestic water supply secondary use types from irrigation and stock water consents. However, this was not a simple process because the flows for secondary uses are only components of the total consent value and are not explicitly stated. Peak flows and daily maximum demands have therefore been estimated based on available information.

Other use types such as industry/commercial and tourism/recreation are also likely to be included as secondary uses in consents. However, they are assumed to be minor quantities in relation to community water supply.

The summary of current demands based on an assessment of consented takes and additional demands from unconsented takes via an assessment of land parcels is presented as summary tables in Appendix A.

Limitations of consent data

The consent data presented maximum allocations in terms of peak flows (l/s) and maximum daily volume (m^3/d).

Peak flows are assumed to be in terms of instantaneous flow rates and will account for the maximum pumping capacity of specific equipment at a site. Some systems may operate on demand at very high flow rates during the day. Other systems may pump to storage over a 24-hour period at moderate flow rates and some systems may operate only at night. Because it is unlikely that all consumers will be demanding water at the same time the sum of the peak flows on a catchment basis is likely to overestimate the potential peak flow.

Maximum daily volume is assumed to be the volume taken on a peak demand day over 24 hours. These figures have been adjusted to an average day demand for calculating annual volumes. These annual adjustments have been calculated by project use type using a brief analysis of typical seasonal variation patterns. Charts of these patterns and annual adjustment figures used for this project are included in Appendix D.

A limitation in using consented maximum volumes for estimating current demands is that the consent may not be currently exercised to the full value. Rather the consent value will only be reached towards the end of the consent period. In the case of community supplies, this may be up to 35 years in the future. Because it would be difficult to accurately determine the proportion of the consent value currently being exercised it is likely that this method will overestimate the potential annual demand.

A limitation of using consents data for total water demand estimation is not all water users hold a current consent. There was a significant difference between the number of consents and the number of farms and land parcels (excluding residential) in the Waitaki Catchment. A way of accounting for this difference is described in Section 2.2.2.3.

2.2.2.2 Method 2: Assessment of demand population and recorded flow data

Because of issues with consent information the community demand calculated from consents is likely to be overstated. We have found an alternative method using recorded flow figures and resident population data. This is also the only method used to estimate out-of-catchment demands. A variation of this method (not population-based) was used to estimate demand for industrial/commercial and recreation/tourism uses.

Methodology

Mackenzie, Waimate, Waitaki, Timaru and Dunedin district/city councils provided recorded flow data for communities they considered likely to require additional water from a Waitaki source. Coupling this information with resident population data provided by Statistics New Zealand we were able to determine an average daily flow on a per person basis. Peak day factors for each community were derived from records of peak day flows.

This information enables us to calculate both peak day flows and a probable annual demand. This method is likely to yield a good approximation of the current demands, as they are specific for communities based on recorded flow data. Where recorded flow data were not available we have inferred that per person flows and peak day factors will be similar to those of nearby communities.

To account for demands arising outside of community schemes we have used a method described in Section 2.2.2.3.

Derived average daily flows (ADF) and peak day factors (PDF)

Average daily flow is calculated from the total water volume used in a year divided by an appropriate timescale (ie, litres used per year/seconds in a year = l/s). To estimate the water used on the peak day of the year a multiplier must be calculated. This is called a peak day factor.

The recorded flows method assumes that peak day demands are taken at a constant rate over a 24-hour period. This assumes consumers, in order to meet the peak instantaneous demand, have on-site storage. For most community supplies and large industries this will be true however it is likely that this will have an averaging effect and tend to understate the actual instantaneous peak flows from the catchment.

The accuracy of community demand estimates will be affected by the assumed demand per person. The main factors influencing the demand per person figures are likely to be:

- the resident population figures from Statistics New Zealand
- the amount of leakage and losses within the reticulated network
- local climate and desire for garden watering during dry/hot periods.

These three points are briefly discussed below.

Resident population figures have a significant impact on the daily flow figure. The communities of Tekapo and Twizel have significant holiday and visitor populations and the water demand from these uses is significant. Hence the total demand distributed over the resident population becomes inflated. This is not a problem for assessing future growth provided that the relative proportions of resident to holiday and visitor populations do not vary significantly in the future.

Leakage and losses in the reticulation of small townships are likely to be significant and may vary in the range of 20 to 50 percent of total water taken for supply. This may explain why water use in these community systems is so high.

The local climate is likely to have a substantial effect on the total water used by a community. Inland the predominantly dry and hot summer climate is likely to result in increased garden watering. This is a significant demand and a large contributor to the summer peak day demand factor (estimated between 2.0 and 2.7 for Waitaki communities).

Average daily flows (ADF) per resident population ranged from 0.0364 l/s in Tekapo to 0.010 l/s in the coastal downland communities of the Timaru and Dunedin districts. These figures appear to be conservative and there was a consistent trend of increasing water use with distance inland.

The following peak day factors were calculated for the communities and detailed tables are shown in Appendix B:

- inland resorts (Tekapo and Mt Cook), peak day factor = 2.0
- inland Mackenzie Basin (Twizel, Lake Ohau, Omarama to Kurow), peak day factor = 2.7
- Waitaki mid-catchment (Duntroon to Glenavy), peak day factor = 2.5
- other coastal north and south of the Waitaki, peak day factor = 2.0.

An indicative example of how demand may be apportioned for a typical community is shown below in Table 2.2. An average daily flow (ADF) of 0.01 l/s/resident equates to 864 litres per average day per person. A typical breakdown of daily demand may be as follows:

Table 2.2: Typical breakdown of demand for a community with ADF= 0.01 l/s/resident

Demand description	Typical percentage of total (%)	Demand proportion (l/ day /resident)
Resident domestic	35%	295
Industrial/commercial	25%	219
Tourism/recreational	15%	130
Losses and leakage	20%	175
Other public uses	5%	45
	100	**864**

The typical demand proportions presented above are for an indicative community only. Actual demand proportions will vary significantly between communities.

Assumptions were made about the industrial/commercial and tourism/recreation activities identified by the consents assessment to derive appropriate peak day factors and probable annual demands. These activities were then assessed by average daily flows and a summary of these figures is presented in Appendix B.

Assumed out-of-catchment demand

Waimate, Timaru, Waitaki and Dunedin district/city councils indicated that some communities that are not presently supplied from the Waitaki Catchment may require water from this source to supply a portion of their **current water needs.** To represent this demand we have included a portion of these communities estimated current water demand as the initial base demand for future projections. These demands are summarised in spreadsheet form in Appendix B.

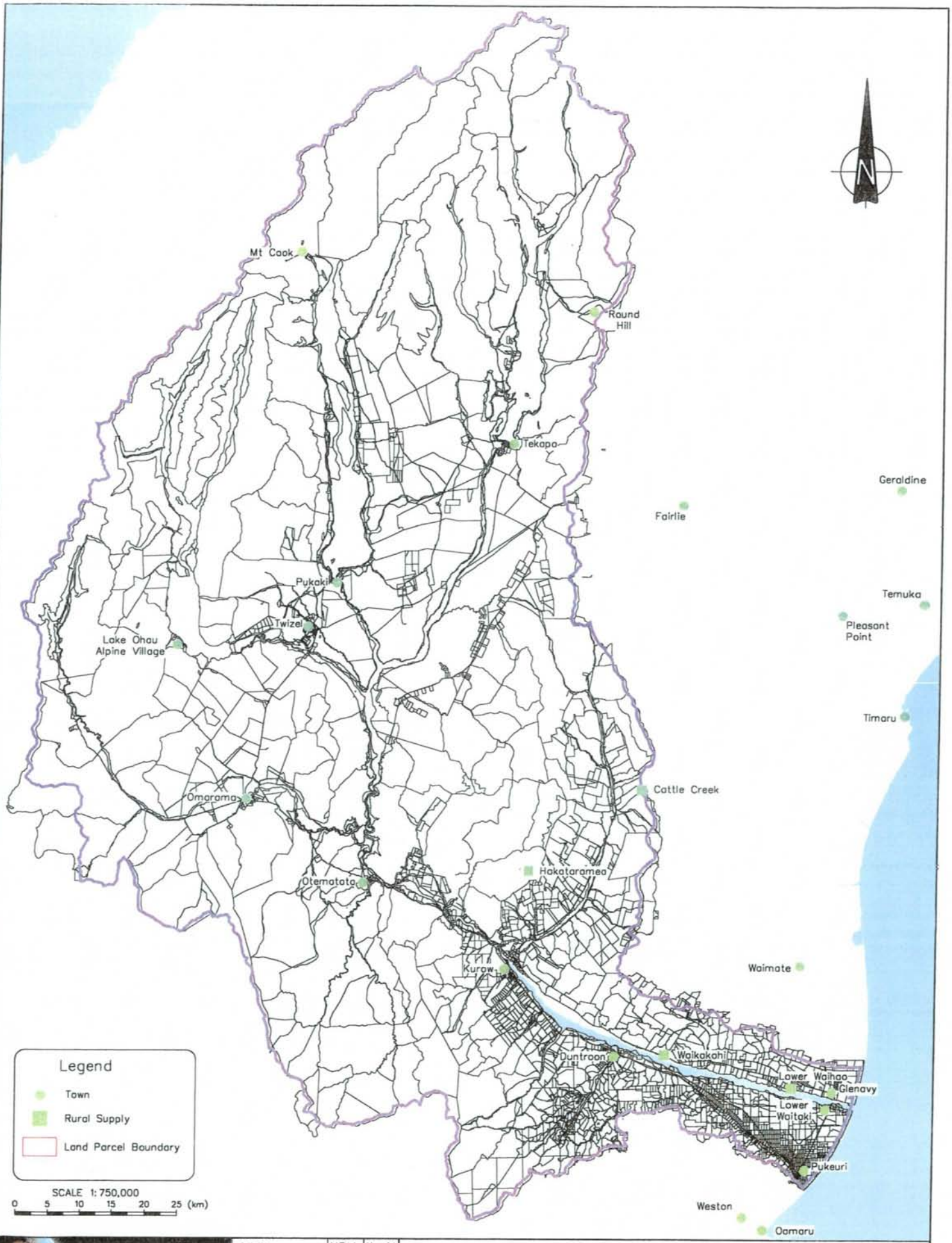
Brief details are also included in the notes column of the spreadsheets. These notes relate to the assumed proportion of a community's total demand that will be provided from the Waitaki. We have not rigorously investigated whether these communities will have no other choice but to use water from the Waitaki.

2.2.2.3 Private potable takes

Although the majority of water for domestic supply is likely to occur in the various communities this will not account for all the demand. A number of consumers will rely on water from private bores or surface water that may not hold a current consent.

For consistency we have adopted the same method for including private potable takes in the consent demand data and the recorded flows data to assign additional demand.

For adding the private potable demands we have summarised the land parcels within the catchment from the Land Information New Zealand (LINZ) DCDB and the Ministry of Agriculture and Forestry's Agribase. All farms and rural residential sized properties (parcels greater than 1 ha) were assumed to require a supply independent of community reticulation. Table 2.2.2.3 below summarises the flows and demands assumed for each private take.



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Ministry for the Environment

Potential Demands – Waitaki Catchment

Waitaki, South Island NZ

LINZ DCDB Land Parcel Data

FIG. No. Figure 2.2.2.3

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Table 2.2.2.3: Estimated demand from a rural residential or farm private take

Details	Estimated flow	Assumptions
Demand per person People per farm (or lot)	0.022 (l/s/p) 2.4	Median per person demand estimated for the catchment Statistics New Zealand average number per household
Average daily flow	**0.0528 (l/s) or 4,562 (l/day)**	
Peak day factor	2.5	Median peak day factor estimated for the catchment
Peak day flow	**0.132 (l/s) or 11,405 (l/day)**	

Note: These figures are deemed to be a conservative estimate for the Waitaki Catchment.

Figure 2.2.2.3 presented on the following page shows the land parcel data that was included in the Land Information New Zealand Digital Cadastral Database (LINZ DCDB) assessment of private potable demands (only rural residential and farm-sized parcels were included in demand estimations).

These demands are assumed to be additional to the figures estimated by either calculation Methods 1 or 2 (consents or population and recorded flows). A description of the land parcels identified using this method is included in Appendix F.

2.2.2.4 Issues to consider under the Resource Management Act

The Transitional Regional Plan for Canterbury and the proposed Canterbury Natural Resources Regional Plan (NRRP) Chapter 5 – Water Quantity contain rules that allow a limited amount of water to be taken without resource consent as a permitted activity. Under both plans, diverting and using water from surface water is permitted on a per property basis. Peak flows up to 5 l/s and 10 m^3/day are permitted under the rules subject to conditions.

Assuming that the conditions were satisfied for all properties outside a reticulated supply (excluding residential size lots from the LINZ DCDB), this means there is a potential for landholders to take, as of right, up to 10 m^3/day.

Section 2.2.2.3 suggests that on a peak demand day the rural household water consumption could be approximately 11,405 litres, which is approximately 10 m^3/day. This observation is important because it suggests that the household would use all water available as a permitted take with no allowance remaining for stock water on peak days. Therefore we have not added this demand into the current demand estimates as it is already counted.

2.2.3 Annual demand adjustment factors

Annual demand adjustment factors for assessment of consent volumes

For Methods 1 and 2, annual demand adjustment factors were required to convert from maximum daily flows to average daily flows. These figures were determined from recorded flows or provided by industry representatives as a description of seasonal variation patterns.

The following adjustment factors were calculated. More detailed information is shown in the charts in Appendix D.

- industrial/commercial, a factor of 0.56
- tourism/recreation, a factor of 0.38
- community and domestic supply, a factor of 0.50.

The average annual adjustment factors for industry and commercial have been derived from seasonal patterns for the largest industries in or near the Waitaki Catchment. As other industries are unlikely to have average annual water use higher than these industries we believe that 0.56 is a conservative estimate.

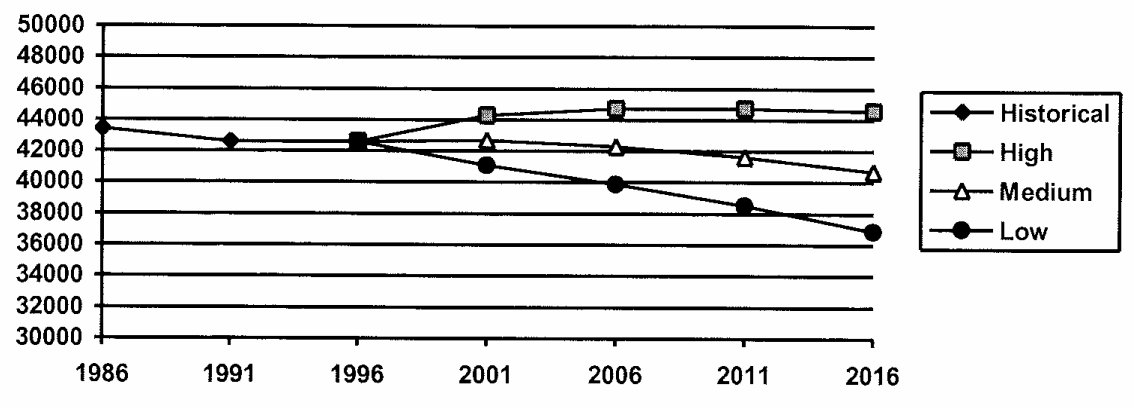
In the Waitaki Catchment, tourism and recreation demands are primarily snow making. For this reason we have adopted the snow making average annual adjustment factor of 0.38 to represent this activity group. Many tourism specific demands such as visitor accommodation will be incorporated in the community and domestic demands.

Community average annual demand will vary with peak day factor. Peak day factors of 2.0 were towards the lower end of the range for Waitaki communities and this assumes reasonably constant water use throughout the year. This means that for consent data an annual factor of 0.5 should be adopted. Since small communities generally have peak day factors greater than 2.0 using this figure will tend to overstate the annual volumes required and is a conservative approximation.

2.3 Demand growth projections

Statistics New Zealand population growth projections for the Waitaki Catchment are likely to be similar to those for South Canterbury. A figure of the projections for the Timaru district is shown below as Figure 2.3a.

Figure 2.3a: Population projection for Timaru district (base 1996)



Current trends assume the population will either:

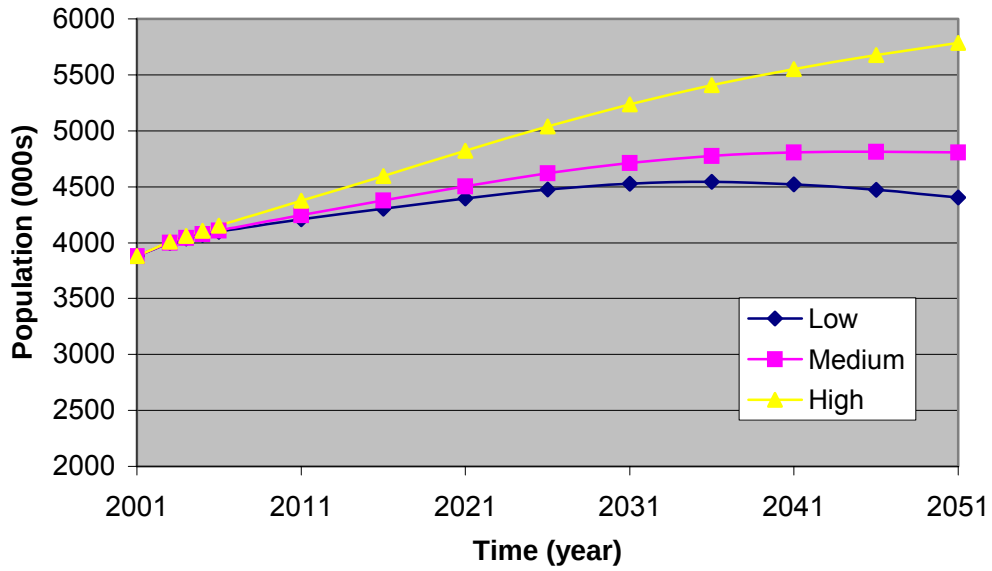
- continue the present slow steady decline (low projection)
- flatten off to no growth (static) and then resume declining from 2006 (medium)
- slow growth that will plateau around 2009 (high).

These projections imply that water demand from population will remain more or less static in the medium term. However the growth potential of the region due to the flow-on effects of irrigation, industry and the development of tourism and recreation sectors cannot be discounted. For these reasons we believe that using national population growth figures will yield a more appropriate estimate of growth in the region for use in this project.

Population data was obtained from Statistics New Zealand. The base for future population projections is the estimated resident population of New Zealand on census night, 30 June 2001. Alternative projection series have been produced incorporating different assumptions on the future fertility, mortality and migration of the population. We have assumed three of these projection series (series 1, 4 and 6) will estimate the low, medium and high population growth ranges.

Charts of the growth scenarios produced by Statistics New Zealand are shown below in Figure 2.3b.

Figure 2.3b: Statistics New Zealand national population projections for the period 2001 to 2051



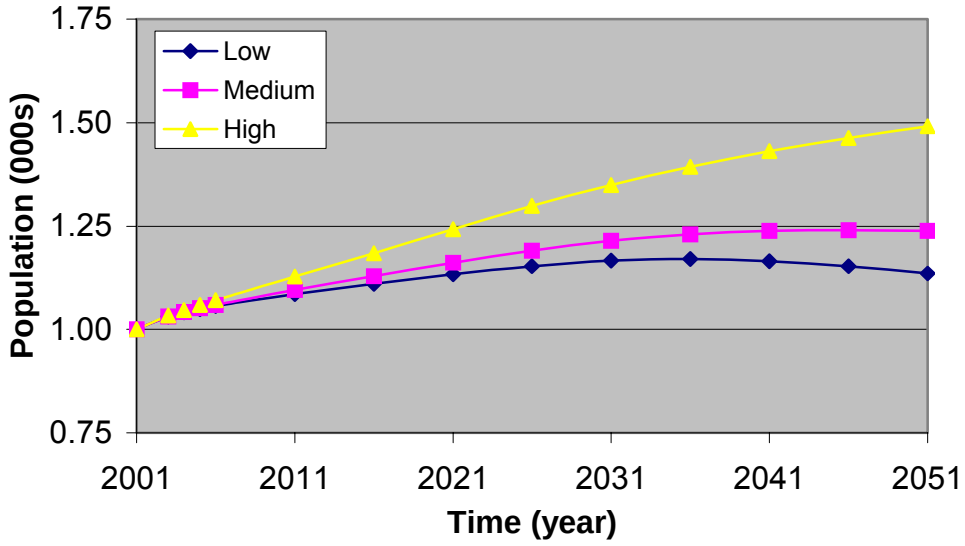
Charts of the growth scenarios and the assumptions used by Statistics New Zealand are contained in Appendix C.

2.3.1 Generation of demand growth scenarios

Growth scenarios for community and domestic use types

The growth scenarios used for community and domestic are the low (series 1), medium (series 4) and high (series 6) growth series projections to generate normalised growth curves.

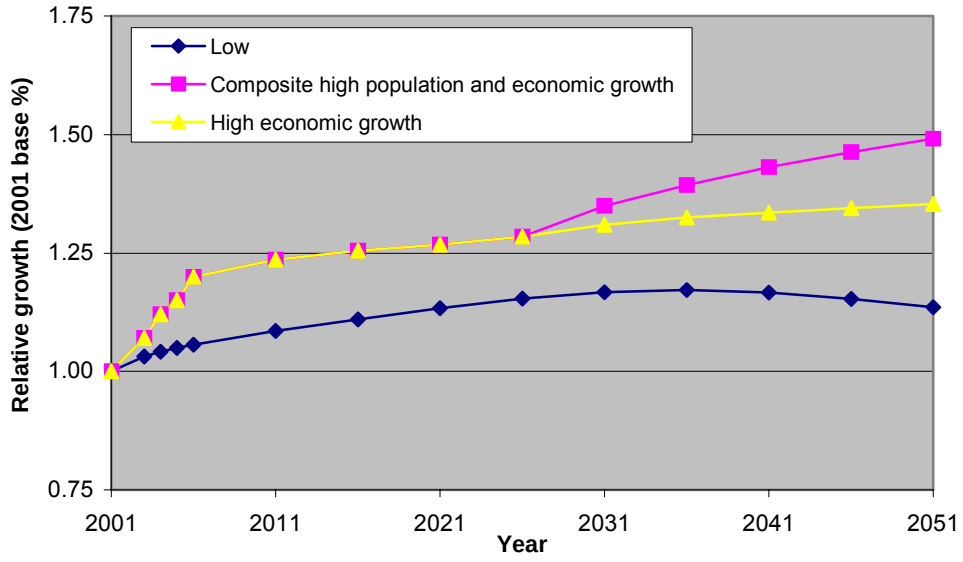
Figure 2.3.1a: Normalised growth projections for the period 2001 to 2051, community and domestic use types



Growth scenarios for industry/commercial and tourism/recreation use types

The growth scenarios used for industrial and tourism are a combination of the Statistics New Zealand growth curves and independent data on economic growth. The economic growth data may be more representative of the way in which industry and tourism activities will grow differently from domestic population. Economic growth data was assessed from the "high production" growth scenario of the agriculture production input–output analysis supplied in the regional economic analysis of use of water from the Waitaki Catchment (Harris Consulting et al, 2004). We have assumed that demand for water is proportional to economic growth.

Figure 2.3.1b: Normalised growth projections for the period 2001 to 2051, industrial and tourism use types



The low projection was assumed to be the Statistics New Zealand projection based on low fertility, high mortality and low immigration estimates (series 1). The medium projection was a curve developed from the economic development data. The high growth projection was assumed to be a composite curve of the maximum values for the economic development data and the Statistics New Zealand population projections based on medium fertility, mortality and immigration (series 6).

2.4 Summary of demand inputs and outputs

Summary of demands calculated by Method 1: Assessment of Resource Consent Data plus Private Potable Takes can be found in:

- Appendix A. Potential water demands from significant catchments – consents data.

Summary of demands calculated by Method 2: Assessment of Recorded Flow and Population Data plus Private Potable Takes can be found in:

- Appendix B. Potential water demands including out-of-catchment – recorded flow and population data.

3 Discussions and Interviews Summary

3.1 Territorial local authority discussions

The territorial local authority interviews provided the bulk of the information for evaluating the existing and future water demand types, including their approximate locations.

Mackenzie, Waimate and Waitaki district councils preside over the Waitaki Catchment itself. However significant existing and future water demands are likely to originate out-of-catchment. These areas are administered by councils further a field such as Timaru District Council and Dunedin City Council. Interviews with these councils have revealed concerns that a number of the communities under their administration are water short presently, or are likely to be water short in the future.

The majority of our discussions with territorial local authorities suggest that formal investigations of regional water sources are ongoing. A better understanding of future water requirements at a community level will be established after the Water and Sanitary Services Assessment required by the Local Government Act. This assessment is due for completion prior to June 2005.

A number of territorial local authorities have established, either by formal planning or from in-house knowledge, that their existing water sources will be adequate for the next 10–35 years Beyond those times to the project horizon of 2051, reliable estimates of future demands have not been established. Where councils have identified a future need or are uncertain if a need will arise, access to a Waitaki water source is preferred. The central issues identified by councils as a result of the interviews have been summarised below.

Discussions with both Otago and Canterbury regional councils were helpful in establishing where alternative water supply sources to the Waitaki River may exist.

The principal data sources collected from the councils (where available) were based upon a review of:

- district and regional economic development strategies
- asset management plans
- community outcomes and long-term council community plans
- tourism development planning
- liaison with other tourism and development interests
- recorded flow and consumer data (where available).

3.1.1 Mackenzie District Council

Documents provided by the Mackenzie District Council that were reviewed have been listed in the references section of this report. These documents were used to determine the location of council municipal and rural water supplies and to establish other significant water demanding activities that are likely in the future.

The Mackenzie District Council was able to provide actual flow data for the two town supplies in the catchment (Twizel and Tekapo) and this enabled us to identify both the summer peak and total annual demands.

The information listed below is a compilation of the summarised interview notes and relevant points raised in the documentation reviewed. From these we have established that increased future water demand is likely to result from:

- continued subdivision development for holiday homes and tourist accommodation and supporting industries
- continued development of adventure tourism-based activities and other seasonal events such as the Maadi Cup rowing regatta (especially around Twizel)
- establishment of limited olive and/or wine producers around MacKenzie Basin
- a 1000 bed holiday accommodation at Pukaki is likely to be established in the next 15 to 30 years
- further development of forestry within the district is likely. This may be a council led initiative and planting estimates of 1000 hectares per 10-year cycle has been suggested. This rate of planting may continue to a maximum of 3000 hectares in approximately a 30-year timeframe.

3.1.2 Timaru District Council

The Timaru district is outside the Waitaki Catchment and information provided by the Timaru District Council (TDC) has been used to assess whether out-of-catchment demands are likely, and to comment on the most probable growth industries.

Documents provided by the council that were reviewed have been listed in the references section of this report. These documents were used as a reference for future growth trends in the South Canterbury area.

The information listed below is a compilation of the summarised interview notes and relevant points raised in the documentation reviewed. From these we have established that increased future water demand is likely to result from:

- using water from the Waitaki Rivers as a possible future source of water for the communities of Geraldine, Temuka and Pleasant Point and three other rural schemes that the council administers. This would depend upon demand growth of these communities and the further development of irrigation schemes from Opuha dam. The reasoning behind the link with irrigation is that of economics, as water available from an upland water race is preferred over pumping schemes
- upon reviewing the council's population growth forecasts, however, there is no significant growth predicted in the short to medium term

- enhancement of land productivity and development of primary production industries in the short term (development of existing vegetable and dairy industries), with intensified development of horticultural and functional foods processing industries in the medium to long term.

Recorded annual flows and peak demands from the Timaru District Council activity management plan (water) were useful for confirming per person flows and peaking factors applied to other coastal townships.

To some extent growth in the above areas will depend on additional irrigation schemes in South Canterbury and, as such, a quantitative assessment of industry growth will be very subjective.

Aoraki Development Trust (ADT) is a subsidiary business unit of the Timaru District Council and provided economic development information for this report. Some of its statements are listed below:

- To maximise the potential for economic growth, the amount of water allocated to a geographical area must leave room for land use changes that will occur in the future, such as conversion of arable land to dairy and horticulture. These land use changes will make it possible for the development of additional (wet) food processing industries. From a regional perspective, Aoraki Development Trust would like to see South Canterbury's "options left open" with respect to having water available for these processing industries.
- South Canterbury's economic growth has been two to four times the national average in recent years and this trend is expected to continue.
- Population growth is likely to mirror economic growth. This suggests that the Statistics New Zealand local growth projections may understate potential growth and is one of the reasons for adopting the New Zealand national population growth projections.
- ADT is about to commission an economic development study to determine the effect of Opuha dam and irrigation on the South Canterbury economy. This study may be useful to determine changes in water demand from processing and related industries.

3.1.3 Waimate District Council

Documents provided by the Waimate District Council that were reviewed have been listed in the references section of this report. These documents were used to determine the location of council municipal and rural water supplies and to establish other significant water demanding activities that are likely in the future.

Waimate District Council was able to provide actual flow data for the two council administered rural supplies in the catchment (Waikakahi and Lower Waihao) and the community of Waimate itself. This enabled us to identify both the summer peak and total annual demands. Two private schemes are shown in the Hakataramea Valley (Hakataramea and Cattle Creek); however no operational information for these schemes was collected.

The information listed below is a compilation of the summarised interview notes and relevant points raised in the documentation reviewed. From these we have established that increased future water demand is likely to result from:

- similar growth industries as outlined by the Aoraki Development Trust (see Timaru District overview above); specifically, further growth of the vegetable processing and dairy industries
- private speculation in the Hakataramea for viticulture has prompted the council to recognise this as a possible future industry
- council believes dairy industries that are currently taking over pastoral land will ultimately lead to development of horticulture and will require dramatic increases in the water required for stock.

To some extent, growth in the above areas will depend on additional irrigation schemes in South Canterbury and as such, a quantitative assessment of industry growth will be very subjective.

The council also raised some of its concerns and raised some of the following issues:

- The council is concerned that Waimate groundwater bores may be hydraulically connected to the Waitaki River and that these may be subject to restrictions in the future. The management plan put in place by the board should provide a mechanism to allow for changing water needs and use within a district.
- Should Timaru District seek to take further water from the Waimate region in the future, will this limit the water available for development in the Waimate District?

3.1.4 Waitaki District Council

Additional and revised comments have been requested by the council following a review of the draft report. Revisions are shown in italics.

Documents provided by the council that were reviewed have been listed in the references section of this report. These documents were used to determine the location of council municipal and rural water supplies and to establish other significant water demanding activities that are likely in the future.

Waitaki District Council administers 23 public water schemes of which four community and two rural supply schemes are within the Waitaki Catchment. These are located at Lake Ohau, Kurow, Omarama, Otematata, Duntroon and Lower Waitaki. The council provided estimated flow information that was generally consistent with the demands calculated for other communities within the catchment such as Twizel and Waimate.

The information listed below is a compilation of the summarised interview notes and relevant points raised in the documentation reviewed. From these we have established that increased future water demand is likely to result from:

- Similar growth industries as outlined by the Aoraki Development Trust
- *Irrigation schemes for the Waitaki downlands and the upper catchment will promote economic growth and create additional demand for water both on-farm and in local service centres. Such schemes are proposed by the North Otago Irrigation Company (18,500 ha) and irrigation above Benmore (8000 ha).*

The council believes that horticulture industries that are currently being developed in Oamaru (Nikken Seil Co Ltd) will continue at the expense of the existing pastoral land use.

To some extent, growth in the above areas will depend on additional irrigation schemes in North Otago and as such, a quantitative assessment of industry growth will be very subjective.

Tourism and conference commercial activities may be attracted to the region (especially Oamaru) with development of the heritage areas.

The council believes that there is an increasing demand for property as holiday homes and for recreational activities in the upper catchment. This trend is also evident south of Oamaru where there is significant demand for subdivision development.

The council also raised some of its concerns and the following issues:

- Many of the existing supply schemes are having difficulty gaining resource consents for expanding capacity and this is preventing subdivision development.
- *Recent responses from the regional councils (Otago Regional Council and Environment Canterbury) regarding increasing water takes have indicated that additional quantities may not be able to be guaranteed. This is a serious management problem and has lead the council to refuse expansion of some schemes.*
- *The council believes that many previous studies regarding land development potential have not considered areas south of the Waitaki River to the same extent as areas to the north.*
- Due to the semi-arid climate of the Otago interior and the lack of further water allocation, it is likely that development of communities south of Oamaru will depend on water from the Waitaki river.
- Desalination *is considered to be an impractical and very expensive alternative* water source and is unlikely to be economic.
- The council believes that their existing water take from the Lower Waitaki Irrigation Company (LWIC) scheme is adequate to supply the Oamaru community for a further 10 years. *Additional water will be required to supply the communities of Kakanui, Maheno and Weston.*
- The council's broad estimate of the water required to supply the district communities (inside and outside the Waitaki River catchment) and communities in the Dunedin City district (Waikouaiti, Warrington, Waitati and Dunedin City) is 10 cumecs. The figure of 10 cumecs includes demands for stock water. Figure 2.2.1a in Section 2 suggests that consented flows for stock water may exceed community, industrial, tourism demands by approximately 10 times.
- The council is in the process of completing its water and sanitary services assessments required under the Local Government Act 2002; this includes estimating district water requirements from the Waitaki Catchment.
- *The council also intends to investigate viable strategies of meeting the projected demand including better water management techniques.*

3.1.5 Dunedin City Council

The Dunedin City district is well to the south of the Waitaki Catchment and information provided by the council has been used to assess whether out-of-catchment demands are likely.

Documents provided by the council have been listed in the references section of this report. These documents were used as a reference for future growth trends in the Dunedin area.

The information listed below is a compilation of the summarised interview notes and relevant points raised in the documentation reviewed. From these we have established the following:

- Dunedin has an established process for determining its future water demands and existing supply sources are thought to be relatively secure with capacity likely to be sufficient for the projected 50-year period.
- The need for an alternative water source would further increase security of supply (ie, to prevent summer drought shortages), and likely alternative supplies to be investigated could be:
  - Lake Mahinerangi (approximately 30 km distance from Dunedin)
  - Clutha River at Balclutha (approximately 75 km distance from Dunedin)
  - Waitaki River via State Highway 1 (approximately 130 km distance from Dunedin)
  - desalination.

Water shortages or treatment issues may arise in the future that will have to be considered. Presently the council is investigating options to supply treated water to the northern communities of Waitati, Warrington, Karitane and Waikouaiti. Options may be to supply from Dunedin's existing water treatment plants (WTP) or, if available, a Waitaki water source from the north.

The northern communities are likely to require additional water for the projected population growth and industrial uses. Review of Otago Regional Council water allocation information shows that ground and surface water is very limited in the area and that reduction of consent flows may be encouraged in the future. These reductions will be in order to increase stream health below the existing raw water intakes. If these communities required treated water from a piped source then a pipeline from Dunedin appears logical.

Alternatively a pipeline could be extended from the Waitaki River (or in conjunction with irrigation such as the proposed Downlands scheme). This may rely on a joint venture with Waitaki District Council to serve the Waitaki district's southern communities. This alternative may require additional treatment infrastructure and may be less favourable hydraulically given the large distances and the potentially large capital infrastructure costs.

When considering this information in light of the present location of council infrastructure (namely water treatment plants in the city's south west) it seems unlikely that Dunedin City would use the Waitaki as a source to ensure security of supply.

3.1.6 Otago and Canterbury Regional Councils (ORC and ECan)

The regional councils have been an invaluable source of information regarding regional water policy objectives, water availability and current projects to establish water availability.

3.2 Industry, commerce, tourism and recreation discussions

3.2.1 Industry and commerce

The most significant off-farm 'wet' industries were identified as:

- milk and dairy processing
- meat works and meat processing
- vegetable, food processing and horticulture.

Phone discussions with representatives from the dairy and meat processing industries were documented. Because the vegetable, food processing and horticulture sector is so diverse it was not possible to find a single representative industry to derive useful comments from. It may be appropriate to carry out a further study to establish industry specific water demand trends for this sector.

The discussions held were useful to determine the typical yearly demand regimes and the expected future growth of the respective industry. Documents provided by industry representatives and those researched independently that were reviewed have been listed in the references section of this report.

The information listed below is a compilation of the summarised interview notes and relevant points raised in the documentation reviewed. From these we have established the following.

Locations of significant wet industries

Very little industry is actually located within the Waitaki Catchment itself and most processing occurs on the Otago and Canterbury downlands, which are closer to the trade centres of Timaru and Oamaru. There is one exception to this rule, the freezing works at Pukeuri located near the catchment's southern boundary on State Highway 1.

Meat works and meat processing

The operating season for meat processing is very site specific. Plant operating seasons throughout New Zealand may vary from just a few months over the summer to year-round operations at varying proportions of total plant capacity. The length of operating season depends on climatic conditions, species of animal being processed and market requirements (including food safety and client requirements). Meat processing plants close to the Waitaki Catchment operate almost year-round, processing multiple species and a winter kill. It is likely that meat processing plants located close to the Waitaki Catchment will have similar seasonal operating profiles.

Although the industry is constantly looking at ways to reduce water use in its operations, gains made are often offset by the need to meet regulatory requirements administered by NZFSA-VA and overseas customer requirements relating to food safety and hygiene.

Milk and dairy processing

The operating season for dairy processing is more uniform across New Zealand plants. The operating season may generally range from eight to 10 months beginning in August/September. Peak capacity may be achieved by late October and continue until February/March. The main factors affecting water consumption are the type of products and the processes used. For example cheese production is far more water intensive than milk powder production, which actually creates relatively clean water that can be employed for other uses.

If the milk and dairy processing industry were to expand operations in the future it is likely that less water would be used per tonne of product. This is likely if the production of milk powder continues to expand in preference to cheese and other water intensive dairy products. However, given that it is relatively uncertain to what degree the existing processes may change, a conservative approach to future water demand growth is appropriate. For the purposes of this report we will assume that minimal water efficiencies will be gained as plants expand in the future and that the water required per tonne of product may reduce by up to 10 percent in the long term.

Charts of indicative seasonal operating profiles for the meat and dairy processing industries are shown in Appendix D.

3.2.2 Tourism and recreation

Much of the tourism and recreation activities will use water from community and domestic supplies. Therefore increased tourism in the Waitaki Catchment will most likely result in some additional demand from communities, especially around the lakes and west of Kurow. However this will probably be in much the same relative proportions as is already being accounted for in total community demand.

Snow making is the largest consumer of water for the tourism and recreation sector outside of community and domestic reticulated schemes. Discussions were not held with local operators; however some general details of snow making in New Zealand are listed below. These details have been used to generate seasonal patterns of demand.

- Snow making is used as a secure means of providing snow during the season and as a means to extend the length of operation. Earlier opening dates can be achieved by supplementing natural snow with snow making during June and July. This then translates into later closing dates in September and October.
- Snow making can theoretically operate throughout the season whenever temperatures allow; however this is not necessary when natural snow is abundant.

A diagram of the indicative seasonal operating profile for the predominant tourism/recreation use (snow making) is shown in Appendix D.

4 Water Conservation

4.1 Community and domestic users

Water conservation for community and domestic supply relate to initiatives that either:

- reduce the amount of water required by the end consumer or
- reduce the amount of water lost from the reticulated network (non revenue water or leakage).

With reference to Table 2.2. Typical Breakdown of Demand, in Section 2.2.2.2, this table illustrates that on an average demand day some of the most significant water uses are from domestic demand (35 percent) and leakage (20 percent). However these two uses have the potential to be significantly larger as described in the following paragraphs.

During a hot/dry summer the water demand will reach a peak similar to the peak day demand, approximately 2.5 times higher than average. This additional demand is primarily due to hosepipes for garden watering and cleaning. At these times domestic demand may grow to 75 percent or greater. The means of conserving water from this type of use are generally water use restrictions. Some forms of drip irrigation may be effective in reducing the overall water used for garden watering; however these technologies have a capital cost to be borne by the home owner and they must be maintained.

Leakage or non-revenue water is the other significant demand that can be minimised. Depending upon the state of the infrastructure this may represent between 20 to 50 percent of the total demand. Small communities are unlikely to have reticulated networks requiring sophisticated waste minimisation strategies such as pressure management and active flow control systems. Leak detection and maintenance of infrastructure is likely to be the only practical measure that can be applied. Most local authorities will have some form of leak detection and asset maintenance plan already in place.

The water and sanitary services assessment due to be completed by councils in June 2005 may allow councils to determine the amount of wastage currently experienced in their communities.

4.2 Industry, commerce, tourism and recreation

Increased industrial water use efficiency may be achieved by:

- improvements in process technology as new capacity is added to existing plants or new plants are established
- company internal wastewater minimisation policies and environmental audits require a more stringent compliance standard
- voluntary waste minimisation processes that provide an economic advantage either due to cost of raw materials that can be recovered or a secondary product market is found for waste products
- increasing the amount of water reuse within the process or treated water being used for other applications such as municipal supply or irrigation.

Limitations to the degree of water efficiency may result from:

- difficulty in making existing processes more water efficient, as retrofitting may be prohibitively expensive
- more comprehensive water and waste minimisation techniques may not be justifiable in the present economic environment
- the food processing industry requires a high level of disinfection for compliance with health standards and this limits the applications for water recycling/reuse.

Quality of the end product is a principal health and safety matter that has significant bearing on the amount of water required per tonne of product. Water minimisation strategies incorporating water reuse must ensure that a very high disinfection standard is achieved to prevent contamination. Although disinfection processes are commercially available they are relatively new to New Zealand industrial applications and expensive.

Micro- and ultra-filtration technologies are disinfection processes currently available that may allow some process wastewater streams to be recycled. Principally used for water treatment and supply applications, they are becoming more widely used in New Zealand and are capable of producing potable water from a variety of waste streams. The cost of implementation is also reducing and typical operating costs may range from \$2.00/m^3 to less than \$0.70/m^3 depending on the volume of water being processed.

Most industries using the water volumes required to make ultra-filtration economic will have significant issues with pre-treatment and this will drive the cost of water reuse higher. Pre-treatment processes are required to prevent membrane fouling and optimise efficiency.

Logically there may be the potential for reuse of some very large industry waste streams either within the plant or for municipal supply and irrigation.

5 Results and Recommendations

The tables below show the results from the demand modelling for the various growth scenarios. The tables have been arranged to accommodate data calculated by both estimation Methods 2 and 1 (population/recorded flows and consents). This is indicated where a cell contains a range of values. Where a cell contains a single value, this has been calculated by Method 2 only.

The row designated 'current total' sums the demands within the Waitaki Catchment and the three out of catchment demands that are currently served (Waikakahi and lower Waihao rural schemes and Oamaru).

The row designated 'future out of catchment' incorporates the Timaru and Waitaki districts. While the row designated 'future out of catchment including DCC' represents Dunedin City district.

Because the consents method (Method 1) does not include future out-of-catchment demands, the last 'total' row is a composite total. The 'future out-of-catchment' and 'future out-of-catchment including Dunedin City Council' rows are added to the previous consents total to get the final result.

Table 5.1: Summary of current and projected demands from the Waitaki Catchment (low growth scenarios)

Location of demand	Current peak flow range (flows–consents)[3] (l/s)	Current annual range (flows–consents) (000 m^3/year)	Projected 2051 peak flow range (flows–consents) (l/s)	Projected 2051 annual range (flows–consents) (000 m^3/year)
Current Waitaki[4]	613	8,644	696	9,812
Current out-of-catchment[5]	236	4,094	268	4,646
Current total[6]	**849–1172**	**12,738–13,856**	**964–1330**	**14,459–15,727**
Future out-of-catchment[7]			657	10,112
Future out-of-catchment (including DCC)[8]			100	1,615
Total	**849–1172**	**12,738–13,856**	**1721–2087**	**26,187–27,456**

[3] Where a range is given it indicates that estimates from both recorded flows and consents are included.

[4] Current demand estimated for the Waitaki Catchment only using flow-population data.

[5] Current demand estimated outside the Waitaki Catchment using flow-population data.

[6] Current demand estimated using flow-population data and consents data.

[7] New takes that could be required by Mackenzie, Timaru, Waimate and Waitaki Districts.

[8] New takes that could be required by Dunedin City District.

Table 5.2: Summary by current and projected demands from the Waitaki Catchment (medium growth scenarios)

Location of demand	Current peak flow range (flows–consents) (l/s)	Current annual range (flows–consents) (000 m^3/year)	Projected 2051 peak flow range (flows–consents) (l/s)	Projected 2051 annual range (flows–consents) (000 m^3/year)
Current Waitaki	613	8644	795	11,217
Current out-of-catchment	236	4094	292	5,072
Current total	**849–1172**	**12,738–13,856**	**1087–1484**	**16,289–17,494**
Future out-of-catchment			766	11,751
Future out-of-catchment (including DCC)			113	1,817
Total	**849–1172**	**12,738–13,856**	**1966–2363**	**29,859–31,063**

Table 5.3: Summary of current and projected demands from the Waitaki Catchment (high growth scenarios)

Location of demand	Current peak flow range (flows–consents) (l/s)	Current annual range (flows–consents) (000 m^3/year)	Projected 2051 peak flow range (flows–consents) (l/s)	Projected 2051 annual range (flows–consents) (000 m^3/year)
Current Waitaki	613	8644	915	12,891
Current out-of-catchment	236	4094	352	6,105
Current total	**849–1172**	**12,738–13,856**	**1266–1748**	**18,996–20,663**
Future out-of-catchment			863	13,286
Future out-of-catchment (including DCC)			131	2,122
Total	**849–1172**	**12,738–13,856**	**2261–2743**	**34,405–36,072**

Table 5.4: Summary of peak flows from the Waitaki Catchment (high growth scenarios)

Location of demand	Current peak flow range (flows–consents) (l/s)	Projected 2011 peak flow range (flows–consents) (l/s)	Projected 2021 peak flow range (flows–consents) (l/s)	Projected 2051 peak flow range (flows–consents) (l/s)
Current Waitaki	613	725	770	915
Current out-of-catchment	236	266	293	352
Current total	**849–1172**	**991–1352**	**1063–1463**	**1266–1748**
Future out-of-catchment		699	730	863
Future out-of-catchment (including DCC)		103	110	131
Total	**849–1172**	**1793–2154**	**1903–2303**	**2261–2743**

Table 5.5: Summary by use type within Waitaki Catchment (high growth scenarios – consents data only)

Location of demand	Current peak flow range (flows–consents) (l/s)	Current annual range (flows–consents) (000 m^3/year)	Projected 2051 peak flow range (flows–consents) (l/s)	Projected 2051 annual range (flows–consents) (000 m^3/year)
Industrial/commercial	212.6	3589	317.0	5,352
Tourism	64.0	352	95.4	524
Community	810.0	9930	1208.0	14,808
Private potable	86.0	1081	128.0	1611
Total	**1172.6**	**14952**	**1748.4**	**22,295**

5.1 Discussion of the results

Given the scale of the assessment and diverse nature of potential demands it is difficult to estimate the level of accuracy that has been obtained. Because this project has been undertaken to establish the order of magnitude of demands using available information, we suggest that a relatively wide confidence interval is allowed when interpreting the results. As such an interval of –25% to +50% may be appropriate.

5.1.1 Agreement of estimation methods

The current annual volumes obtained by two methods (consents and recorded flows/population) were 12,738,000 m^3/year and 13,856,000 m^3/year respectively, and these agree to within 8%.

Peak flows by the consents method were approximately 1.4 times higher than by the recorded flow/population method as expected. As discussed in Section 2, this is due to the recorded flow/population method approximation of taking peak day demand to storage over a 24-hour period in contrast to the instantaneous peak demand calculated by summing consent data.

Because we are considering demands from the catchment as a whole, the recorded flow/population method is valid because there will be some averaging that occurs. As a result it is likely that the actual peak flow from the Waitaki Catchment will lie somewhere between the two figures calculated. Hence we have included a range of peak flows in the tables above.

5.1.2 Future Waitaki Catchment demand results

As estimated by this project, the low and high growth scenarios for all areas serviced with water from the Waitaki Catchment may require between 26 million and 36 million cubic metres of water annually for the use types included in the project.

Considering the existing trends of population decline in the Waitaki and adjacent districts these figures rely on a significant change in terms of attracting more people and industries to the region. In the event that this trend does not change, then it may be possible that the future water demand could remain at levels similar to what they are today, around 12 million to 14 million cubic metres annually.

5.1.3 Future out-of-catchment demand results

As stated in Section 3, future out-of-catchment demands were estimated using Method 2: Assessment of recorded flows and population data. Represented by rows four and five in the summary tables 5.1 to 5.3 as 'future out-of-catchment' and 'future out-of-catchment (including DCC)', these demands represent communities and industries that may require water from the Waitaki catchment in the future as expressed by the territorial local authorities.

Considering the low and high growth scenarios, these areas may require between 11.7 million and 15.4 million cubic metres of water annually for the use types included in the project. These estimates are the least certain because of the assumptions that underpin them and these are discussed below.

Future out-of-catchment demands are estimates of the water that could be used if new takes were established from the Waitaki. These takes would service communities within the Mackenzie, Timaru, Waimate and Waitaki districts and Dunedin city that presently do not have access to water from the Waitaki. Examples of the possible nature of supply are:

- supply to the Mackenzie and Timaru districts from Fairlie to Timaru, possibly from a source below Lake Tekapo
- supply to the Waitaki district from Oamaru to Palmerston in the south, possibly from a piped extension of the current Lower Waitaki Irrigation Company scheme
- supply to Dunedin from a similar piped extension of the Lower Waitaki Irrigation Company scheme. It may be more likely that this demand would be supplied from an extension of the Dunedin City Council water supply scheme if it is required.

We have assumed that supplying districts from the Waitaki by some method will be feasible and in the general proportions indicated. Notes regarding how demand was estimated are included in the summary spreadsheets of Appendix B.

5.1.4 Relevant additional research

There are two projects in progress that may provide further information supporting the conclusions and recommendations made in this report. The two projects are:

- Water and Sanitary Services Assessment of Council Water and Wastewater Assets, required under the Local Government Act 2002
- Effect of Irrigation on Economic Development in South Canterbury – Post Construction of Opuha Dam, to be commissioned by Aoraki Development Trust.

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Otago Regional Council

Miscellaneous digital media in the form of compact discs and downloaded documents.

Ministry for the Environment

Miscellaneous digital media in the form of compact discs and downloaded documents.

Applicability

This report has been prepared for the benefit of Ministry for the Environment with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

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Appendix A: Potential water demands from significant catchments – consents data

Summary of demand for significant catchments using consents data (two sheets)

- community and domestic consent summary
- industry and tourism consent summary.

Waitaki Catchment Present and Projected Demands (Industrial and Tourism Sectors Only) - Low, High Economic Growth and Composite High Popn & High EG Growth Scenarios

			Present			Low Growth Estimate						Medium Growth Estimate						High Growth Estimate					
						2011		2021		2051		2011		2021		2051		2011		2021		2051	
Catchment	Total Water use by Sector		Peak Flow (l/s)	Max Volume (m3/yr)	Probable Volume (m3/yr)	Peak Flow (l/s)	Probable Volume (m3/yr)	Peak Flow (l/s)	Probable Volume (m3/yr)	Peak Flow (l/s)	Probable Volume (m3/yr)	Peak Flow (l/s)	Probable Volume (m3/yr)	Peak Flow (l/s)	Probable Volume (m3/yr)	Peak Flow (l/s)	Probable Volume (m3/yr)	Peak Flow (l/s)	Probable Volume (m3/yr)	Peak Flow (l/s)	Probable Volume (m3/yr)	Peak Flow (l/s)	Probable Volume (m3/yr)
1	Industrial & Commercial		0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
	Tourism		38.00	782,195	297,234	41.23	322,514	43.05	336,763	43.13	337,376	46.97	367,389	48.17	376,816	51.44	402,385	46.97	367,389	47.22	376,816	56.67	443,247
2	Industrial & Commercial		10.00	315,360	176,602	10.85	191,622	11.33	200,088	11.35	200,452	12.36	218,284	12.68	223,885	13.54	239,077	12.36	218,284	12.68	223,885	14.91	263,355
	Tourism		0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
3	Industrial & Commercial		0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
	Tourism		0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
4	Industrial & Commercial		0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
	Tourism		0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
5	Industrial & Commercial		0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
	Tourism		0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
6	Industrial & Commercial		15.00	473,040	264,902	16.28	287,433	16.99	300,132	17.03	300,678	18.54	327,426	19.02	335,828	20.31	358,616	18.54	327,426	19.02	335,828	22.37	395,032
	Tourism		14.00	130,305	49,516	15.19	53,727	15.86	56,101	15.89	56,203	17.30	61,203	17.75	62,773	18.95	67,033	17.30	61,203	17.75	62,773	20.88	73,840
7	Industrial & Commercial		0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
	Tourism		0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
8	Industrial & Commercial		0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
	Tourism		0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
9	Industrial & Commercial		0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
	Tourism		0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
10	Industrial & Commercial		0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
	Tourism		0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
11	Industrial & Commercial		14.00	146,000	81,760	15.19	88,714	15.86	92,633	15.89	92,802	17.30	101,058	17.75	103,651	18.95	110,684	17.30	101,058	17.75	103,651	20.88	121,924
	Tourism		0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
12	Industrial & Commercial		0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
	Tourism		0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
13	Industrial & Commercial		0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
	Tourism		0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
14	Industrial & Commercial		173.60	5,475,000	3,066,000	188.36	3,326,768	196.69	3,473,746	197.04	3,480,068	214.57	3,789,657	220.08	3,886,896	235.01	4,150,643	214.57	3,789,657	220.08	3,886,896	258.88	4,572,133
	Tourism		0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
15	Industrial & Commercial		0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
	Tourism		12.00	12,775	4,855	13.02	5,267	13.60	5,500	13.62	5,510	14.83	6,000	15.21	6,154	16.25	6,572	14.83	6,000	15.21	6,154	17.89	7,239
16	Industrial & Commercial		0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
	Tourism		0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
Total Consented Flows By Catchment																							
1	Total for Catchment 1		38.00	782,195	297,234	41.23	322,514	43.05	336,763	43.13	337,376	46.97	367,389	48.17	376,816	51.44	402,385	46.97	367,389	47.22	376,816	56.67	443,247
2	Total for Catchment 2		10.00	315,360	176,602	10.85	191,622	11.33	200,088	11.35	200,452	12.36	218,284	12.68	223,885	13.54	239,077	12.36	218,284	12.68	223,885	14.91	263,355
3	Total for Catchment 3		0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
4	Total for Catchment 4		0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
5	Total for Catchment 5		0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
6	Total for Catchment 6		29.00	603,345	314,418	31.47	341,160	32.86	356,233	32.92	356,881	35.84	388,629	36.76	398,601	39.26	425,648	35.84	388,629	36.76	398,601	43.25	468,872
7	Total for Catchment 7		0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
8	Total for Catchment 8		0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
9	Total for Catchment 9		0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
10	Total for Catchment 10		0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
11	Total for Catchment 11		14.00	146,000	81,760	15.19	88,714	15.86	92,633	15.89	92,802	17.30	101,058	17.75	103,651	18.95	110,684	17.30	101,058	17.75	103,651	20.88	121,924
12	Total for Catchment 12		0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
13	Total for Catchment 13		0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
14	Total for Catchment 14		173.60	5,475,000	3,066,000	188.36	3,326,768	196.69	3,473,746	197.04	3,480,068	214.57	3,789,657	220.08	3,886,896	235.01	4,150,643	214.57	3,789,657	220.08	3,886,896	258.88	4,572,133
15	Total for Catchment 15		12.00	12,775	4,855	13.02	5,267	13.60	5,500	13.62	5,510	14.83	6,000	15.21	6,154	16.25	6,572	14.83	6,000	15.21	6,154	17.89	7,239
16	Total for Catchment 16		0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
72	**Total Projected Consent Flows By Year for All Catchments**																									
73	Present	2001 - 2004	Peak Flow		276.60		(l/s)																			
74			Max Annual		7,334,675		(m3/year)																			
75			Probable Annual		3,940,869		(m3/year)																			
76	Low Growth	2011	Peak Flow		300.13		(l/s)																			
77			Probable Annual		4,276,045		(m3/year)																			
78		2021	Peak Flow		313.38		(l/s)																			
79			Probable Annual		4,464,963		(m3/year)																			
80		2051	Peak Flow		313.96		(l/s)																			
81			Probable Annual		4,473,089		(m3/year)																			
82	Medium Grow	2011	Peak Flow		341.88		(l/s)																			
83			Probable Annual		4,871,018		(m3/year)																			
84		2021	Peak Flow		350.66		(l/s)																			
85			Probable Annual		4,996,004		(m3/year)																			
86		2051	Peak Flow		374.45		(l/s)																			
87			Probable Annual		5,335,009		(m3/year)																			
88	High Growth	2011	Peak Flow		341.88		(l/s)																			
89			Probable Annual		4,871,018		(m3/year)																			
90		2021	Peak Flow		349.70		(l/s)																			
91			Probable Annual		4,996,004		(m3/year)																			
92		2051	Peak Flow		412.48		(l/s)																			
93			Probable Annual		5,876,769		(m3/year)																			
94																										
95																										
96																										
97																										
98	Note that industrial & commercial stated above is only for independently consented operations NOT on town supply.																									
99	Large Commercial is more or less indistinguishable from Industrial (ie small operations are likely to occur in townships)																									

Waitaki Catchment Present and Projected Demands (Community & Domestic Sectors Only) - Low, Medium & High Growth Scenarios

				Present			Low Growth Estimate						Medium Growth Estimate						High Growth Estimate					
							2011		2021		2051		2011		2021		2051		2011		2021		2051	
Catchment	Total Water use by Sector			Peak Flow (l/s)	Max Volume (m3/yr)	Probable Volume (m3/yr)	Peak Flow (l/s)	Probable Volume (m3/yr)	Peak Flow (l/s)	Probable Volume (m3/yr)	Peak Flow (l/s)	Probable Volume (m3/yr)	Peak Flow (l/s)	Probable Volume (m3/yr)	Peak Flow (l/s)	Probable Volume (m3/yr)	Peak Flow (l/s)	Probable Volume (m3/yr)	Peak Flow (l/s)	Probable Volume (m3/yr)	Peak Flow (l/s)	Probable Volume (m3/yr)	Peak Flow (l/s)	Probable Volume (m3/yr)
1	Municipal			30.00	439,460	439,460	32.55	476,837	33.99	497,904	34.05	498,810	32.85	481,141	34.84	510,363	37.17	544,455	33.84	495,638	37.28	546,040	44.74	655,339
	Private Potable			1.98	62,441	24,977	2.15	27,101	2.24	28,298	2.25	28,350	2.17	27,345	2.30	29,006	2.45	30,944	2.23	28,169	2.46	31,034	2.95	37,246
2	Municipal			35.69	1,156,685	578,343	38.73	627,531	40.44	655,256	40.51	656,449	39.08	633,196	41.45	671,652	44.22	716,519	40.25	652,275	44.35	718,605	53.22	862,446
	Private Potable			1.32	41,628	16,651	1.43	18,067	1.50	18,865	1.50	18,900	1.45	18,230	1.53	19,337	1.64	20,629	1.49	18,780	1.64	20,689	1.97	24,831
3	Municipal			55.00	1,292,830	646,415	59.68	701,394	62.31	732,382	62.43	733,714	60.22	707,724	63.87	750,708	68.14	800,855	62.03	729,049	68.34	803,187	82.02	963,958
	Private Potable			0.79	24,977	9,991	0.86	10,840	0.90	11,319	0.90	11,340	0.87	10,938	0.92	11,602	0.98	12,378	0.89	11,268	0.98	12,414	1.18	14,898
4	Municipal			15.00	473,040	236,520	16.28	256,636	16.99	267,975	17.03	268,462	16.42	258,953	17.42	274,680	18.58	293,029	16.92	266,756	18.64	293,882	22.37	352,707
	Private Potable			0.40	12,488	4,995	0.43	5,420	0.45	5,660	0.45	5,670	0.43	5,469	0.46	5,801	0.49	6,189	0.45	5,634	0.49	6,207	0.59	7,449
5	Municipal			0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
	Private Potable			0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
6	Municipal			4.00	109,865	54,933	4.34	59,605	4.53	62,238	4.54	62,351	4.38	60,143	4.65	63,795	4.96	68,057	4.51	61,955	4.97	68,255	5.96	81,917
	Private Potable			0.66	20,814	8,326	0.72	9,034	0.75	9,433	0.75	9,450	0.72	9,115	0.77	9,669	0.82	10,315	0.74	9,390	0.82	10,345	0.98	12,415
7	Municipal			0.69	7,300	3,650	0.75	3,960	0.78	4,135	0.78	4,143	0.76	3,996	0.80	4,239	0.85	4,522	0.78	4,117	0.86	4,535	1.03	5,443
	Private Potable			3.17	99,906	39,962	3.44	43,361	3.59	45,277	3.60	45,359	3.47	43,753	3.68	46,410	3.92	49,510	3.57	45,071	3.94	49,654	4.72	59,593
8	Municipal			99.00	4,744	2,372	107.42	2,574	112.17	2,688	112.37	2,692	108.39	2,597	114.97	2,755	122.65	2,939	111.66	2,675	123.01	2,947	147.63	3,537
	Private Potable			0.79	24,977	9,991	0.86	10,840	0.90	11,319	0.90	11,340	0.87	10,938	0.92	11,602	0.98	12,378	0.89	11,268	0.98	12,414	1.18	14,898
9	Municipal			0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
	Private Potable			0.79	24,977	9,991	0.86	10,840	0.90	11,319	0.90	11,340	0.87	10,938	0.92	11,602	0.98	12,378	0.89	11,268	0.98	12,414	1.18	14,898
10	Municipal			60.00	1,892,014	946,007	65.10	1,026,466	67.98	1,071,816	68.10	1,073,767	65.69	1,035,731	69.68	1,098,636	74.34	1,172,025	67.67	1,066,940	74.55	1,175,438	89.47	1,410,721
	Private Potable			2.77	87,418	34,967	3.01	37,941	3.14	39,617	3.15	39,689	3.03	38,284	3.22	40,609	3.43	43,321	3.13	39,437	3.44	43,448	4.13	52,144
11	Municipal			205.50	5,332,869	2,666,435	222.98	2,893,219	232.83	3,021,043	233.25	3,026,541	224.99	2,919,333	238.66	3,096,638	254.60	3,303,492	231.77	3,007,298	255.34	3,313,114	306.45	3,976,286
	Private Potable			5.54	174,836	69,934	6.02	75,882	6.28	79,235	6.29	79,379	6.07	76,567	6.44	81,217	6.87	86,643	6.25	78,874	6.89	86,895	8.27	104,289
12	Municipal			49.00	1,081,860	540,930	53.17	586,937	55.52	612,868	55.62	613,983	53.65	592,235	56.91	628,204	60.71	670,168	55.26	610,080	60.88	672,119	73.07	806,655
	Private Potable			3.96	124,883	49,953	4.30	54,202	4.49	56,596	4.49	56,699	4.34	54,691	4.60	58,012	4.91	61,888	4.47	56,339	4.92	62,068	5.91	74,492
13	Municipal			63.38	1,659,655	829,828	68.77	900,406	71.81	940,186	71.94	941,897	69.39	908,533	73.61	963,712	78.52	1,028,088	71.48	935,909	78.75	1,031,082	94.51	1,237,470
	Private Potable			8.71	274,742	109,897	9.45	119,244	9.87	124,512	9.89	124,738	9.54	120,320	10.12	127,627	10.79	136,153	9.83	123,945	10.82	136,549	12.99	163,882
14	Municipal			65.83	1,999,799	999,899	71.43	1,084,942	74.58	1,132,876	74.72	1,134,937	72.07	1,094,735	76.45	1,161,223	81.56	1,238,793	74.25	1,127,721	81.80	1,242,401	98.17	1,491,087
	Private Potable			47.39	1,494,428	597,771	51.42	648,613	53.69	677,269	53.79	678,501	51.88	654,467	55.03	694,216	58.71	740,589	53.45	674,187	58.88	742,746	70.67	891,419
15	Municipal			25.00	750,440	375,220	27.13	407,133	28.32	425,120	28.38	425,894	27.37	410,808	29.03	435,758	30.97	464,867	28.20	423,186	31.06	466,221	37.28	559,542
	Private Potable			6.34	199,812	79,925	6.87	86,723	7.18	90,554	7.19	90,719	6.94	87,505	7.36	92,820	7.85	99,020	7.15	90,142	7.87	99,309	9.45	119,187
16	Municipal			102.19	3,220,468	1,610,234	110.88	1,747,187	115.78	1,824,379	115.99	1,827,699	111.88	1,762,957	118.68	1,870,029	126.60	1,994,947	115.25	1,816,078	126.97	2,000,757	152.39	2,401,241
	Private Potable			1.06	33,302	13,321	1.15	14,454	1.20	15,092	1.20	15,120	1.16	14,584	1.23	15,470	1.31	16,503	1.19	15,024	1.31	16,551	1.57	19,864
Total Consented Flows By Catchment																								
1	Total for Catchment 1			31.98	501,901	464,437	34.70	503,938	36.23	526,202	36.30	527,159	35.01	508,486	37.14	539,369	39.62	575,399	36.07	523,808	39.74	577,074	47.69	692,585
2	Total for Catchment 2			37.01	1,198,313	594,994	40.16	645,599	41.93	674,122	42.01	675,348	40.52	651,426	42.98	690,990	45.85	737,148	41.74	671,055	45.99	739,295	55.19	887,276
3	Total for Catchment 3			55.79	1,317,807	656,406	60.54	712,234	63.21	743,701	63.33	745,054	61.08	718,663	64.79	762,310	69.12	813,232	62.92	740,317	69.32	815,601	83.20	978,856
4	Total for Catchment 4			15.40	485,528	241,515	16.71	262,057	17.44	273,634	17.48	274,132	16.86	264,422	17.88	280,481	19.07	299,218	17.36	272,389	19.13	300,089	22.96	360,157
5	Total for Catchment 5			0.00	0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
6	Total for Catchment 6			4.66	130,679	63,258	5.06	68,638	5.28	71,671	5.29	71,801	5.10	69,258	5.41	73,464	5.77	78,371	5.26	71,345	5.79	78,600	6.95	94,333
7	Total for Catchment 7			3.86	107,206	43,612	4.19	47,322	4.37	49,412	4.38	49,502	4.22	47,749	4.48	50,649	4.78	54,032	4.35	49,188	4.79	54,190	5.75	65,036
8	Total for Catchment 8			99.79	29,721	12,363	108.28	13,414	113.06	14,007	113.27	14,032	109.26	13,535	115.89	14,357	123.63	15,316	112.55	13,943	123.99	15,361	148.81	18,436
9	Total for Catchment 9			0.79	24,977	9,991	0.86	10,840	0.90	11,319	0.90	11,340	0.87	10,938	0.92	11,602	0.98	12,378	0.89	11,268	0.98	12,414	1.18	14,898
10	Total for Catchment 10			62.77	1,979,432	980,974	68.11	1,064,407	71.12	1,111,434	71.25	1,113,456	68.73	1,074,015	72.90	1,139,245	77.77	1,215,346	70.80	1,106,377	78.00	1,218,886	93.61	1,462,865
11	Total for Catchment 11			211.04	5,507,705	2,736,369	228.99	2,969,101	239.11	3,100,278	239.55	3,105,920	231.06	2,995,901	245.09	3,177,855	261.47	3,390,135	238.02	3,086,173	262.23	3,400,009	314.72	4,080,575
12	Total for Catchment 12			52.96	1,206,743	590,883	57.46	641,139	60.00	669,464	60.11	670,683	57.98	646,926	61.50	686,216	65.61	732,055	59.73	666,419	65.80	734,187	78.98	881,147
13	Total for Catchment 13			72.09	1,934,397	939,724	78.22	1,019,649	81.68	1,064,698	81.83	1,066,635	78.93	1,028,853	83.72	1,091,339	89.32	1,164,241	81.31	1,059,854	89.58	1,167,631	107.51	1,401,352
14	Total for Catchment 14			113.22	3,494,226	1,597,670	122.85	1,733,555	128.27	1,810,144	128.51	1,813,438	123.96	1,749,202	131.48	1,855,439	140.27	1,979,382	127.69	1,801,909	140.68	1,985,147	168.83	2,382,505
15	Total for Catchment 15			31.34	950,252	455,145	34.00	493,856	35.50	515,674	35.57	516,613	34.31	498,313	36.39	528,578	38.82	563,887	35.34	513,328	38.94	565,529	46.73	678,729
16	Total for Catchment 16			103.25	3,253,770	1,623,555	112.03	1,761,641	116.98	1,839,471	117.19	1,842,818	113.04	1,777,541	119.90	1,885,499	127.91	2,011,451	116.44	1,831,102	128.29	2,017,309	153.96	2,421,105

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
72	**Total Projected Consent Flows By Year for All Catchments**																							
73	Present	2001 - 2004	Peak Flow		895.95		(l/s)																	
74			Max Annual		22,122,655		(m3/year)																	
75			Probable Annual		11,010,895		(m3/year)																	
76	Low Growth	2011	Peak Flow		972.15		(l/s)																	
77			Probable Annual		11,947,388		(m3/year)																	
78		2021	Peak Flow		1,015.10		(l/s)																	
79			Probable Annual		12,475,230		(m3/year)																	
80		2051	Peak Flow		1,016.95		(l/s)																	
81			Probable Annual		12,497,933		(m3/year)																	
82	Medium Grow	2011	Peak Flow		980.92		(l/s)																	
83			Probable Annual		12,055,227		(m3/year)																	
84		2021	Peak Flow		1,040.50		(l/s)																	
85			Probable Annual		12,787,395		(m3/year)																	
86		2051	Peak Flow		1,110.01		(l/s)																	
87			Probable Annual		13,641,591		(m3/year)																	
88	High Growth	2011	Peak Flow		1,010.48		(l/s)																	
89			Probable Annual		12,418,473		(m3/year)																	
90		2021	Peak Flow		1,113.24		(l/s)																	
91			Probable Annual		13,681,321		(m3/year)																	
92		2051	Peak Flow		1,336.07		(l/s)																	
93			Probable Annual		16,419,855		(m3/year)																	
94																								
95																								
96																								
97																								
98	Note that industrial & commercial stated above is only for independently consented operations NOT on town supply.																							
99	Large Commercial is more or less indistinguishable from Industrial (ie small operations are likely to occur in townships)																							

Appendix B: Potential water demands including out-of-catchment – recorded flow and population data

(Demands originating from the Waitaki Catchment and surrounding districts)

- Summary of current demands from community/domestic and industry/tourism (two sheets)
- Projected demands from community/domestic and industry/tourism (two sheets).

Demands from Community and Domestic Consumers (Base Year 2001)									
Notes	Township	Population	Calculated Current Demand		Recorded	Recorded	Estimated	Peaking factors	
		Base 2001	Peak Flow (l/s)	Annual Demand (m3/yr)	flows?	ADF	ADF	ADF	PDF
					Yes/No	(l/s/p)	(l/s/p)		
	Waitaki catchment								
Census	Mt Cook	234	17.04	295472	No		0.0364	1.10	2.00
Census	Tekapo	303	22.06	382599	Yes	0.0364		1.10	2.00
Census	Pukaki	14	1.02	13161	No		0.0271	1.10	2.70
Census	Twizel	1011	73.97	950429	Yes	0.0271		1.10	2.70
Census	Lake Ohau	50	3.66	47004	No		0.0271	1.10	2.70
Census	Omarama	279	20.41	262285	No		0.0271	1.10	2.70
Census	Otematata	243	17.78	228441	No		0.0271	1.10	2.70
Census	Aviemore	270	19.76	253824	No		0.0271	1.10	2.70
Census	Lake Waitaki	270	19.76	253824	No		0.0271	1.10	2.70
Census	Kurow	387	28.32	363814	No		0.0271	1.10	2.70
Census	Duntroon	120	6.00	83255	No		0.0200	1.10	2.50
Estimate	Glenavy	50	2.50	34690	No		0.0200	1.10	2.50
Estimate	Lower Waitaki	50	2.50	34690	No		0.0200	1.10	2.50
Census	Pukeuri	183	9.15	126964	No		0.0200	1.10	2.50
derived from LINZ	Mackenzie Distri	195	9.75	135289	No		0.0200	1.10	2.50
derived from LINZ	Waitaki District	870	43.50	603599	No		0.0200	1.10	2.50
derived from LINZ	Waimate District	454	11.35	157491	No		0.0100	1.10	2.50
	Sum:	**4983**	**308.52**	**4226831**					
	North of Catchment								
TDC AMP (50%)	Pleasant Point	610	12.20	211607	Yes	0.0100		1.10	2.00
TDC AMP (50%)	Temuka	2000	35.00	693792	Yes	0.0100		1.10	1.75
TDC AMP (50%)	Geraldine	1150	23.00	398930	Yes	0.0100		1.10	2.00
WDC Dwelling data	Waikakihi	295	5.90	102334	Yes	0.0100		1.10	2.00
WDC Dwelling data	Lower Waihao	422	8.44	146390	Yes	0.0100		1.10	2.00
unknown	Timaru District		0.00	0	No		0.0100	1.10	2.00
	Sum:	**4477**	**84.54**	**1553053**					
	South of Catchment								
Census (100%)	Weston	708	14.16	245602	No		0.0100	1.10	2.00
Census (100%)	Oamaru	11085	221.70	3845342	No		0.0100	1.10	2.00
Census (100%)	Kakanui	411	8.22	142574	No		0.0100	1.10	2.00
Census (100%)	Hampden	303	6.06	105109	No		0.0100	1.10	2.00
Census (100%)	Palmerston	810	16.20	280986	No		0.0100	1.10	2.00
Estimate (50%)	Waitaki District	1787	35.74	619903	No		0.0100	1.10	2.00
	Sum:	**15104**	**302.08**	**5239517**					
	Extreme South of Catchment								
DCC AMP (100%)	Waikouaiti	1098	21.96	380892	Yes	0.0100		1.10	2.00
DCC AMP (100%)	Karitane	399	7.98	138412	Yes	0.0100		1.10	2.00
DCC AMP (100%)	Warrington	396	7.92	137371	Yes	0.0100		1.10	2.00
DCC AMP (100%)	Waitati	495	9.90	171714	Yes	0.0100		1.10	2.00
Estimate (30%)	Dunedin City Dis	356	7.12	123495	Yes	0.0100		1.10	2.00
	Sum:	**2744**	**54.88**	**951883**					
	Current Demand:	**16,785**	**544.56**	**8,320,897**					
	Projected Demand:								

Highlighted rows indicate Out of Catchment demands that currently take water from the Waitaki (Waikakahi, Lower Waihao and Oamaru), all other Out of Catchment demands are assumed to create new takes in the future

Demands from Industry and Tourism Consumers (Base Year 2001)

Notes	Consumer Type	Calc Current Demand		Recorded	Recorded	Estimated	Peaking factors	
		Peak Flow	Annual Demand	flows?	ADF	ADF	ADF	PDF
		(l/s)	(m3/yr)	Yes/No	(l/s/p)	(l/s/p)		
	Waitaki catchment							
	Tourism/Recreation							
CRC982130	Tokarahi Golf Club Inc	0.41	5109	Yes	0.16		1.00	2.50
CRC010006.1	Roundhill Ski Field	24.78	130244	Yes	4.13		1.00	6.00
CRC905018C	Ohau Ski Area Limited	4.13	21728	Yes	0.69		1.00	6.00
	Industry/Commercial							
CRC921428	Mr Clifford George Peart	4.64	87702	Yes	3.09		0.90	1.50
WTK870011	NZ Water Development Corp	3.30	62441	Yes	2.20		0.90	1.50
WTK860161	Ben Ohau Station Limited	4.95	93662	Yes	3.30		0.90	1.50
LWIC	Alliance Pukeuri Meatworks	174.02	2759337	Yes	97.22		0.90	1.79
	Estimates based on sum of In-catchment demand							
Estimate (10%)	Mackenzie District	22.16	314451	No		11.08	0.90	2.00
Estimate (15%)	Waitaki District	33.24	471677	No		16.61865	0.90	2.00
Estimate (15%)	Waimate District	33.24	471677	No		16.61865	0.90	2.00
	Sum:	**304.86**	**4418028**					
	North of Catchment							
	Estimates based on sum of In-catchment demand							
Fonterra	Dairy Processing Cldboye	162.31	2437481	Yes	85.88		0.90	1.89
Estimate (20%)	Mackenzie District	44.32	628903	No		22.1582	0.90	2.00
Estimate (20%)	Waimate District	44.32	628903	No		22.1582	0.90	2.00
Estimate (50%)	Timaru District	110.79	1572257	No		55.3955	0.90	2.00
	Sum:	**361.737**	**5267544**					
	South of Catchment							
	Estimates based on sum of In-catchment demand							
Estimate (30%)	Waitaki District	66.47	943354	No		33	0.90	2.00
	Sum:	**66.47**	**943354**					
	Extreme South of Catchment							
	Estimates based on sum of In-catchment demand							
Estimate (15%)	Dunedin City District	33.24	471677	No		16.61865	0.90	2.00
	Sum:	**33.24**	**471677**					
	Current Demand	**304.86**	**4418028**					
	Projected Demand:							

Note: Estimate (XX%) is a relative estimate based on the sum of in catchment demand

Demands from Community and Domestic Consumers (Base Year 2001)							to Projected Year 2051 using Statistics New Zealand National Population Projections														
Notes	Township	Population	Calculated Current Demand		Low Growth Projection						Medium Growth Projection						High Growth Projection				
					Peak		Peak Flow		Peak Flow		Peak Flow		Peak Flow		Peak Flow		Peak Flow		Peak Flow		Peak Flow	
		Base 2001	Peak Flow (l/s)	Annual Demand (m3/yr)	Flow (l/s)	Volume (m3/yr)	(l/s)	Volume (m3/yr)	(l/s)	Volume (m3/yr)	(l/s)	Volume (m3/yr)	(l/s)	Volume (m3/yr)	(l/s)	Volume (m3/yr)	(l/s)	Volume (m3/yr)	(l/s)	Volume (m3/yr)	(l/s)	Volume (m3/yr)
					2011		2021		2051.00		2011.00		2021.00		2051.00		2011.00		2021.00		2051.00	
	Waitaki catchment																					
Census	Mt Cook	234	17.04	295472	18.48	320,602	19.30	334,767	19.34	335,376	18.65	323,496	19.78	343,144	21.11	366,066	19.21	333,244	21.17	367,132	25.40	440,619
Census	Tekapo	303	22.06	382599	23.93	415,139	24.99	433,480	25.04	434,269	24.15	418,886	25.62	444,327	27.33	474,008	24.88	431,508	27.41	475,389	32.89	570,545
Census	Pukaki	14	1.02	13161	1.11	14,281	1.16	14,912	1.16	14,939	1.12	14,410	1.19	15,285	1.27	16,306	1.16	14,844	1.27	16,353	1.53	19,627
Census	Twizel	1011	73.97	950429	80.27	1,031,265	83.81	1,076,826	83.97	1,078,786	80.99	1,040,573	85.91	1,103,772	91.65	1,177,503	83.43	1,071,927	91.92	1,180,933	110.31	1,417,315
Census	Lake Ohau	50	3.66	47004	3.97	51,002	4.15	53,256	4.15	53,352	4.01	51,463	4.25	54,588	4.53	58,235	4.13	53,013	4.55	58,404	5.46	70,095
Census	Omarama	279	20.41	262285	22.15	284,592	23.13	297,166	23.17	297,707	22.35	287,161	23.71	304,602	25.29	324,949	23.02	295,814	25.37	325,895	30.44	391,129
Census	Otematata	243	17.78	228441	19.29	247,871	20.14	258,822	20.18	259,293	19.47	250,108	20.65	265,298	22.03	283,020	20.05	257,644	22.09	283,844	26.51	340,660
Census	Aviemore	270	19.76	253824	21.44	275,412	22.38	287,580	22.42	288,103	21.63	277,898	22.94	294,776	24.48	314,467	22.28	286,271	24.55	315,383	29.46	378,511
Census	Lake Waitaki	270	19.76	253824	21.44	275,412	22.38	287,580	22.42	288,103	21.63	277,898	22.94	294,776	24.48	314,467	22.28	286,271	24.55	315,383	29.46	378,511
Census	Kurow	387	28.32	363814	30.73	394,757	32.08	412,198	32.14	412,948	31.00	398,320	32.89	422,512	35.08	450,736	31.94	410,322	35.18	452,048	42.23	542,533
Census	Duntroon	120	6.00	83255	6.51	90,336	6.80	94,327	6.81	94,499	6.57	91,151	6.97	96,687	7.43	103,146	6.77	93,898	7.46	103,447	8.95	124,153
Estimate	Glenavy	50	2.50	34690	2.71	37,640	2.83	39,303	2.84	39,374	2.74	37,980	2.90	40,286	3.10	42,978	2.82	39,124	3.11	43,103	3.73	51,730
Estimate	Lower Waitaki	50	2.50	34690	2.71	37,640	2.83	39,303	2.84	39,374	2.74	37,980	2.90	40,286	3.10	42,978	2.82	39,124	3.11	43,103	3.73	51,730
Census	Pukeuri	183	9.15	126964	9.93	137,762	10.37	143,849	10.39	144,111	10.02	139,006	10.63	147,448	11.34	157,298	10.32	143,194	11.37	157,756	13.64	189,333
derived from LINZ	Mackenzie Distric	195	9.75	135289	10.58	146,796	11.05	153,282	11.07	153,560	10.67	148,121	11.32	157,117	12.08	167,612	11.00	152,584	12.11	168,101	14.54	201,749
derived from LINZ	Waitaki District	870	43.50	603599	47.20	654,936	49.29	683,871	49.37	685,116	47.63	660,848	50.52	700,984	53.89	747,809	49.06	680,760	54.05	749,987	64.87	900,109
derived from LINZ	Waimate District	454	11.35	157491	12.32	170,886	12.86	178,435	12.88	178,760	12.43	172,428	13.18	182,900	14.06	195,118	12.80	177,624	14.10	195,686	16.93	234,856
	Sum:	**4983**	**308.52**	**4226831**	**334.77**	**4,586,329**	**349.56**	**4,788,956**	**350.19**	**4,797,671**	**337.79**	**4,627,726**	**358.30**	**4,908,788**	**382.24**	**5,236,695**	**347.96**	**4,767,168**	**383.35**	**5,251,946**	**460.08**	**6,303,207**
	North of Catchment																					
TDC AMP (50%)	Pleasant Point	610	12.20	211607	13.24	229,604	13.82	239,748	13.85	240,184	13.36	231,676	14.17	245,747	15.11	262,163	13.76	238,657	15.16	262,927	18.19	315,556
TDC AMP (50%)	Temuka	2000	35.00	693792	37.98	752,800	39.65	786,059	39.73	787,490	38.32	759,595	40.65	805,729	43.36	859,551	39.47	782,483	43.49	862,054	52.19	1,034,608
TDC AMP (50%)	Geraldine	1150	23.00	398930	24.96	432,860	26.06	451,984	26.11	452,807	25.18	436,767	26.71	463,294	28.50	494,242	25.94	449,928	28.58	495,681	34.30	594,900
WDC Dwelling data	Waikakihi	295	5.90	102334	6.40	111,038	6.68	115,944	6.70	116,155	6.46	112,040	6.85	118,845	7.31	126,784	6.65	115,416	7.33	127,153	8.80	152,605
WDC Dwelling data	Lower Waihao	422	8.44	146390	9.16	158,841	9.56	165,858	9.58	166,160	9.24	160,275	9.80	170,009	10.46	181,365	9.52	165,104	10.49	181,893	12.59	218,302
unknown	Timaru District		0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
	Sum:	**4477**	**84.54**	**1553053**	**91.73**	**1,685,143**	**95.78**	**1,759,593**	**95.96**	**1,762,796**	**92.56**	**1,700,353**	**98.18**	**1,803,623**	**104.74**	**1,924,105**	**95.35**	**1,751,588**	**105.04**	**1,929,709**	**126.07**	**2,315,971**
	South of Catchment																					
Census (100%)	Weston	708	14.16	245602	15.36	266,491	16.04	278,265	16.07	278,771	15.50	268,897	16.44	285,228	17.54	304,281	15.97	276,999	17.59	305,167	21.12	366,251
Census (100%)	Oamaru	11085	221.70	3845342	240.56	4,172,394	251.18	4,356,733	251.64	4,364,662	242.73	4,210,055	257.47	4,465,750	274.67	4,764,062	250.04	4,336,912	275.47	4,777,937	330.61	5,734,317
Census (100%)	Kakanui	411	8.22	142574	8.92	154,700	9.31	161,535	9.33	161,829	9.00	156,097	9.55	165,577	10.18	176,638	9.27	160,800	10.21	177,152	12.26	212,612
Census (100%)	Hampden	303	6.06	105109	6.58	114,049	6.87	119,088	6.88	119,305	6.63	115,079	7.04	122,068	7.51	130,222	6.83	118,546	7.53	130,601	9.04	156,743
Census (100%)	Palmerston	810	16.20	280986	17.58	304,884	18.35	318,354	18.39	318,933	17.74	307,636	18.81	326,320	20.07	348,118	18.27	316,906	20.13	349,132	24.16	419,016
Estimate (50%)	Waitaki District	1787	35.74	619903	38.78	672,627	40.49	702,344	40.57	703,622	39.13	678,698	41.51	719,918	44.28	768,009	40.31	699,149	44.41	770,246	53.30	924,423
	Sum:	**15104**	**302.08**	**5239517**	**327.77**	**5,685,146**	**342.25**	**5,936,319**	**342.88**	**5,947,122**	**330.73**	**5,736,461**	**350.82**	**6,084,862**	**374.25**	**6,491,330**	**340.70**	**5,909,311**	**375.34**	**6,510,235**	**450.47**	**7,813,362**
	Extreme South of Catchment																					
DCC AMP (100%)	Waikouaiti	1098	21.96	380892	23.83	413,287	24.88	431,546	24.93	432,332	24.04	417,018	25.50	442,345	27.21	471,894	24.77	429,583	27.29	473,268	32.75	568,000
DCC AMP (100%)	Karitane	399	7.98	138412	8.66	150,184	9.04	156,819	9.06	157,104	8.74	151,539	9.27	160,743	9.89	171,480	9.00	156,105	9.92	171,980	11.90	206,404
DCC AMP (100%)	Warrington	396	7.92	137371	8.59	149,054	8.97	155,640	8.99	155,923	8.67	150,400	9.20	159,534	9.81	170,191	8.93	154,932	9.84	170,687	11.81	204,852
DCC AMP (100%)	Waitati	495	9.90	171714	10.74	186,318	11.22	194,550	11.24	194,904	10.84	188,000	11.50	199,418	12.27	212,739	11.17	193,665	12.30	213,358	14.76	256,066
Estimate (30%)	Dunedin City Dis	356	7.12	123495	7.73	133,998	8.07	139,919	8.08	140,173	7.80	135,208	8.27	143,420	8.82	153,000	8.03	139,282	8.85	153,446	10.62	184,160
	Sum:	**2744**	**54.88**	**951883**	**59.55**	**1,032,842**	**62.18**	**1,078,473**	**62.29**	**1,080,436**	**60.09**	**1,042,164**	**63.73**	**1,105,460**	**67.99**	**1,179,304**	**61.90**	**1,073,567**	**68.19**	**1,182,739**	**81.84**	**1,419,483**
	Current Demand:	**16,785**	**544.56**	**8,320,897**																		
	Projected Demand:				**813.82**	**12,989,460**	**849.77**	**13,563,341**	**851.32**	**13,588,024**	**821.16**	**13,106,705**	**871.03**	**13,902,733**	**929.22**	**14,831,433**	**845.90**	**13,501,634**	**931.92**	**14,874,629**	**1118.46**	**17,852,023**

Highlighted rows indicate Out of Catchment demands that currently take water from the Waitaki (Waikakahi, Lower Waihao and Oamaru), all other Out of Catchment demands are assumed to create new takes in the future

Demands from Industry and Tourism Consumers (Base Year 2001) to Projected Year 2051 using Statistics New Zealand National Population Projections

Notes	Consumer Type	Calc Current Demand		Low Growth Projection						Medium Growth Projection						High Growth Projection					
		Peak Flow	Annual Demand	Peak Flow (l/s)	Volume (m3/yr)	Peak Flow (l/s)	Volume (m3/yr)	Peak Flow (l/s)	Volume (m3/yr)	Peak Flow (l/s)	Volume (m3/yr)	Peak Flow (l/s)	Volume (m3/yr)	Peak Flow (l/s)	Volume (m3/yr)	Peak Flow (l/s)	Volume (m3/yr)	Peak Flow (l/s)	Volume (m3/yr)	Peak Flow (l/s)	Volume (m3/yr)
		(l/s)	(m3/yr)	2011		2021		2051.00		2011.00		2021.00		2051.00		2011.00		2021.00		2051.00	
	Waitaki catchment																				
	Tourism/Recreation																				
CRC982130	Tokarahi Golf Club Inc	0.41	5109	0.44	5,543	0.46	5,788	0.46	5,799	0.50	6,315	0.51	6,477	0.55	6,916	0.50	6,315	0.51	6,477	0.60	7,618
CRC010006.1	Roundhill Ski Field	24.78	130244	26.89	141,321	28.08	147,565	28.13	147,833	30.63	160,985	31.41	165,115	33.55	176,319	30.63	160,985	31.41	165,115	36.95	194,224
CRC905018C	Ohau Ski Area Limited	4.13	21728	4.49	23,576	4.68	24,618	4.69	24,663	5.11	26,857	5.24	27,546	5.60	29,415	5.11	26,857	5.24	27,546	6.16	32,402
	Industry/Commercial																				
CRC921428	Mr Clifford George Peart	4.64	87702	5.03	95,161	5.25	99,365	5.26	99,546	5.73	108,402	5.88	111,183	6.27	118,727	5.73	108,402	5.88	111,183	6.91	130,784
WTK870011	NZ Water Development Corp	3.30	62441	3.58	67,752	3.74	70,745	3.75	70,874	4.08	77,179	4.18	79,159	4.47	84,531	4.08	77,179	4.18	79,159	4.92	93,115
WTK860161	Ben Ohau Station Limited	4.95	93662	5.37	101,628	5.61	106,118	5.62	106,311	6.12	115,769	6.28	118,739	6.70	126,796	6.12	115,769	6.28	118,739	7.38	139,672
LWIC	Alliance Pukeuri Meatworks	174.02	2759337	188.82	2,994,023	197.17	3,126,300	197.53	3,131,990	215.10	3,410,613	220.62	3,498,127	235.59	3,735,493	215.10	3,410,613	220.62	3,498,127	259.51	4,114,826
	Estimates based on sum of In-catchment demand																				
Estimate (10%)	Mackenzie District	22.16	314451	24.04	341,196	25.11	356,270	25.15	356,919	27.39	388,670	28.09	398,643	30.00	425,693	27.39	388,670	28.09	398,643	33.04	468,922
Estimate (15%)	Waitaki District	33.24	471677	36.06	511,794	37.66	534,405	37.73	535,378	41.08	583,005	42.14	597,965	45.00	638,540	41.08	583,005	42.14	597,965	49.56	703,383
Estimate (15%)	Waimate District	33.24	471677	36.06	511,794	37.66	534,405	37.73	535,378	41.08	583,005	42.14	597,965	45.00	638,540	41.08	583,005	42.14	597,965	49.56	703,383
	Sum:	**304.86**	**4418028**	**330.79**	**4,793,788**	**345.40**	**5,005,581**	**346.03**	**5,014,690**	**376.82**	**5,460,800**	**386.48**	**5,600,919**	**412.71**	**5,980,971**	**376.82**	**5,460,800**	**386.48**	**5,600,919**	**454.62**	**6,588,328**
	North of Catchment																				
	Estimates based on sum of In-catchment demand																				
Fonterra	Dairy Processing Cldboye	162.31	2437481	176.12	2,644,792	183.90	2,761,640	184.23	2,766,666	200.62	3,012,790	205.77	3,090,096	219.73	3,299,775	200.62	3,012,790	205.77	3,090,096	242.05	3,634,861
Estimate (20%)	Mackenzie District	44.32	628903	48.09	682,392	50.21	712,540	50.30	713,837	54.78	777,341	56.18	797,286	59.99	851,387	54.78	777,341	56.18	797,286	66.09	937,843
Estimate (20%)	Waimate District	44.32	628903	48.09	682,392	50.21	712,540	50.30	713,837	54.78	777,341	56.18	797,286	59.99	851,387	54.78	777,341	56.18	797,286	66.09	937,843
Estimate (50%)	Timaru District	110.79	1572257	120.21	1,705,980	125.53	1,781,351	125.75	1,784,593	136.94	1,943,352	140.45	1,993,216	149.98	2,128,466	136.94	1,943,352	140.45	1,993,216	165.22	2,344,608
	Sum:	**361.737**	**5267544**	**392.50**	**5,715,556**	**409.84**	**5,968,073**	**410.59**	**5,978,933**	**447.12**	**6,510,823**	**458.59**	**6,677,885**	**489.71**	**7,131,015**	**447.12**	**6,510,823**	**458.59**	**6,677,885**	**539.44**	**7,855,156**
	South of Catchment																				
	Estimates based on sum of In-catchment demand																				
Estimate (30%)	Waitaki District	66.47	943354	72.13	1,023,588	75.32	1,068,811	75.45	1,070,756	82.16	1,166,011	84.27	1,195,930	89.99	1,277,080	82.16	1,166,011	84.27	1,195,930	99.13	1,406,765
	Sum:	**66.47**	**943354**	**72.13**	**1,023,588**	**75.32**	**1,068,811**	**75.45**	**1,070,756**	**82.16**	**1,166,011**	**84.27**	**1,195,930**	**89.99**	**1,277,080**	**82.16**	**1,166,011**	**84.27**	**1,195,930**	**99.13**	**1,406,765**
	Extreme South of Catchment																				
	Estimates based on sum of In-catchment demand																				
Estimate (15%)	Dunedin City District	33.24	471677	36.06	511,794	37.66	534,405	37.73	535,378	41.08	583,005	42.14	597,965	45.00	638,540	41.08	583,005	42.14	597,965	49.56	703,383
	Sum:	**33.24**	**471677**	**36.06**	**511,794**	**37.66**	**534,405**	**37.73**	**535,378**	**41.08**	**583,005**	**42.14**	**597,965**	**45.00**	**638,540**	**41.08**	**583,005**	**42.14**	**597,965**	**49.56**	**703,383**
	Current Demand	**304.86**	**4418028**																		
	Projected Demand:			**831.49**	**12,044,727**	**868.22**	**12,576,869**	**869.80**	**12,599,757**	**947.18**	**13,720,639**	**971.48**	**14,072,699**	**1037.40**	**15,027,606**	**947.18**	**13,720,639**	**971.48**	**14,072,699**	**1142.75**	**16,553,632**

Note: Estimate (XX%) is a relative estimate based on the sum of in catchment demand

Appendix C: Demand growth summary information

- Statistics New Zealand national population projections 2001 to 2051.
- Economic growth information provided by Harris Consulting.

Table 1

Projected Population of New Zealand

2001 (Base) – 2101

Note Highlighted cells: Growth scenarios 1, 4 and 6 were used as the Low, Medium and High population projections in the MfE Project.

Year at 30 June	Projection Assumptions[2]	Alternative Projection Series[1]							
		1	2	3	4	5	6	7	8
	Fertility	Low	Medium	Medium	Medium	Medium	Medium	Medium	High
	Mortality	Medium	High	Medium	Medium	Medium	Medium	Low	Medium
	Net Migration	5,000	5,000	0	5,000	10,000	20,000	5,000	5,000
				Population (000)					
2001 (Base)		3,880	3,880	3,880	3,880	3,880	3,880	3,880	3,880
2003		4,000	4,001	3,993	4,001	4,001	4,009	4,001	4,002
2004		4,040	4,042	4,024	4,043	4,043	4,062	4,044	4,047
2005		4,071	4,077	4,049	4,078	4,079	4,108	4,079	4,084
2006		4,099	4,108	4,073	4,109	4,113	4,154	4,111	4,119
2011		4,210	4,243	4,182	4,248	4,279	4,376	4,253	4,287
2016		4,305	4,368	4,280	4,379	4,439	4,597	4,389	4,453
2021		4,396	4,489	4,374	4,506	4,597	4,821	4,523	4,616
2026		4,475	4,596	4,455	4,622	4,747	5,039	4,647	4,770
2031		4,527	4,678	4,511	4,714	4,873	5,236	4,749	4,904
2036		4,544	4,728	4,534	4,775	4,971	5,407	4,822	5,014
2041		4,523	4,746	4,526	4,807	5,039	5,552	4,866	5,103
2046		4,473	4,741	4,495	4,814	5,086	5,676	4,886	5,176
2051		4,404	4,721	4,447	4,807	5,117	5,786	4,891	5,238
				Population Change 2001-2051					
Number (000)		524	841	567	926	1,236	1,906	1,010	1,358
Percent		13	22	15	24	32	49	26	35
				Population (000)					
2061		4,230	4,660	4,322	4,758	5,147	5,972	4,856	5,340
2071		4,024	4,586	4,179	4,689	5,153	6,128	4,791	5,441
2081		3,797	4,499	4,025	4,606	5,143	6,261	4,713	5,548
2091		3,566	4,407	3,865	4,514	5,121	6,377	4,622	5,652
2101		3,360	4,325	3,716	4,431	5,105	6,495	4,537	5,759
				Population Change 2051-2101					
Number (000)		-1,044	-396	-732	-376	-12	709	-354	521
Percent		-24	-8	-16	-8	0	12	-7	10

Note Highlighted cells: Growth scenarios 1, 4 and 6 were used as the Low, Medium and High population projections in the MfE Project.

(1) These projections have as a base the estimated resident population of New Zealand at 30 June 2001. Eight alternative projection series have been produced incorporating different assumptions on the future fertility, mortality and migration of the population as outlined in (2) below.

(2) Projection assumptions comprise:

(a) Fertility: Three alternative variants - designated low, medium and high - which assume that fertility rates will vary until the year 2011 when the total fertility rate will reach 1.60, 1.85 and 2.10 births per woman, respectively. After 2011, fertility rates are assumed to stay constant. The estimated base rate in 2001 was 1.97 births per woman.

(b) Mortality: Three alternative variants - designated low, medium and high - which assume that mortality rates will continue to drop so that the average life expectancy at birth for males will increase to 84.5, 82.5 and 80.5 years, respectively, by 2051. The corresponding life expectancies for females in 2051 will be 88.0, 86.5 and 85.0 years. After 2051, mortality rates are assumed to stay constant. The estimated base life expectancies in 2001 were 76.1 years for males and 81.0 years for females.

(c) Migration: All series assume short-term net levels for between three and five years before reaching the long-term annual net levels of 0, 5,000, 10,000 and 20,000. All series assume net migration in 2002 of 33,000. Series with long-term annual net migration of 0 assume net migration in 2003 of 27,000 and in 2004 of 5,000. Series with long-term annual net migration of 5,000 assume net migration in 2003 of 35,000, in 2004 of 16,000, in 2005 of 9,000 and in 2006 of 7,000. Series with long-term annual net migration of 10,000 assume net migration in 2003 of 35,000 and in 2004 of 16,000. Series with long-term annual net migration of 20,000 assume net migration in 2003 of 43,000 and in 2004 of 27,000.

Note: Owing to rounding, individual figures may not sum to give the stated totals.

Table 2

Projected population data used as a basis for estimating demand growth in the Waitaki catchment and surrounding districts

2001 (Base) – 2101

These normalised figures have been used to estimate growth of the Community and Domestic use types

Note Charts: Growth scenarios 1, 4 and 6 were used as the Low, Medium and High population projections in the MfE Project.

Growth projections shown in Chart 1 are shown as normalised projections in Chart 2
Base population 2001

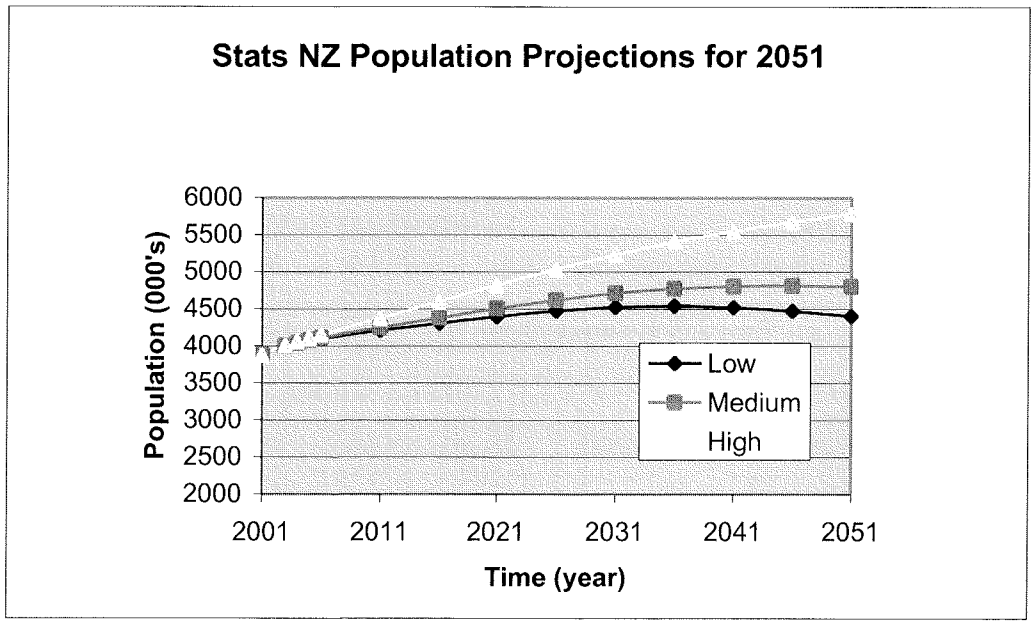


Chart 1 - Stats NZ Population Projections for 2051

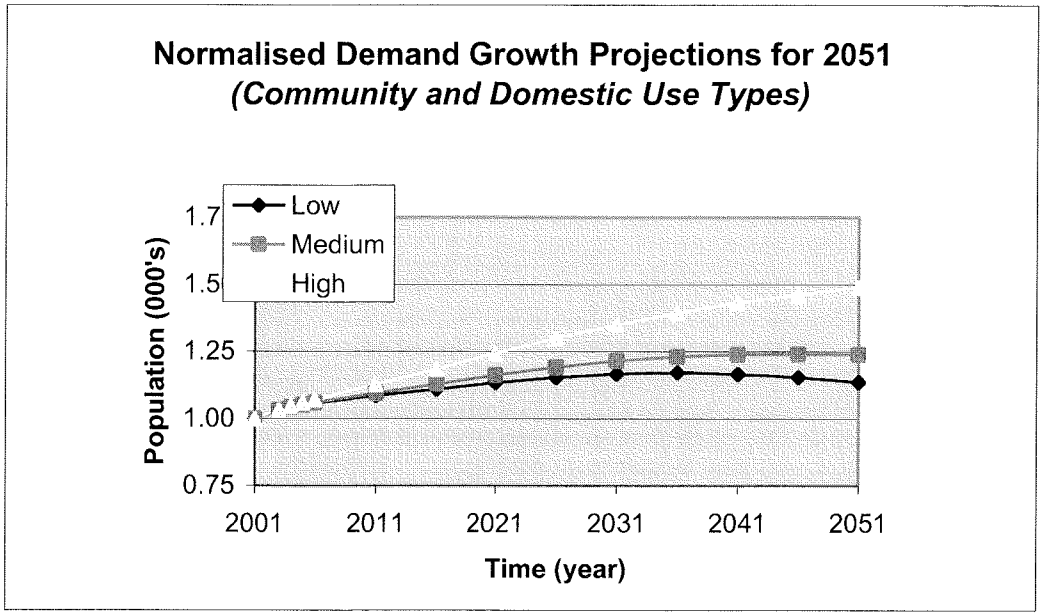


Chart 2 - Normalised Growth Projections for 2051, Community and Domestic Use Types

Table 3

Projected population and Economic Growth data used as a basis for estimating demand growth in the Waitaki catchment and surrounding districts

2001 (Base) – 2101

These normalised figures have been used to estimate growth of the Industrial and Tourism use types

Note Charts: Growth scenario 1 was used as the Low Projection; Economic Development "High production" growth scenario was used as the meduim growth projection; and Growth scenario 6 combined with the Economic Development "High production" growth scenario generated a composite high growth projection for the MfE project. Economic growth data is assessed from the Agriculture production IO analysis supplied by Harris Consulting. We have assumed that demand for water is proportional to economic growth.

Normalised growth projections in Chart 3
Base population 2001

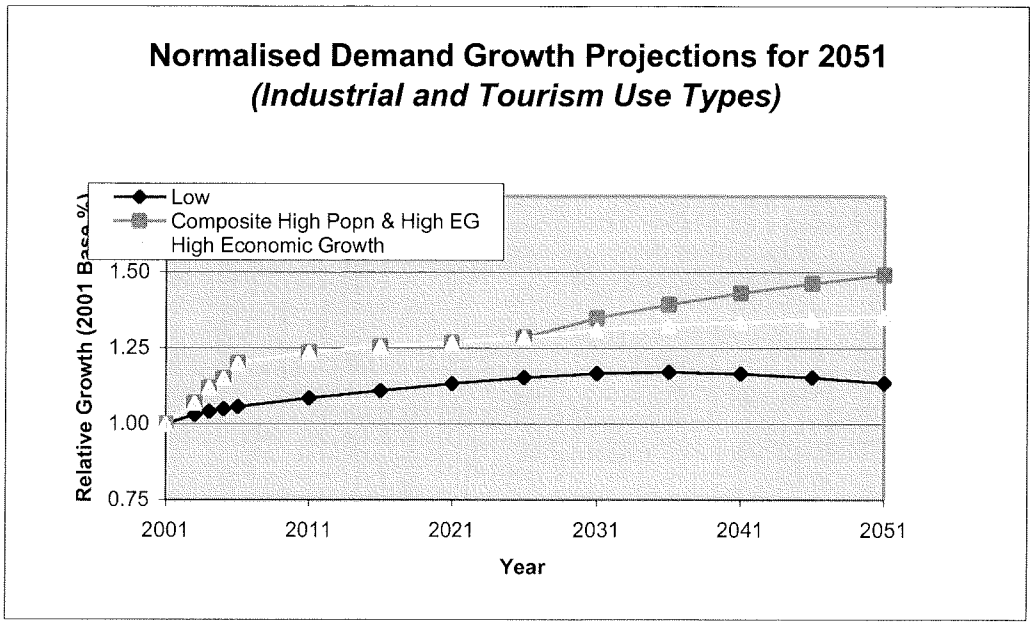


Chart 3 - Normalised Growth Projections for 2051, Industrial and Tourism Use Types

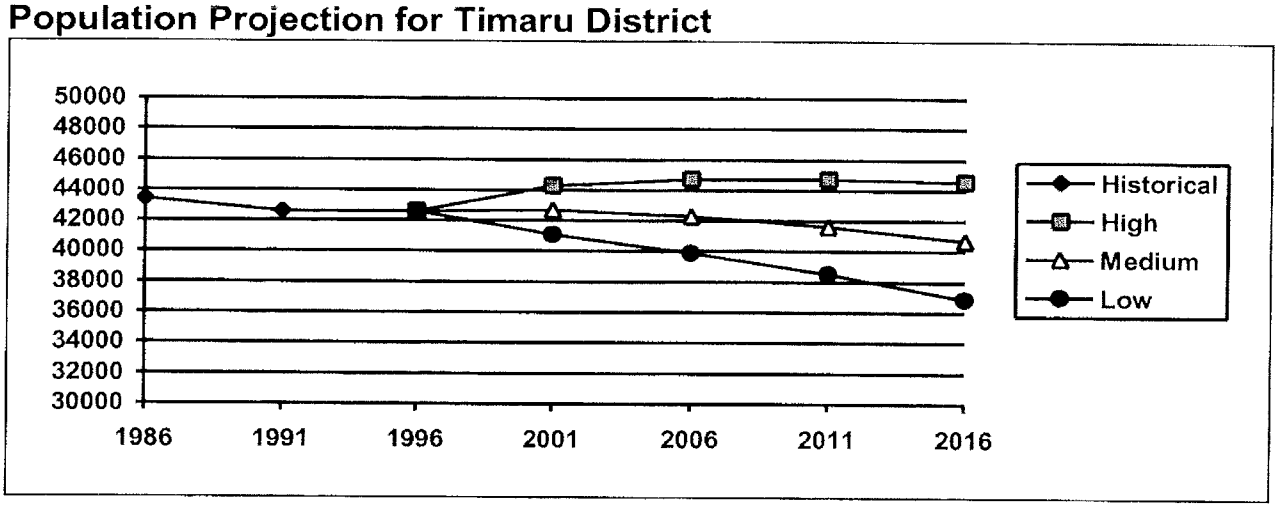


Chart 4 - Population Projections for Timaru District (source TDC Activity management plan - water)

Appendix D: Seasonal variation of water demand by consumer type

- Seasonal variation of water demand for industrial consumers
  - meat works and meat processing
  - milk and dairy processing.
- Seasonal variation of water demand for tourism consumers
  - snow making.
- Seasonal variation of water demand for community and domestic consumers
  - typical community (peak day factor of 2.0).

Seasonal variation of water demand for industrial consumers

Chart 1: Meat works and meat processing

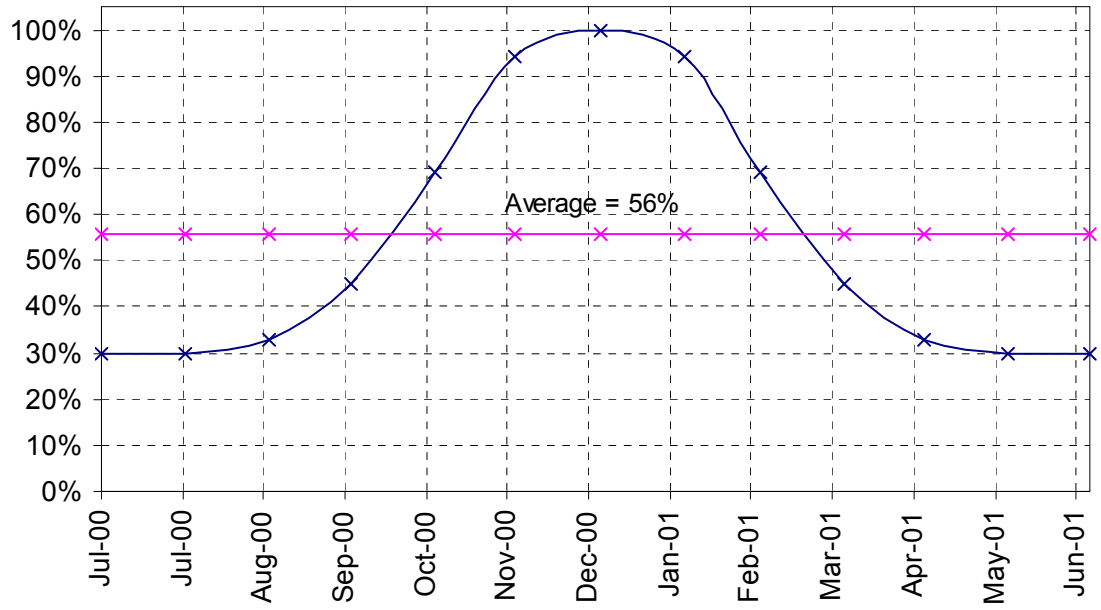
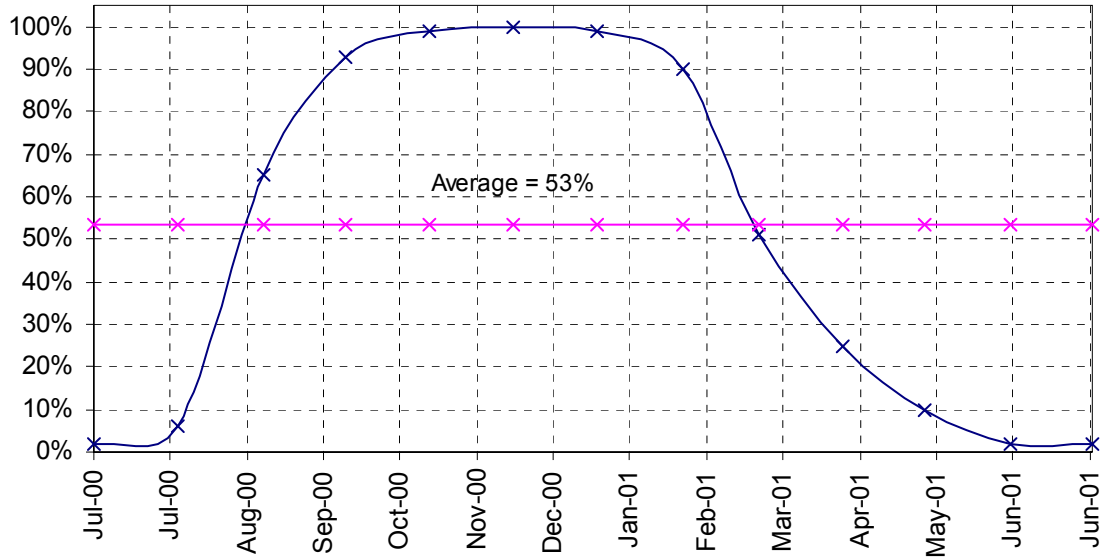


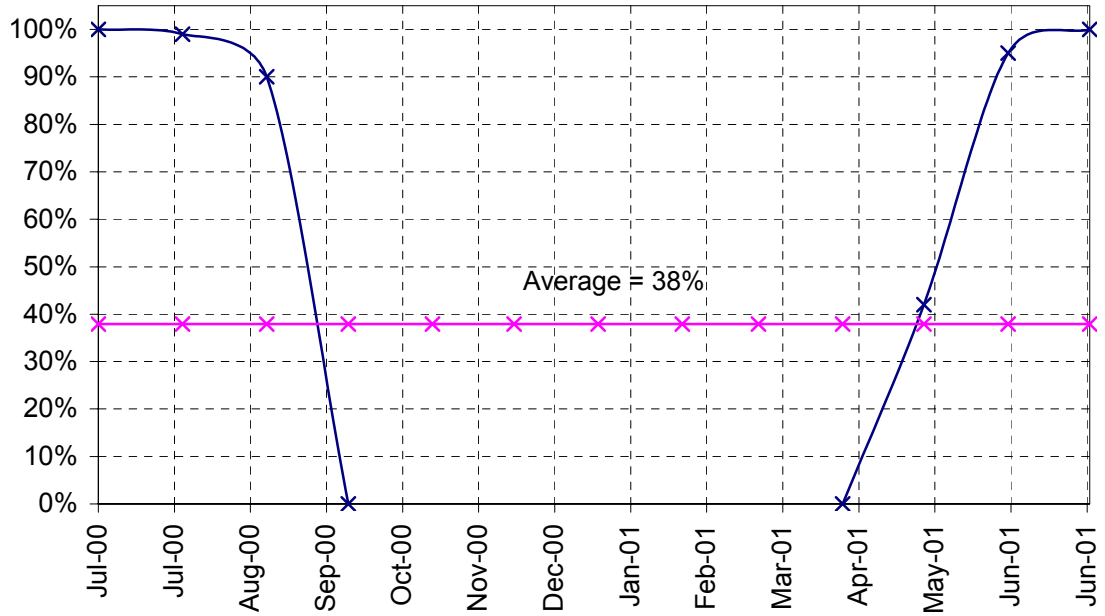
Chart 2: Milk and dairy processing



These curves are generic for the industries shown and may not relate to actual water use for a specific plant.

Seasonal variation of water demand for tourism consumers

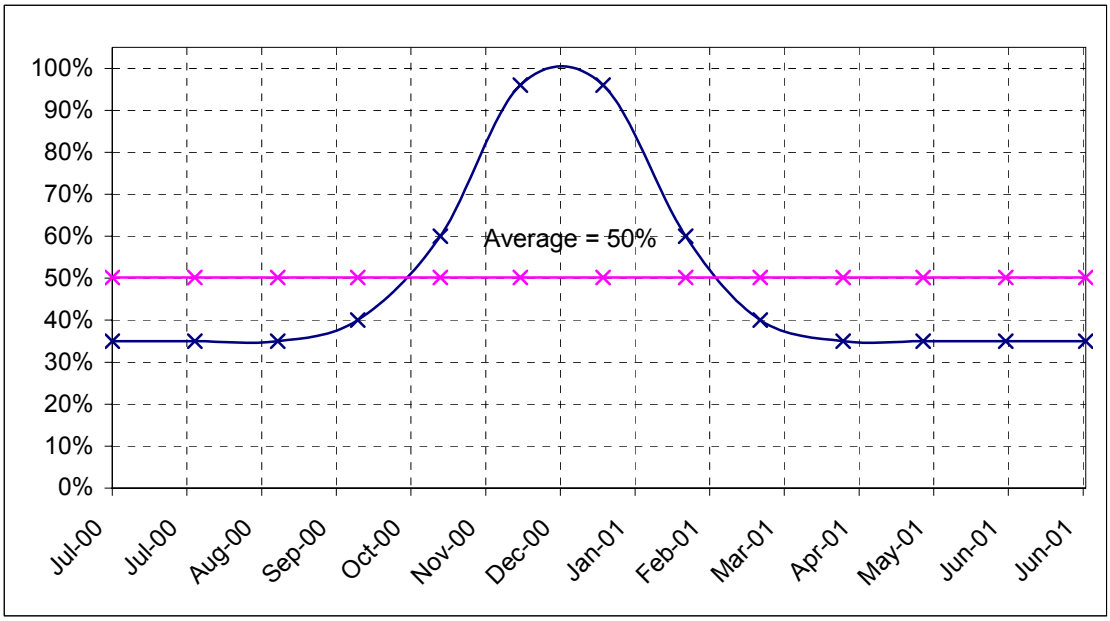
Chart 3: Snow making



Seasonal variation of water demand for community and domestic consumers

Chart 4: Typical community (peak day factor of 2.0)

(Community seasonal variation will include population, industry, commercial, tourism and recreation users)



These curves are generic and may not relate to actual water use for a specific operation.

Appendix E: Classification of use codes from Environment Canterbury consents database

Use code	Classification
Municipal	
40	Rural water supply
41	Public water supply (local authority)
42	Institutional water supply (eg, schools, camps etc)
44	Community water supply
45	Domestic supply
Industrial/commercial	
79	Fish processing
80	Fertiliser works
81	Dyeworks
82	Soapworks
83	Fellmongery
84	Woolscouring
85	Meat works (including poultry processing)
86	Milk or dairy
87	Fruit and vegetable processing
88	Pottery or ceramics
89	Quarry
90	Mining (gold, coal, etc)
91	Timber milling (non-polluting)
92	Timber treatment site
94	Cooling water/refrigeration
96	Bottling/export
97	Brewery
98	Vehicle washing
99	Other industrial
137	Washdown water
Tourism/Recreation	
50	Swimming pools
51	Sports/recreation (playing fields, etc)
95	Snow making

Appendix F: Catchment numbering for significant catchment analysis and LINZ land parcel summary

Catchment number	Residential		Rural residential		Farms		Unproductive land area	Calculated area of land parcels	Actual area of catchment	Difference
	Parcel ID	Area (ha)	Parcel ID	Area (ha)	Farm ID	Area (ha)	(ha)	(ha)	(ha)	(%)
1	2	0.5640	4	91.5198	11	61,848.3500	64,413	126,354	145,312	-13%
2	1	0.4500	0	0.0000	10	64,739.0187	58,392	123,132	137,160	-10%
3	0	0.0000	0	0.0000	6	50,903.9380		50,904	9,957	411%
4	0	0.0000	3	0.0000	0	23,616.7226	2,914	26,530	49,628	-47%
5	0	0.0000	0	0.0000	0	0.0000	0	8,914	8,914	0%
6	1	0.0000	0	0.0000	5	71,893.0000	8,014	79,907	125,386	-36%
7	0	0.0000	5	214.8900	18	101,851.5304	245	102,312	102,362	0%
8	0	0.0000	0	0.0000	6	28,536.9400		28,537	28,263	1%
9	0	0.0000	0	0.0000	6	9,375.8075	1,672	11,048	30,552	-64%
10	33	6.2240	13	401.1453	8	24,093.7333	2,003	26,504	28,122	-6%
11	1	0.0000	4	124.9465	38	238,626.4527	8,493	247,244	248,557	-1%
12	2	0.0000	16	722.4335	14	52,619.1604	4,188	57,529	59,864	-4%
13	0	0.0000	10	307.8488	56	85,280.9852	3,767	89,355	89,898	-1%
14	10	1.7604	45	1166.4370	314	103,893.1527	184	105,245	105,403	0%
15	4	1.7806	12	208.4899	36	29,540.3644	2	29,753	29,780	0%
16	1	0.0000	1	63.0470	7	12,679.8000	0	12,743	12,977	-2%
All catchments	55	11	113	3301	535	959,499	154,287	1,126,011	1,212,135	-7%

Appendix G: Unproductive land use descriptions from LINZ DCDB

Parcels within these descriptions were excluded from the land parcel analysis

Acquired for conservation purposes
Acquired for the generation of electricity
Aerodrome reserve
Automatic telephone exchange
Better utilisation
Buildings of general government (staff housing)
Buscot Pest Destruction Board
Camping reserve
Camping site
Catchment Commission buildings
Cemetery
Cemetery (closed)
Closed road
Composite school
Conservation purposes
County depot
Crown land
Crown land reserved from sale (marginal strip)
Declared Crown land
Declared government road and stopped
Declared to be held for conservation purposes
Declaring disposition exempt from Sec 24 Conservation Act
Defence purposes
Development of water power
Education purposes
Education purposes (playing fields)
Electricity generation
Electricity generation purposes
Electricity purposes
Electricity works
Fire break
Fire station
Forestry
Forestry purposes
Functioning indirectly of a road
General education
Generation of electricity
Government purpose reserve (wetland management)
Government purpose reserve (wildlife management)
Government purposes
Gravel pit
Gravel reserve
Headworks site
Held for conservation purposes
Historic reserve
Huxley State Forest
Irrigation purposes (Racemans Cottage)
Irrigation race
Kurow Cemetery reserve
Kurow Pest Destruction Board buildings
Land set apart for water power development
Land taken
Leasehold estate acquired for generation of electricity
Leasehold estate acquired for generation of electricity and declared Crown land
Leasehold estate surrendered
Leasehold estate surrendered and acquired for generation of electricity
Local purpose reserve (cemetery)
Local purpose reserve (community buildings)
Local purpose reserve (esplanade)
Local purpose reserve (fire station)
Local purpose reserve (fishing settlement)
Local purpose reserve (passive recreation)
Local purpose reserve (recreation)
Local purpose reserve (road)
Local purpose reserve (rubbish utility)
Maori reservation (marae and meeting place)
Metal storage
Mount Cook National Park
Municipal reserve
Museum site
National park
Oamaru Borough water race
Oamaru Borough water supply
Oamaru Hospital endowment

Otago University endowment
Paddock for rabbit inspector
Plantation
Plantation purposes
Plantation reserve
Police purposes
Police reserve
Police station
Post Office purposes
Primary school
Private burial ground
Protective works
Public hall site
Public recreation ground
Public school site
Quarry reserve
Rabbit Board buildings
Racecourse and recreation
Rangers residence
Recreation
Recreation purposes
Recreation reserve
Reserve (riverbank)
Reserve classified as a local purpose (transfer station) reserve
Reserve for general education
Reserve for local purposes
Reserve for tree planting purposes
Reserve for war memorial and community centre
River bank protection reserve
River conservation
Road reserve
Road stopped and declared Crown land
Road stopped and set apart for the generation of electricity
Road stopped
Scenic reserve
School site
Scientific and industrial research purposes
Scientific reserve
Set apart for defence purposes
Set apart for electricity generation and declared Crown land
Set apart for railway purposes
Severance
Sewage treatment works
Soil conservation and river control purposes
Soil conservation reserve
State forest
State primary school
Steward settlement water race
Stopped road
Stopped road amalgamated
Subject to the provision of esplanade strips
Subject to the provision of marginal strips
Teachers residence
Tekapo domain
Telephone exchange
Temple State Forest
Transmission of electricity (staff housing)
University of Otago endowment
Use, convenience and enjoyment of a road
Vesting on deposit for local purpose reserve
Water easement acquired over part
Water power development
Water race
Water reserve
Water supply purposes