Our Uses

Southland Water 2010: Part 3

TE AO MARAMA INC.

environment SOUTHLAND
Te Taiao Tonga

Toi tu te marae a Tane
Toi tu te marae a Tangaroa
Toi tu te iwi

When the land and waters are strong,
so are the people.

Our Uses: How do we use our water and is there enough for our different needs?

Southland Water 2010: Part 3

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Kowhaiwhai design featured illustrates ngaru (cutting the waves where the waka travelled).

Foreword

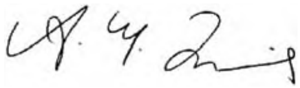
Water is our most valuable resource. Our lives and our livelihoods depend on it. This four-part report series has focused on the values Southlanders have for freshwater, from how healthy it is to swim in and drink, to how healthy it is for our aquatic life and how we would be affected by freshwater natural disasters. This report turns attention to our use of freshwater and considers the issue of quantity rather than quality.

Southlanders put enormous value on freshwater and all of the opportunities it presents, economically and socially, but how much of it we use adds more pressure on the other themes of this report series. Exhausting the supply will have a dramatic effect on those values, limiting our capabilities and not only affecting the quality of our water but the quality of life for the people and animals that rely on it.

There is a careful balance at play, and one that this Council is well aware of. The next few years will see Council in the middle of the debate around the competition for water use in Southland. It will be our job to ensure that community needs are balanced with economic value for the region, while also making sure that our ecosystems don't suffer environmentally.

I am sure there will be lengthy debate on these issues in the coming years, so I'm pleased that this collaborative report is available to get some of these discussions started now.

Our Uses, the final report to be published in this report series, represents a significant amount of work, and we are pleased to have been able to partner with Te Ao Marama Incorporated in writing this series, Southland Water 2010.



Ali Timms
Environment Southland Chairman

The introduction of the first report of the Southland Water 2010 series, Our Health', started with the whakatauki/proverb 'Ko te aroha, te waipuna o te ao Māori'. This translates as 'We cannot live without water or love'. Water is linked together to manawhenua cultural identity and wellbeing, as it does to all Southlanders.

Cultural use of our waters, particularly mahinga kai (the gathering of food and resources) lies at the heart of Ngāi Tahu's cultural identity, and it is a crucial link to keeping our traditions and knowledge vibrant for future generations. Deterioration of the freshwater environment harms us as a people and our very cultural survival.

Ngāi Tahu ki Murihiku are concerned about the state of water and compiling the Southland Water 2010 series has been an important step in the collaborative journey that will help to inform our resource management decisions.

Our recreational, social and economic wellbeing is interlinked to the freshwater environment. We need water for our economic prosperity. Māori are not separate from economic development and uses of the environment; in fact many of us are involved in the fishing and agriculture sectors. We also need water of good quality and sufficient quantity to do everyday things that we take for granted as Southlanders, such as turning on the tap, going whitebaiting or fishing, boating or swimming. For the wide range of our uses for the freshwater environment, we can only put monetary values on some, yet many of our other uses are priceless and lie at the very essence of who we are as Southlanders and indeed New Zealanders.

We need to ensure we recognise the concepts of natural/environmental capital, in that we only use the interest generated from that capital and that we definitely do not dip into and therefore deplete or destroy that capital, which is provided from the natural environment.

Stewart Bull
Te Ao Mārama Incorporated Chairman

At a glance

Our Uses is one of four reports which together make up *Southland Water 2010: Report on the State of Southland's Freshwater Environment*.

Here we report on our uses of the freshwater environment as a value, with particular focus on cultural use, water allocation, discharges, structures, and gravel extraction.

This report is about people, and as such we include a number of case studies on individuals and groups, and their different uses and links to Southland's freshwater environment. These case studies are titled 'Our People' and they are found throughout the report.

Cultural use

- Cultural use is an inclusive term that describes not only mahinga kai (the gathering of resources from the freshwater environment) but also varied cultural links between manawhenua and waterways. This includes customary, recreational and commercial cultural values of water.
- Cultural use by Ngāi Tahu in Southland/ Murihiku is expected to be higher than other regions.
- Cultural use can be site specific, and much mahinga kai gathering occurs on our lowland waters.
- Mahinga kai activities are at the heart of Ngāi Tahu culture. Impacts on mahinga kai could harm Ngāi Tahu ki Murihiku cultural wellbeing and identity.

Water allocation and use

- Groundwater and surface water are important to meet our domestic, stock, municipal, irrigation or industry requirements. They are also important for freshwater ecology, as well as recreational and other 'in-stream' uses.
- Allocation refers to the volume of water authorised to be taken from a particular water body.
- The total volume of water allocated by resource consents in 2009/10 was approximately 65.7 million cubic metres. Just over half of this was allocated for use from the regions groundwater resources.
- In 2009/10 the majority (75%) of consented water takes from surface and groundwater was for dairy shed supply, with irrigation the next most common use.
- Consented groundwater and surface water takes are centred in the Oreti and Mataura catchments.
- Between 2000/01 and 2009/10 groundwater allocation has more than trebled, while surface water allocation has remained relatively stable.
- Water use information is important to determine if observed changes in the environment reflect natural variability or result from water used. Unfortunately we can only report on rough estimates because of poor data quality and non-supply of data from some consent holders. We are working with consent holders to obtain more reliable data for future reporting.

Discharges

- Discharges refer to the release of contaminated water to the environment. This use is important for industry and everyday life in order to remove wastes and can occur via direct 'point-source' and in-direct 'non-point source' discharges.
- As of 30 June 2010, the majority of discharge consents in Southland were discharges to land (88%). There were 128 consented discharges to freshwater and 13 to estuaries.
- Between 2000/01 and 2009/10 the total number of consents allowing for discharges to freshwater, estuaries and land has increased by 46%.

Structures

- Across the region there are a range of structures built in or on our waters. These structures provide many benefits and can enhance our enjoyment and general use of the environment.
- We are unable to accurately report on the number or location of structures across the region, because many structures can be erected/placed as a permitted activity.

Gravel extraction

- River gravel from riverbeds and adjacent flood plains are an important source of aggregate needed to supply roading and construction needs. If extraction is not managed properly it can be unsustainable and lead to adverse environmental effects.
- During 2009/10 a total volume of 321,506 cubic metres of river gravel was extracted throughout the region. With most gravel being extracted from the Oreti catchment (166,464 cubic metres).

What limits our uses of water and what we are doing to manage our uses are outlined in later sections of the report.

S. Ledington

Introduction to Southland Water 2010

Water is essential for life. We rely on it for our social, cultural, economic and environmental wellbeing. Our quality of life depends on a constant and clean supply of water to our homes and businesses, and the ability to flush or drain away waste.

Our region has an abundance of water. This water comes in the form of rainfall, surface water (eg rivers, lakes and wetlands), groundwater and coastal marine waters. Our water is all connected in the hydrological cycle: rainwater supplies our rivers and groundwater aquifers, groundwater supplies some of our surface waters, surface waters contribute to some of our aquifers, and rivers and some aquifers discharge water to the sea.

The value Southlanders place on their environment is the basis of the *Regional Policy Statement* and our *Regional Water Plan for Southland. Ngāi Tahu ki Murihiku Natural Resource and Environmental Iwi Management Plan 2008: Te Tangi a Tauira – the Cry of the People*, articulates the Māori values for the freshwater environment.

The management outcomes within these documents have provided the framework for *Southland Water 2010: Report on the State of Southland's Freshwater Environment*. This enables our monitoring and reporting to inform future management of Southland's freshwater resources, and helps determine the planning for work programmes (including identifying gaps in our monitoring) within the next Long-term Plan 2012-2022.

The report, *Our Uses*, is part of the Southland Water 2010 report series. It builds and expands upon Environment Southland's first *Southland's State of the Environment Report for Water* published in October 2000, and provides a baseline to measure the success of the Water Plan that became operative in January 2010.

Southland Water 2010 consists of a series of four reports:

- Our Health
- Our Ecosystems
- Our Uses
- Our Threats.

The sustainable management of our freshwater resources requires a balance between the uses and values we have for the freshwater environment and the requirements for the health of the habitats and life that depends on these waters. Our use of freshwater can be viewed as a pressure on the other themes within the Southland Water 2010 series. In this report we recognise our uses as a value, and outline the extent of use within the freshwater environment, focusing in particular on cultural use, water allocation and use, discharges, structures, and gravel extraction.

Southland / Murihiku: Our place and our people

Our Place

Southland is the second largest of the 16 regions in New Zealand, covering 12.5% of the country's landmass. Our region includes Fiordland to the west and Stewart Island/Rakiura to the south, and has a total land area of over 34,000 sq km.

In Southland, water is used domestically and commercially for a huge variety of activities throughout our region, including; drinking, cooking, food production, cleaning, swimming, fire fighting, irrigation, transport, recreation, cultural activities, waste disposal, and electricity production.

Over half (53%) of the landmass in Southland is managed as part of our conservation estate. The five large lakes in our region (Te Anau, Manapouri, Monowai, Hauroko and Poteriteri) create a divide (Figure 1), effectively splitting the vast mountainous conservation estate of Fiordland in the west from the predominantly farmed land in the east (85% of our non-conservation estate is farmed). Eastern Southland is spanned by four major river catchments (Waiau, Aparima, Oreti, and Mataura) that, in total, spread over 54% of the region's area.

Our Waterways

Ki uta ki tai (From the mountains to the sea)

Ngāi Tahu view water as an undivided entity; as part of a system of lakes, rivers, lagoons, wetlands and their margins and beds. This report makes the distinction between various kinds of water such as groundwater and surface water. While this may be necessary for conventional water management purposes, this distinction is considered artificial by Ngāi Tahu, who contend that an integrated and holistic approach to water management is necessary.

Lakes

Lake Te Anau is the largest lake in the South Island, and is drained by the upper Waiau River, which then flows into Lake Manapouri. Both lakes Te Anau and Manapouri have control structures which regulate lake levels for Meridian Energy Limited's Manapouri Power Station (see Meridian Manapouri Power Scheme case study pg 44).

Lake Monowai is the smallest of the five lakes and is a popular destination for boating. The lake was raised approximately two metres in the 1920s for hydroelectric generation.

Rivers

The Waiau catchment lies on the eastern edge of Fiordland and is bounded by the Livingstone, Takitimu and Longwood ranges. With an area of just over 8,000 sq km, the Waiau is the largest catchment in Southland, and the fourth largest in New Zealand.

The Mataura is Southland's second largest catchment in area and water flow. The lower Mataura has been an important source of water for use in industrial processing and cooling, and for electricity generation. The lower Mataura has also been a major receiving environment for industrial and municipal effluent. The river has high recreational values and supports an internationally renowned brown trout fishery. It also supports a significant whitebait fishery.

The Oreti catchment covers about 10% of Southland's total land area. The headwaters of the Oreti River drain the high country tussock lands, while its middle and lower reaches drain heavily stocked sheep, cattle and deer country. Much of this land was originally wetlands. Extensive drainage, flood control and channel clearance has been undertaken to convert it to productive farmland.

The Aparima is the smallest of the four main catchments, rising on the steep eastern slopes of the Takitimu Mountains, and draining to Jacobs River Estuary near Riverton. Prior to drainage and agricultural development, much of the lower catchment contained extensive wetlands. Some important areas of wetlands remain in the upper reaches, particularly in the Hamilton Burn catchment.

The cultural importance of the four main rivers and lakes Te Anau (Te Anau-au), Manapouri

(Moturau), Hauroko, Mavora (Manawapopore/Hikuraki), Waituna and George (Uruwera) to Ngāi Tahu are formally recognised as mahinga kai (food and resource gathering areas) and traditional trails in the Ngāi Tahu Claims Settlement Act 1998. National Water Conservation Orders on the Mataura and Oreti Rivers reflect their national significance, particularly as brown trout fisheries.

Groundwater

Groundwater (the freshwater found beneath the ground) forms an integral component of the hydrological cycle (See 'The water cycle' pg 19) and has a significant influence on aquatic ecosystems. Groundwater is a vital source of water in Southland which is widely used for domestic, stock, municipal, irrigation and industrial use

Most rock and soil materials beneath the earth's surface contain water within pore spaces, fractures or other discontinuities. Where water is able to move sufficiently through these materials to enable abstraction for consumptive use, they are classified as forming an aquifer. Aquifers are hosted in many different physical environments, ranging from the coarse gravel materials of old river channels to the fractured and folded bedrock which form the region's hills.

Aquifers are typically recharged by infiltration of rainfall or water seeping out of the bed of rivers and streams. Once it reaches the water table (the point where all pore spaces in the rock or soil are saturated), water moves horizontally from the

Figure 1: Southland Region

point of recharge following the overall gradient of the landscape. Due to the often irregular nature of the geological materials, groundwater flow is typically slow and often follows a relatively tortuous (but always downhill) path to the point where it either discharges to surface water (rivers, lakes, streams or wetlands) or the coast.

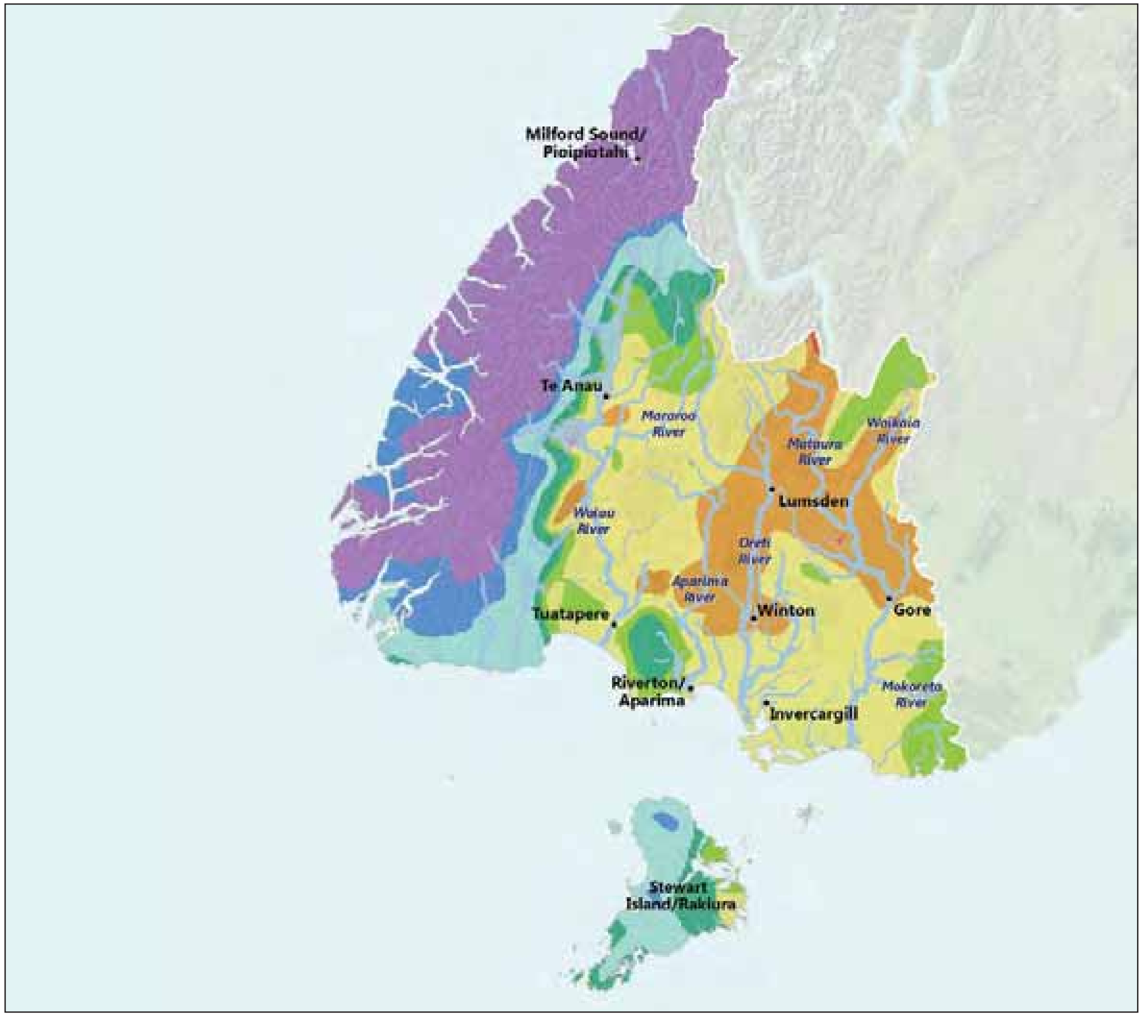
We commonly refer to two types of aquifer. Unconfined aquifers occur where water can freely infiltrate from the land surface into underlying rock and soil materials where it accumulates. The point at which all the pore spaces in these materials become completely filled with water is termed the water table. Confined aquifers are formed where the aquifer materials are separated from the land surface by layers of low permeability materials such as silt or clay (confining layers). In this case water has to flow laterally to fill the aquifer from areas where the confining layer is absent.

Climate Variability

Water and weather are permanently entwined; parameters like air temperature, humidity and rainfall, wind speed, cloud cover and sunlight levels are all related. The weather patterns over southern New Zealand are characterised by westerly airflows, which supply reliable and plentiful rainfall, and a narrow annual range in temperature.

Overall the Southland region has a cool temperate climate, with rainfall evenly distributed throughout the year; however the interaction between the prevailing weather conditions and

Figure 2: Annual rainfall totals across the Southland Region (NIWA) (1960-2010)



0 - 750 mm	1,500 - 2,000
750 - 1,000	2,000 - 3,000
1,000 - 1,250	3,000 - 4,000
1,250 - 1,500	Over 4,000

the mountainous terrain results in considerable rainfall variability across the region (Figure 2). The large mountains of Fiordland form a partial barrier to the prevailing westerly airflow and consequently receive extremely high rainfall, which can be more than 10,000mm/yr. In general, the inland valleys of northern Southland are relatively dry, receiving just 800-1000mm/yr of rainfall. Along the south coast, limited shelter from the prevailing westerly conditions means rainfall tends to be slightly higher, more frequent and reliable than inland areas.

Water has its own whakapapa

To Māori water has its own whakapapa (genealogy). Whakapapa is the relationship of all life forms and phenomenon to each other, as well as to people and the atua (gods). Whakapapa describes bonds, relationships, and connections which are linked by whakapapa. No distinction is made between the inanimate and the animate or between abiotic and biotic. Māori relationships with water are part of this indivisible whakapapa linkage. Water is the medium flowing through a catchment that makes connections.

Our People

Southland has a population of 90,873 people (Census 2006), with 78.6% identifying as of European decent, 16.5% as New Zealanders, 11.8% as Māori, 1.7% as Pacific people, and 1.3% as Asian. Southlanders make up 2.3% of the total population of New Zealand.

Southland's main urban centre is Invercargill, with a population of 50,328 people. Other significant population areas are Gore (9,870), Winton (2,088), Te Anau (1,899), Riverton/Aparima (1,512) and Otautau (753). Southland's 27% rural population is almost twice the national average of 14%.

Manawhenua

Māori have a long history in Southland/Murihiku with a major settlement on Ruapuke Island and other settlements along the Southland coast at Waikawa, Bluff, and Riverton/Aparima.

Manawhenua refers to the iwi or hapū that hold the traditional/customary authority over resources within a particular area.

In Southland/Murihiku there are four Ngāi Tahu papatipu rūnanga (traditional local Māori councils) which hold manawhenua status within the region:

- Te Rūnaka o Waihōpai: Waihōpai/Invercargill
- Te Rūnanga o Awarua: Awarua/Bluff
- Te Rūnanga o Oraka/Aparima: Oraka/Colac Bay
- Te Rūnanga o Hokonui: Gore.

Where we live and what we do

Where Southlanders live is largely dictated by water – from rainwater to rivers and glaciers, water has shaped the patterns of human settlement and development in Southland/Murihiku. In Māori terms, Ka Huika, the confluence of the Mataura and Waikaia Rivers, also denotes the various streams of peoples who have come together in southern New Zealand.

Human settlement started on the coast, with Māori moving inland along waterways, which were also used to transport pounamu and mahinga kai from the surrounding areas. Early European settlement followed similar patterns, beginning with coastal whaling and sealing settlements from 1829, in Fiordland, around Stewart Island/Rakiura and at Bluff and Riverton/Aparima.

More widespread settlement and development began in 1856, from the new town of Invercargill. Those settlers noted the mud flats, dangerous creeks, peat mosses and lagoons, and began bush clearance and drainage to convert the land to pasture for cattle and sheep grazing, and crop production. Southland's rivers were scoured for gold in the 1860s, but the region's real economic boom happened in the late 1870s, when refrigeration made possible the export of dairy products and frozen mutton to Great Britain. Dairy factories and freezing works, together with other agricultural industries like limestone fertiliser production, were soon more common than flaxmills and sawmills.

Rail and road systems linked the region further, along with the many bridges, culverts and ferries needed to connect the towns and industries that had been established close to rivers. The Port of Bluff remained a key gateway for immigrants and exports, and supported fishing and oyster fleets.

By the early 1900s, the development of Southland encompassed lowland and rolling hills, broken only by the chain of lakes west of the Waiau River and the mountainous terrain beyond. Fiordland National Park, gazetted in 1904, was reserved as an area for the fledgling tourist industry, although a survey of the hydro-electric potential of lakes Manapouri and Te Anau in November 1903 noted the considerable scope for electro-industrial development, later realised with the completion of the Monowai power station in 1925, and the Manapouri power station in 1971.

Agriculture, primary production and manufacturing continue to be the main contributors to Southland's economy. Nearly 19% of Southlanders are employed in the agriculture, forestry and fishing sectors, 15% in manufacturing. Farms in Southland are predominantly involved in livestock production, with 45% involved in sheep production, 16% dairy cattle, 8% beef cattle, 10% mixed sheep and beef and 7% deer.

Tourism accounts for 10–12% of Southland's workforce, servicing a mixture of international and domestic visitors. In New Zealand as a whole, a large proportion of the international tourism (70%) is based around activities in the natural environment.

Southland trout fisheries attract international anglers. The region is the most frequently fished by travellers with over 25% of the total overseas visitors' fishing experience in New Zealand happening in Southland.

How this report works

The Southland Water 2010 report series has been written to:

- Raise awareness and understanding of issues that affect our shared environment
- Tell us how effective our decisions and actions have been
- Help us set priorities for future action
- Help people and organisations make informed decisions to protect what they value in the environment
- Inspire community action.

State of the environment reporting

State of the environment (SOE) reporting is the equivalent to a report card on the environment.

SOE reports are not technical documents, but they are based on large amounts of technical information. They instead set out to show the properties of a specific aspect of our environment.

Our Uses asks: 'How do we use the freshwater environment and is there enough for our different needs?' It is important to keep in mind that water is also used by each and every living thing, in every ecosystem throughout our region.

As such this report extends beyond strictly 'environmental' elements.

Our use of water puts pressure on the freshwater environment and this is reported within the other themes of the Southland Water 2010 series.

Approach taken in this report

Southland Water 2010 focuses on the freshwater environment, but includes the estuaries and coastal areas influenced by freshwater.

Nationwide, regional councils work together to ensure and improve national consistency and robustness of the environmental information collected. As such, Environment Southland's monitoring programmes encompass aspects that are traditionally monitored by regional councils in New Zealand, and are consistent with current national best practice.

By reporting collaboratively, Environment Southland and Te Ao Mārama Incorporated seek to provide Southlanders with a more complete, more holistic picture of environmental and cultural health.

Report structure

The report structure is based on the Regional Water Plan for Southland, the Regional Policy Statement and the *Ngāi Tahu ki Murihiku Natural Resource Management Plan 2008: Te Tangi a Tauira – the Cry of the People.*

We report on information collected by both Environment Southland and Te Ao Mārama Incorporated.

The first part of this report on Our Uses looks at certain types and extent of uses of the freshwater environment, in particular;

- **Cultural Use** of freshwater by Ngāi Tahu ki Murihiku and the link between cultural identity and wellbeing with the freshwater environment of Murihiku/Southland.
- **Water Allocation and Use** of surface water and groundwater resources. This section also looks at how much is allocated to different activities and how much we actually use.
- **Discharges** that can release contaminants into water. This section describes the kinds and extent of discharges that require resource consents in Southland.
- **Structures** that are found in our waterways and their benefits and potential adverse effects.
- **Gravel Extraction** from our waterways and adjacent river banks.

This report on *Our Uses* of the freshwater environment is about people. Therefore, this report includes case studies of individuals (and groups) focusing on their different uses of and linkages to Southland's freshwater environment. These are entitled 'Our People'.

The first of 'Our People' is Rewi Anglem, manawhenua, who provides insight on contemporary cultural use in the Mataura River, pg 24.

Two of 'Our People', Jonny Brown and Ron Granneman, illustrate recreational use of the freshwater environment – kayaking and trout angling, pg 50 and 56.

Another case study focuses on Riversdale farmer, Alistair Gibson, and his use of water for irrigation, pg 45.

Rachael Millar talks about her work as a Principal Planner involved in freshwater policy development, pg 62.

Uses of our natural resources require a future view, which is at the heart of the case study of Otama School and its direct linkage to their local stream, pg 65.

Kī mai koe ki ahau,
He aha te mea nui o tēnei ao?
Māku e kī atu
He tangata, he tangata, he tangata

If you ask me, what is
the greatest thing in the world?
Then I shall reply
It is the people, the people, the people.

The later part of the report asks two questions:

- What limits our uses of water?
- What are we doing about managing our uses?

The purpose of SOE reporting is also to determine future management actions, and inform the wider community about how they can help directly, so we also report on 'What we don't know and could do better', pg 63, as well as 'What you can do', pg 64.

Where and what we monitor

Monitoring our water resources is essential to managing the allocation and use of surface water and groundwater.

Environment Southland regularly carries out detailed monitoring for several key water parameters including; rainfall, river flow, groundwater and lake levels, springs and soil moisture. These measurements allow us to monitor some of the water inputs, storage, and movements occurring around Southland.

Check out the latest monitoring data collected by our monitoring stations at www.es.govt.nz/rivers-and-rainfall.

Rainfall

Environment Southland currently monitors rainfall in 12 surface water resource zones (Figure 6) across our region using a network of 38 telemetered and 18 manual rainfall recorders (Figure 3). Data from our telemetered rainfall recorders is automatically sent to Environment Southland's offices, and is immediately available for our use.

The manual rainfall recorders are checked by members of the public who record rainfall daily and send us monthly reports. This information is very useful and we appreciate the goodwill of those involved. The National Institute of Water and Atmospheric Research (NIWA) also operate a telemetered rainfall site in the upper Mararoa catchment and provide us with this data.

River Flow

Our estimates of river flow are based on river water levels. A good relationship can be determined between river flow and river level at a particular site, and we establish this relationship using flow gauging equipment. We regularly check this flow-water level relationship to ensure our flow estimates are still accurate, particularly after events like a big flood, where the river channel profile is likely to have changed.

River water levels are recorded in a variety of ways by Environment Southland including; water towers, pressure transducers and radar technology. To ensure all of these water level monitoring devices are measuring correctly, we manually check water levels at all sites once a month (Figure 3).

Lake Levels

Lake water levels are generally recorded through the use of a tower and a float and counter-weight system, the same method typically used to record water levels in our rivers. Manual checks of gauges in lakes are done regularly to ensure that the water level recorder is reading correctly.

Groundwater

Regular monitoring of groundwater levels in Southland began in 1995 in the Edendale area, as part of the Sustainable Farming Fund Oteramika Catchment Study. Upon completion of this project in 1998, monitoring ceased until 2000 when Environment Southland established its baseline groundwater monitoring programme. Since 2000, the groundwater level network has grown in size in direct response to the increased pressure on groundwater resources in the region, in terms of quality and quantity. Environment Southland currently monitors groundwater levels in over 100 bores throughout the region (Figure 3). About 20 bores have had data loggers installed which automatically record groundwater levels every 30 minutes. This provides a continuous record of short term variations in the aquifer in response to recharge events or abstraction (water being pumped out). These 'real-time' groundwater level sites are located in aquifers that have the highest levels of groundwater allocation.

Several automatic level monitoring sites are used to manage groundwater abstraction at critical times through resource consent conditions (typically by way of restrictions on abstraction based on water levels). The remainder of the bores are manually measured once a month as a cost-effective way of increasing the spatial coverage of the groundwater monitoring programme.

Springs

Springs are formed where the water table intersects the earth's surface and groundwater discharges to the surface. Streams sourced from springs or receiving a high proportion of groundwater discharge (collectively termed spring-fed streams) form a highly valued water component of the region's water resource. Compared to streams sourced from rainfall runoff, spring-fed streams tend to have a stable, year-round discharge and exhibit water quality features (such as stable temperatures and low turbidity) which support a unique aquatic habit including mahinga kai values.

Spring discharge also makes a major contribution to the region's river systems, particularly during periods of low flow. For example, the Brightwater Spring near Garston is Southland's largest spring and accounts for up to 60% of the flow in the upper reaches of the Mataura River during dry periods.

A spring gauging programme has been established to monitor major springs across our region to improve the understanding of their hydrology, including the effects of changing groundwater levels on spring discharge. This monitoring was undertaken on an irregular basis until 2002 when the regional spring gauging monitoring programme was established as part of our SOE reporting requirements. The current programme involves monitoring seven significant spring-fed stream systems on a six-weekly basis during winter and spring, and monthly during summer and autumn. The number of springs monitored is increased when groundwater levels in an area are particularly low or during extended dry periods.

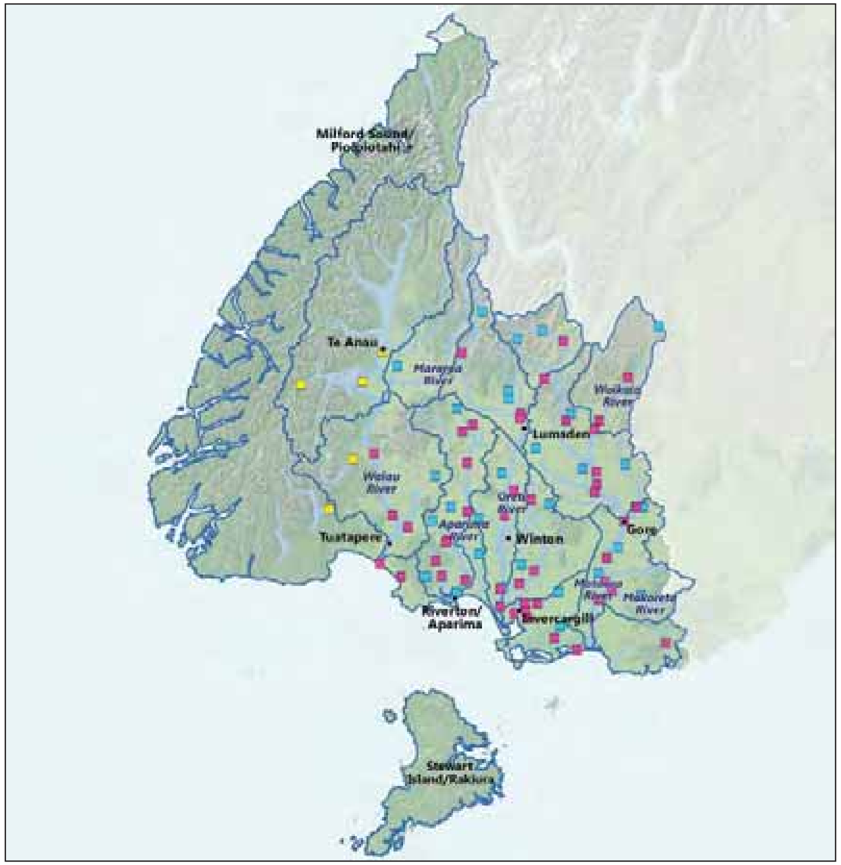
The sites that have been frequently monitored as part of the SOE spring monitoring programme are shown in Figure 3.

Soil moisture network

Environment Southland has a network of sites across Southland that measure soil moisture (Figure 3), rainfall and soil temperature. This information is particularly useful in assisting farmers to manage their irrigation programmes in terms of farm dairy effluent application and pasture irrigation. Several factors influence the decision on when and how much to irrigate, including current and expected weather patterns, soil moisture, soil temperature and feed budgets. From an environmental perspective, the weather, pasture growth and application rate are critical factors in mitigating environmental effects.

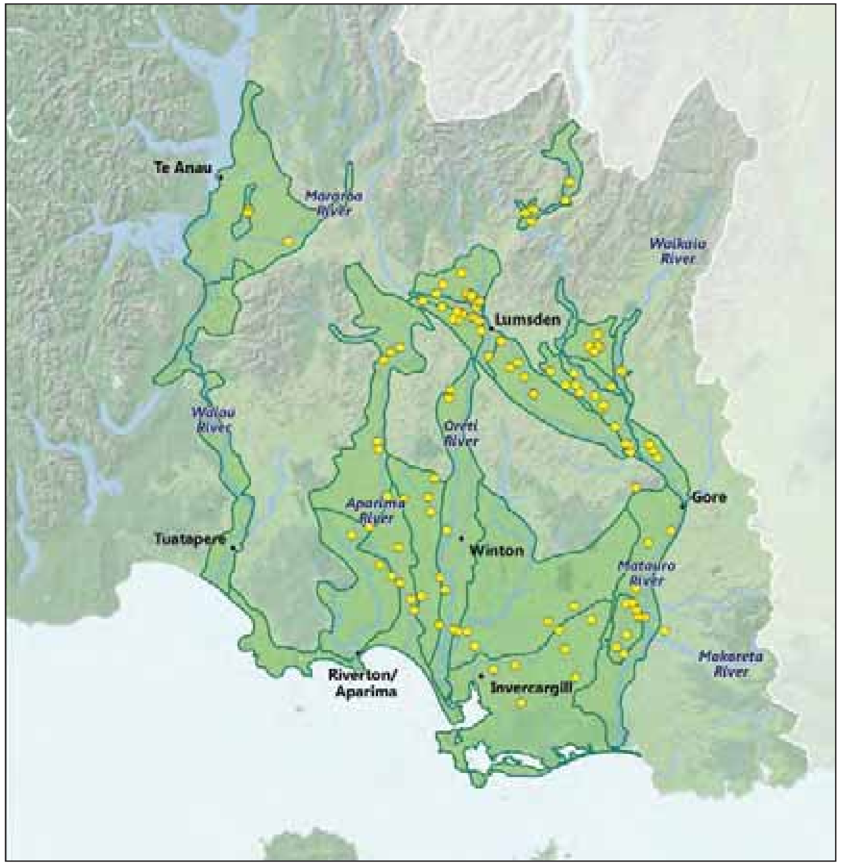
Figure 3: Location of water quantity monitoring sites

Rainfall, river and lake level monitoring sites



- Lake Sampling Sites
- Water Level / Flow
- Rainfall
- Surface Water Zones

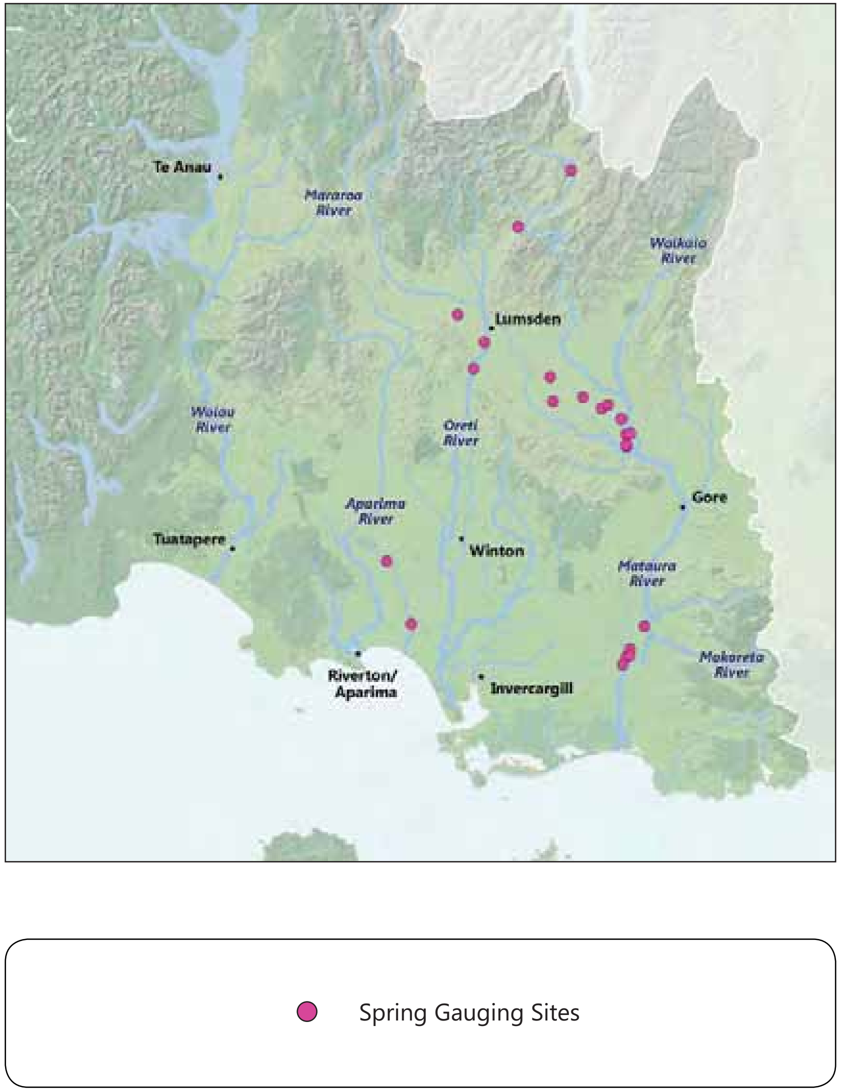
Groundwater level monitoring sites



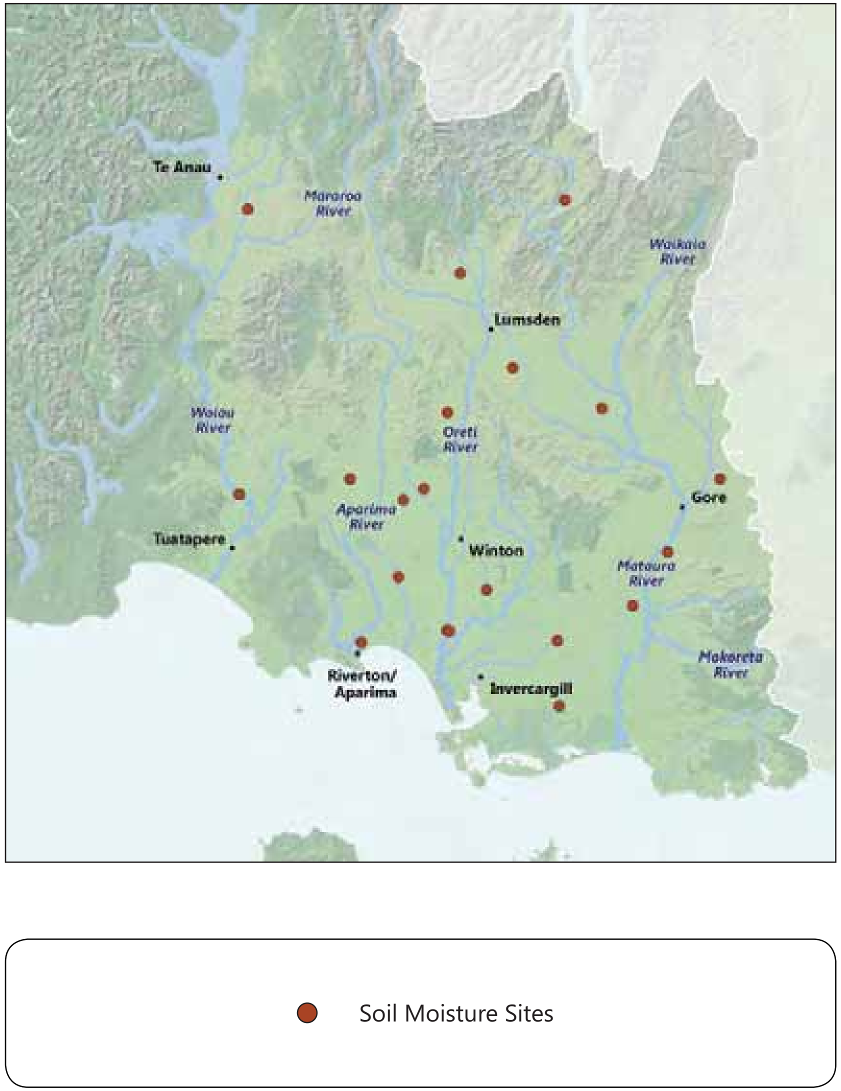
- Groundwater Level Monitoring Sites
- Groundwater Zones

Figure 3 (continuted): Location of water quantity monitoring sites

Spring gauging sites



Soil moisture network sites



Sustainably managing water use in Southland

Environment Southland

Environment Southland is responsible for the governance and management of Southland's natural and physical resources: air, land, water and coast.

The 'outcomes' we aim for in our sustainable management of freshwater resources are the community expectations set out within the Regional Policy Statement and the Regional Water Plan for Southland. The Water Plan sets out in detail the community's standards and targets for water management within Southland.

Under the Resource Management Act 1991, many activities that involve water can only occur if they are allowed by a rule in a regional plan or resource consent.

Southland's groundwater and surface water quantity is managed via the Water Plan, which establishes a groundwater management framework that was designed to be adaptive so information and knowledge could be immediately fed back into the management of the resource.

There are other regional plans that place controls on activities that may affect water use and development, including the Regional Effluent Land Application Plan, Regional Solid Waste Management Plan, and the Regional Coastal Plan.

District councils are also responsible for the management of surface water activities, like boating and noise on the surface of rivers and lakes, and the use of land adjacent to river and lake beds.

Te Ao Mārama Incorporated

Ngāi Tahu was, at the time of the signing of the Treaty of Waitangi in 1840, the tangata whenua that held manawhenua and manamoana within the takiwā of Ngāi Tahu, which includes all of Murihiku, Rakiura/Stewart Island and into the adjacent ocean as far as New Zealand's statutory limits, 200 miles offshore. Ngāi Tahu ki Murihiku still hold this role today and, as kaitiaki, work actively to ensure that spiritual, cultural and mahinga kai values of the takiwā are upheld and sustained for future generations

The central traditional principle behind Ngāi Tahu management of the environment is kaitiakitanga (guardianship).

There are 18 papatipu rūnanga that constitute the membership of Te Rūnanga o Ngāi Tahu. Te Rūnanga o Ngāi Tahu is the tribal representative body of Ngāi Tahu. It is a body corporate established under section 16 of the Te Rūnanga o Ngāi Tahu Act 1996. The Te Rūnanga o Ngāi Tahu Act 1996 and the Ngāi Tahu Claims Settlement Act 1998 give recognition to the status of papatipu rūnanga as kaitiaki and manawhenua of the natural resources within their takiwā boundaries.

Te Ao Mārama Incorporated looks after manawhenua interests in resource management and other aspects related to local government in Southland. It represents the four Ngāi Tahu papatipu rūnanga in Murihiku/Southland.

The planning document Te Tangi a Tauira consolidates manawhenua values and perspectives on natural resource management. This document assists Ngāi Tahu ki Murihiku in carrying out kaitiaki roles and responsibilities.

In Southland, we are never far from some kind of water, whether it be a river, lake, estuary, groundwater or the sea.

The hydrological cycle

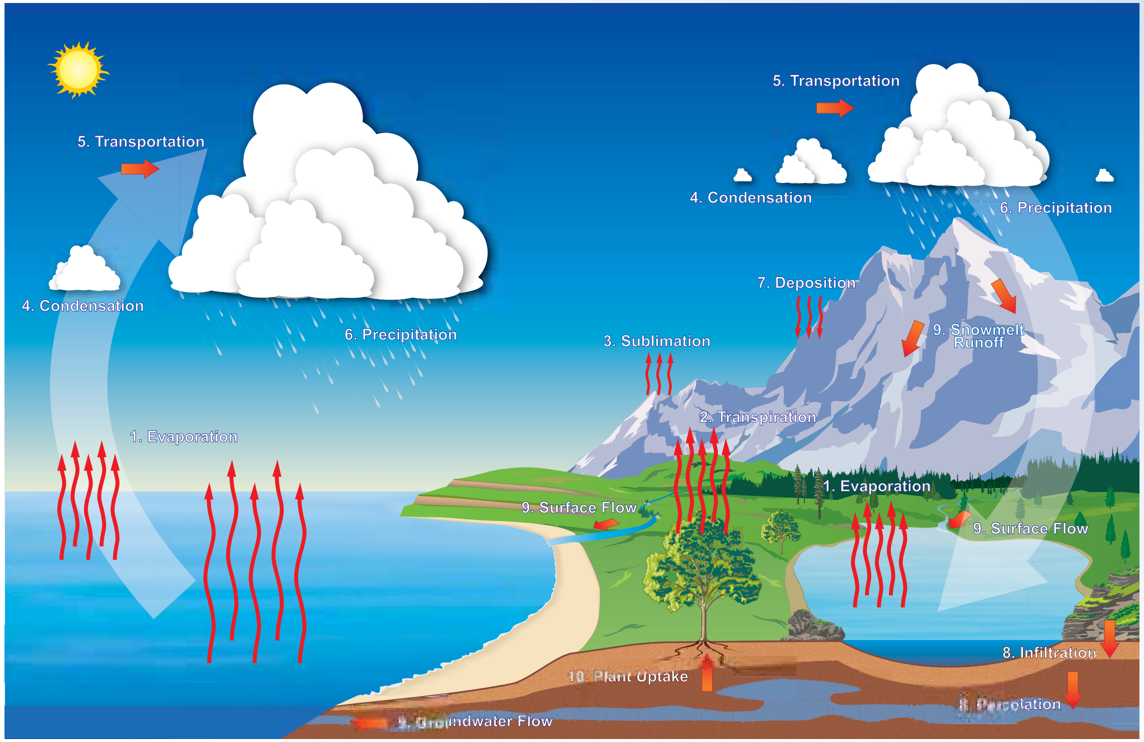
The hydrological cycle describes the movement of water above, on and below the earth's surface. This concept is illustrated in Figure 4.

Water evaporates from the land, oceans and vegetation into the atmosphere by the sun and returned to the land via the processes of condensation and precipitation (rain or snow). Rain either runs off the land forming lakes, rivers and streams or seeps into the ground to replenish soil moisture. Excess water in the soil seeps through the ground to underlying aquifers where it moves laterally to the sites of groundwater discharge. Water discharging to streams via runoff or groundwater, flows to lakes or the sea where it is again evaporated to continue the cycle.

The pattern illustrates the connections between all water bodies and demonstrates why it is so important that we monitor our water resources and their uses carefully.

While many of the atmospheric (clouds, snow and rainfall) and surface water (runoff, lakes and rivers) processes involved in the water cycle are readily observable, the importance and contribution of groundwater to overall catchment processes is often poorly appreciated.

Figure 4: The hydrological cycle (NOAA, 2010)



Understanding how surface water and groundwater interact

Groundwater and surface water are not isolated components of the hydrological cycle and there are few settings where some interaction does not occur between these forms. In many areas of Southland flow lost from rivers and streams make a major contribution to water recharging underlying aquifers, while in other areas drainage of groundwater provides a baseflow which sustains rivers and streams between rainfall events.

Due to the significant contribution of groundwater discharge to stream flow, both the quality and quantity of groundwater can exert a major influence on flow and water quality in rivers, streams, lakes and wetlands. As a consequence, changes in the condition of the groundwater can often be indirectly observed through effects on the quantity and quality of surface water.

For information on groundwater and surface water quality interactions in Southland, see the Groundwater Case Study on the State of the Environment page on our website, www.es.govt.nz.

Understanding the dynamics of groundwater is complex and challenging not just because it is so difficult to 'see' what is going on underground, but because of the close interaction with surface waters. Surface waters such as rivers and streams can be intimately connected to unconfined aquifers such that water can flow both ways between the two water bodies, depending on local conditions. For example, when adjacent groundwater levels are high, groundwater may discharge into the stream (ie the stream gains water from the surrounding aquifer). Conversely, if surrounding groundwater levels are low, then water may flow from the stream down into the aquifer (ie effectively losing water to the aquifer). A stream may contain various sections where it is gaining or losing water in this way at any one time, but the locations will change over time in response to rainfall and changes in river flow. How we extract water for use, either from the stream or the groundwater aquifer, can effect these processes.

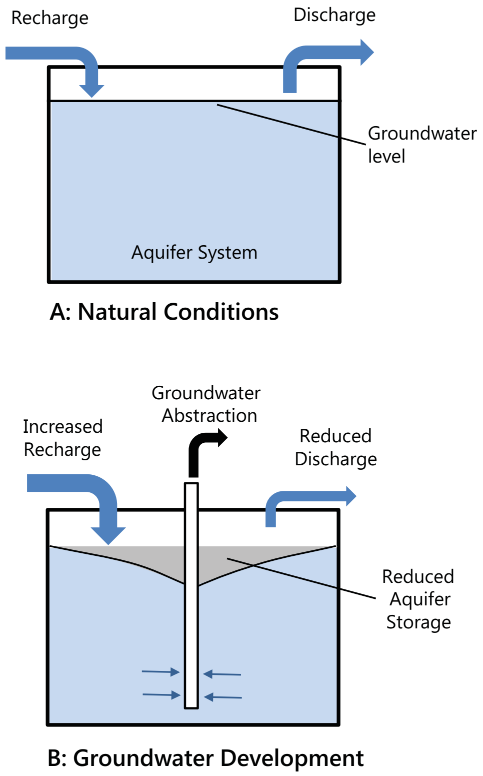
The water balance in an aquifer system represents an equilibrium between aquifer recharge, discharge and storage. In general, groundwater levels rise when recharge is more than the discharge (such as following heavy or extended rainfall) and fall when aquifer discharge is greater than recharge. Groundwater levels tend to exhibit a relatively uniform seasonal variation with highest groundwater levels in spring after recharge during the winter months, followed by a gradual decline as water is discharged from the aquifer system during summer and autumn.

Under natural conditions, aquifer recharge and discharge tend to balance out over the medium-term. So, although varying from month to month and year to year, groundwater levels tend to fluctuate around a stable long-term average.

Groundwater abstraction alters the balance between aquifer recharge and discharge. Initially, water pumped from an aquifer system is removed from storage resulting in a lowering in the water table in the vicinity of the abstraction point. However, over time groundwater levels will reach a new equilibrium with pumping by either reducing the amount of groundwater discharge (ie reducing flow in river or streams) from the aquifer system or inducing additional recharge (eg increasing flow loss from hydraulically connected rivers or streams; Figure 5).

A key distinction between groundwater and surface water movement is the time involved. For example, following rainfall, surface water is typically drained from a catchment rapidly (days to weeks) while it may take months, years, or even decades for groundwater to infiltrate through the soil zone and flow through an aquifer system to its final discharge point. Because of this lag, groundwater volumes often fluctuate in response to seasonal and longer-term variations in rainfall and climate.

Figure 5: Schematic representation of the potential effect of groundwater abstraction on aquifer water balance



Cultural Use

Ngāi Tahu ki Murihiku recognise that the welfare of the people and the success of their activities within the environment depends on water being maintained in the best possible condition.

- Ngāi Tahu Ki Murihiku, Te Tangi a Tauira, 2008

What does cultural use mean?

Cultural use is often described as relating to activities like collecting plants, fish, animals and other natural materials for cultural purposes. This also includes activities related to visiting or interacting with a place or landscape, such as campsites or settlements. However, this description is too narrow to express the numerous and varied Ngāi Tahu cultural use and values associated with Murihiku/Southland waterways.

Tangibly and intangibly waterways feature in all aspects of culture. They provide symbolic links between the spiritual world of tūpuna/ancestors and tangata whenua. Waterways feature prominently in stories, placenames and waiata which consistently reflect important symbolic messages. Each community has its own traditions associated with areas, the characteristics of which can vary greatly. Specific waterways are protected and valued for particular cultural occasions. Wāhi tapu sites support the most important roles. They could be burials sites or places where people can communicate with their tūpuna.

In some cases, specific resources (ie eels) serve as cultural symbols valued throughout the region, while others are significant to specific groups. For example, tītī are harvested by Rakiura Māori, and kanakana/lamprey are harvested from the Mataura Falls for Hokonui rūnanga and other whānau who travel from around the Rohe/tribal area to gather at the Falls (see Rewi Anglem case study on pg 24).

Ngāi Tahu also enjoy the use of water for a range of activities that they share in common with other members of our society including:

- Domestic supply – for homes and marae
- Stock water
- Fishing
- Swimming, boating and other recreational activities
- Agriculture.

As such Māori cultural values include customary, recreational and commercial aspects of water and should be considered to include 'instream values' and 'out-of-stream-values'.

Cultural use can be site specific

Some cultural uses can be undertaken at any place in a catchment but some are site specific. For example food gathering opportunities are often place specific (eg Mataura Falls, Māngai Piri/ Niagara Falls for kanakana/lamprey) or in certain parts of the catchment (eg many mahinga kai species are harvested in the lowland waters such as estuaries and areas where fish are migrating from or to the sea).

Another example of site specific cultural use is the use of customary lands or lands marked as reserves. Use of these places is an inherited right derived through whakapapa/genealogy, and therefore cannot be relocated.

For this reason, it is important that the management of water recognises and accommodates these place specific cultural use sites.

Core values associated with water and cultural use

There are core Māori values relating to the freshwater environment. Here we describe each core value and link it to freshwater and the concept of cultural use and practice.

Table 1: Core Maori values and uses relating to the freshwater environment (from Tipa 2011)

Core Value	Description	Relationship to Cultural Use of freshwater environment
Whakapapa	Whakapapa (genealogy) is about the relationships of all life forms to each other as well as the atua (gods). Whakapapa describes bonds, relationships, and connections. All things are linked by whakapapa.	Water has its own whakapapa and Māori link to this whakapapa. Whakapapa is also central to passing on kai gathering knowledge through the generations.
Te Ao Māori	The environment is viewed as a whole – not as divided parts.	This holistic view of the freshwater environment requires consideration of the whole catchment. A catchment constitutes soils, water, flora, fauna and the relationships between them.
Mauri	Mauri is a central component of the Māori perspective on the environment. It can be defined as the life principle, life supporting capacity, or life force present in all things. For example, in a river mauri is about the diversity of life in and around a river. Mauri also refers to the 'working ability of a river' specifically its role in building floodplains, reshaping channels, building river mouths, sustaining biodiversity etc.	Protecting the mauri of a resource is the fundamental management principle for Māori. Māori treasure the mauri of freshwater and may experience cultural offence and distress when that mauri is degraded. The overuse, depletion or destruction of natural resources leads to a diminishment of mauri.
Wairua	Spiritual connection/wellbeing.	Ngāi Tahu, like other Māori, use different ways to feel spiritually connected with their takiwā. This spiritual connection can occur by gathering kai with whānau at a traditional fishing place that they know was named by their tūpuna/ancestors, and utilised by successive generations of their whānau; being able to contribute the kai that their takiwā is renowned for, to ceremonies. Being denied these opportunities can impact on spiritual wellbeing.
Kaitiakitanga	The exercise of guardianship/stewardship by the tangata whenua of an area and resources in accordance to tikanga Māori (customs and rules).	Kaitiakitanga governs the way humans interact with ecosystems. The notions of sharing and maintaining balance within nature underpin cultural uses and practices. Balance requires respect to be shown when interacting with the environment; and use of the resource (within limits) afforded by healthy ecosystems. Māori continue to have a duty to protect the natural world.
Tino Rangatiratanga	Tino Rangatiratanga is having the right to make decisions for your own people concerning the resources within your tribal area.	This means determining what, from a cultural perspective, represents satisfactory aquatic conditions and appropriate use.
Mahinga kai	Mahinga kai that encompasses the resources harvested, the ability to access the resource, the site where gathering occurs, the act of gathering and using the resource, and the good health of the resource.	Mahinga kai is considered by Ngāi Tahu to be the principal 'environmental indicator' in natural systems. If mahinga kai is not present, or is unsafe to harvest, then that natural system is under stress and requires remedial action. The state of freshwater is therefore important to Ngāi Tahu as a medium for sustaining and accessing mahinga kai. Ideally streams will sustain healthy and diverse koiora/life.
Manaakitanga	The support, caring and hospitality shown to guests.	Having the ability to manaaki visitors by supplying kai sourced from one's area means that the activities of fishing, eeling and gathering foods creates and maintains whanau and hapū ties and reinforces identity. Conversely the inability to manaaki guests and sustain whānaungatānga can lead to cultural loss. Sustaining waters, lands and resources, and thereby enabling manawhenua to manaaki others, is a strong driver for their participation in freshwater management.

Core Value	Description	Relationship to Cultural Use of freshwater environment
Mātauranga Māori	Māori knowledge	Interacting with waterways serves the functions of passing on traditional knowledge from one generation to the next. Mātauranga Māori is developed and transmitted through the use of natural resources, such as the practices of food management, harvesting and preparation. For example, gathering kai requires knowledge of techniques and ecosystems. If populations of aquatic species decline because of degraded water systems, knowledge of the techniques of gathering these foods along with the associated ecological and cultural knowledge will likely also begin to disappear.
Te Reo	Language. Te Reo contains knowledge and is another expression of culture and identity.	Stories, waiata and Te Reo that pertain to particular uses, and these uses sustain the culture. When a valued species disappears from a local ecosystem or the activities associated with a species decrease, the associated Te Reo drops away.
Whānaungatānga	The interrelationship of Māori with their ancestors, their whānau, hapū and iwi as well as the natural resources within their tribal boundaries eg mountains, rivers, streams, forests, etc. This genealogical relationship is one of the foundations upon which the Māori culture is based.	Sustainable management seeks to sustain the health, wealth and well-being of the natural environment while sustaining communities dependent upon it. In a catchment it is water that makes and maintains connections between different waterbodies and entities within a catchment.

Our water use is global

Water is an essential requirement for all life on earth and it is impossible to overstate the importance of such a vital resource. We use water constantly. This simple statement is so obvious, especially in Southland where water seems so abundant. And yet, it is worth reflecting upon because our individual water use extends well beyond our personal daily consumption of water.

On average, each New Zealander uses 250 litres of freshwater in their house each day. This is the water used for daily tasks like washing ourselves and our clothes, cooking and drinking, flushing the toilet, and watering the garden. These are direct uses, but our water consumption does not stop there. Most of the goods and services we consume also require water and this water use is unseen by the consumer – it is sometimes referred to as 'virtual' water. Some of these virtual water uses are obvious, such as the water required to grow crops and food. Other uses are less apparent. For example, if you are drinking a cup of coffee while you read this report, then you might consider that to grow and prepare the 7 grams of beans used on average for a cup of coffee, requires about 130 litres of water. Similarly, if you are reading a printed copy of this report then you may be interested to learn that each A4 sheet of paper requires between 2-13 litres of water to produce. Cotton production requires almost 10,000 litres of water per kilogram of fabric – so if you are wearing a pair of cotton jeans then they probably needed about that amount of water.

When you consider all of the water that is used to produce all of the goods and services we consume, our individual water 'footprint' is considerably larger than our direct daily use. After accounting for all of these indirect water uses, it has been calculated that, on average, each person in New Zealand has an average water footprint of 1,589 cubic metres of water per year. This is equivalent to every New Zealander using a little over 4,300 litres of water each day. The global average is 1,385 cubic metres per person, per year.

A clear reminder of the global nature of personal consumption can be seen by the fact that 58% of our individual water footprint occurs overseas (for example we don't grow cotton or coffee beans in New Zealand). In this sense, the importing and exporting of goods can be expressed not just in money, but also in terms of importing or exporting water use.

While this report focuses on how we use the water that exists within Southland – it is still worth keeping in mind that our water use is intrinsically linked with the outside (national and international) environments and the markets we trade with.

OUR PEOPLE Case Study – Rewi Anglem, Manawhenua (Hokonui Rūnanga and Te Ao Mārama Incorporated)

Rewi Anglem has been Chairman of the Hokonui Rūnanga for the past 12 years. In that time he has been involved in many projects, but is particularly proud of the Mātaitai restoration they are working on at the Mataura Bridge.

A Mātaitai reserve is created in an area of traditional importance to Māori for customary food gathering. Tangata whenua are authorised to manage and control the non-commercial food gathering in that area. Mātaitai reserves are permanent, and once established, commercial fishing is not allowed unless recommended by the tangata tiaki/kaitiaki.

The site of the Mātaitai on the Mataura River, was formally opened in 2006, and is the first and only freshwater Mātaitai in New Zealand. If the condition of the Mataura River deteriorates, so too does its mauri (life force). The Mātaitai reserve will enable the Hokonui Rūnanga to manage its historic fishery in an holistic way, caring for the habitats and ecosystems that support it.

Rewi says the Mātaitai will enhance the river. "Rather than having gorse and weeds falling into the river, this will be better for the river."

The Mataura Mātaitai covers 3kms upstream of the bridge and 7kms downstream. So far, native trees and flax have been planted and maintained on the paper mill (eastern) side of the river, upstream of the bridge. The next step, Rewi says, is to plant downstream. "It all depends on the funding."

The Hokonui Rūnanga was the recipient of $25,000 from the Community Conservation Fund, which got the project off the ground. Rewi says it's been a community effort. The Rūnanga cleared the ground and sourced the trees, the Corrections Department supplied the labour to dig the holes, and students from Otama amd Mataura Schools planted the trees and grasses. "I'm getting calls from the schools now to find out when they can help with the next stage."

The Mataura Mātaitai holds a special significance for Maori, not just local iwi. Tūpuna (ancestors) valued the Mataura as a highway, meeting place and for its mahinga kai – the food and physical resources essential for survival in a harsh environment. Anecdotal evidence suggests that iwi used to travel long distances to come to the Mataura, well known for the size of the eels that could be caught there.

The Mataura Falls, once a spectacular tourist attraction, didn't look the way they do now. Once they would have been 50ft higher. Dynamite was used to destroy the biggest rocks on the falls, as part of the development of the paper mill which opened in 1873 and subsequent meat works. Both operations began to generate hydroelectric power from the falls, building turbines under their premises. Today, the paper mill is closed, but power generation still continues.

The consent to generate power expires in 2022, and Rewi hopes it won't be renewed. "We won't be supporting a renewal of the consent."

Rewi is hoping that the freezing works will come to the party and support the Mātaitai by planting out their side of the river. He would also like them to fulfil a condition of their consent and create a fish passage. He says with the falls the way they are, fish movement to the upper reaches of the river is more difficult and a passage needs to be created to assist.

A fish passage would not only help the small native fish and trout, but also the highly valued kanakana. Kanakana have long been harvested from this site, and now it is one of the last strongholds in the country. Rewi says one time kanakana would have been found in every river south of Canterbury, but now are mainly found in the Mataura and Waikawa rivers. They have been struck by bacterial illness recently, with the Ministry of Agriculture and Forestry stepping in to work with the Rūnanga and Environment Southland on finding the strain and cause of the illness. So far, the illness has caused mass death of this customary mahinga kai, and to lose more would be very damaging to cultural use at this important site.

Rewi and the Hokonui Rūnanga will continue to work at this Mātaitai with the local community for the enhancement of the river. As well as this, they are working to create a wetland on the rūnanga grounds in Gore, with a view to it being a habitat for ground birds such as weka and takahē. In the future, Rewi thinks that they will be able to propagate seedlings from the Mātaitai to support other planting projects on important waterways in Southland.


A. Henderson

Extent of Cultural Use

There is currently little data available to calculate the extent of Ngāi Tahu engaging in cultural activities across Southland/Murihiku. However it is expected that cultural use and dependence on Southland waterways is greater than in other regions, because:

1. There is a large Ngāi Tahu population living in Southland/Murihiku. Invercargill has the second highest resident Ngāi Tahu population after Christchurch – more than Dunedin. In Bluff approximately half the population is Māori, which makes it quite unique compared to other townships in the South Island.
2. There is an extensive history of use – with some historic settlements considered to be some of the oldest in New Zealand, dating back to 800 AD. Harvests of resources such as kanakana/lamprey, tītī/muttonbirds are traditions that have been handed down through the generations.
3. Many whānau in Southland directly or indirectly derive their livelihood from resource use – including fishing and its support activities.

Ngāi Tahu ki Murihiku cultural associations with Murihiku/Southland's main river catchments can be found in Te Tangi a Tauira section 3.5, table 3 pg 152.

This can be found on www.es.govt.nz.

The contribution of mahinga kai to wellbeing

Ngāi Tahu maintain a strong sense of community, and continue to identify themselves with a specific hapū, takiwā and community. These associations can remain even after an entire family has moved away from its whānau lands and community.

The impact of environmental change of the mahinga kai patterns of Ngāi Tahu clearly demonstrate the impact on the wellbeing of Ngāi Tahu whanui. Many in Southland remain dependent upon mahinga kai, physically and culturally. Mahinga kai has been the primary food and the basis of the economy of Ngāi Tahu for many years. Eel, kanakana, wild plants, seeds, and game were plentiful and healthy sources of food. Today Māori are often have difficultly accessing their traditional foods and quality and quantities of former dietary staples are often insufficient. Of significant concern is the loss of entire species.

Acquiring kai also provided exercise that kept people in good physical condition. Because hunting, gathering, fishing, storing and preparing food was an integral part of daily life and seasonal celebration, kai held great cultural and social meaning. These important social activities served to bring people together to work, socialise, and pass down values and information from one generation to the next. Food is central to some social obligations of Ngāi Tahu for hospitality and caring for kaumatua/elders. Overall, the benefits of mahinga kai include better nutrition and prevention of illness, physical activity during harvesting, lower food costs, and many socio-cultural values and traditions that contribute to mental, spiritual and cultural health.

The cultural and spiritual dimensions of kai have probably received more recent attention than any other recent iwi issue. Existing documents provide in-depth and critical testimony concerning the cultural and spiritual importance of aquatic species and of water bodies themselves. Mahinga kai activities are at the very heart of Ngāi Tahu culture.

Changes in mahinga kai could lead to loss of culture and identity. Just as the everyday activities of fishing, eeling and gathering cultural materials creates and maintain whānau and hapū ties and provide identity, so too does their absence and decline lead to further cultural disruption. Without doubt, food and resources play an important role in cultural continuity and identity - the loss of the same resources can lead to cultural, social and economic stress experienced by whānau.

Water allocation and use

> *"Our people rely on rivers such as the Mataura River for mahinga kai. There is too much water being applied for and allocated from aquifers and if this is allowed to continue the mauri, or life force, of our streams and the Mataura river will be put at risk."*
>
> ***- Ngāi Tahu ki Murihiku, Te Tangi a Tauira, pg 149***

To meet our domestic, stock, municipal, irrigation or industry supply requirements water is sourced from surface or groundwater resources to meet our needs. Water use is generally classified as either 'consumptive' or 'non-consumptive'. Use of water is considered consumptive if the water taken is not returned to its original source. Uses that return water to its source (such as water used for cooling) are considered non-consumptive.

Sustainable water resource management requires a balance to be struck between 'in-stream' and 'out-of-stream' values. In-stream values are associated with a river or stream's natural environment and include freshwater ecology as well as recreational, cultural, scenic, aesthetic and educational uses. Out-of-stream values are associated with the use of water outside of the river system. These uses may be associated with significant economic or social values (eg municipal supply, hydroelectric power generation, irrigation).

Allocation refers to the volume of the water authorised to be taken from a particular water body under the Resource Management Act 1991 (RMA) or other relevant legislation. In managing allocation, many different elements need to be considered including:

- Potential interconnection between groundwater and surface water (see 'Understanding how surface water and groundwater interact' pg 19) and the consequential effects of groundwater abstraction on stream flow, an effect referred to as 'stream depletion'
- Whether the water take is consumptive or non-consumptive, the demand for water for some activities can vary between seasons rather than be constant all year round. For example, irrigation typically occurs for a restricted duration while municipal and many industrial uses occur year round
- The amount of water already allocated from a particular water body, and the ability for it to sustain further water abstraction, while maintaining environmental and other non-use values at or above set thresholds
- The continued availability of water, taking into account seasonal and long-term climate variability and climate change.

With increasing demand for water allocation, there is a growing need to have accurate and detailed information on water use. Without this information it is difficult to determine if observed changes in the environment reflect natural variability or result from water use.

In the following section we describe the rate and volume of water allocated via the resource consent process and the proportion allocated to certain use types. We also discuss when and where the water is allocated and how allocation has changed over time. This is followed by a discussion of actual water use and concludes with a comparison on how water allocation in Southland compares at a national scale.

This section contains four case studies. The first describes how we establish minimum flows and flow allocation for rivers and streams, pg 29. The second examines the level of 'permitted' water takes in Southland, ie water takes that are small and do not require resource consent, pg 58, and the third looks at the use of groundwater for irrigation, pg 41.

The final case study describes the Manapouri Power Scheme, pg 44, which accounts for 98.5% of all water allocated in Southland and 40% nationally. Because of the large disparity between hydroelectric generation and other activities, we have excluded this activity from the main discussion of water allocation.

What limits our ability to take and use water and what we are doing to manage our uses are outlined in later sections of this report.

The goals of our management system

The desired outcome for water management in Southland identified in the Water Plan is to have sufficient water available to support the social, economic and cultural wellbeing of current and future generations, while protecting the life supporting capacity, health, natural character and outstanding features of our water bodies.

The Water Plan does not set any specific water allocation limits for groundwater or surface water resources. Instead, it adopts an 'adaptive management' framework, the basic premise of which is that the level of information and assessment required to support the granting of water takes escalates as cumulative allocation increases. This approach recognises that, while limited information is currently available to characterise water availability for many water bodies, knowledge of the resource will progressively improve over time as a result of investigations and monitoring associated with development. This effectively establishes a repetitive process that allows the resource consent decision-making process to be based on a more comprehensive understanding of the limits to sustainable allocation as information comes to hand.

To achieve the stated water quantity management objectives the Water Plan utilises stepwise allocation bands where each allocation step has a corresponding set of management considerations, assessment criteria and environmental monitoring requirements. For surface water resources, the allocation bands are based on a percentage of the seven-day mean annual low flow (see 'Minimum flow setting' case study pg 29). For groundwater resources, the allocation bands are based on a percentage of the mean annual rainfall recharge for unconfined aquifers. As part of our adaptive management approach, allocation provisions for confined and fractured rock aquifers have recently been updated.

Under the RMA, individuals are able to access water for 'reasonable' stock and domestic use, provided there are no adverse effects on the environment. The Water Plan also allows smallscale water takes to avoid the requirement to obtain resource consent provided the takes meet criteria which ensure adverse effects are no more than minor. The level of permitted use for groundwater takes is up to 20 cubic metres per day per landholding and 10 cubic metres per day per landholding for surface water abstraction.

Southland's Water Management Zones

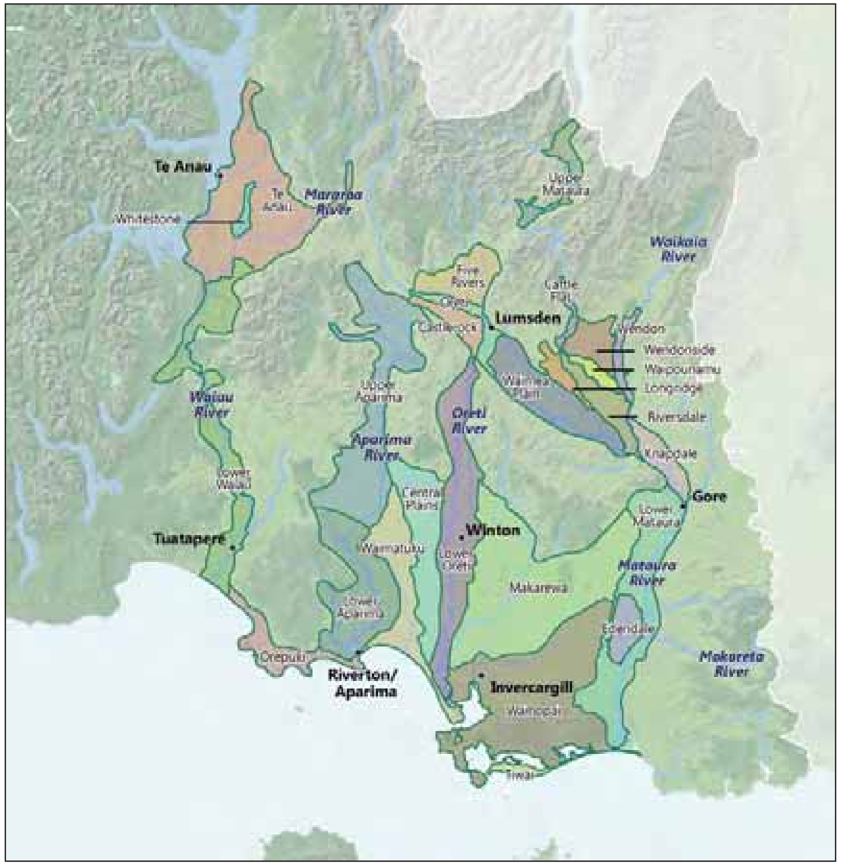
To provide a basic framework for water allocation Southland's surface water systems and unconfined aquifers have been divided into management zones.

There are 17 surface water zones, based on sub-catchment boundaries and source of flow (Figure 6). Cumulative levels of allocation in each water management zone are monitored through the consenting process to ensure appropriate allocation and minimum flow cut-off levels are maintained.

The unconfined aquifer systems across Southland have been subdivided into the 26 groundwater zones illustrated in Figure 6. Each groundwater management zone essentially represents a separate groundwater flow system (although some interconnections occur between individual zones). Total groundwater allocation (including an allowance for cumulative stream depletion effects) is managed in each zone according to allocation criteria specified in the Water Plan. These criteria vary between aquifers and change as the level of allocation increases.

Figure 6

Groundwater management zones (unconfined aquifers)



Surface water management zones

Case study: Minimum flow setting – balancing instream and out-of-stream values

When establishing a minimum flow and flow allocation for a river or stream, we need to determine an appropriate balance between a wide range of environmental, social, cultural and economic values associated with the water resource.

As a consequence, management of water resources can often be a difficult and contentious process. While it is important water is available for industrial, municipal, and agricultural use in Southland to help provide for our social, economic, and cultural wellbeing, it is equally important that sufficient flow remains to maintain healthy aquatic ecosystems and other intrinsic, recreational and cultural values.

There are a variety of scientific methods available to help to calculate how much water needs to remain in a particular stream in order to maintain values associated with the river or stream at or above a nominated threshold. One approach commonly used is based on how flow variations influence stream or river habitats, including water depth and velocity, temperature and habitat availability as well as interactions between water quality and quantity (see 'Our Ecosystems' report).

This process, termed 'In-stream Habitat Modelling' involves computer simulation of the stream habitat. This process utilises information collected as part of our monitoring and investigation programmes to replicate the physical environment of the river system. Once the model is able to replicate observed variations in the natural environment, we analyse different scenarios to predict what might happen to key environmental measures under different flow conditions.

Ian Jowett Consulting used In-stream Habitat Modelling on the Oreti River near Lumsden, to estimate the minimum flow required to maintain acceptable habitat for native fish and brown trout in the middle and lower reaches of the river.

Information collected from the river at Ram Hill (near Lumsden) was used to develop a computer model which was utilised to predict how water depth, velocity and the amount of stream bed covered by water changes as flow varies (Figure 7).

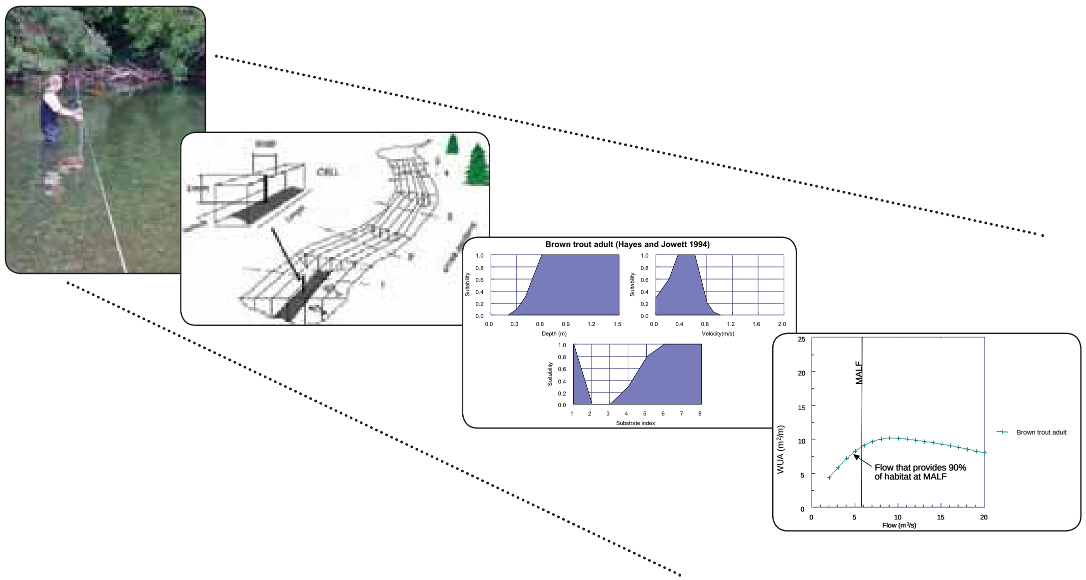
We were then able to take the predictions from this model, over a range of flow conditions, and compare them with the known habitat preferences for key species that are known to live in the Oreti River (eg adult brown trout and longfin eel). This allows us to predict how the availability and quality of habitat would change as flow changes.

Levels of environmental protection, in terms of habitat retention at minimum flow for key species in different parts of the region's river systems, are set out in the Water Plan. These thresholds are usually expressed in terms of the percentage of habitat available over a seven-day mean annual low flow (also known as the 'seven-day MALF').

The seven-day MALF is a measure of the lowest flow recorded over a continuous period every year, averaged over many years (depending on the length of flow information, but usually over a minimum period of 10 years).

Some of our larger rivers, such as the Oreti, have highly valued fisheries. To ensure the continued health of the fishery, the Water Plan specifies that the minimum flow should be established at a level which ensures at least 90% of the habitat available at the seven-day MALF is retained all year. For the middle and lower reaches of the Oreti River, modelling results indicate that a minimum flow of 4.9 cubic metres per second at Ram Hill maintains 90% of the habitat available at the 7-day MALF, and also provides more than 90% habitat retention for most native fish species found in the Oreti River.

Figure 7: Schematic diagram of habitat modelling process. (Source: Jowett 2009)



How much water do we have in Southland?

It is estimated that each year on average, the region receives approximately 86 billion cubic metres of rain and snowfall. This water either runs off the land surface via the river and stream network, infiltrates through the soil into underlying aquifers or returns to the atmosphere via direct evaporation or transpiration by plants.

The cumulative discharge from our four major catchments (Mataura, Oreti, Aparima and Waiau) averages approximately 9,200 million cubic metres per year. For comparison, it is estimated that the total volume of groundwater storage is approximately 35,800 million cubic metres (due to the slow movement of groundwater, only a small percentage of this total flows into or out of the groundwater system in any given year).

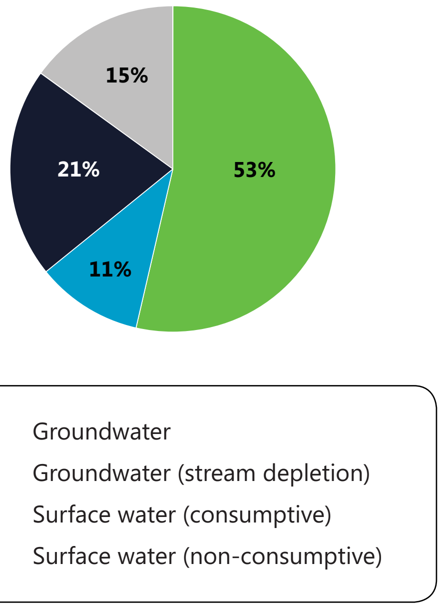
Currently, the total average volume of water allocated for use in Southland is 124 million cubic metres per year, or around 0.14% of our total annual rainfall. This may represent a small percentage of the total rainfall, but because of the uneven distribution of rain in both time and space, shortfalls in water availability may occur. These are either due to natural limitations (eg low yielding aquifers) or as a result of the need to protect environmental values (eg minimum stream flows to protect aquatic ecosystem habitat and health) or because water use is not distributed evenly.

In some areas of Southland water availability is very limited at certain times of the year.

What is the current level of allocation of water in Southland?

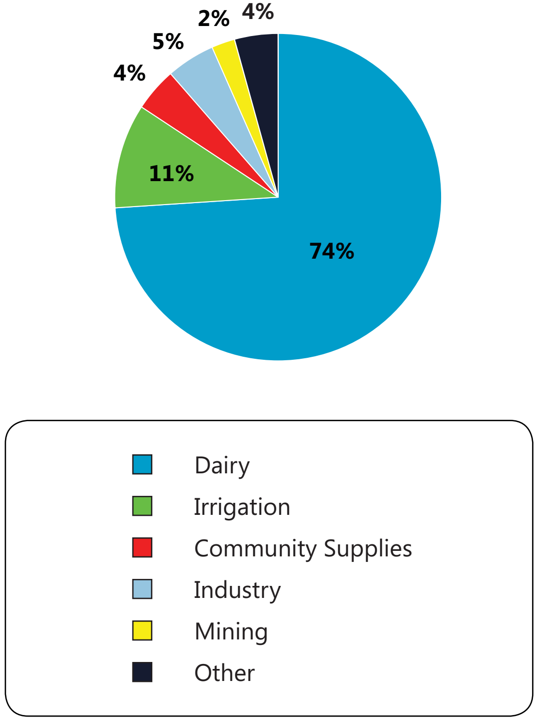
Of the total volume of abstraction authorised by resource consents in 2009/10 about 65.7 million cubic metres (53%) of water was allocated for use from the region's groundwater resources. However, of this total, approximately 13.6 million cubic metres (11% of the total volume) was actually considered to be surface water resulting from stream depletion effects. The remaining 44.6 million cubic metres (36%) was allocated from surface water sources over 2009/10[1] (Figure 8).

Figure 8: Annual volume of water allocated in Southland 2009/10



In 2009/10, 998 water permits[2] for groundwater and surface water abstraction were active in Southland. Of those, about 87% were for groundwater abstraction, with surface water takes making up the balance. Approximately 75% of all active water permits are for dairy shed supply, with irrigation the next largest comprising approximately 10% of the total (Figure 9).

Figure 9: The categories of activities that have surface water and groundwater takes by number of resource consents granted during 2009/10



[1] This includes non-consumptive (20.1 million cubic metres per year) and consumptive (24.5 million cubic metres per year)

[2] Resource consents authorising the diversion, abstraction or storage of water are referred to as water permits in the RMA

Time dependent water allocation activities

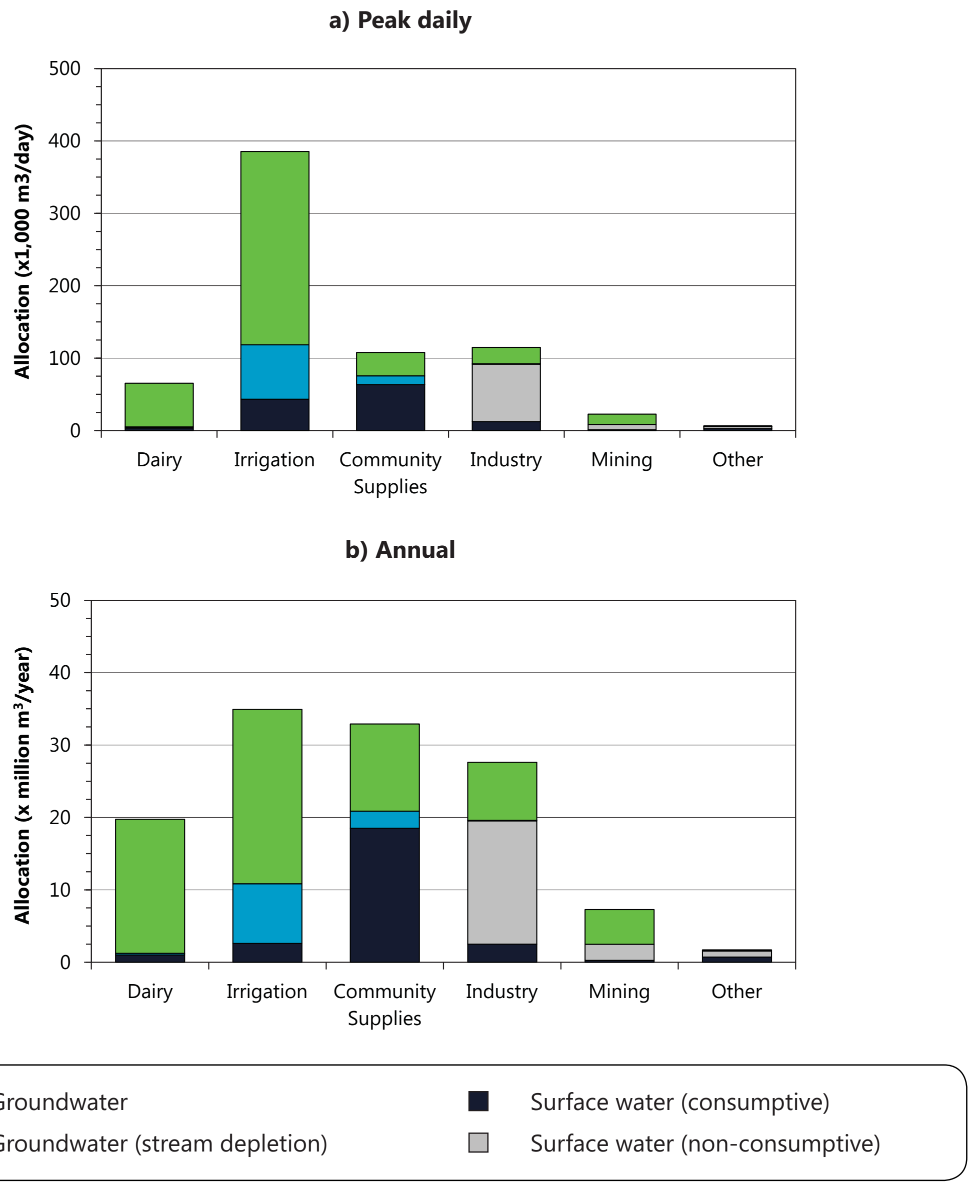
Due to differences in the timescale over which effects associated with water abstraction effect groundwater and surface water resources, daily and seasonal allocation rates and volumes are a vital for water resource management. For surface water takes, because water is sourced directly from the river, stream or lake, effects typically occur over a short timescale. As a result, surface water takes are typically managed in terms of daily abstraction rates.

Effects associated with groundwater abstraction typically occur over a longer time. Peak daily limits are used to manage localised effects like stream depletion; while annual[3] (or seasonal) allocation limits are used for managing longer-term cumulative effects such as effects on baseflow and overall aquifer sustainability.

For many, water take demand varies with the season, while for others demand is relatively steady throughout the year. For example, on a daily basis current allocation for irrigation is almost three times that of any other use. However, because irrigation usage only occurs for a restricted period, other water uses, including community supply and industry, have a comparable allocation on an annual basis.

Of the four main water uses, dairy and irrigation rely mostly on groundwater (95 and 89% of daily allocation respectively),[4] while community supply and industry rely more on surface water (59 and 80% of daily volume; Figure 10).

Figure 10: a) peak daily and b) annual consented water allocation for different water users in 2009/10



[3] Note annual is based on a hydrological year which is 1 July to 30 June.

[4] With stream depletion included in stream depletion and non-consumptive included in surface water percentages.

Where is the water allocated?

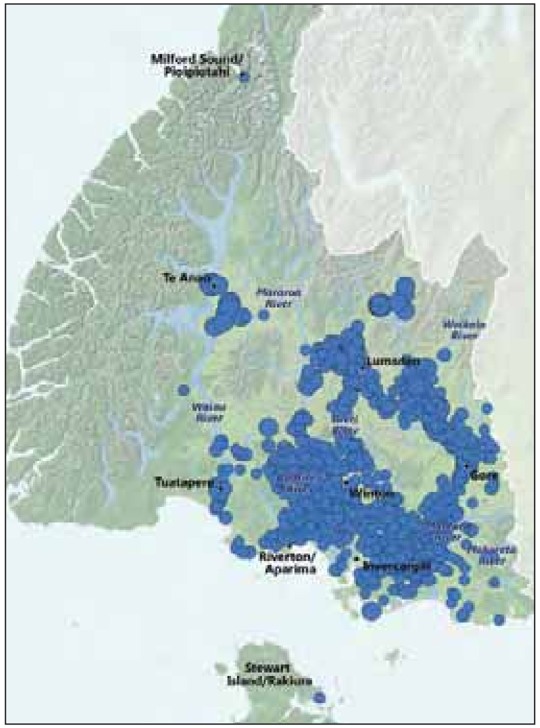
By Consent

Figure 11 shows the distribution and size of consented water allocation in Southland. These figures show that groundwater abstraction is mainly concentrated in three areas; the Oreti Basin, the middle reaches of the Mataura catchment and in the Edendale area. In general, the larger groundwater takes in northern Southland are for pasture irrigation or community supplies, while those near Edendale are for industrial supply, horticultural irrigation and community supply. Approximately two thirds of all groundwater consents granted are in the Mataura and Oreti catchments.

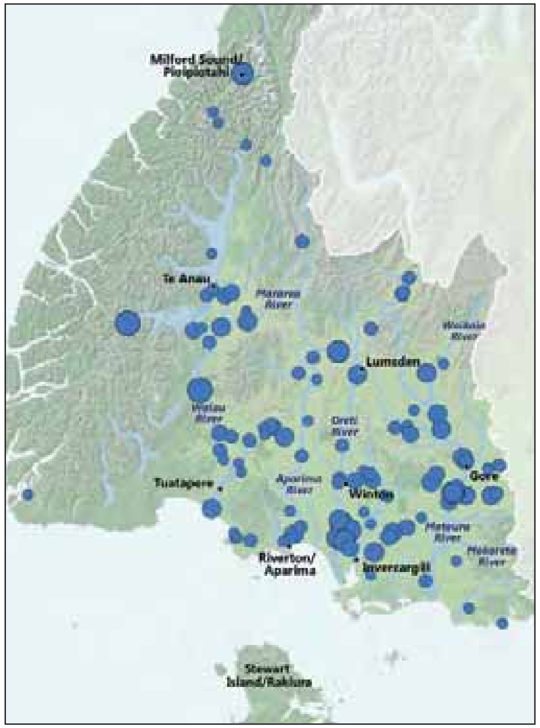
The majority of the large surface water takes are centred close to major urban areas, such as Invercargill, Gore and Mataura and provide for industrial and community water supplies. The three large takes in Fiordland are all for hydroelectric power generation.

Figure 11: Map of consented peak daily a) groundwater and b) surface water takes in Southland 2009/10

A) Groundwater



B) Surface water



Cubic metres per day

- 10 - 99
- 100 - 499
- 500 - 999
- 1,000 - 4,999
- 5,000 - 99,999
- 100,000 and over

Case study: What is the volume of permitted water abstraction?

The abstraction of small volumes of surface or groundwater is considered to have limited impact on our water resources and, in a majority of cases, do not require resource consent. As previously described, abstraction for 'reasonable' stock and domestic water supply are permitted under the RMA provided no adverse effects occur. Similarly, the Water Plan authorises abstraction of 10 cubic metres per day of surface water and 20 cubic metres per day of groundwater without resource consent.

The following section only describes what we know about groundwater takes, as we have very little information on the volume of permitted surface water abstraction.

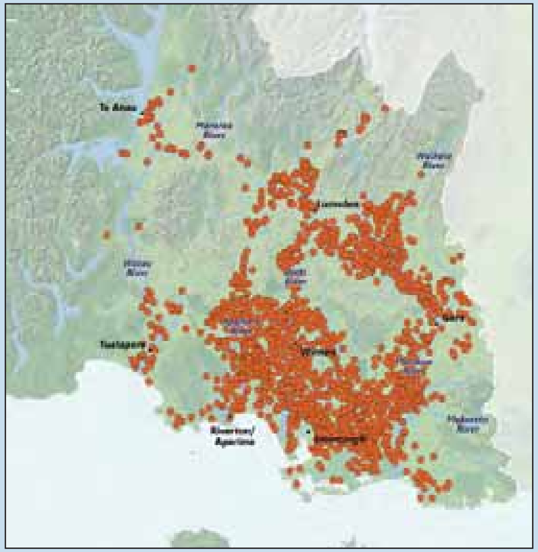
Groundwater

The number of bores and wells recorded as being used for domestic or stock supply (ie permitted use) has increased significantly in recent years and is currently more than 1,900. This increase is largely attributed to:

1. Since 1998, door-knocking surveys in northern and eastern Southland have recorded the location and details of more of the bores and wells in this areas.
2. The Water Plan introduced a requirement in 2005 to obtain resource consent before drilling a new bore or well, or modifying an existing one. The primary reason for requiring resource consent is to ensure construction of bores and wells to an appropriate standard (NZS 4411: Environmental Standard for Drilling of Soil and Rock) to protect the quality and quantity of the groundwater resource. This resource consent process is simple and low cost and helps Environment Southland effectively manage groundwater, including providing landowners with advice on appropriate siting, construction and maintenance for water supplies, and to help improve data capture of number of permitted takes.
3. Changes in land use and climate (see 'Our Threats: Climate Variability and Climate Change') in recent years have made groundwater an increasingly more attractive water supply. This partly reflects the greater reliability of groundwater supply compared to rainwater, as well as the generally better quality of groundwater (particularly in terms of microbial contaminants) compared to surface waterways. Between 2005 and 2010, 960 consents for drilling were issued.

Figure 12 shows the distribution of permitted groundwater takes in Southland. It shows the widespread use of groundwater across a majority of the region with the exception of the Waiau catchment. The lower use of groundwater for domestic and stock water supplies in the Waiau catchment is attributed to 1) a greater number of reliable springs and other surface water sources and 2) groundwater quality in the lower reaches of the catchment that can be unpalatable, due to shallow lignite and mudstone which contain high iron, manganese and sulphate concentrations,

Figure 12: Known permitted groundwater takes in Southland (Feb 2011)



Permitted Groundwater Takes

and 3) groundwater yields being less in the lower portion of the catchment.

A survey of rural water use conducted in 1998[5] found 52% of Southland farms obtained stock water from a bore, well or spring for domestic and stock supply. Over 40% used rivers and streams and 20% of Southland farms used

[5] Belton *et al.* 1998

rainwater (note: these percentages sum to more than 100% because some farms used more than one source). It was noted that the portion of farms using rainwater in Southland was much higher than the rest of the country where, on average, only 5% use rain as a water source.

Given ongoing variations in both climate and land use in Southland over the past decade, it is uncertain if the sources and volume of water taken for domestic and stock supply has significantly changed in that time. In order to investigate this issue, and to help address this knowledge gap, Environment Southland is undertaking a survey of non-consented water use in 2012 for the Mataura catchment.

Elsewhere in the region, the use of groundwater as the primary source of domestic, farm or dairy supply is becoming increasingly common. Groundwater supplies (provided they are properly sited, constructed and maintained) are less subject to seasonal variations in availability than surface and rainwater supplies and typically exhibit stable water quality which is at lower risk of contamination from bacteria and other microbial contaminants. In areas with limited groundwater availability, springs are often used as an alternative water source due to stable and reliable flows and generally good water quality.

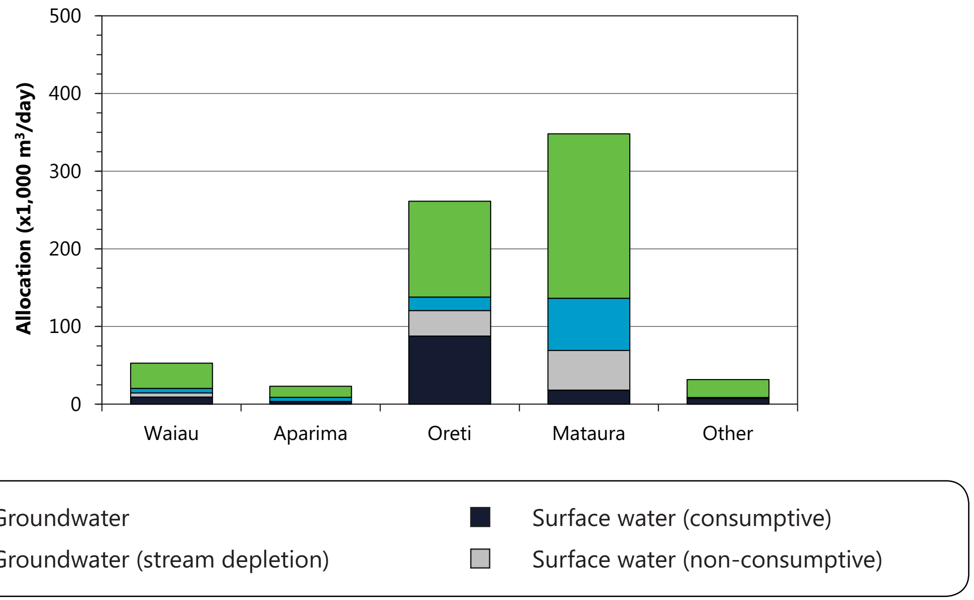
By Volume

Approximately 50% of the total volume of water allocated in Southland is sourced from the Mataura catchment with a further 30% sourced from the Oreti catchment. Stream depletion is highest in the Mataura and Waiau catchments, reflecting the presence of highly permeable riparian aquifers that can sustain high yields, in part due to their high degree of hydraulic connection with surface water. Most of the larger takes in the Oreti catchment are sourced from confined aquifers which have little or no hydraulic connection to surface water.

The majority of surface water allocation in Southland occurs in the Oreti and Mataura catchments (Figure 13). A significant proportion from the Oreti catchment is associated with Invercargill City Council's Branxholme abstraction (Invercargill and Bluff town supply) and industrial takes near Invercargill. The Mataura catchment also has a significant allocation for non-consumptive water abstraction, the majority of which occur at the Mataura Industrial estate, including the Alliance Group Meat Processing Plant. These include diversions for hydroelectric power generation, industrial cooling and processing water.

Surface water allocation in the Waiau River is largely restricted due to Meridian Energy's Manapouri power scheme. Part of the non-consumptive use associated with this scheme involves a requirement to maintain a summer time minimum flow of 16 cubic metres per second in the Mararoa Weir.

Figure 13: Peak daily consented water allocation for Southland's major river catchments in 2009/10



How has allocation changed over time?

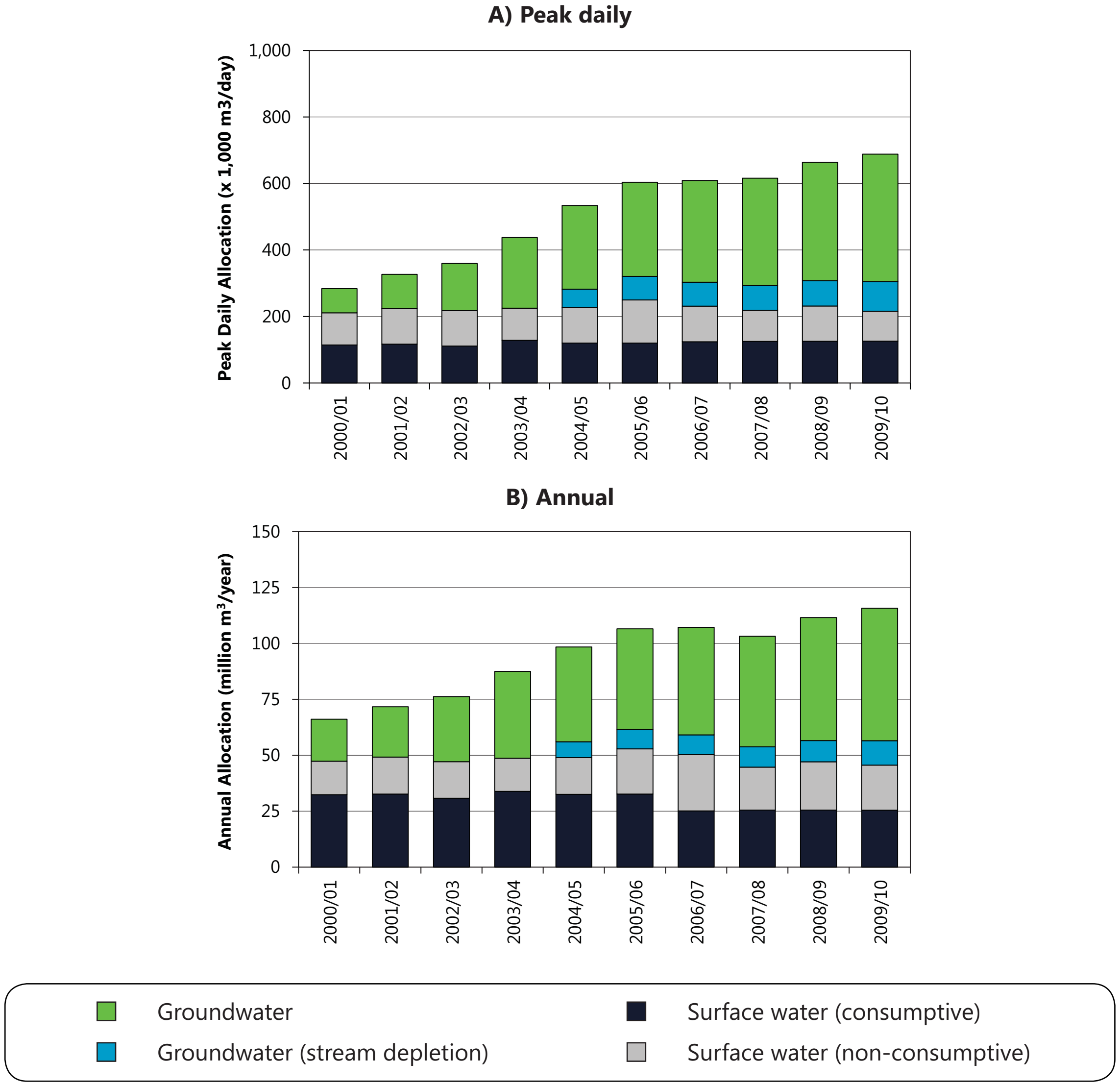
Over the last ten years, groundwater allocation has more than trebled while surface water allocation has remained relatively stable. This pattern can be seen in both peak daily and annual consumption (Figure 14). Between 2000/01 and 2009/10 groundwater allocation has increased from 18.8 to 70.2 million cubic metres per year while surface water allocation reduced marginally from 47.3 to 45.6[6] million cubic metres per year over the same period excluding stream depletion effects.[7]

How much of the water allocated do we use?

From a management perspective it would be ideal if water use matched rates and volumes authorised by conditions on individual resource consents. However, available data indicates significant differences between water allocation and actual use. Significant differences between allocation and actual water use can have serious management consequences: use of water in excess of authorised rates and volumes can result in adverse effects on the environment (and other water users), while under-use can effectively 'lock up' water, potentially restricting social and economic benefits, preventing additional users accessing the available resource.[8]

Studies in other regions have found actual water use is typically around 50% of the total amount allocated.[9] One reason for the significant under-

Figure 14: a) Peak daily and b) annual consented water allocation volumes for Southland 2000-2010 (note: the groundwater stream depletion allocation framework was introduced in 2004/05).



[6] Includes non-consumptive and consumptive

[7] Environment Southland only began allowing for stream depletion effects in 2004/05

[8] There is an important distinction here between not using water that is considered available for allocation and leaving enough water to provide an environmental safety margin or buffer. For more information see 'Minimum Flow setting' case study.

[9] Rajanayaka *et al.* 2010

utilisation of existing allocation is that many consent holders apply for the amount of water required to meet demand during peak periods which occur infrequently. As a consequence, average use may be significantly lower than rates and volumes authorised by resource consent conditions. While it is possible to more accurately match consented allocation with actual use, this requires accurate and timely monitoring and reporting of water use which would allow both water users and resource managers to keep better track of water use and ensure we use this precious resource wisely.

Reasons for under and over use

Possible reasons why water allocation and actual water often do not match include:

- Pumping restrictions – minimum flow or level restrictions can prevent abstraction occurring during periods of peak high demand
- Management factors eg equipment failures, maintenance, calibration and set-up of monitoring and recording equipment
- Allocation efficiency – consent holders typically apply for the amount of water they need to get them through dry spells or critical periods which may occur infrequently
- Climate variability – many water uses are significantly affected by climate variability which may influence both demand and water availability

Accurate and reliable monitoring of water use is important

Measurement and recording of water use is an integral part of effective water management. Without data to quantify actual water use it is difficult to determine if observed changes in the environment are the result of natural variations or occur in response to water use. While monitoring water usage is essential, it also comes with a cost. Water meters need to be purchased and maintained (including checks to ensure they remain accurate). The data collected from water meters needs to be carefully collected, stored and analysed.

We have found that our ability to reliably report water use is constrained by the availability and quality of available water use data. Many consent holders either provide poor quality water use data, or don't report their use at all, although they are required to as part of their consent. The value of accurate water use data has been recognised at a national level through the introduction of a National Environmental Standard (NES), which resulted in the Resource Management (Measurement and Reporting of Water Takes) Regulations 2010. This regulation makes it compulsory, by 2016, for any water permit larger than 5 litres per second, to record water usage and supply the information electronically to the regional council.

In addition to allowing us to check actual use against allocation, monitoring also:

- helps us better understand the characteristics of water resources
- allows users to see how much water they actually use. This can help improve efficiency and increase economic benefit, plus provide assurance that systems are working properly (eg by finding leaks)
- allows us to implement alternative water management options, including collectively managing takes (by groups of water users) and enabling transfer of allocation between individual users
- provides important information for water shortage management (ie during a drought).

Monitoring of water use: reporting annual use or daily use

Although water in Southland is typically allocated on an instaneous, daily and/or annual (or seasonal) basis (ie there can be limits to daily and/or annual use), the following section focuses on annual water usage. We would like to be able to report on daily usage in more detail, but much of the data collected is not stored in a way that allows sufficient analysis. We are working on improving our daily water use reporting. Because of these limitations this section provides only a rough guide to actual water use in Southland. We are working with consent holders to obtain more reliable water use information.

What is our annual groundwater use?

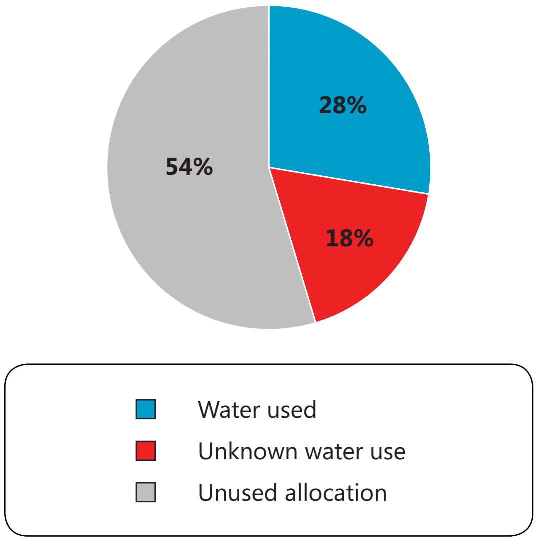
Due to poor data quality and the non-supply of data by some consent holders, the information reported in this section should be treated with caution. For some consents, missing, incomplete or unreliable data on water use made inclusion impossible, while for other consents (mainly those issued prior to 2000) there is no requirement for the supply of water use data.[10]

The following section provides an indicative estimate of actual water use in groundwater zones and aquifers that have the highest levels of allocation in Southland including the Castlerock, Edendale, Knapdale, Lower Mataura, Lower Oreti, Oreti, Riversdale, Tiwai, Upper Mataura, Waimea Plains, Waipounamu, Wendon and Whitestone groundwater zones and the confined Garvie, Lumsden and North Range Aquifers. Together, these groundwater resources account for 55% of the total volume of groundwater allocated (and 25% of the total number of resource consents).

Annual water use in high demand aquifers in 2009/10

Of the 43.3 million cubic metres allocated in high demand aquifers, recorded water use during 2009/10 totalled 11.96 million cubic metres (or 28% of total allocation; Figure 15). Of the remainder, 23.7 million cubic metres (54%) was unused with the remaining 7.7 million cubic metres (18%) associated with consents that we have no reliable data for (so we do not know how much water was used).

Figure 15: Annual water use, as a proportion of the total volume allocated in high demand aquifers in 2009/10.



How does annual groundwater use vary by activity?

Available monitoring data indicates dairy farms used the highest proportion of the water they were allocated in 2009/10 (56%), followed by industry (44%), community supplies (34%) and irrigation (32%; Figure 16). It is noted that the comparatively low rate of irrigation usage during this season is likely to reflect the relatively wet conditions during the 2009/10 summer period which potentially reduced demand to levels below previous years.

The data shows irrigation and industry had the lowest rates of unknown use (15% and 12% respectively) indicating relatively good compliance with water use monitoring requirements compared to dairy and community use, which recorded a significantly higher percentage of unknown use.

Irrigators have markedly improved their reporting of water use in recent years (see 'Groundwater use for pasture irrigation' pg 41) and this activity, on a volume basis, represents the greatest proportion of groundwater allocation (Figure 16).

How has water use in high demand aquifers changed over time?

The total volume of water allocated in the high demand aquifers described above has increased fivefold in the past ten years, from 7.6 million cubic metres in 1999/00 to 43.3 million cubic metres in 2009/10 (Figure 17). The largest increases in allocation occurred between 2000 and 2006 with more gradual increases during the subsequent period. Measured water use increased considerably over this time, from 0.05 million cubic metres in 1999/00 to 11.96 million cubic metres in 2009/10. The volume of allocated water with unknown use peaked at 13.39 million cubic metres in 2007/08 but has dropped in recent years to 7.67 million cubic metres in 2009/10, reflecting improved compliance with monitoring requirements by resource users.

Known groundwater use (as a percentage of available allocation) increased from 1% in 1999/00 to 34% in 2009/10, peaking at 40% during the dry 2007/08 year (Figure 18).

[10] Notwithstanding the requirements of the Resource Management (Measurement and Reporting of Water Takes) Regulations 2010 which will be phased in over the next five years.

Figure 16: Annual groundwater use for different activities in 2009/10

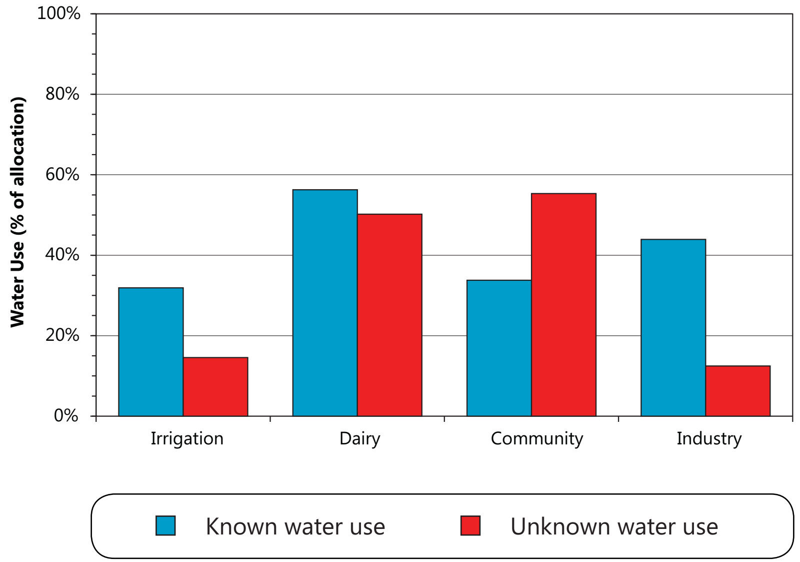


Figure 17: Groundwater use in high demand aquifers between 2000 and 2010

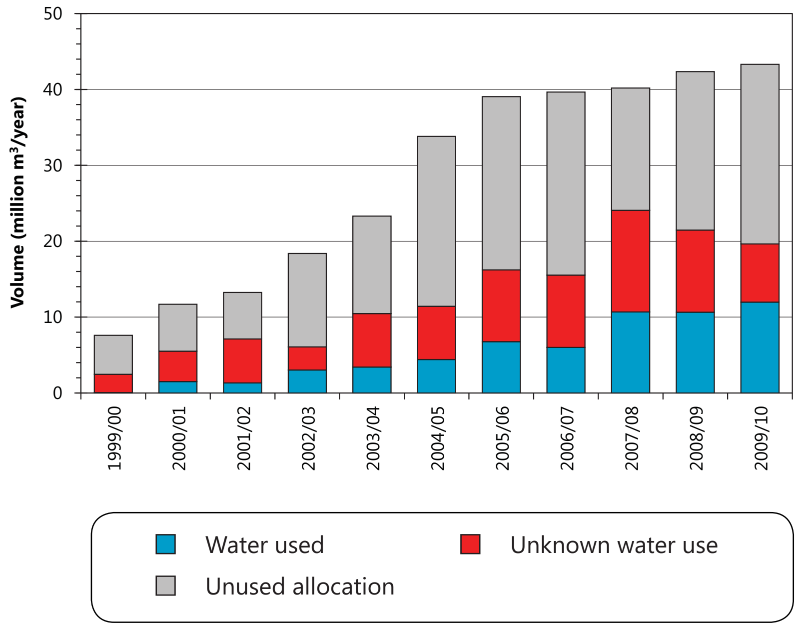
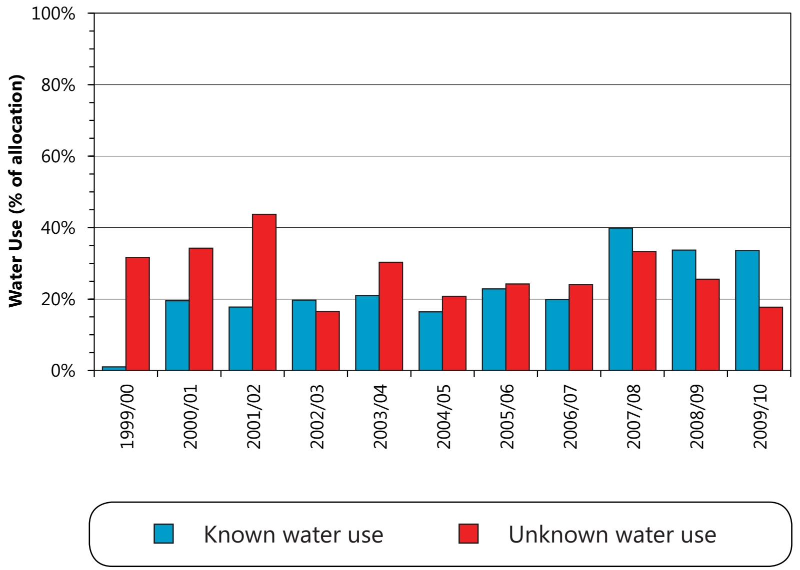


Figure 18: Annual groundwater use in high demand aquifers as a percentage of allocation 2000 to 2010



These results suggest that on an annual basis, a considerable amount of groundwater is effectively unused, and could be made available to other users if improvements were made to align allocation with actual use. With improved information available to characterise actual water use for various water use types across a range of climatic conditions, all water permit applications (new or replacement) are now assessed to ensure the volumes of water allocated are 'reasonable' for the intended end use.

What is our annual surface water use?

The comparatively low number of consents for surface water takes allows us to summarise all reported surface water use throughout the region, although again poor quality reporting and missing data means the results should be interpreted with some degree of caution.

More than half of the 45.6 million cubic metres of surface water allocated in Southland[11] was reportedly used in 2009/10 (Figure 19). A further 10.1 million cubic metres of surface water was allocated but left unused (22%). Use of the remaining 11.5 million cubic metres (25%) is unknown due to the lack of data.

How did annual surface water use vary by activity?

The bulk of surface water allocation by volume is for community supply and industry use. In 2009/10 these two groups comprise approximately 83% of total surface water allocation (23.4 million cubic metres).

In terms of water use compliance monitoring, Industry and Community use had proportionally low allocation with unknown use (5.6% and 25.1%) compared with dairy, irrigation, and mining (45.3%, 83.3%, and 97.1%; Figure 20).

Figure 19: Annual surface water use as a proportion of the total volume allocated in 2009-10

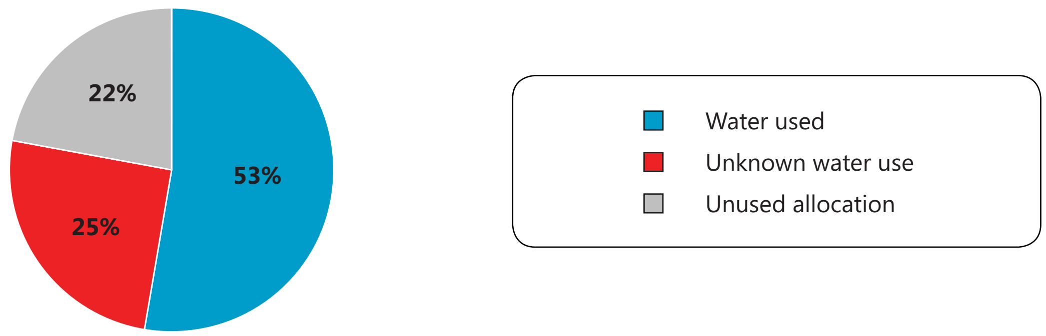
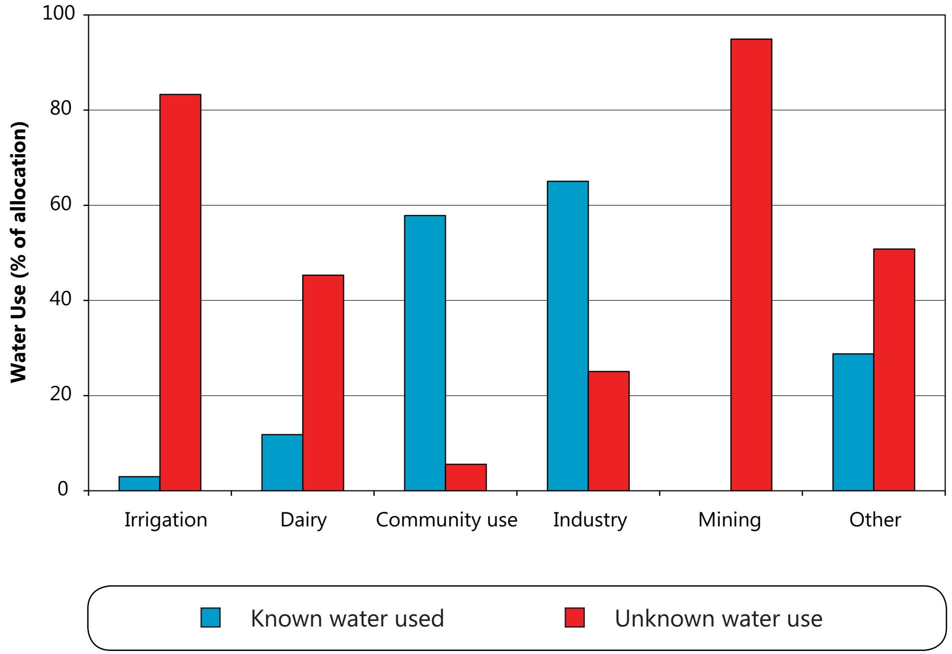


Figure 20: Annual surface water use for different activities in 2009/10



[11] Note this section excludes surface water use from hydroelectric surface water takes.

How has annual surface water use changed over time?

Figure 21 shows annual surface water use by community supply and industry over the period 1999/2000 through to 2009/10. During this time the volume of known use for community and industry supply increased from 8.7 million cubic metres in 1999/2000 (34% of available allocation) to 23.4 million cubic metres (61%) in 2009/10 (Figure 22). The highest volume of known use was 24.2 million cubic metres (64%) in 2004/05.

Figure 21: Surface water use of community supply and industry between 2000 and 2010

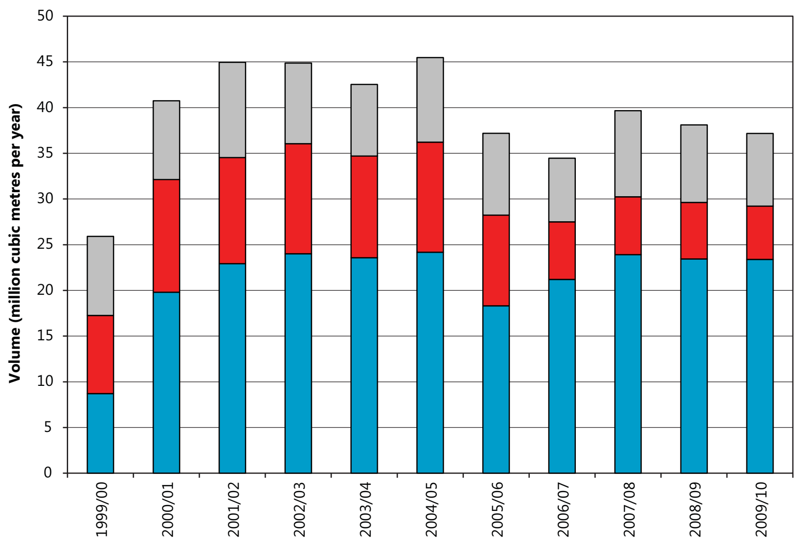
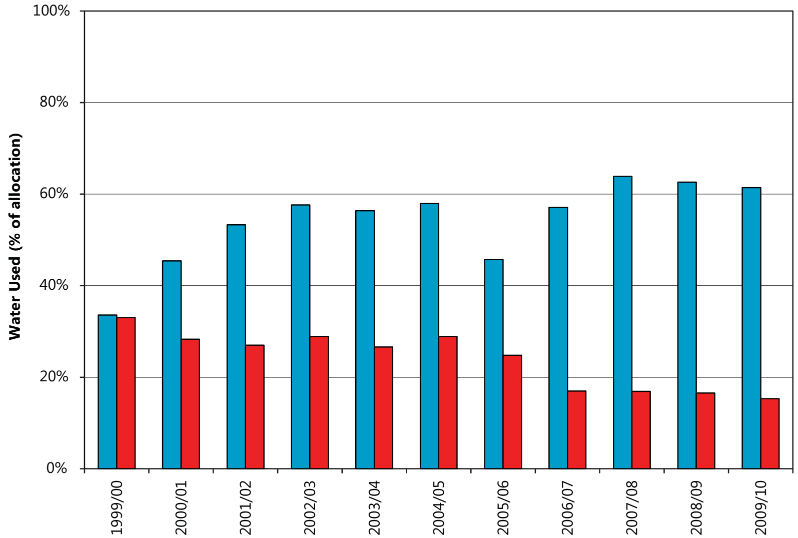


Figure 22: Annual surface water use for community supply and industry between 2000 and 2010



Case Study: Groundwater use for pasture irrigation

Allocation

The significant increase in groundwater allocation during the past 10 years has mainly been driven by the development of large-scale irrigation (Figure 23). Water allocated for irrigation has increased tenfold since 2002, essentially going from a few small-scale irrigation takes to approximately 70 large-scale irrigation takes in 2009/10. The Mataura catchment contains 60% of the groundwater allocation for irrigation, with a further 32% in the Oreti catchment.

Use

Over the period 2001/02 to 2009/10, average water use for pasture irrigation ranged between 15% and 54% of the total consented allocation (Figure 24). Irrigation water use in Southland also varies across different parts of the region, typically reflecting localised climate conditions (Figure 25). In 2009/10 the water use was generally higher in the Mataura catchment (35%) and lowest in the Aparima catchment (26%) broadly matching patterns in seasonal rainfall.

Water use can also be less than the annual allocation, because it is related to the duration of irrigation. Previously, a nominal irrigation period of 150 days was assumed between November through to April. However available monitoring data over recent years has shown the duration of the irrigation season has averaged between 10 and 82 days with a maximum recorded duration of 135 days.[12] Because of this issue, we are undertaking a review of the methodology for setting seasonal limits for pasture irrigation in Southland in 2011/12.

[12] based on consent holders who supplied daily water use data.

Figure 23: Consented peak daily groundwater allocation for Southland 1995 to 2010

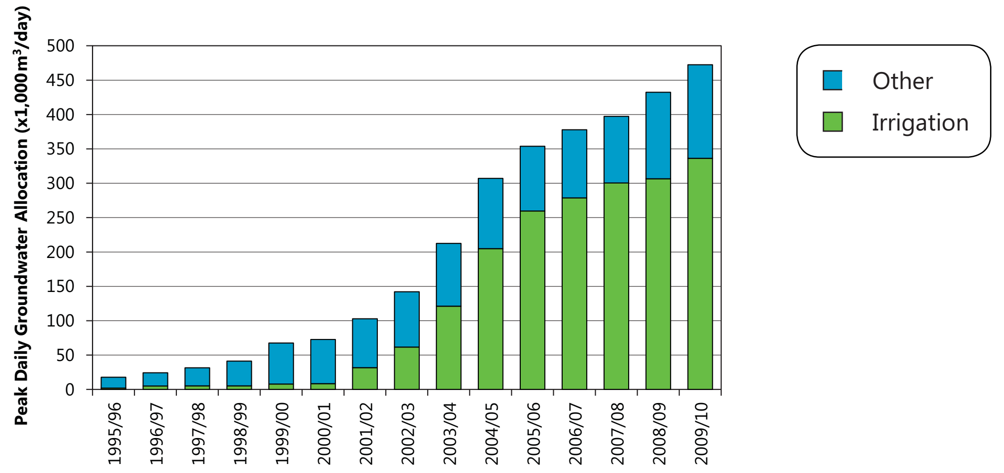


Figure 24: Average groundwater use for pasture irrigation from 2000 to 2010

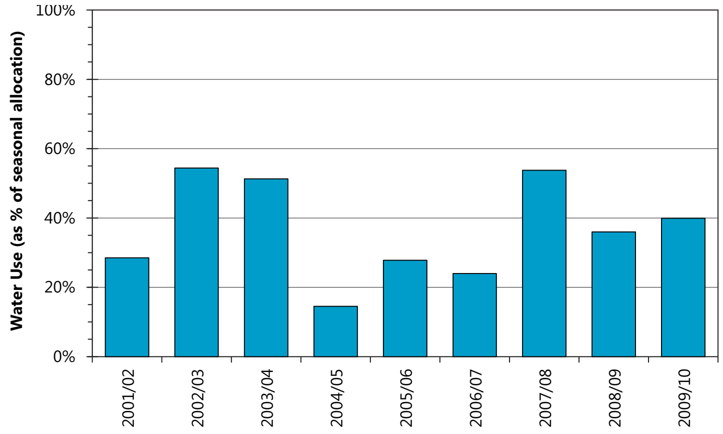


Figure 25: Water use for pasture irrigation for different aquifers in 2009/10

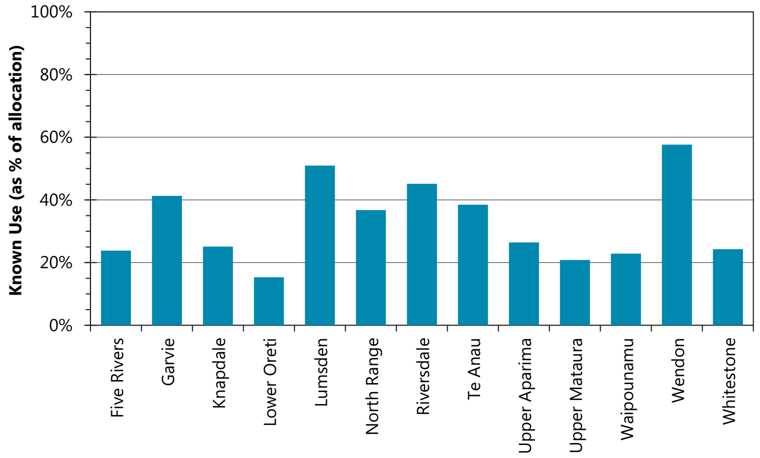
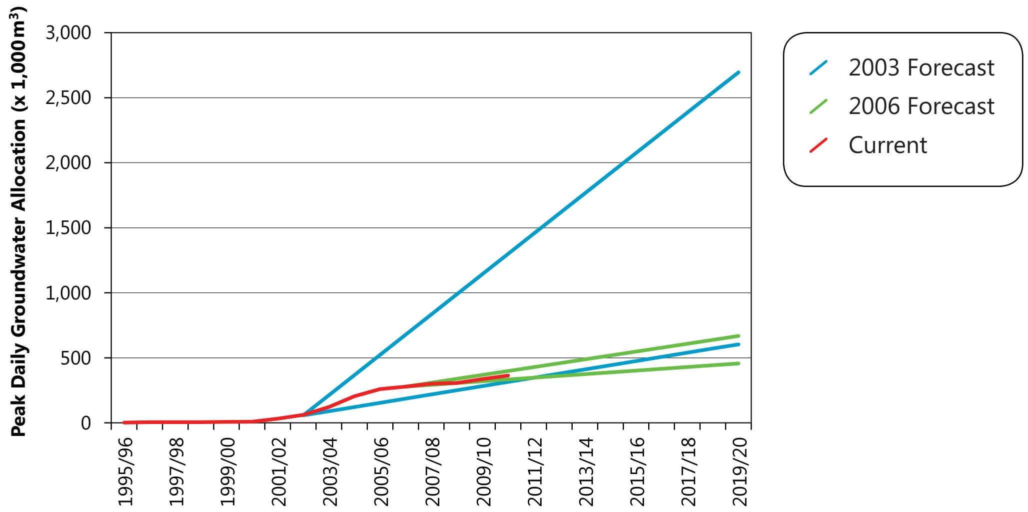


Figure 26: Time-series plot of projected and actual peak daily groundwater demand for irrigation in Southland[15]



A Southland Water Resources Study[13] in 2003 identified irrigation as having the greatest potential for a substantial increase in demand in Southland and projected accelerated and conservative irrigation water demand scenarios for Southland out to 2020 and 2050. These estimates were then refined in 2006.[14] Figure 26 shows the actual peak daily consented groundwater demand for irrigation is plotting above the 2003 conservative 2020 projection and mid-way between the 2006 conservative and accelerated projections for 2020.

One significant factor influencing the increase in groundwater allocation for pasture irrigation is the reliability of supply. Provisions of the Water Plan link groundwater takes from many high yielding riparian aquifers (where much of the irrigation demand occurs) to minimum flows in nearby rivers and streams. Current allocation, particularly in the Mataura catchment, is at a point where existing restrictions on water availability effectively mean further allocation from riparian aquifer systems is likely to be economically marginal. This reduction in supply reliability is likely to be a major influence on the reduction in the rate of irrigation development.

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[13] Morgan and Evans 2003

[14] SKM 2006

[15] '2003 Forecast' from Morgan and Evans (2003) and '2006 Forecast' from SKM (2006)

How does our water allocation compare nationally?

Although overall water allocation in Southland has increased in recent years, our overall levels of surface water and groundwater allocation remains modest compared to other regions (Figures 27 & 28). Southland currently accounts for only 2% of the country's groundwater allocation and 1% of consumptive surface water allocation.[16]

Figure 27: Annual groundwater allocation for New Zealand Regions 2009/10[17]

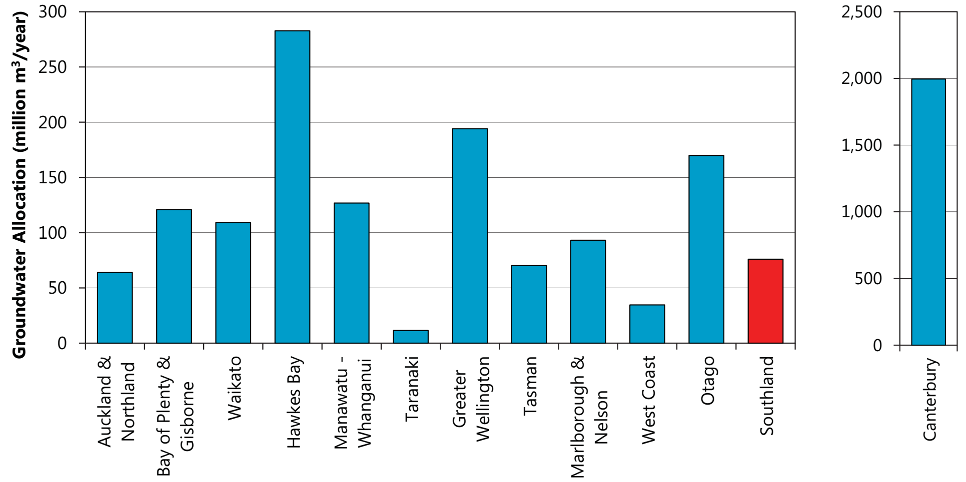
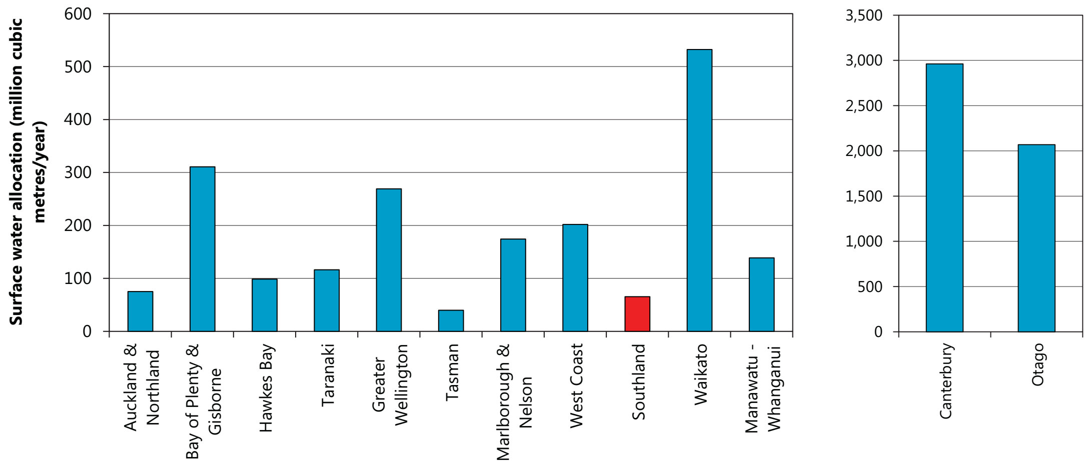


Figure 28: Annual consumptive surface water allocation for New Zealand Regions 2009/10[18]



[16] These figures exclude the Manapouri hydroelectric power scheme, which is 40% of the nations allocation.

[17] Includes stream depletion effects. Data sourced from Table C-14 Rajanayaka *et al.* 2010

[18] Data sourced from Table C-15 Rajanayaka *et al.* 2010

Case Study: Meridian Manapouri Power Scheme – New Zealand's largest water user

Meridian Energy Limited's Manapouri Power Station (MPS), at the West Arm of Lake Manapouri in Fiordland National Park, is New Zealand's largest hydroelectric power station. The heart of the station is 200 metres below the surface of Lake Manapouri. Considered one of the greatest engineering feats undertaken in New Zealand, the MPS was fully commissioned in 1971 after several years of construction.

The MPS uses water from the Lake Te Anau and Manapouri catchments. Water is also sourced from the Mararoa catchment which is diverted into Lake Manapouri via the Mararoa Weir. Water flows within the scheme are also managed by a control gate installed at the outlet of Lake Te Anau.

Water enters the MPS at the lake surface, and then drops 200 metres vertically down penstocks to drive the seven turbines in the machine hall. Water then flows for 10 km through two tailrace tunnels, before discharging into Doubtful Sound at Deep Cove on Fiordland's west coast. Electricity generated at the MPS is transported back to the surface via cables and on to the national grid through the Invercargill and Makarewa substations.

The system is unique, as there are very few hydroelectric power schemes in the world where 100% of the used water is removed from one catchment and displaced elsewhere.

The MPS is capable of producing up to 840 mega-watts (MW) of electricity and produces around 5100 giga-watt hours (GWh) per year, which represents about 12.5% of New Zealand's power requirement. Meridian has a contract to provide electricity to the Tiwai Point aluminium smelter, near Bluff. With a demand of approximately 625 MW, the smelter is New Zealand's single largest user of electricity.

Allocated (Consented) Water use

Meridian's diversion of water through the MPS is easily the largest water take, not only in Southland, but all of New Zealand. The MPS consent accounts for 98.5% of all surface and groundwater allocation in Southland and 41% of the total water allocated in New Zealand.[19]

Until August 2010, Meridian had consent to divert a maximum of 510 cubic metres of water per second (cumecs) through the power station, and the station was operated to ensure that this volume was not exceeded. In August 2010, Meridian was granted consent to increase the maximum discharge to 550 cumecs from the MPS.[20]

Actual Use

Between 1999 and 2009, the mean discharge rate through the MPS was 368.5 cumecs,[21] which equates to approximately 72% of the maximum possible discharge actually being used.

Water Plan

In 2005, the Water Plan made all new water takes from the Waiau catchment a non-complying activity. This change was introduced to reflect the significance of the ongoing effects on the environmental flow and level regime of the Waiau River due to the allocation of water for hydroelectric generation.

The Lower Waiau River

The Waiau River was once one of New Zealand's largest rivers, in terms of volume discharged (520 cubic metres per second, second only to the Clutha River, in Otago). After the commissioning of the MPS, the resultant flow in the lower Waiau River was heavily diminished. At one time as little as 1 cubic metre per second of water (equivalent to a stream such as the Waihopai River, near Invercargill) was released downstream of the Mararoa Weir. However, consent conditions now ensure that at least 16 cubic metres per second of water flows through the Mararoa Weir during the summer months and the lower Waiau is now one of New Zealand's premier rainbow and brown trout fisheries.

[19] Rajanayaka *et al.* 2010

[20] Meridian spends approximately $1.3 million per year on mitigation such as operating a fish pass, and physical and biological monitoring in the lakes, Waiau River and Doubtful Sound as required by the consents which enable the station's operation.

[21] 1999-2008 water use data sourced from: Dunmore *et al.* 2009; 2009 water used data from J Holloway pers. comms

OUR PEOPLE Case study – Alistair Gibson, irrigator

Seeing irrigators in Southland has only become a common sight in the last decade, many due to the expansion of the dairy industry in the region. For crop farmer Alistair Gibson, irrigation has meant consistent crop production in the dry Riversdale area.

Alistair has a small operation, around 50ha, which he plants out in whole-crop in spring and brassicas after the harvest in mid-January. He is able to consistently produce and sell around 16,000 kilos of dry matter per hectare each year.

Alistair says irrigation in Southland is a totally different regime compared to Canterbury. Up there they irrigate for 120 days and then switch the machine off. "Here we are filling holes," he says. 'Filling holes', meaning topping up the soil moisture deficit so as it's maintained at peak level for crop growth.

About three years ago, Alistair invested in a computerised soil moisture monitor. The equipment measures soil moisture and soil temperature, providing real-time data. Since then he's been able to work out that his optimum soil moisture level is about 30%, and he can see when he needs to 'fill the holes.'

Alistair's consent allows him to pump water from the Riversdale aquifer for around 90 days of irrigation per year. At the moment, he irrigates for around 30-40 days and this year he has only just begun to irrigate as the spring period was wetter than previous years. Alistair says getting his consent renewed in 2014 is a major concern. "They are trying to cut the days back, but if we get a dry year, we'll need all of what we've got."

Environment Southland is concerned about the lowering groundwater levels in the Riversdale aquifer and the effect this has on surface water flows and ecosystems. Alistair says the consent renewal is a huge cost, particularly considering the amount of capital already put in. He also believes that the consent will be no good if it only works 80% of the time. "If we get a dry year and we can't irrigate that would take the grasses out, and you would have to start again."

Alistair feels that it's important to look the science and technology behind the activity. He also says that there are considerable benefits to the community from irrigation. "Although there haven't been any Southland studies done, it's clear from Canterbury that there are considerable community benefits."

Alistair is part of a group of irrigators who are planning a field trip for Councillors in early 2012. He says many people think we are just sucking water out of the bottom of the aquifer, but they don't see what's being put back into the community. 'We are seen as mass users, but we're not when you look at it over the whole year."

He says that at some point the balance of using water will mean we will have to look at storage as an option. "We will need to balance the use of water, the over allocation and the community benefit. Storage may be necessary down the track."

A. Henderson

Discharges

Water discharges refer to the release of contaminated water (or just contaminants or water) into the environment.

In industry and in everyday life, liquid waste like sewage, wastewater and stormwater is produced. There are only a few avenues for waste disposal – one is the freshwater environment via direct 'point-source' discharges or indirect 'non-point source' discharges to land.

Point source discharges are those that are clearly identifiable, have specific locations, and are typically pipes and drains discharging wastes from various industries and municipal sources. These discharges are the result of processing of raw materials and the need to dispose of waste products. Discharging to water has been an economical and practical means of waste disposal in Southland and the industries and infrastructure that produce discharges are an important part of the economy of Southland.

Non-point source or indirect discharges generally arise from land use activities, where water flows over or through land, picking up contaminants and leaching them in surface or groundwater bodies, or by stream bed and bank erosion. These discharges are much harder to manage, and because of their nature, are difficult to report on. The effects of these discharges pose a significant threat to water quality in Southland, and the effects are described in the 'Our Health' and 'Our Ecosystems' reports.

This section describes the nature and extent of discharges that require resource consent in Southland. As such these are largely point-source discharges or those activities that require resource consent to discharge to land. Reporting this does give useful information on the current level of consented discharges and how this has changed over time.

What contaminants are discharged into Southland waterways?

Discharging to freshwater and estuaries can result in a range of contaminants entering our water bodies and the coastal environment. Some of these contaminants are more harmful than others. Contaminants of particular concern include:

- Nutrients – particularly nitrogen (N) and phosphorus (P).
- Pathogens – tiny germs and bugs like bacteria from animal and human effluent
- Oxygen-depleting substances – water contains oxygen which is essential for all living things to survive. Some substances make this oxygen unavailable and suffocate waterways.
- Suspended solids – small particles that are suspended in the water and can affect light levels and smother stream beds as it settles.
- Organic matter – material derived from plants and animals.
- Heavy metals – metals such as copper, lead, zinc that may be required by plants and animals but become toxic at high levels.
- Other toxins – such as ammonia.

The types of discharge likely to contain some of these more harmful contaminants include stormwater, wastewater, industrial effluent, oil/grease, sewage effluent, sludge, and wash down water.

The goals of our management system

Regional plans set out the relevant rules and standards for discharging depending on where and what the discharge is.

There are currently four regional plans that manage discharges to freshwater, estuaries, and land in Southland:

1. *Regional Water Plan:* deals with rules regarding discharges to freshwater (rivers, lakes and wetlands) and land (if not covered by 3 and 4 below).
2. *Regional Coastal Plan:* deals with rules regarding discharges to coastal waters (including estuaries).
3. *Regional Effluent Land Application Plan*
4. *Regional Solid Waste Management Plan*

Environment Southland is currently working on a Discharge Plan project, which involves a review of the current regional plans that deal with discharges to land and combining these with the Regional Water Plan to create a single document dealing with all discharges.

The Water Plan goal for the management of discharges is to ensure that the region's water quality meets the present and future uses, while safeguarding the life-supporting capacity of water and related ecosystems.

Discharges of contaminants into water should not compromise the water quality standards within the Water Plan (See 'Our Health' and 'Our Ecosystems' for the progress towards meeting the water plan standards).

When practicable, and effects less adverse, it is desirable for discharges to be to land rather than to water. However, discharges to land can also have adverse effects on surface water, groundwater and soil quality. Runoff can pick up contaminants (eg excess nutrients from fertiliser or animal waste) as water flows over the land and discharges them into our waterways. Water percolating down through the soil profile can also potentially transport contaminants into the groundwater.

For Ngāi Tahu ki Murihiku discharging to land is considered a better option than discharging to water, because this allows for the filtering and cleansing of contaminants in a natural way, before the discharge enters water bodies. The preference is for wastewater to be treated to remove contaminants, then discharged to land via wetlands and riparian areas. Where discharge to water is the only practical and feasible option, it is important that adverse effects are mitigated through treatment to a high standard, and robust monitoring programmes are put in place.[22]

What discharges occur in the Southland region?

As of 30 June 2010, the majority of discharge consents in Southland were for discharges to land (88%, 1,047 consents). There were 128 consented discharges to freshwater and 13 to estuaries.

Dairy farming holds the greatest proportion of consents to discharge to land with 826 consents (79%) – the majority of which were for the discharge of dairy shed or wintering pad effluent. Other land discharge consents were for industry (other and primary), mineral and rock (exploration, quarrying, extraction, dredging), each of which held the next highest proportion of consents, with 3% each (Figure 29).

Power generation (hydroelectric and wind) and mineral and rock (exploration, quarrying, extraction, dredging) made up the highest proportion of consented discharges to water with 22% and 18% of the consents. Water discharge consents for the purposes of primary industry and wastewater treatment had the next highest proportion of consents with 13% each (Figure 30).

Over half (54%) of consented discharges to estuaries were for the purpose of industry (primary and other).

What volume is discharged?

The impact of a discharge on the environment depends on the amount and type of contaminant, as well as the size and sensitivity of the aquatic ecosystem receiving the discharge.

While discharge consents detail the type of discharge permitted, the volume is not always known. This is for several reasons; firstly some consents are for sporadic discharges. For example, when a consent cannot meet compliance conditions due to extreme weather or mechanical failures, a second/back-up consent may apply during times of non-compliance. Secondly, some consents are only broadly defined. For example, one consent is for discharging contaminants (sediment) to water as a result of bridge and culvert maintenance works at various locations along the lower Hollyford Road, Fiordland. Because of this we are not able to report on the total volume of the various types of discharges in Southland.

[22] Ngāi Tahu ki Murihiku 2008

Figure 29: Number of resource consents to discharge to land in Southland (as 30 June 2010)

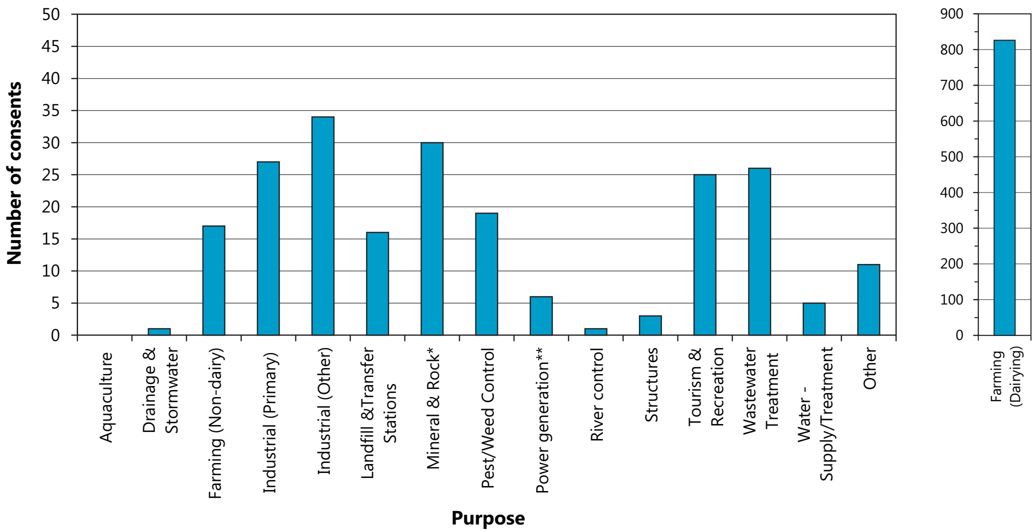
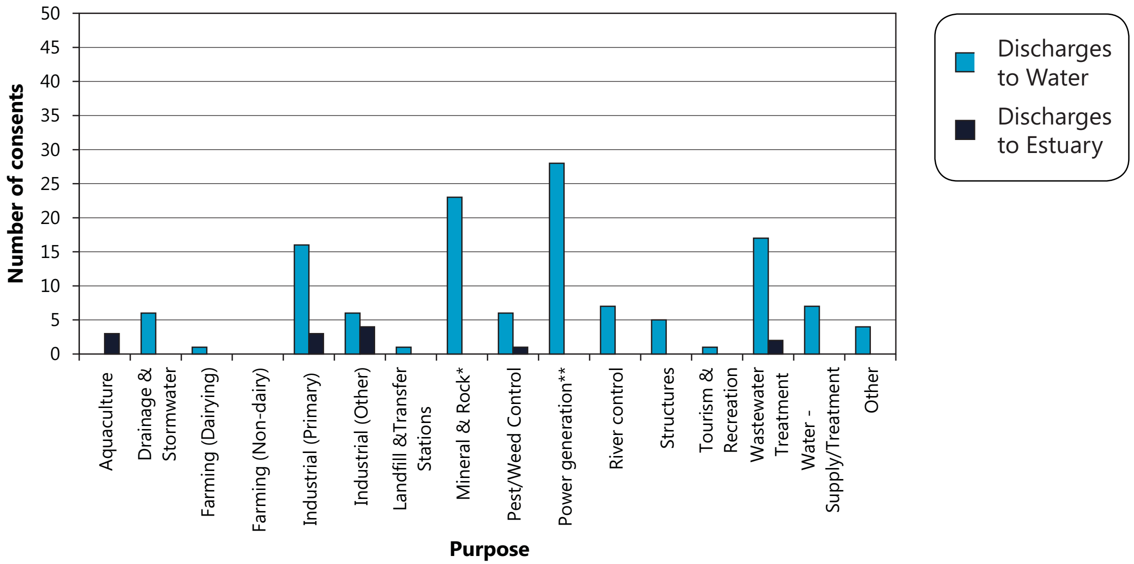


Figure 30: Number of resource consents to discharge to water in Southland (as 30 June 2010)



* exploration, quarrying, extraction and dredging

** hydroelectric, wind etc

Have our discharges changed over time?

The total number of consents allowing for discharges to freshwater, estuaries and land has increased by 46% in the last decade; an increase of 376 consents between 2000/01 – 2009/10 (Table 2). Over this time, consents for discharges to water, estuaries and land have increased 49%, 18%, and 46% respectively.

The most notable change is the increase in consents issued to dairy farms for discharges to land (60%).

The large increase in consents for discharging to land associated with dairy farming, and a subsequent decrease in consents for discharging to freshwater (from 11 to one) is due to an increase in dairy farming in the region, and because:

- The Southland Regional Policy Statement became operative in 1997 and this promoted the use of land treatment for the discharge of sewage and effluent rather than water,
- The Regional Effluent Land Application Plan became operative in 1998 and this plan also promotes that the discharge of sewage and effluent use land treatment methods,
- The Water Plan, which was first notified in September 2000 (plus subsequent changes to it), has a number of rules that directly control the discharge of dairy farm effluent and also prefers dairy effluent discharges to land over discharges to water,

Table 2: Changes in Discharge consents from 2000 to 2010[23]

	Discharge to Freshwater			Discharge to Estuaries			Discharge to Land		
Activity	2000	2010	Change?	2000	2010	Change?	2000	2010	Change?
Aquaculture	0	0	No change	1	3	↑	2	0	↓
Drainage & Stormwater	0	6	↑	0	0	No change	0	1	↑
Farming (Dairying)	11	1	↓	0	0	No change	498	826	↑
Farming (Non-dairy)	0	0	No change	0	0	No change	16	17	↑
Industrial (Primary)	10	16	↑	3	3	No change	61	27	↓
Industrial (Other)	6	6	No change	6	4	↓	30	34	↑
Landfill &Transfer Stations	0	1	↑	0	0	No change	24	16	↓
Mineral & Rock	23	23	No change	0	0	No change	18	30	↑
Pest/Weed Control	5	6	↑	1	1	No change	4	19	↑
Power generation	8	28	↑	0	0	No change	10	6	↓
River Control	2	7	↑	0	0	No change	5	1	↓
Structures (Construction and Maintenance)	2	5	↑	0	0	No change	0	3	↑
Tourism & Recreation	1	1	No change	0	0	No change	11	25	↑
Wastewater Treatment	15	17	↑	0	2	↑	21	26	↑
Water Supply/Treatment	1	7	↑	0	0	No change	9	5	↓
Other	2	4	↓	0	0	No change	6	11	↑
TOTAL	**86**	**128**		**11**	**13**		**715**	**1047**	

- Farm dairy effluent best practice guidelines were also released by Environment Southland in May 2007. The implementation of this non-regulatory method has also likely lead to changes in the management of dairy farming effluent.

In contrast, the number of consents for discharging to land by primary industries decreased from 61 to 27, a change largely due to the decrease in consents held by the dairy processing industry. In 2000, the Fonterra Co-operative group held a large number of discharge to land consents (41), for discharging whey/sludge on various properties in Southland. In 2010, Fonterra held significantly less consents (five) for the same activity because the Regional Effluent Plan permits the discharge of whey to production land provided certain criteria are met. Sludge discharges to land are also covered in the Effluent Plan, and consent requirements vary depending on nature and characteristics of those discharges.

The number of consents for discharging to water for power generation-related activities more than tripled from eight to 28. This is largely because the Monowai Power Station obtained 11 consents in 2002. The Monowai Power Station held a number of 'lawful existing uses' pursuant to the Soil & Water Conservation Act 1967 but these expired in 2001.

[23] Current to 30 June

OUR PEOPLE Case study – Jonny Brown, Kayaker

Jonny Brown is an outdoors man. He spent much of his youth travelling the country, only taking on work to keep him fed and watered, and the truck fuelled. He worked as an instructor of many activities including kayaking, rock climbing, bush craft, surfing and high ropes. He also spent time helping kids out at school camps.

Jonny says he got his passion for the outdoors, and water in particular, from his parents. He's always felt a spiritual connection with water. He has always been attracted to rivers because they provide him with a calming influence, a sort of 'water is life' type feeling.

Kayaking is his passion and he admits he used to take risks. Since having a couple of kids, Jonny's stepped back from the 'extreme', channelling his passion for the outdoors as head of the outdoor department at a rural Southland high school.

He says after seeing what the waterways are capable of, you get to the point where you can only make a certain number of mistakes before they cost you. That's why he got into freestyle kayaking. Freestyle kayaking is a growing sport in New Zealand where competitors get points for technical moves performed within a set time. Jonny recently won his first competition.

Growing up in Southland and returning as an adult, Jonny has noticed many changes in our waterways. He remembers biking out to the Makarewa Stream as a kid to catch eels and freshwater crays. He says he never killed anything he caught. He had a fish tank in his room that was home to eels, bullies and crays. Returning to the Makarewa Stream with his own children he says they couldn't find many of what he used to see there.

He says the changes in the Mataura River are the most disappointing. He used to be able to take his students there, but now he always checks the water quality first. He can't risk the kids or himself getting sick.

The appearance of didymo in our rivers has also had an impact on the kayaking community. "From a teaching perspective," Jonny says, "if I take the Year 10 students to Mavora or somewhere like that, there are 100 students and all their gear that has to be cleaned afterwards."

Accessibility to some of the best kayaking spots has also changed in recent years. He says many were only accessed by crossing farmland, but now that much of it has been converted to dairy and ACC and OSH are stricter in their rules, these places are much harder to get to.

Jonny believes that Southland has a lot to offer for kayaking and recreational water sports in general. You only have to drive for an hour or so in any direction to get to some nice rivers. And he says we're lucky. "We have a lot of rivers suited to low to medium ability kayakers. And we have quite safe beaches for practicing tricks and improving fitness."

J. Brown

Structures

Across the region a range of public and privately owned structures have been built in or on our water. These structures provide many benefits including economic, and often enhance the enjoyment and general use of the environment. For example, structures like boat ramps, jetties, wharves, and navigation aids, can enhance the enjoyment and general use of the environment and often define the built character of an environment.

Adding structures may also have unwanted effects on our waters. Adverse effects may not be immediately apparent, and can occur well away from the structure itself; down or even upstream in some cases. We need to ensure our structures are appropriately located and built so that we can maximise their benefit and minimise any adverse effects. Table 3 summarises the different types of structures found in Southland, and the benefits and potential adverse effects associated with these.

The extent and number of structures are difficult to quantify, because many structures can be erected/placed as a permitted activity under conditions in regional plans. Because of this, we are not able to accurately report on the number or location of structures across the region. Many are checked for compliance, particularly whitebait stands and wharves, but many erected as a permitted activity do not require checking.

What is a structure?

The Resource Management Act (1991) defines a structure as "any building, equipment, device, or other facility made by people and which is fixed to land; and includes any raft."

The goals of our management system

The Water Plan sets out all the many rules that apply to structures, including their erection, placement, reconstruction, use, maintenance, alteration, extension, demolition and removal. These are to ensure structures do not adversely affect the other values we have for the freshwater environment.

Many structures can be built without a consent, provided all of the particular conditions or standards outlined under the relevant rule are met (eg fish passage isn't impeded, or the structure doesn't cause a hazard to navigation).

For coastal structures the rules are more complicated but focus more on the appropriate positioning of a new structure and less on the intended use. Where possible, the use of temporary structures as an alternative to permanent structures is encouraged. When structures need to be permanent, they are required to have a form and finish that doesn't degrade the natural character of an area. This is of particular importance in areas of high natural value like Fiordland and Stewart Island/Rakiura.

Table 3: Structures in waterways, their benefits and potential adverse effects

Structure	Use /Benefit	Potential Adverse Effects
Monitoring and Sampling Structures	• Environmental monitoring (eg river flow, lake level, water temperature) • Improved water management	• Generally little or no adverse effects after construction • Natural character and amenity values
Boat ramps, jetties & wharves	• Enhance public access to waterways • Social/recreational use eg fishing, power boating • Economic benefits eg use for tourism	• Reduce navigational safety • Increase biohazard risk • Alter physical and ecological processes • Reduce water quality • Spoil natural character and amenity • Put added pressure on natural resources • Harm cultural values
Bridges	• Allows passage and transport over water ways	• Reduce navigational safety • Restrict other uses • Increase biohazard risk • Alter physical and ecological processes • Spoil natural character and amenity • Put added pressure on natural resources • Harm cultural values
Cables, wires and pipes	• Service provision (eg gas, water, electricity, communications)	• Reduce navigational safety • Can be difficult to maintain (particularly underwater structures)
Culverts	• Allow vehicles, stock to cross over water bodies	• Fish passage can be restricted • Drainage capacity of rivers/streams can be reduced • Flood risk and erosion • Harm cultural values
Dams and Weirs	• Vary in scale and purpose • Small scale – to create ponds for drinking water/irrigation, or wetlands for habitat. • Large scale – to provide flood protection or water storage for hydropower generation	• Can alter flow regimes • Reduce water quality and aquatic ecosystems (including fish passage) • Alter gravel movement and replenishment • Spoil natural character • Harm cultural values
Erosion Control Structures	• Protect land and infrastructure from harm • Can help maintain water quality and habitat	• Alter physical and ecological processes • Spoil natural character and amenity • Harm cultural values
Fords	• Provide stock or vehicle access where bridges/culverts don't exist	• Increase erosion and deposition (structural fords) • Fish passage impeded by structural fords • Alter physical and ecological processes • Reduce water quality • Harm cultural values
Moorings, Navigational Aids, signs	• Increase navigation safety • Allow vessels to be moored • Increased safety and communication	• Spoil natural character and amenity
Temporary Markers eg Canoe Gates and Ski Lane Markers	• For sporting/recreational use	• Generally little or no adverse effects
Whitebait Stands	• Aid access for white baiting	• Spoil natural character and amenity

Gravel extraction

Gravel extraction as a water use

Gravel extraction is undertaken in Southland primarily to supply roading and construction needs, and in some cases to alleviate flooding or erosion problems and threats to infrastructure.

Although riverbeds and adjacent flood plains are not the only source of aggregate in Southland, river gravel has often been preferred because it is economical to extract and generally high quality. The amount of gravel extracted each year has depended largely on the demand from roading and construction. Large volumes were extracted from the Oreti River in the late 1960s for the construction of highways and the Tiwai aluminium smelter. Large volumes of material were also taken from the Aparima and Oreti rivers in the late 1980s and early 1990s for stop-bank construction.

River gravel is often viewed as a renewable resource. However if extraction is not managed properly it can be unsustainable and lead to significant adverse effects on the environment. Given the variables involved and potential for adverse effects, it is considered necessary that all gravel extractions are assessed through the resource consent process.

What are the potential adverse effects of gravel extraction?

Historically we obtained much of our river-sourced aggregate from in or directly adjacent to our waterways – by skimming gravel beaches, bars or dredging river beds using heavy machinery such as draglines, diggers and scrapers. These methods can result in adverse effects to our rivers and streams. The extent of any adverse effect depends on many factors including the sensitivity of the river to disturbance, the natural rate of gravel replenishment, the location and method of extraction, and the amount (volume) of gravel being removed.

If too much gravel is removed from the river itself, bank erosion, and changes to the river channel such as bed degradation can occur. Over extraction (down to bedrock) in parts of the Mataura River has resulted in extensive backscour upstream as the river attempts to re-establish a stable gradient. This has resulted in the need for more extensive works to protect against the resultant bank erosion.

Channel alterations can also jeopardise structures like bridges, fords, weirs, pipelines and subsurface cables. For example the Iron Bridge at Wallacetown has required protective work to combat channel scour, likely as a result of gravel extraction in the 1960s.

Extracting gravel from river channels also has the potential to adversely effect aquatic ecosystems. Gravel extraction in river channels can directly impact wildlife by destruction of habitat, such as removal of spawning gravels, disturbance of bird nesting sites and degradation of riparian areas. Sediment suspension (released through bed material removal or disturbance of the stream bed) may also adversely affect aquatic species such as fish, as reduced visibility may change feeding and behavioural patterns. Deposited sediments can impede spawning and suffocate eggs. Biological material may also be removed from the river along with bed material.

The goals of our management

All river gravel extractions are assessed through the resource consent process.

A River Aggregate Management Strategy (RAMS) was developed and published by Environment Southland in 1997, in response to concerns regarding continued degradation and loss of traditional sources of gravel supply in Southland.

As a result a policy was implemented shifting gravel extraction from being primarily based on bar skimming, to habitat restoration approaches that involve creating self-sustaining ponds, oxbow lakes, backwaters and channels on floodplains. Extracting gravel away from the active river channel means active channel gravel bars and channel stability can be maintained or enhanced.

To create ponds, backwaters and oxbow lakes, gravel is extracted from a site that then fills with water creating a habitat for fish and water fowl. Excavating gravel to create a secondary channel results in the creation of a mid-channel bar. These bars are essential aquatic habitats for trout spawning, nesting and loafing for wading birds. Longevity of such excavations is highly variable, and there are many factors that must be taken into account for these proposals.

Environment Southland and Ngāi Tahu ki Murihiku promote gravel extraction techniques which aim to restore habitats degraded or lost by drainage, riverbank protection and flood control.

In this section we report on the number of land use gravel extraction consents issued by Environment Southland, the volume that can be extracted for those consents, and total amount of gravel actually extracted for the year ending 30 June 2010. This section also looks at changes that have occurred over time.

The volume of gravel consented and extracted

A total volume of 321,506 cubic metres of river gravel was extracted throughout the region, with 33 new consents being issued during 2009/10 (Figure 31).

In 2009/10, the most gravel was extracted from the Oreti catchment (166,464 cubic metres). This is more than double the amount of gravel extracted from the next largest source, the Aparima catchment (63,739 cubic metres).

How have the levels of gravel extraction changed over time?

Since 2000, the volume of gravel consented for extraction per year has fluctuated, with a peak volume of 1,543,906 cubic metres in 2005/2006 (Figure 31).

The total amount of gravel actually extracted each year also fluctuates to a small degree, with 286,641 cubic metres extracted in 2003/2004, and 404,510 cubic metres extracted in 2002/2003 (Figure 31).

The Oreti catchment has historically been Southland's most significant source of river gravel, with approximately 3,500,000 cubic metres of sand and gravel extracted in the 20 years to 1996.[24] For the period 2000-2010, the Oreti River catchment continued to have the highest annual gravel extraction rates in Southland, with a maximum of 190,868 cubic metres extracted in 2006/2007, and an average annual gravel extraction rate of 149,437 cubic metres for the 10-year period (Figure 32). The Aparima River catchment had the second largest annual average extraction rate of 77,119 cubic metres followed by the Mataura River catchment with an annual average of 54,922 cubic metres for the period year 2000 to 2010 (Figure 32).

The Mataura catchment has seen a significant decrease from historic extraction rates. Annual extraction rates from 1970-1996 (preceding the implementation of RAMS) were averaging more than 110,000 cubic metres per year,[25] double what is currently being extracted. Since the implementation of RAMS there has also been an overall decline in the volume of gravel extracted from active river channels, with the majority of gravel extraction in the region now occuring in 'off-channel' gravel deposits such as ponds. Of all consents (as at June 2010), 51% of gravel was extracted from ponds, 32% from beaches (primarily on the banks of rivers), while only 5% involve river bed gravel extraction (with another 2% recorded as both riverbed and beach).

The overall volume of gravel consented each year is significantly more than the volume actually extracted in 2000 (Figure 31). There are several reasons for this; a consent may be granted and the holder never removes gravel (gravel may not have been suitable for intended use), a consent holder may apply for more than what they currently need in case more is required in the future (to save applying for another consent), or a consent with a large volume is granted one year but gravel is extracted over several years.[26]

[24] Veint *et al.* 1997

[25] Hudson *et al.* 2000

[26] J Veint and K Marshall pers comms

Figure 31: Number of consents, volume consented and amount of gravel extracted in Southland over the past 10 years

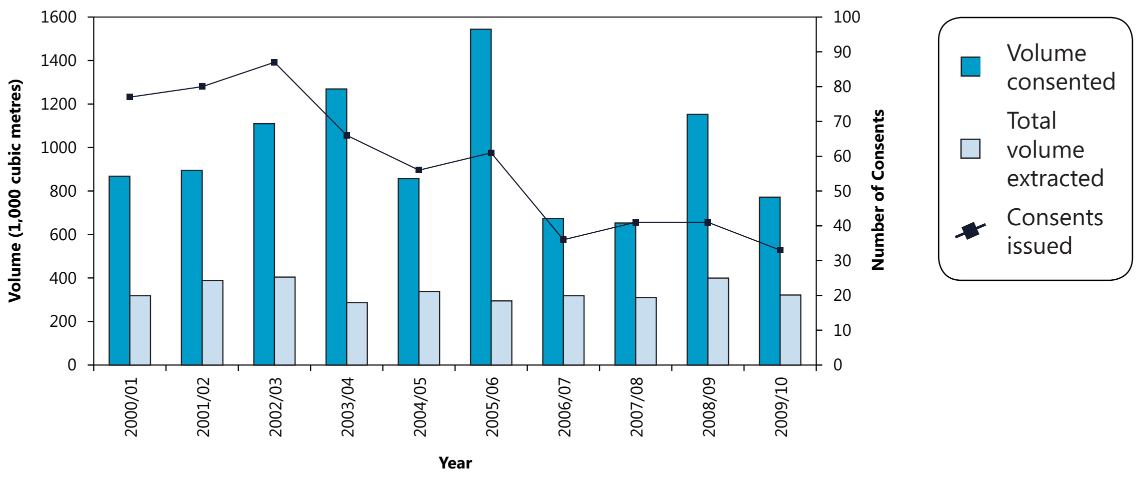
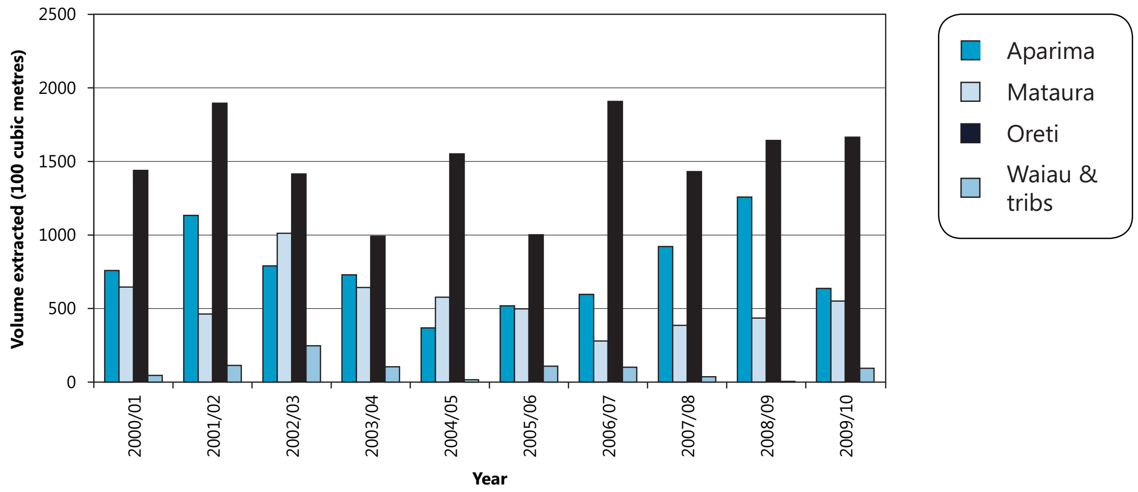


Figure 32: Total volume of gravel extracted from the major catchments in Southland 2000 to 2010



OUR PEOPLE Case study – Ron Granneman, Fly Fisherman

Not much compares to fishing the Bighorn River in Montana, USA, but for Ron Granneman, the Mataura River right here in Southland is still his favourite.

Ron is a long-time fisherman from Fort Smith, Montana, a small, former cavalry outpost nestled in the foothills of the Bighorn Mountains. His hometown river, the Bighorn, became an internationally renowned trout fishery after the Yellowtail Dam was built in the late 1960s.

For almost 20 years, Ron guided fishermen on the Bighorn in order to support his own passion for fishing some of the world's best lakes and rivers. In the summer of 1985 he found New Zealand, and for the six months he was here, he visited about 45 rivers. Since then, Ron has returned to New Zealand almost every year, spending six months here, and six months in the United States.

For about 10 years, Ron fished rivers in both the North and South islands looking for a 'home' river. Ron reckons over the years he has fished about 180 different rivers across New Zealand, plus 12 or so lakes.

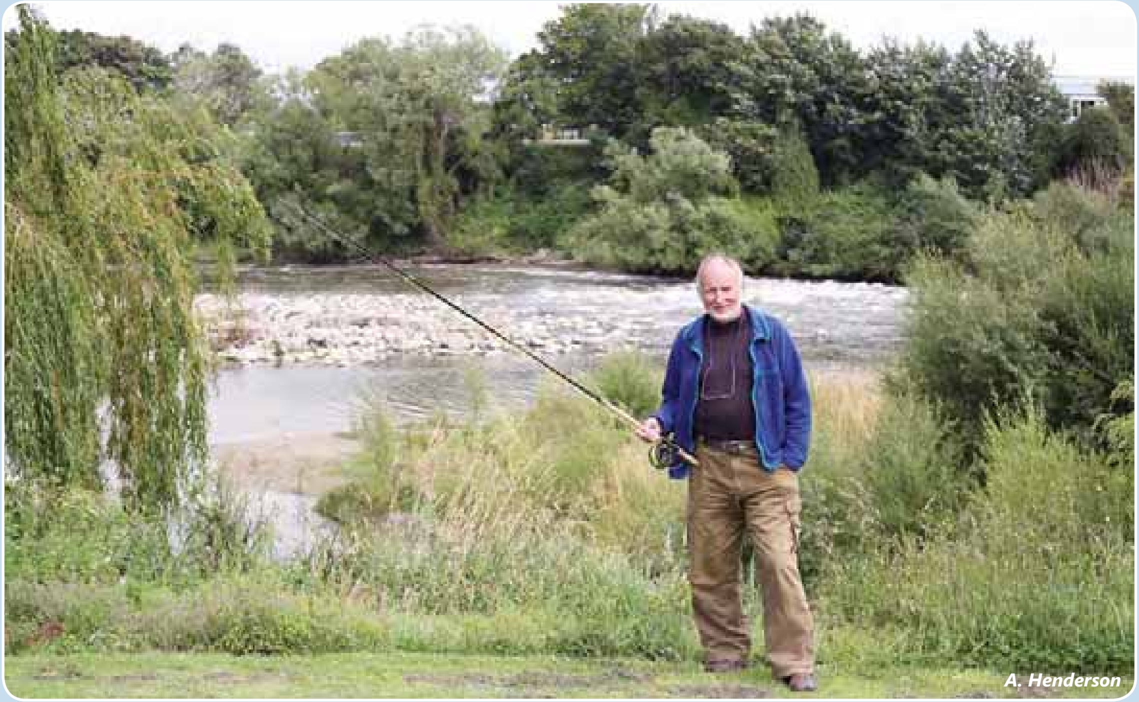
He first fished the Mataura River in the early 1990s, but says he really discovered it in 1997. He'd finally settled on a home river – "a fly fisherman's paradise," he says. It's not the size of the fish, but the dry fly quality of the river that attracted him. "Then, it had almost daily hatches (of mayflies), was more dependable, more fish in the river."

Ron has been noticing a drop off of fish every year. He's been told that 1996 was a bumper year. He figures it must have peaked around then. With the number and frequency of hatches declining, the number of fish will too.

Ron feels that Fish and Game management have missed an opportunity with this river. If the focus was on what the fish eat rather than the fish themselves, then the river would take care of itself.

Ron reckons the Mataura River still deserves its international reputation as a quality fly-fishing river. The lower reaches in particular has maintained its quality. For the Bighorn, eight to nine years of drought have dried up the hatches and lowered the river and reservoir level at the dam, but they still get 80-120 boats a day plus the walk-in fishermen. Ron says the two rivers are special, and attract a special type of fisherman; those that fish for the love of seeing the fish, not for the meat.

In 2001, Ron bought the house in Mataura that he had stayed in on previous visits to New Zealand. He says he still doesn't understand the rules of rugby, and he's still never been to Australia. Why would you want to when the fishing in New Zealand is so much better?



A. Henderson

What limits our uses of water?

In this section we look at what can limit our uses of freshwater. Information about potential impacts of our use on other aspects of the freshwater environment that we value are described in 'Our Health', 'Our Ecosystems' and 'Our Threats'.

Competition

Given the vast array of uses we have for water, it is not surprising that competition can arise. Our need to get rid of waste through point-source and non-point source discharges can impact on the water quality and consequently, the uses that require high water quality like contact recreation, food gathering and domestic water supply. Similarly, if too much water is taken from an aquifer, this may result in conflict with other existing takes and affect flows of connected streams (See 'Case study: Determining our impacts on groundwater levels').

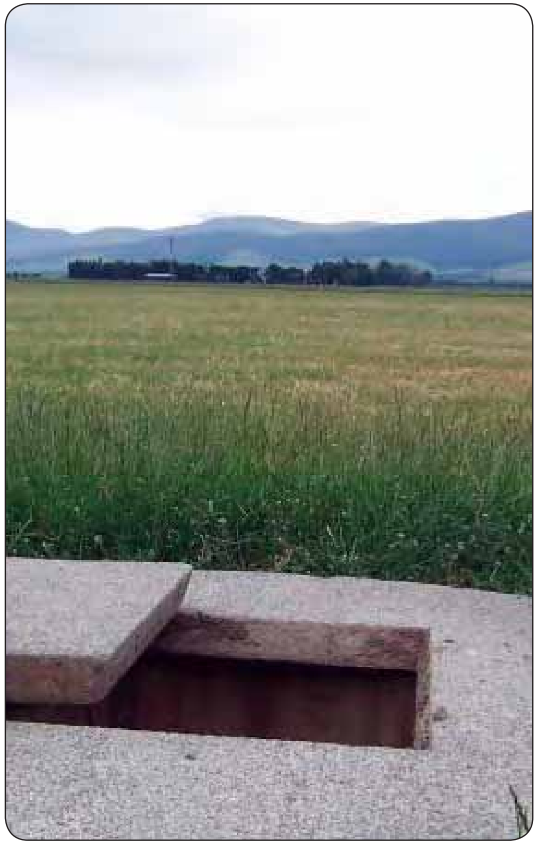
We need to carefully consider and balance the various needs and demands as we manage this resource.

Climate and climate variability

The amount of water within a water body is linked to climate. Despite the high and reliable rainfall in the region, water shortages and drought events are not unusual in Southland.

Our local climate is influenced by a complex interaction between atmospheric and oceanic patterns. We are particularly affected by two large-scale climatic events, known as the the El Niño Southern Oscillation (ENSO) and the Interdecadal Pacific Oscillation (IPO). Both have phases when water is less (or more) available (see 'Our Threats' report).

Climate change predictions suggest Southland will have an increased likelihood of natural hazards such as flooding and drought, and when overlaid with climate variability, these events could be far more extreme than in the past. Climate is therefore likely to become a major factor in determining whether our use of water resources remain sustainable.



Case study: Determining our impacts on groundwater levels

Southland has experienced significant change in the natural hydrological cycle through historic and existing land drainage. Rainfall recharge is now diverted to rivers and streams through soil and sub-soil mole, tile and surface drains instead of the extensive wetland areas which existed prior to development. This reduces the quantity of seasonal water storage of many shallow unconfined aquifers, with subsequent reductions in outflows to rivers and streams during summer and autumn.[27]

Groundwater takes can also alter the balance between aquifer recharge and discharge, and if not properly managed, can lead to adverse environmental effects in connected waterbodies (rivers, streams, lakes and wetlands) as well a lowering of groundwater levels over time.

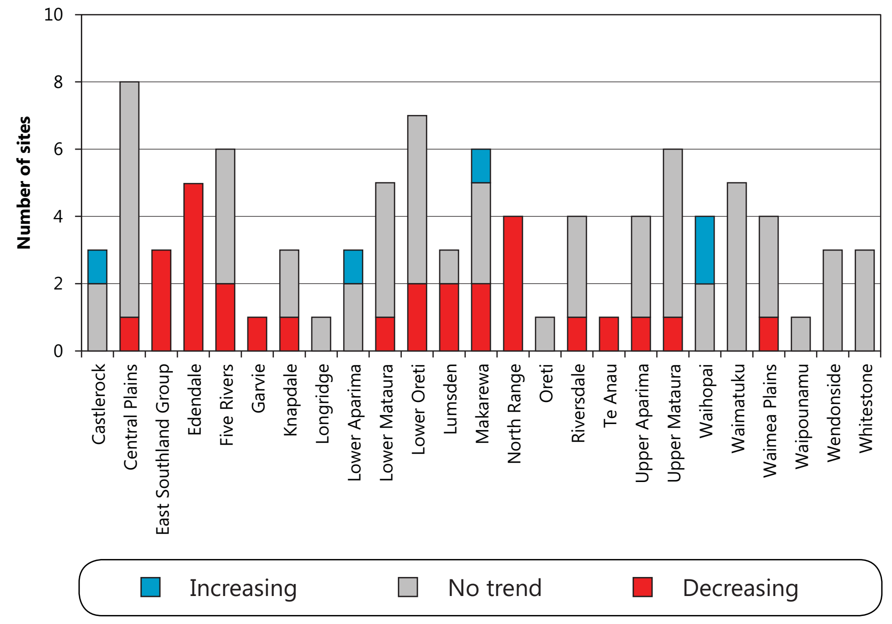
Analysis of trends for 94 sites in monthly groundwater levels found that 31% of sites had decreasing levels trends, 5% of sites had increasing level trends, and 64% showed no trend.[28] The majority of the sites with decreasing groundwater levels were in the Mataura and Oreti catchments, the catchments where the majority of increased demand for groundwater abstraction has occurred over the past 10 years.

Climate patterns have significant effects on groundwater and surface water flows and levels. Over the last decade, Southland has on average experienced a drier than usual climate, along with increased demand for water allocation and use. Decreasing groundwater level trends are expected while the system adjusts to a new equilibrium. However, it is important to be able to determine whether the observed trends are indicative of potential ongoing decline or have occurred in response to natural climate variability.

Springs and spring-fed streams form unique and highly valued aquatic environments which are closely linked to groundwater levels in individual aquifer systems. We currently monitor flows in eight spring-fed stream systems in order to characterise natural variability and identify potential adverse effects of groundwater abstraction on discharge in these waterways.

Environment Southland monitors 25 of Southland's known 34 aquifer systems. The trends in groundwater levels and number of sites in each aquifer systems are shown in Figure 33. For some aquifers, all monitoring sites have shown consistent trends (eg Edendale and North Range aquifers), which indicates the possibility of aquifer-scale effects. Others aquifers have a range of trends represented in individual monitoring sites (eg Five Rivers and Lower Oreti groundwater zones) which could indicate either localised effects or a range of responses within an aquifer system due to changes in recharge/discharge. Some aquifers that show changes have too few

Figure 33: Groundwater level trends for groundwater zones/aquifers



[27] Hughes 2003

[28] Wilson 2011

sites (eg Te Anau groundwater zone) or have sites with insufficient data for analysis (eg Garvie Aquifer). For these systems it is not possible to know whether trends are representative of a whole system or reflect localised changes due to abstraction.

To investigate the significance of the declining groundwater level trends on aquifer storage and to determine the cause, a subset of four aquifers (Edendale, Riversdale groundwater zones, and the confined North Range and Lumsden aquifers) were analysed further by comparing changes in groundwater storage against trends in water use and climate data.

The results indicate the North Range Aquifer to be the only system (out of the four assessed) which exhibited an environmentally significant decline in aquifer storage. Of particular significance was the lack of complete recovery between seasons, which suggests current aquifer discharge (including abstraction) exceeds recharge, despite only being accessed by four current resource consents (three for irrigation and one for dairy supply).

Available water use data indicates that existing water use in the North Range Aquifer seldom exceeds 30% of the current consented allocation. Given the observed decline in groundwater levels, this suggests that current levels of allocation (if they were to be fully exercised) are unlikely to be sustainable. In part this is likely to reflect the small spatial scale of the aquifer system and extent of confining layers which limits the magnitude of recharge reaching the aquifer system from the overlying unconfined aquifer.

Uncertainty with regard to the sustainability of further allocation from this aquifer was recognised with the decline of an additional resource consent application to take water for irrigation in 2005. Further analysis of aquifer sustainability in 2007,[29] led to Environment Southland reviewing allocation provisions for confined aquifers, like North Range.

Environment Southland has also been working with the users of the North Range aquifer since 2008 on how to best manage water from this aquifer in the future. The latest available data suggests some recovery of water levels over the 2011 year has occurred.

The decreasing level trends in the Edendale, Riversdale and Lumsden aquifers were assessed as indicative of increased variability of groundwater levels in response to natural variations in climate not considered indicative of adverse effects on aquifer sustainability. However, due to the strong connection between surface water and groundwater in the Riversdale groundwater zone, active management of minimum aquifer levels is required in this system to ensure ongoing sustainability of the groundwater resource and associated spring-fed stream systems.

Further details on Southland groundwater quantity can be found in State of the Environment: Groundwater Quantity Technical Report and other reports which can be accessed on our website: www.es.govt.nz/environment/water/groundwater/reporting

[29] Hughes 2007, 2008

What are we doing to manage our uses?

Managing our uses in the freshwater environment requires us to balance the values we hold for it and ensure we safeguard the lives that are dependent on its health. As such, the management responses of Environment Southland and Te Ao Mārama Incorporated also need to look to future needs and uses. It's important that the management of our uses is adaptive in order to respond to changes in our knowledge about our water resources and the changing needs and values associated with the freshwater environment.

Many of the actions Environment Southland and Te Ao Mārama Incorporated undertake to manage the pressures of our uses are described in the other Southland Water 2010 reports ('Our Health', 'Our Ecosystems' and 'Our Threats'). In this section we focus on the actions undertaken to manage the balance of conflicting uses and those on managing the amount of water available for our use.

The National Policy Statement (NPS) on Freshwater Management came into affect on 1 July 2011. Environment Southland must consider the NPS in regional planning and resource consent decision-making. It includes direction for decision-makers on setting limits for water quality and quantity, and improving and maximising the efficient allocation and use of water. The NPS will be a major driver for Environment Southland's work programmes during the next Long-term Plan period (2012-2022).

Planning and policy development

The Water Plan, which became operative in January 2010, sets the goals and approach for managing water. This is a 'living document' which allows for changes to be made to the plan as new information becomes available. Key proposed changes to the plan include:

- Improvements to how we manage the impact of groundwater abstraction on surface water resources,
- Enhancements to the plan provisions for fractured and confined aquifers, and
- New rules specifically providing for existing community water takes.

The Ngāi Tahu ki Murihiku Natural Resource Management Plan 2008: Te Tangi a Tauira, indentifies social, economic, health and wellbeing outcomes. These outcomes include:

- *'the sense of belonging and social responsibility to the surrounding environment is encouraged'*
- *'economic development and growth do not have implications for Ngai Tahu ki Murihiku in exercising kaitiakitanga, or have adverse impacts on the environment and communities'.*

This plan also lists policy on the management of water abstraction, including avoiding impacts on the relationship between tangata whenua and waterways.

Regulation and enforcement

Resource consents are monitored to ensure compliance with consent conditions, and enforcement actions are undertaken when necessary.

Minimum flow and level restrictions/cut-off apply to the region's water resources, and need to be enforced during dry conditions to maintain the necessary water levels and avoid the adverse effects of drought.

Working with the Community and Industry

Water User Groups

Environment Southland collaborates with water users at aquifer, catchment and regional scale groups. Irrigation New Zealand has set up a Southland branch.

Communications

Environment Southland uses a variety of methods to inform Southlanders about their water resources and provide guidance on best management practices. These include press releases, website updates, information sheets and brochures such as *'How Well is your Well'*, and regular newsletters such as Enviromoos, Enviroweek and Envirosouth.

Investigations

Southland Water Resources Study

The Southland Water Resources Study which commenced in 2003 was the first comprehensive assessment of the region's water resources. The first stage of the report completed in 2003 attempted to quantify water availability across Southland's surface and groundwater resources and compare this to potential future water demand to identify potential future constraints or shortfalls in water availability. The study identified the potential for a significant increase in consumptive water demand, particularly in the Mataura catchment, driven largely by increased pasture irrigation. Technical assessment undertaken for this report provided significant input into the development of the current water management framework in the Water Plan.

The second stage of the report was focused more specifically on the occurrence of drought conditions in Southland and its potential impact on agricultural production. The report included assessment of the economics of irrigation in Southland as well as options for addressing future shortfalls in supply.

Mataura Strategic Water Study

The 2011 Mataura Strategic Water Study undertook a detailed assessment of current and predicted future water demand in the Mataura catchment, drawing on work undertaken for the earlier Southland Water Resources Study and included a detailed assessment of costs and benefits associated with potential future water use. The report also evaluated a range of options to address future supply shortfalls, ranging from improved efficiency to infrastructure development (water storage) and regulatory change.

Irrigation water use

In 2011, a review of available irrigation water use data was undertaken for the Riversdale groundwater zone. The report utilised available data to characterise a range of parameters including application rate and depth, timing and duration of irrigation, as well as factors that contribute to the apparent discrepancy between modelled irrigation demand and actual water use.

Cultural values of groundwater and groundwater emergence sites

Te Ao Mārama Incorporated will be conducting research in 2012 on cultural values of groundwater and groundwater-contributed systems (springs, wetlands and rivers). This will enable cultural values to be further incorporated into the management of these resources.

Monitoring

Water resources

Monitoring and understanding the level of the water resource available for our needs is crucial to its management. This is conducted by Environment Southland and often required by consent holders (see 'Where and what we monitor' pg 14).

Gravel resources

The gravel resource with our river beds and berms areas will continue to be sought after. Inappropriate extraction methods and locality can impact on our water resource. Environment Southland undertakes a programme of monitoring associated with bed levels and channel capacity through a survey programme. Regular (5-10-yearly) analysis of the survey data allows us to make management decisions that allow for extraction of the resource, where appropriate, and to limit extraction where adverse effects are likely.

OUR PEOPLE Case Study – Rachael Millar, Senior Resource Planner

Rachael has always been interested in natural resources. Growing up in rural Southland, Rachael left to study at Lincoln University and then worked in Australia and Dunedin. Rachael returned to the region in 2002 and has been working in the policy and planning team at Environment Southland ever since.

The most well known piece of Rachael's work is probably the Regional Water Plan. This began in 1996 well before Rachael's arrival at Environment Southland – and at a time when there was less water demand; in fact, irrigation wasn't really on the radar.

Since the Water Plan was notified in 2000, the goal posts have moved with a significant increase in water demand. Before then, Rachael says irrigation was not considered necessary for reliable agricultural production in the region.

In more recent years, with land intensification and the need for more efficient production to remain competitive, irrigation is increasingly being used as a tool to increase reliability and production, particularly in the drier northern parts of the region. Rachael was instrumental in writing the policy framework, which is the Water Plan as we know it today, to meet these changing demands, ensuring sustainable management of this precious resource.

Rachael describes her role of Senior Planner as a co-ordinator, working in collaboration with stakeholders, councillors and the community to develop policy responses to the environmental issues facing the region. She undertakes significant plan changes (variations), appeals and notifications as well as mentoring her team members.

One of the things that Rachael says is key, is good engagement. "It's great to get people involved really early in the process through workshops, industry group and community meetings", Rachael says. This also gives her the opportunity to get out of the office, running workshops, meetings and attending field days, to meet face to face, and see the issues for herself.

While initially there may be diverging points of view Rachael enjoys working through these different viewpoints and coming up with solutions. Although she acknowledges that planning processes can take a long time, she also thinks it's certainly "worthwhile in the end".

What we don't know and could do better

What we don't know

We still have large information gaps on the extent of our water resources. The groundwater monitoring network, established in 2000, is relatively young and there remains significant portions of the region where we have an incomplete understanding of the groundwater system, particularly aquifers occurring in tertiary sediments at depth beneath the Southland plains.

The hydrological surface water monitoring network is designed mainly for flood warning and has gaps in information available to characterise low flows on many smaller tributaries. This results in some difficulty establishing minimum flows and flow allocation for many smaller streams. Because of this, our management is based on a precautionary and adaptive approach so we can amend initial conservative limits as we gain more information.

Our knowledge of the interactions between surface water and groundwater is evolving. In particular, the role and influence of groundwater quality on surface water bodies is not particularly well understood.

We have limited knowledge of recreational and cultural uses of the freshwater environment and how these contribute to Southlander's health and wellbeing. Understanding these factors is important because many of these activities are a major part of our cultural identity.

What we could do better

We are still working on a better ways to characterise water availability under our adaptive management framework. This is made particularly difficult when there are different regulatory frameworks for different catchments that overlap with the Water Plan, eg Water Conservation Orders for the Oreti and Mataura rivers and the special provisions in the Water Plan for the Waiau River's large hydroelectric generation takes.

The current framework is relatively effective at managing the impact of groundwater takes on surface water with a high degree of connectivity through the application of controls on pumping. However, in its current form it is not particularly effective in terms of addressing cumulative effects of groundwater abstraction on surface water at a wider catchment scale. Environment Southland is currently developing a new framework to amend the Water Plan to better manage the cumulative effect of groundwater abstraction on surface water flows.

Although water in Southland is typically allocated on a daily and annual basis (ie there can be limits to daily and/or annual use), we can only report on annual usage. We would like to be able to report on daily usage in more detail, but much of the data currently collected isn't stored in a way that allows analysis on a daily basis. We are working on improving our daily water use reporting.

The extent and number of structures in and on our water is difficult to quantify, partly because many can be erected/placed as a permitted activity. Therefore we are not able to accurately report on the number or location of structures across the region, which means the level of permitted structures and potential adverse effects is unknown.

Refinements for future monitoring

Because there have been major changes in both climate and land use in Southland in the past decade, it is unknown whether the sources and volume of permitted water takes for domestic and stock supply have significantly changed in the intervening period. To investigate this issue and help address an existing knowledge gap, Environment Southland is undertaking a survey in 2012 of permitted (non-consented) water users in the Mataura catchment.

The National Policy Statement for freshwater management requires Environment Southland to set limits for water quality and quantity for each catchment. A large amount of monitoring will be required to be able to meet this requirement.

What you can do

Environment Southland's website has the most up-to-date water monitoring information - www.es.govt.nz

It's the best place to visit if you want to find information on river level, river flow and groundwater.

Rivers and Rainfall

You can easily access the latest rainfall, river level, and river flow information from the numerous automated monitoring sites around our region that are constantly updated. You can also access historical data from each site.

Groundwater

Our website also provides access to the latest groundwater monitoring information from our 'WELLS' database, that allows you to select any well from a map of the Southland and then retrieve information about it.

To find it easily, search groundwater on our home page.

If you visit our website looking for water monitoring information, why not take the time to look around and see what else is available. The Environment Southland website is an invaluable source of information about our region and how we manage it.

Environment Southland encourages the use of good management practices when constructing your bore or well. Resource consent is required and staff are always available to provide advice on the consent process. Before you start you should make sure that your contractor is familiar with the *Environmental Standard for Drilling*.

Most water take consents now require data on actual use to be sent to Environment Southland. It's important that you send in accurate, useful information and be aware of your consent limits and restrictions.

Before you irrigate, check the soil moisture level on the Environment Southland website. Irrigating when the soil is too wet can cause overland runoff to rivers and streams.

Environment Southland has produced four best practise brochures which outline how you can use gravel extraction to restore oxbow lakes, backwaters, ponds and river channels and the benefits of doing so. Hard copies can be obtained from Environment Southland, or you can visit our website to view the brochures online (under flood warning).

It may be possible for you to recycle your used water as 'grey water'. Grey water is water that has been used in showers, handbasins, baths, dishwashers, and laundries and is recycled to water gardens, collected for ponds etc. Not only does it provide you with an environmentally friendly alternative for your garden, it would also take some pressure off your septic tank or the community stormwater system.

Do you collect rainwater and use it in your home? Do you know where your water supply comes from? Find out today and get more involved in the work being done to protect our waterways.

Water is a valuable resource, not only for humans, everything around us relies on a sustainable supply of water - our animals, the land, fish and our precious ecosystems. Can you think of ways that you can conserve water at your home, school and workplace?

Get involved in decision-making by voting and letting your councillors know your ideas/concerns. You can let us know what we are doing well, and what we could do better, by making submissions on annual or long-term plans.

Find out...

- What rules, plans and policies affect you, your land, and your community. Plans and policies for water in Southland are available online at www.es.govt.nz.
- More about your local waterway and how your school can get involved through the Stream Connections Programme. Contact the Environmental Education Officer for more information.
- What the best environmental practices are for industrial and commercial properties. Check out the Pollution Prevention Guide at es.govt.nz or contact the Pollution prevention officer.

OUR PEOPLE Case study – Otama School

For the kids at Otama School, their local stream is not just a decoration extra frill – it is used to increase their knowledge of the environment. From creative writing about the weather, to graphing and reporting on water quality results, students use their local stream for rich learning experiences. Everyone is involved in the school's project which is now part of school and community life.

Otama students have learned about water through Environment Southland's Stream Connections programme, some years ago, and have enriched this through their involvement with the Enviroschools programme. Students learned about macroinvertebrates that live in their nearby stream and the importance of having healthy water for these and other aquatic creatures to survive and thrive. By completing the hands-on component of Stream Connections, students learned how to monitor water quality and assess stream and ecological health.

The students expanded their involvement by monitoring their local creek through the Environmental Monitoring Action Project (EMAP). The school has now been monitoring at three sites for over four years.

Initially, the school had an EMAP facilitator to help with the monitoring, but now, it has become so well embedded in school life, students teach each other how to monitor their local stream sites. Parents or teachers take the students to their sites twice a term to continue the monitoring programme.

As part of their monitoring, the students decided to do some riparian planting. They have planted trees at one site and continue to monitor the water quality at all sites.

After students investigated where their stream was flowing into, and what was happening further down the catchment, the school began working with the Hokonui Rūnanga, which has a restoration project at the Mataitai on the Mataura River. Otama School pupils buddied up with Mataura School pupils and taught them how to plant plants, a new experience for many Mataura pupils. Seven hundred plants were planted last year, and another 700 in September 2010.

One of the next steps the school is looking to take is EMAP monitoring at the Mataura River Mataitai site, to compare the health of their smaller tributary stream with the Mataura River. It could also undertake a cultural health index assessment.

Glossary

Confined aquifer: An aquifer that is 'closed' to the land surface, ie it has a low permeability upper layer such as clay and silt that prevents it from being directly replenished by rainfall.

Consumptive water takes: A consented activity where water is taken from its source and not returned. For example, when water is used for irrigating a crop in a paddock.

In-stream values: Uses or values of streams and rivers that are derived from within the river system itself and include those associated with freshwater ecology and recreational, scenic, aesthetic and educational uses.

Manaaki: To support, take care of, or provide hospitality to people.

Manamoana: traditional/customary authority or title over the seas. Manamoana is held by an iwi or hapū rather than individuals.

Manawhenua: Traditional/customary authority or title over land, and the rights of ownership and control of usage on the land, forests, rivers etc. Manawhenua is held by an iwi or hapū rather than individuals.

Non-consumptive takes: Occur when water returned to the same location it was taken from, after it is used. An example being when water is taken from a river to be used.

Out-of-stream values: Values associated with the use of water outside of the river system. These values are frequently associated with an economic or social value (eg abstraction, power generation, irrigation).

Papatipu Rūnanga: Traditional local Māori Councils. Papatipu Rūnanga in Southland are Waihopai Rūnaka, Te Rūnanga o Awarua, Te Rūnanga o Oraka/Aparima and Hokonui Rūnaka.

Permitted use: Describes an activity that can take place without requiring consent.

Spring (waipuna): Springs are formed where the water table intersects the land surface and groundwater discharges to the land surface.

Stream depletion: The effect of groundwater abstraction on stream flow.

Takiwā: Tribal region.

Tūpuna: Ancestors, elders.

Unconfined aquifer: Aquifers that are 'open' to the land surface, ie there is no low permeability confining layer between them and the land surface. Typically shallow, they are normally comprised of permeable surface sands and gravels and recharged directly by rainfall seeping through the soil.

Whakapapa: Genealogy.

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