

Tourism, Water and Waste in Westland: Implications of Increasing Demand on Infrastructure

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Te Whare Wānaka O Aoraki



Tourism, Water and Waste in Westland: Implications of Increasing Demand on Infrastructure

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Summary

The growth of tourism, and its consequent benefits, are dependent on the maintenance, if not enhancement, of the West Coast's unique natural environment. Parts of this natural environment have been described as ecologically fragile. There are a range of tourist activities that consume water and produce solid waste and wastewater. An important issue is the tourists' additional demand for potable water and their production of additional wastewater. The major objectives of this research were to:

- Develop models to estimate and project aggregated tourist water use and wastewater production at Hokitika, Harihari, Franz Josef, and Haast.
- Assess the adequacy and resourcing of the facilities to provide water, manage wastewater and solid wastes associated with tourism.

This research develops a simple model based upon monthly tourist numbers entering a region and using proportional factors to determine demand placed on the specific centres. Standard engineering estimates of water use and wastewater production per capita were used to compare tourist and permanent resident monthly loadings. Despite having only limited independent variable data available, the model was reasonably successful in tracking monthly water use in the four centres, when compared to metered water use.

The model indicates that in centres such as Franz Josef, which have a small resident population, peak season tourist use of water is a significant proportion of monthly water use. A major tourism event, such as the Wild Foods Festival which attracts 20,000 people to Hokitika, similarly places a large peak demand on the existing water supply and wastewater systems. The model indicates that projected tourism growth will lead to design capacity being exceeded in some centres.

Solid waste disposal occurs at ten sites in Westland District, only one of which has a resource consent. Major decisions are soon to be made on future options for solid waste disposal. Management by waste minimization will need to apply specific strategies in centres with relatively high tourist activity.

Resourcing of the water supply, wastewater and solid waste disposal systems is examined by considering District Council, Department of Conservation and privately provided facilities. By payment of separate rates and user charges, users collectively meet the current and amortised costs of water supply, wastewater and solid waste disposal provided by Westland District Council. Charges are based upon actual use of the systems or proxies for use such as numbers of beds or number of toilets connected to the wastewater system. Wastewater charges based upon numbers of toilets on each property connected to the sewerage system may not detect the variation between properties in the volume of wastewater they produce. Similarly, reliance on property values can be a misleading basis for water charges where there is only a weak relationship between the value of a property and the actual use of the water services.

Rapid growth in tourism numbers will necessitate new investments at some sites to provide water, and dispose of wastewater. Westland District Council should investigate whether more accurate charging policies for wastewater, based perhaps on metered water use, can be introduced at acceptable cost, to ensure that all users meet their fair share of costs.

The Department of Conservation provides water supply, and disposal of wastewater and solid waste at several sites in Westland District. Visitor numbers vary greatly between sites, with approximately 250,000 people per year visiting the Franz Josef Glacier, and 95,000 per year visiting the National Park Headquarters building in Franz Josef township. Legislation allows the Department to charge for services provided in parks and reserves, but at present there are no charges for use of toilet facilities provided at the Franz Josef Glacier, or the Park Headquarters building in Franz Josef township. At Department of Conservation campgrounds and huts, bundling of services means that some revenue is collected from users to meet part of the costs of water supply and wastewater systems. Greater use of direct user charges for water supply, and wastewater systems would reduce the need for general taxpayers to fund these systems.

Chapter 1

Introduction: Tourism Effects, Research Objectives and Outline of Methods

1.1 Introduction

There are various ways environmental performance can be evaluated. These can include such tools as the ecological footprint (Bicknell et al., 1998), sustainability process index (SPI) (Krotscheek et al., 1996) or more site specific environmental indicators, such as water and air quality, biodiversity and others. The Ministry for the Environment (MfE) has prepared a national Environmental Indicators and Monitoring Programme for New Zealand (see website: www.mfe.govt.nz/monitoring/index.htm). The MfE study focused initially on New Zealand indicators for land, water, and air and has since progressed to indicators for: waste; indigenous habitat and biodiversity; pests, weeds, and diseases; fisheries resources; energy; climate change; ozone depletion; and transport. The intention is to have the core set of indicators allowing the environment to stand alongside economic and social considerations in policy development and implementation.

The critical importance of the interdependence between ecosystems and human development has significant implications for the criteria we should use in planning for rural and urban economic development, and in designing and building the physical facilities and infrastructure that support our societies. The Ministry for the Environment (1997) provides a statement on the impact of tourism on New Zealand's environment. A number of the issues identified in this statement are relevant to Westland.

Tourism growth and the environment

World tourism has boomed in recent decades as international travel has become easier and global income has become more unevenly distributed among the world's rich and poor. New Zealand's tourism growth has been much greater than the world average, partly because of a favourable exchange rate which made us a relatively cheap destination, and partly because of the aggressive marketing of our "clean, green" image. ...Since the 1980s there has been a switch from pre-arranged package tours, in which visitor impacts were confined to major routes, to what is known as "free and independent travel" (FIT) holidays where people drive campervans and rental cars wherever the spirit moves them... Even more recent developments include adventure tourism (bungy jumping, white water rafting)... ...The rapid increase in visitors during the past decade has raised concerns about environmental effects and sustainability ...Overcrowding lowers the quality of visitors' experiences and intensifies pressure on facilities such as parking, space in huts, and toilets. Fouling of ground and streams, including water supplies, by human waste was seen as a nationwide problem at huts, bivouacs, camping areas, reserves and (especially) roadside areas... Other visitor effects can include: habitat destruction and wildlife disturbance (particularly at nesting sites) by off-road vehicles, jetskis, horses, dogs and guided tours; increased risk of fires and new weed introductions; vandalism and souveniring at historic sites; vegetation clearance for campsite firewood; track deterioration; noise; and visual pollution... Visitor impacts are greatest in fragile landscapes such as sand dunes and subalpine areas. Although problems with visitor numbers have started to show at some tourist destinations, the effects are still relatively limited when compared with the widespread devastation caused by introduced animal pests.

Ministry for the Environment (1997), p 9.38

Table 1 presents a systematic framework for identifying and categorising the possible environmental effects of tourism, including emissions, resource abstraction and ecological habitats

Table 1
Three Main Categories and Examples of Environmental Effects

Emissions		
Liquid	Solid	Gaseous
Campervan wastewater	Paper, metal, plastic, glass	Exhaust from vehicles, coal fires

Resource Abstraction	
Renewable	Non-renewable
Water, energy food, biomass	Oil, Minerals

Ecological Habitats and Biodiversity		
Modification	Fragmentation	Destruction
Boating, jet skiing	Roading, tracks,	Reservoirs, oxidation ponds, roads

Tourist activities produce emissions (liquid, solid and gaseous), consume resources (which may be renewable or non-renewable) and modify, fragment and/or destroy habitats. If the objective is to enhance the *environmental performance of the tourist sector* then all aspects of impacts and their inter-relationships will need to be considered in a systematic manner.

For the West Coast, the Parliamentary Commissioner for the Environment (PCE, 1997), believes the geology and high rainfall make the problem of environmental re-entry of waste a particular problem.

1.2 Specific Research Objectives

This study focuses on the environmental impacts of tourism on four centres in Westland District, New Zealand. The specific objectives of this research were to:

- Develop models to estimate and project aggregate tourist water use, solid waste and wastewater production at Hokitika, Harihari, Franz Josef, and Haast.
- Assess the adequacy and resourcing of infrastructure to provide water, and manage wastewater and solid waste associated with tourism.

The total tourist experience is made up of a number of activities, each of which consume water and produce solid waste and wastewater. These are listed in Table 2.

Table 2
Tourist Activities, Waste Production and Water Consumption

Activity	Wastewater Type	Solid Waste Type	Water Consumption
Hotel/motel accommodation	Sewage, storm water	Paper and cardboard, plastics, glass, putrescibles, and some rubber, textiles and metal	Yes
Camping grounds	Sewage, storm water	Paper and cardboard, plastics, glass, organics, putrescibles, and some metal	Yes
Public toilets	Black water with smaller quantities of grey water	Some public toilets may have rubbish bins, producing - paper and cardboard, plastics, glass, putrescibles, and some metal	Yes
Campervan dumping	Black water	Paper and cardboard, plastic, putrescibles, cans	Maybe
Visitor Centres	Sewage and storm water	Paper and cardboard, plastics, glass, and some metal	Yes
Restaurants	Sewage	Paper and cardboard, plastics, glass, putrescibles, and some metal	Yes
Tourist shops etc	Sewage	Paper and cardboard, plastics, glass, organics, and some textiles, rubber and metal	Yes
Adventure tourism	Black water Maybe some grey water	Variable	Maybe
“Off-road” activities	Black water	Paper and cardboard, plastics, glass, organics, putrescibles, and metal and textiles	No

Note that Table 2 has not included the environmental impact of the construction industry. During construction, industry can produce a significant quantity of waste material – in particular solid wastes (paper, plastic, glass, metal, rubble, concrete, timber, rubber, textiles and potentially hazardous materials), and in time these would need to be taken into account in a full environmental assessment.

1.3 Impact of Tourism on Regional and District Infrastructure

The presence of tourists in the Westland District has direct and indirect impacts on infrastructure. Direct infrastructure impacts are noted for many of the services that are provided by the District Council. Those relevant to this study include:

1. Potable water supply
2. Sewage systems, including public toilets

3. Solid waste management
4. Stormwater management.

Tourism is likely to impact more on the first three and less on the stormwater system. For this reason stormwater is not considered in this study. The direct impacts are in terms of the extra demand and loading tourist activities place on these services.

Indirect infrastructure impacts include many of the services that are provided informally. Not all permanent residents within an area are connected to a particular service. For example, in Harihari, only 40 per cent of the residents are connected to the town water supply and there is no central sewerage system in Harihari. In this case a significant proportion of residents will have their own individual water supply and onsite wastewater system, such as a septic tank system. The individual onsite water supply and wastewater system (and particularly the latter) may be more vulnerable to increased demand and loading than say a community scheme that is normally designed with a safety margin. Some onsite septic tank systems may be old and poorly managed. It is possible that more than 30 per cent of tourists may use private overnight accommodation (Forsyte Research, 2000). In such cases impact on the individual onsite system may result in surface and ground pollution and increased disease risk. If individual water supplies are limited, or of poor quality, the increased demand caused by tourism will clearly exacerbate this. The indirect infrastructure implications are manifest in terms of increased regulatory and monitoring demands being placed on the Regional and District Council.

1.4 Methods

The research presented in this report draws on monthly regional tourist flow data to work out how much demand they place on potable water supply and how much wastewater they produce. While the details of the methods will be presented later, the general approach was to work out precisely where tourists go, what types of accommodation they use, and then take standard engineering data for water use and wastewater produced to estimate the total aggregate effects produced by tourists at each study site.

1.5 Outline of Report

This report comprises three chapters. Chapter 2 presents the key results on water demand and wastewater produced by tourists. Chapter 3 considers the implications of the results for resourcing the infrastructure associated with water and waste. Chapter 4 reviews the study and draws out the main findings.

Chapter 2

Estimates of Potable Water Demand and Wastewater Produced by Tourists

2.1 Introduction

This chapter estimates potable water demand and wastewater produced by tourists in each of the four case study towns in Westland. The chapter begins with a description of the water supply and wastewater systems that are currently in place. It then considers the key questions and assumption that underlie our analysis before going on to present the key findings. The final section focuses on solid waste.

2.2 Water Supply and Wastewater Systems

Details of the existing water supply and wastewater¹ services at the four centres are summarised in Table 3 (page 6).

To estimate of the quantity of wastewater produced and potable water consumed by the permanent residents, an estimate of the number of connected permanent residents is required. The 1996 census data does not necessarily represent the population connected to the service. In order to gain a reasonable estimate, the number of rated domestic connections (i.e., excluding commercial connections) was obtained from the Westland District Council. By assuming 2.7 people per connection (which is typical for New Zealand), an estimate of the total number of connected people was made. These data are provided in Table 4 (page 7).

There is a significant difference between the census population and the connected population especially for the three smaller centres of Haast, Franz Josef and Fox Glacier. The higher census population for the three smaller towns may be explained in terms of the presence of tourist and itinerant workers on census night or by the fact that the census catchment extends beyond the serviced areas.

¹ In this study the term **wastewater** includes greywater and blackwater; stormwater is not included (although an infiltration factor of 2.2 is applied).

Table 3
Description of Water Supply and Wastewater Systems for each Town

Town	Wastewater System	Water Supply System
Hokitika	Conventional pond treatment system. Designed for a population of 5,500 (Hokitika) + 500 (Kaniere). The District Council plan an additional anaerobic pond and polishing wetlands. Discharge to sea. Ground water infiltration to sewers can be high.	Supply comes from Lake Kaniere – in competition with hydropower. Dry weather shortage requires minimum level policy. Commercial sector metered. Large reservoir. Dairy Company uses about 40% of total water consumption. Connected population 3,853 MOH Grade D ²
Harihari	No community system. Individual onsite systems. Poor drainage on lower flats with drainage from higher slopes. Some septic tanks do not have adequate dispersal fields.	Gravity water supply. Has no treatment at present but it is proposed to install treatment. Connected population is 221 plus some dairy farms. Continuity of supply a problem MOH Grade E ²
Franz Josef	Oxidation pond system, with discharge to river. Riverbed movement threatens outfall. Issue of risk to pedestrians. Designed for population of 720.	Water supply currently at limit. Water use metered. MIOX water treatment. 640 m ³ /day. Not enough storage. Complaints about taste and smell. Water supply under pressure. Connected population 105. MOH Grade E (Motor Camp U) ²
Haast	Pumped sewer to oxidation pond. Discharge to river through infiltration gallery. Sufficient capacity. Designed for a population of 240	Water supply from ground water. Coping OK. Connected population 90. MOH Grade D (Motor camp and School U) ²

Source: WDC (2001)

² Refer to Ministry of Health (2001). Grading: D is unsatisfactory, high level of risk; E is completely unsatisfactory, very high level of risk; U is ungraded.

Table 4
Connected Population

	Connected Persons Domestic		Population 1996 Census	Projected Population for 2001
	Water Supply	Sewerage		
Hokitika	3,853	4,074	3,555	3,782
Harihari	221	NA	417	433
Franz Josef	105	119	940	1,264
Haast	89	97	672	818

2.3 Assessing Tourist Infrastructure Loadings

The question considered in this chapter is what proportion of the community water supply (potable) and wastewater sewer and treatment plant is used by the international and domestic tourists in the designated centres of Hokitika, Harihari, Franz Josef and Haast.

The demand placed by tourists on potable water supply and wastewater services will depend on tourist numbers and on tourist activity and behaviour. Tourist numbers vary throughout the year and from day-to-day. This presents some difficulty for the water supply and wastewater service provider. For the design of sewers (pipelines and pump stations) peak flows, even within the day, must be used to size these facilities. For example, the Hokitika sewer system needs to be designed with a capacity to handle the volume of wastewater produced by the 20,000 people visiting Hokitika during the Wild Food Festival. The water reticulation system also requires the capacity to cope with such an influx of people. However the wastewater treatment plant could be designed for a lower peak load due to built-in buffer storage within the system and the ability of biological treatment systems to provide some buffer to shock loading.

Tourist activity and behaviour is influenced by the facilities available to them to use and by their length of stay. Both of these influences have been taken into account in the following analyses.

2.4 Assumptions

To quantitatively address the above question a number of assumptions have been made. The first assumption is that additional water consumption and wastewater production are based on quantities typically used for the engineering design of urban water supply schemes. Using these figures leads to the standard rates shown in Table 5.

Table 5
Standard Rates of Water Consumption and Wastewater Volumes by Type of Accommodation

Accommodation Type	Water Consumption ltrs/day/bed-night	Wastewater Production ltrs/day/bed-night
Hotel	300	300
Motel	150	150
Hosted accommodation	180	180
Packpackers accommodation	100	100
Caravan and camping parks	90	90

The additional volume of wastewater from tourists is assumed to be the same as the potable water volume used by the tourist. This is a valid assumption as the tourist is very unlikely to use water for external activities such as garden irrigation and car washing. Also, any stormwater infiltration to sewers is independent of the presence of tourists.

The per capita water demand and wastewater production for permanent residents and itinerant workers was assumed to be as given in Table 6.

Table 6
Permanent Resident Water Demand and Wastewater Production by Location

Town	Connected Permanent Residents		Water Consumption ltrs/person/day³		Wastewater Production ltrs/head/day⁴
	Water	Sewage	Summer	Winter	All Year
Hokitika	3,853	4,074	600	300	220
Harihari	221	0	600	300	0
Franz Josef	105	119	500	250	220
Haast	89	97	500	250	220

The in-house wastewater production for permanent residents and itinerant workers were assumed to be constant throughout the year, however a variable infiltration factor was applied to the wastewater volume entering the treatment oxidation ponds. The mean infiltration factor was 2.2, adjusted to mean monthly rainfall. The water demand and wastewater production of the commercial sector were not included in the analyses.

2.5 Estimates of Water Demand and Wastewater Production

This section takes data for permanent residents and tourists to estimate water demand and wastewater production for each town.

³ Based on measured values with allowance for leakage.

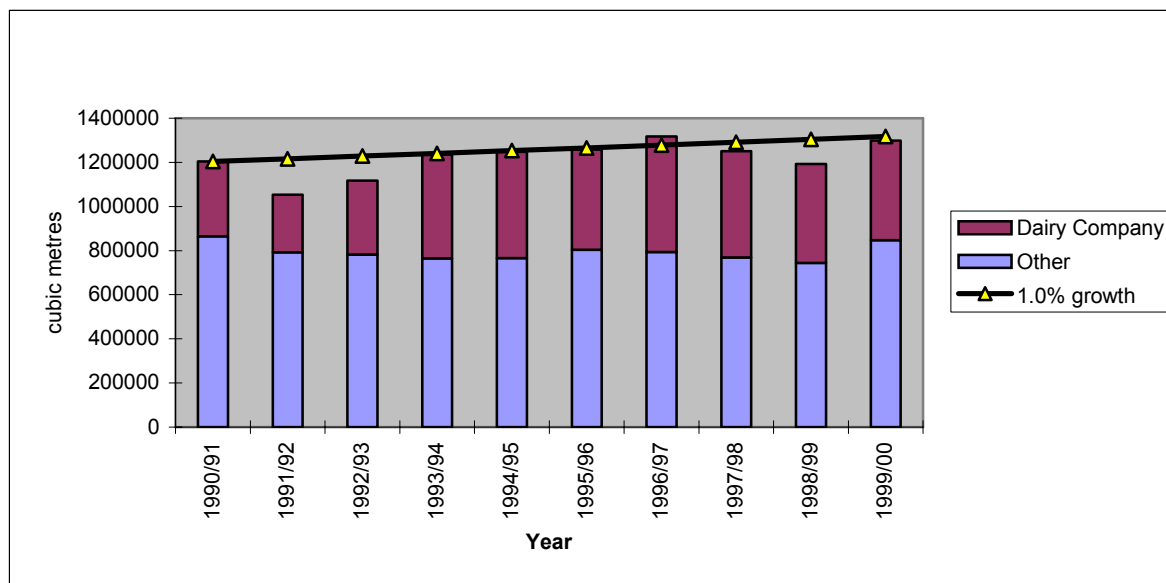
⁴ Infiltration is added to this value in proportion to the monthly rainfall for the site.

2.5.1 Permanent Residents

There are no detailed sets of measured data available for water demand by residents or wastewater production from the permanent residents in the four centres. The Westland District Council were able to provide water consumption data for December 1999 to December 2000 for Hokitika and Franz Josef.

The dairy factory in Hokitika places a significant demand on the town's water supply. This is illustrated in the Figure 1 (Westland District Council, 2001).

Figure 1
Hokitika Water Consumption (1990-2000)



To estimate water consumption and wastewater production for permanent residents, the values in Table 8 (page 13) were used.

2.5.2 Tourists

Ideally, the analysis should use a time series of the number of guest-nights for the different types of accommodation for the four centres. These data are not available and it would be a major task collecting these.

Monthly data from Commercial Accommodation Monitor (CAM) (January 1999 to December 2000) for the West Coast were used (Statistics New Zealand, 2001). These data gave monthly domestic and international guest nights in the West Coast region for hotel accommodation, motels, hosted accommodation, backpackers and caravan parks

The regional monthly CAM figures were then factored to provided monthly tourist flows to Westland District. These factors were based on data provided by Tourism West Coast in Greymouth.

For each of the four centres, Hokitika, Harihari, Franz Josef and Haast, a tourist accommodation factor (TAF) was determined. The TAF was determined using survey data provided by Forer et al. (2001) who surveyed accommodation behaviour for 1,240 respondents over the 2000/2001 summer. The CAM monthly flows did not include tourist

staying with friends and family. To allow for these additional tourist numbers the CAM monthly bed nights were multiplied by 1.37. This 37 per cent increase was based on work that was reported by Forsyte Research (2000). The tourist accommodation factors (TAF) are shown in Table 7.

Table 7
Tourist Accommodation Factors for Each Town

Town	Hotel	Motel	Hosted	Back-packers	Caravan/Campers
Hokitika	0.272	0.213	0.371	0.153	0.159
Harihari	0.049	0.040	0.098	0.008	0.066
Franz Josef	0.358	0.351	0.161	0.453	0.345
Haast	0.111	0.227	0.056	0.142	0.196

The table indicates, for example, that after factoring to include those visiting friends and family (VFR), 27.2 per cent of the CAM district tourist hotel bednights were attributed to Hokitika. These values will be conservative for two reasons:

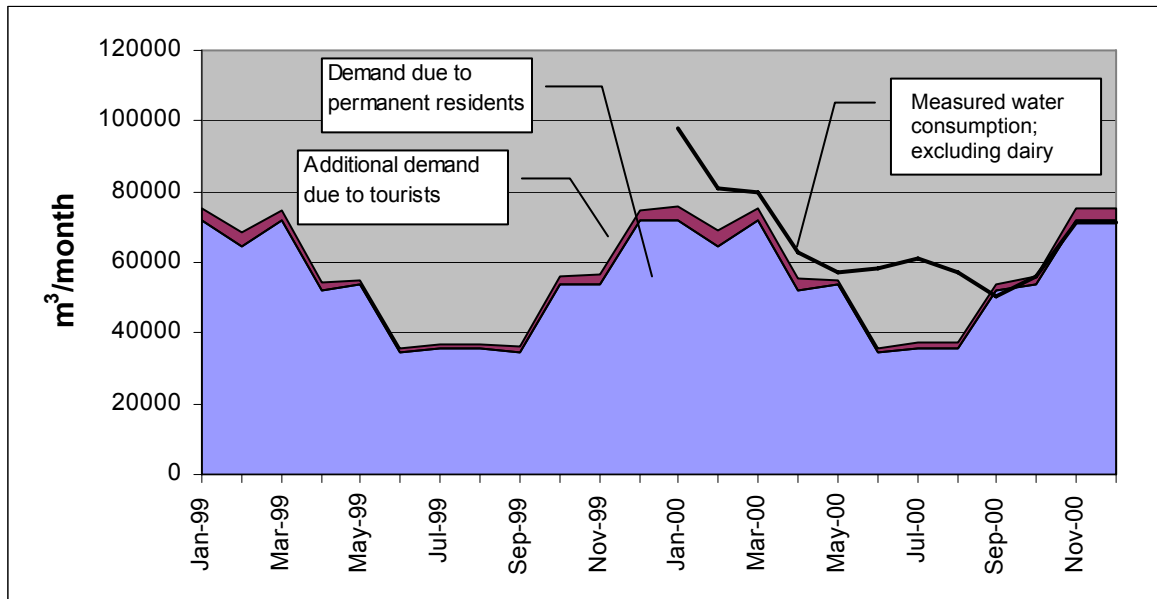
- Not all VFR bednights would have necessarily stayed within zones serviced by the infrastructure.
- Not all the respondents of the Forer et al. (2001), survey would have necessarily stayed within zones serviced by infrastructure.

The results of this analysis are graphically presented in the following sections.

2.5.3 Water Demand

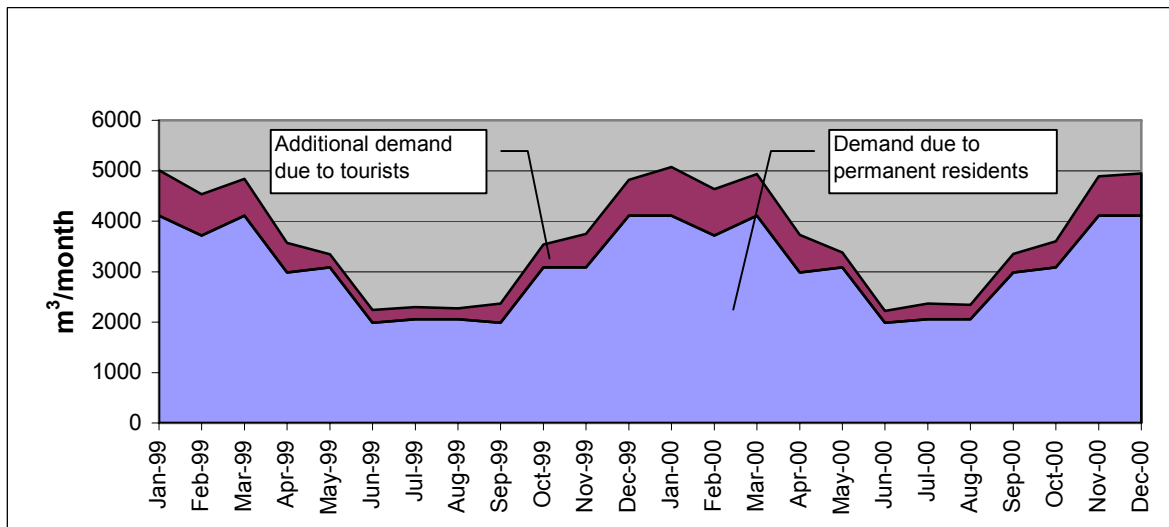
For Hokitika the proportion of water consumed by tourists is relatively minor. What is not illustrated on Figure 2 is the peak demand resulting from events such as the Wild Food Festival. Twenty thousand visitors to Hokitika for one day could increase peak flow requirements by 125 per cent (excluding the Dairy Company demand). While the Dairy Company demand has been excluded from the measured water consumption, other commercial demands have not. This explains why the measured water demand is higher than is demand determined by the model which did not include commercial water demand. On average tourist water demand was 4.5 per cent of the residential demand, with a maximum of 6.3 per cent for April 2000.

Figure 2
Water Demand for Hokitika



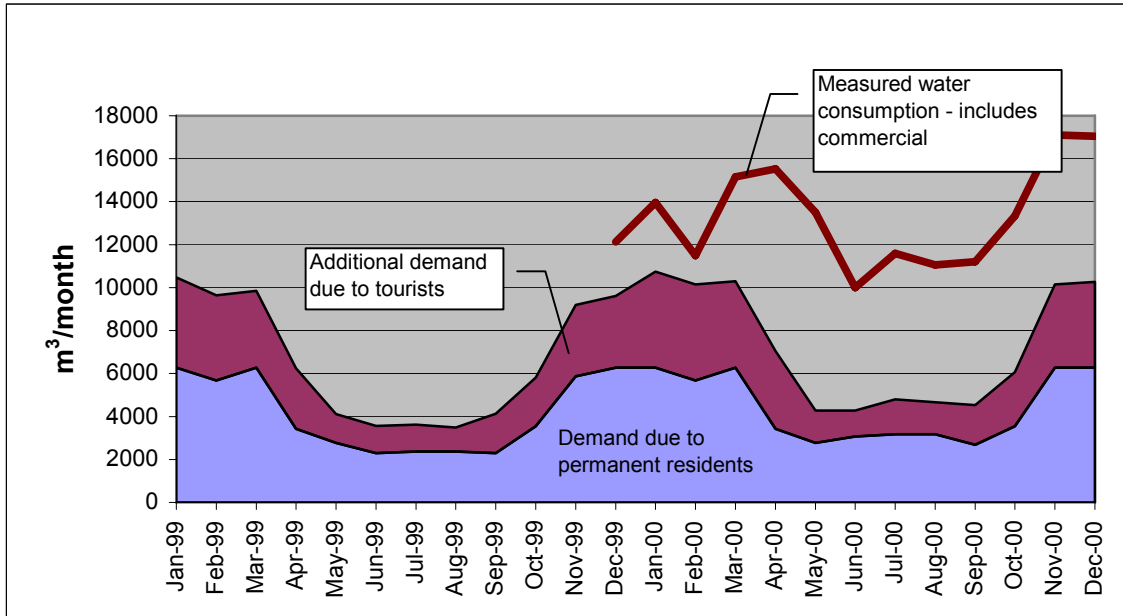
The impact of tourism on the water demand in Harihari is illustrated in Figure 3. On average, tourist demand was 17.8 per cent of the residential demand, with a maximum of 24.9 per cent for the month of April 2000.

Figure 3
Water Demand for Harihari



Franz Josef has a much higher ratio of tourists to the permanent resident population. As can be noted from Figure 4 there is a significant difference between the measured water demand and the demand calculated by the model. This may be due to the high water demand of the commercial sector. Franz Josef is a small rural town and some of the connections may be dairy farms, which would draw a significant proportion of the total flow. In this case the average tourist demand was 64 per cent of the residential demand, with a maximum of 106 per cent, again for the month of April 2000.

Figure 4
Water Demand for Franz Josef



The Haast model (Figure 5) indicates that tourism has a significant impact on the water services of Haast resulting in an average tourist demand of 108 per cent of the residential demand, with a maximum of 153 per cent, again for the month of April 2000.

Figure 5
Water Demand for Haast

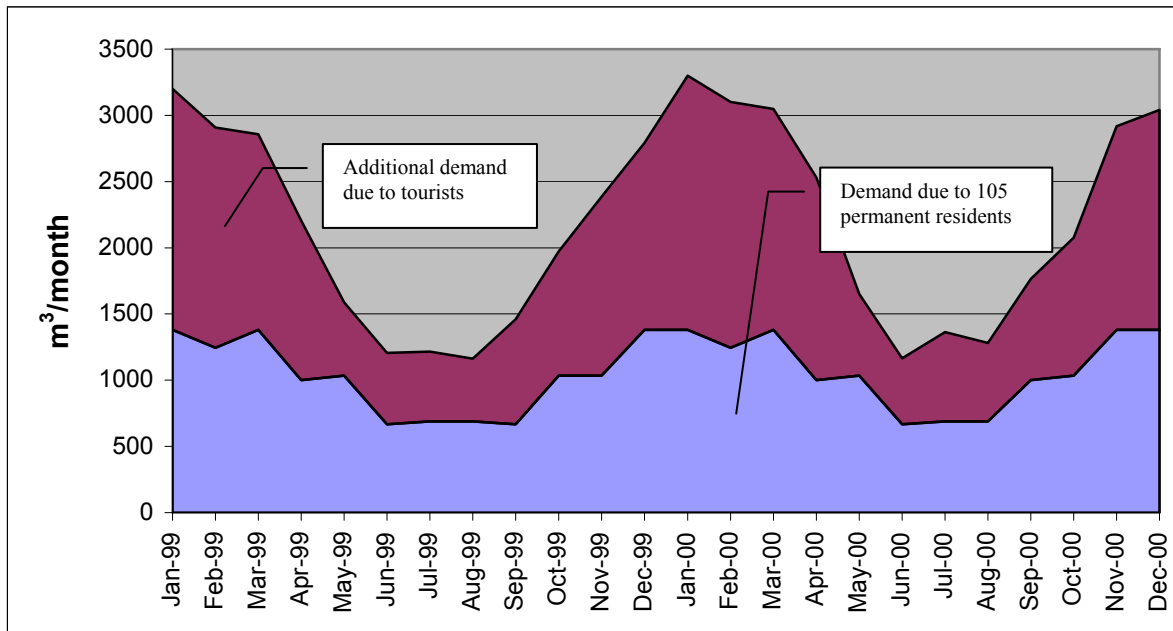


Table 8 provides a summary of the comparison of the monthly tourist water consumption to permanent residents consumption by reporting the tourist consumption as a percentage of resident quantities. In Haast and Franz Josef tourist use of water exceeds local residents use.

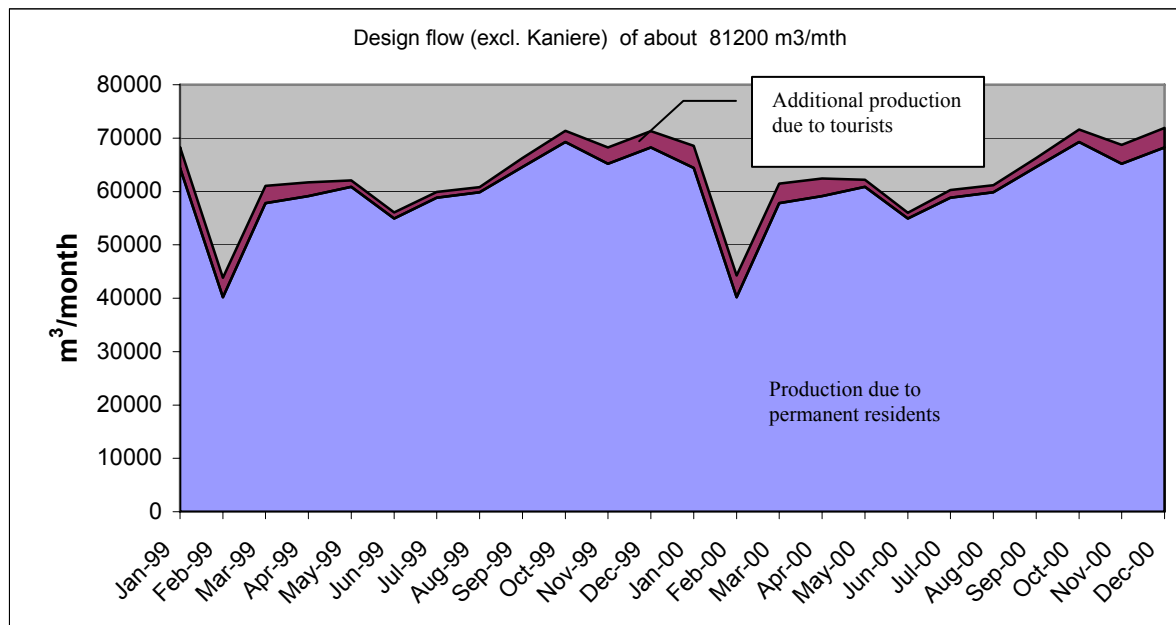
Table 8
Monthly Tourist Water Consumption as a Percentage of Permanent Resident Consumption.

Town	Mean	Maximum	Minimum
Hokitika	4.5	6.3	2.2
Harihari	17.8	24.9	8.5
Franz Josef	63.6	106	39.1
Haast	108	153	53.4

2.5.4 Wastewater Production

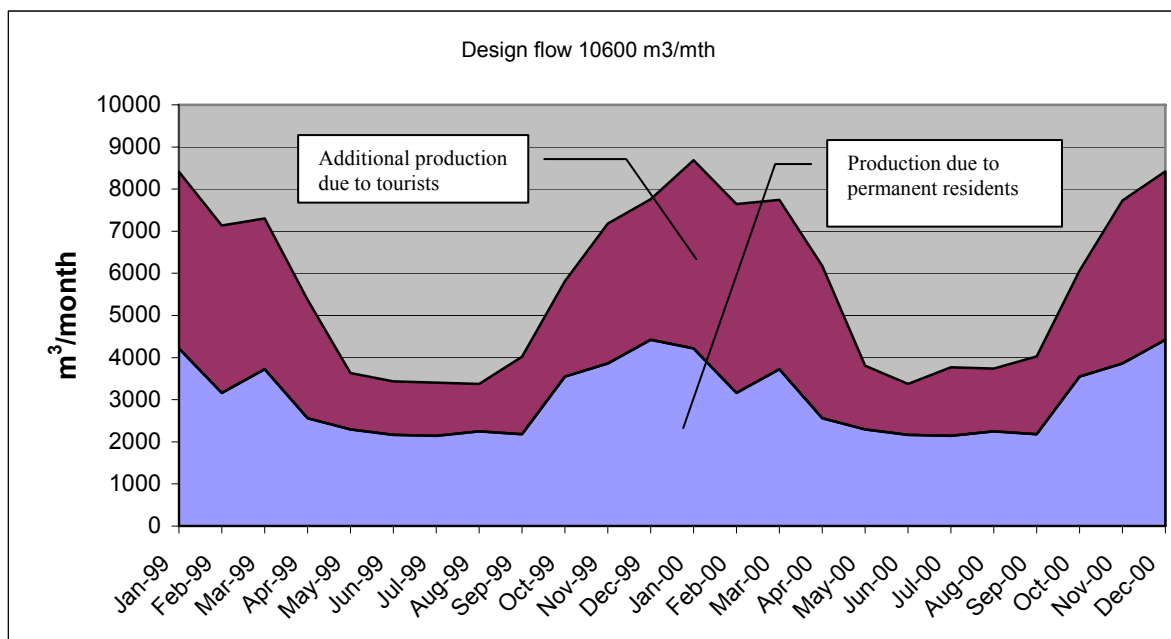
As with water demand, the impact of tourism on the wastewater services is relatively small for Hokitika (Figure 6). Based on monthly flow estimates, tourism will increase wastewater total flow on average by 4.1 per cent with a maximum increase of 10.2 per cent for the month of February 2000.

Figure 6
Wastewater Production for Hokitika



In contrast to Hokitika, tourism has a significant impact on the Franz Josef (Figure 7) wastewater infrastructure, causing an average increase of 88.8 per cent and a maximum of 142 per cent for the months of February and April 2000.

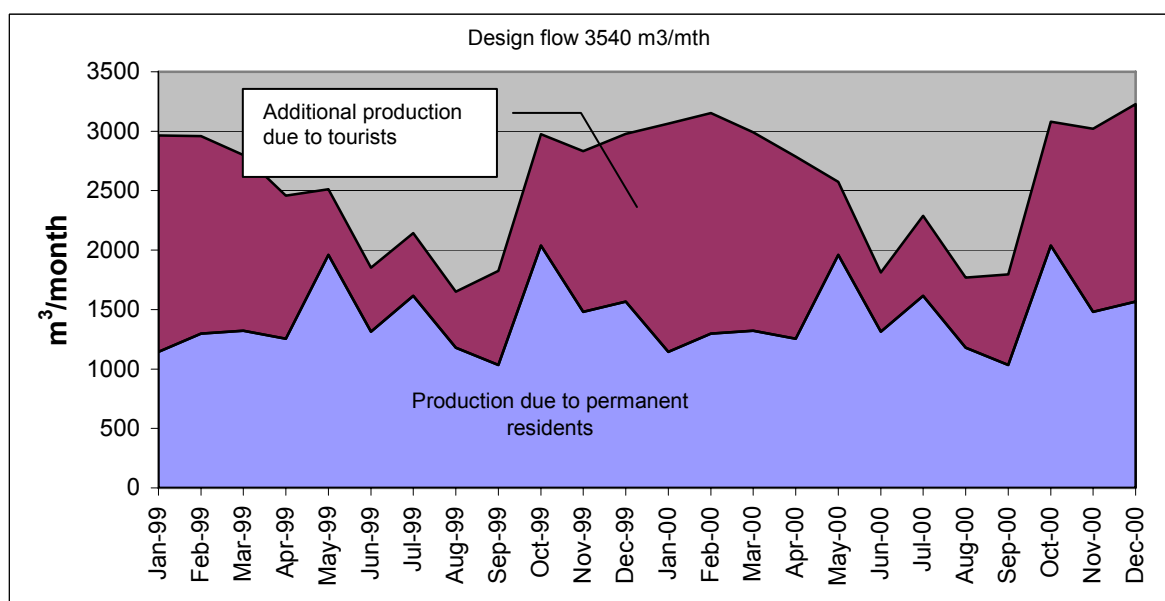
Figure 7
Wastewater Production for Franz Josef



The peak total flow rate in December/January ($8,000\text{m}^3$) is close to the design flow of $10,600\text{m}^3/\text{mth}$.

The situation is similar in Haast. The average increase in wastewater flow volumes due to tourism is 79 per cent and the maximum increase is 168 per cent for the months of February and April 2000.

Figure 8
Wastewater Production for Haast



The impact of wastewater production due to tourism is summarized in Table 9 by comparing monthly tourist production to permanent resident production.

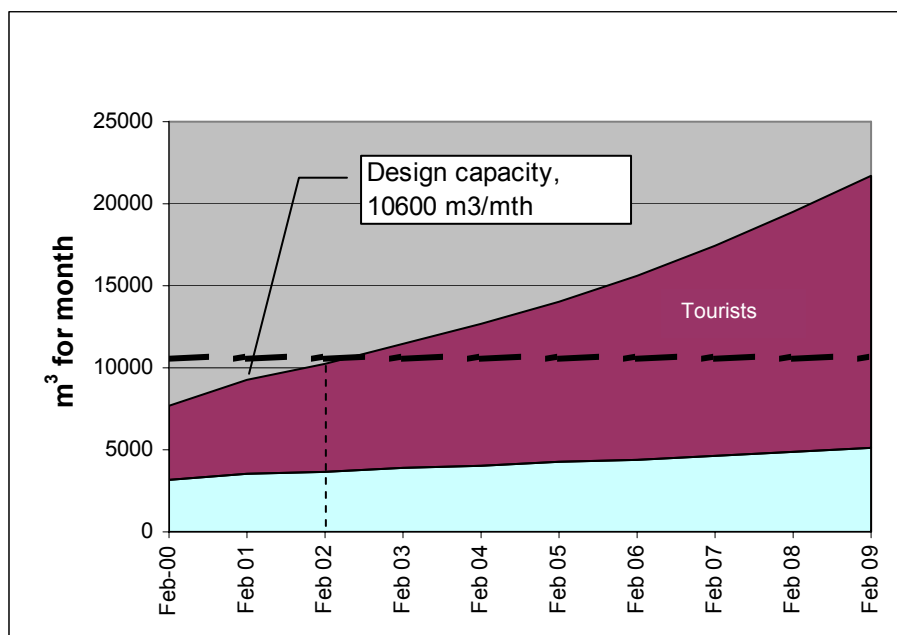
Table 9
Monthly Tourist Wastewater Production as a Percentage of Permanent Resident Production

Town	Mean	Maximum	Minimum
Hokitika	4.1	10.2	1.7
Harihari	N/A	N/A	N/A
Fanz Josef	88.8	142	49.9
Haast	78.8	168	28.2

2.6 Implications of Projected Growth in Tourism

In addition to modelling the current situation, it is possible to project future increases in service demand. The projected estimates are based on yearly growth rates of five per cent and 14 per cent for permanent population and tourist bed nights respectively. The residents' growth rate is based on 1991 and 1996 census data for Franz Josef. The tourists' growth rate is based on the CAM data (Statistics NZ, 2001) using the average annual increase for the three years 1997 to 2000. For example, Figure 9 illustrates the increase in wastewater production in Franz Josef for the peak month of February.

Figure 9
Projected Wastewater Flows for Franz Josef for the Month of February



Forsythe (2000) presents the Government's official forecasts to 2000 and indicates an increase in aggregate national tourist flows of 57 per cent for the six year period. The New Zealand tourism strategy has reported an estimate of 80 per cent (to 3.25 million visitors annually) by 2010. Regional data have not been presented in either study but regional flow to destination areas such as the West Coast is expected to continue to grow at above national rates as tourists continue to seek remote regions.

Figure 9 indicates that, for the peak tourist period (February), at current projected growth rates, the design capacity of the Franz Josef oxidation ponds will be exceeded by early 2002. This will require immediate attention from Westland District Council.

2.7 Solid Waste and Campervan Waste

While the main focus of this report is on potable water and wastewater, there are data that can be examined that give an overview of solid waste. This topic is addressed here briefly using available data plus some minor calculations. We give attention to the topics of landfill, roadside and campervan wastes.

2.7.1 Landfill Waste

A 1989 regional waste survey for the West Coast⁵ found that a substantial number of the region's 32 landfill sites were substandard. Many of these were full and do not comply with the Resource Management Act 1991(RMA), including those within the Westland District.

All landfills must comply with the RMA and each territorial authority is required to adopt a waste management plan under the Local Government Act. Both the West Coast Regional Council and Westland District Council are actively pursuing waste minimisation strategies. To this end the West Coast Regional Council have set up the West Coast Waste Working Group. This group includes Councillors, representatives from Grey Buller and Westland District Councils, West Coast Recycling Coalition, DoC, Community Employment Group and Iwi. The purpose of this group is to provide a regional forum for integrated waste management, including waste minimization and hazardous wastes.

The management of solid wastes in Westland District is by disposal to ten landfills. Only one is consented (Hokitika) and gate charges only apply to the Hokitika landfill (Westland District Council, 2001). In November 2000, Westland District Council carried out a waste analysis survey of the mixed refuse delivered to the Hokitika landfill (Cotton et al., 2001). This is the only known survey of solid wastes within the Westland District. According to the results of that survey, the Hokitika landfill receives about 170 tonnes/week of solid waste. About seven per cent of this is diverted for recycling or reuse. The remaining quantity, which corresponds to 1500kg/person/year, is placed in the landfill. This can be compared with the Tasman District Council at 332 kg/person/yr (Tasman District Council, 2000) and Christchurch City at 800 kg/person in 1996 reduced to 700kg/person/yr in 2000. Christchurch City is achieving a two per cent per annum reduction in the solid waste production as a consequence of its waste minimization strategy. The Hokitika landfill survey suggests that 23 per cent of the solid waste presently disposed to the landfill site could potentially be recycled or reused (Cotton et al., 2001). Cotton et al. (2001) drew attention to the growing problem of derelict cars.

The number of derelict cars is rising with the rate of tourism growth, as many tourists buy cheap cars for holidays. When these break down they are abandoned all over Westland. The Westland District Council arranges collection and transportation to Hokitika at ratepayers' expense.

Based on a simplified analysis of Kaikoura⁶ solid waste production, tourists can produce in the order of 2-4 tonnes per 1,000 visitor nights. Assuming an average of three T/1,000 visitor nights, Table 10 gives an indication of annual solid waste production due to tourism by using

5 The West Coast region comprises the Grey, Buller and Westland Districts.

6 Kaikoura was chosen because nine months of solid waste data were available (from Innovative Wastes Kaikoura Ltd, pers. comm) that could be correlated to tourist flows in Kaikoura.

Commercial Accommodation Monitor (CAM) visitor flows with a 30 per cent addition for tourists visiting friends and family (Statistics New Zealand, 2001).

Table 10
Estimated Weight of Solid Waste Due to Tourism (Tonnes/annum)

Hokitika	Harihari	Franz Josef	Haast
400	90	680	340

In areas such as Franz Josef where tourism development is occurring, building and construction will create substantial additional solid waste quantities from construction site activities (Westland District Council, 2001).

The West Coast councils are currently formulating a strategy for waste minimisation. Successful waste minimisation practices require the implementation of a service, supported by the appropriate engineering infrastructure and a major community education effort. There has been no research completed on the relative success of community education in waste minimization where tourists comprise a significant proportion of the local population. It can be anticipated that educational programmes to change the waste management behaviour of tourists (and itinerant workers) will be different to that required for permanent residents. A second issue is the extent to which the tourism industry is able or willing to respond to waste minimization initiatives. For these reasons, a community with significant tourism activity will face additional and different requirements for implementing waste minimisation strategies.

2.7.2 Roadside Waste

Roadside sites on the West Coast are open to use by campervans, picnickers, cyclists, hitch-hikers, campers and trampers. In 1996 the Westland District Council carried out a *State Highway Refuse Survey* (Westland District Council, 1996). The Council found only low volumes of waste on the roadside. However, of the sites surveyed on State Highway 6 (the main north-south highway), 61 per cent contained toilet paper and 73 per cent of signposted sites contained toilet paper. The survey also pointed out that 69 per cent of the sites holding toilet paper were within 50m of a waterway. The report expressed minimal concern for direct contamination of drinking water sites, however there was concern that animals (ground birds and possums) may transport faecal material to roof water supplies and drinking water catchments, increasing the risk of diseases such as *giardia*, *cryptosporidiosis* and other microbiological pathogens. The survey concluded, however, that campervan holding tank waste was present at only one of the sites surveyed, Lake Moeraki. The report showed widespread use is made of lay-bys and rest areas for toilet stops, and many of these sites are less than one km from public toilets.

2.7.3 Campervan Waste

Campervans are fitted with toilets and holding tanks that contain both black and greywater. The capacity of these holding tanks can vary from 20ltr to 45ltr. According to recent research (Smith, 2000) the typical daily volume of wastewater produced by campervan occupants is 4 ltrs of blackwater and 1-17ltr of greywater.

The NZ Motor Caravan Association (Inc.) lists 11 campervan dump stations on the West Coast with five in the Westland District located in Hokitika, Ross, Franz Josef Fox Glacier and Haast. Apart from the health and environmental risks of rogue dumping, there are two other issues of concern. First, campervan waste tanks typically have chemicals (e.g., masking

agents, preservatives such as formaldehyde). Such chemicals can cause problems in the receiving biological treatment system. Second, international visitors may introduce foreign disease species (Westland District Council, 1996).

Both domestic and international tourists use campervans. In 1999 a Lincoln University postgraduate student surveyed the behaviour of NZ Motor Caravan Association members giving details of their travel patterns and behaviour (Smith, 2000). The results of this survey indicated that out of a total of 110 visits to natural sites, there were 63 discharges of wastewater (either black or greywater). Table 11 lists the different natural sites that the campervan travellers visited, the number of visits to each site and the frequency of dumping blackwater and greywater (Smith, 2000).

Table 11
NZMCA Survey Results (Smith, 2000)

Sites	Number of each type visited	Number of overnight travellers	Number of times black water was discharged	Number of times grey water was discharged
Remote locations	50	154	6	10
Beaches	22	102	10	14
Lakes	21	119	8	10
Rivers	8	44	2	2
Mountains	5	10		
Forests	4	9		1

It can be concluded that campervan and caravan wastes introduce significant additional waste management problems to the region.

2.8 Conclusion

This chapter has estimated potable water demand and wastewater produced in each of the four case study towns in Westland. Each system in each town was described, and estimates were made of the connected population. The key issue was to estimate the proportion of service used by tourists. Assumptions about standard rates were combined with estimates of tourist types and numbers in each town for each month, along with permanent residents, to estimate water demand and waste water production. Graphs showing monthly levels highlighted the additional effects due to tourists. For some of the towns the tourist contribution was a significant proportion of the total, especially for Franz Josef and Haast. Projected growth for Franz Josef showed that design capacity will be exceeded by early 2002. Less attention was given to solid waste but available data showed that there is little recycling and there may be significant challenges in achieving waste minimisation in towns with a high proportion of tourists. Roadside waste and campervan waste introduces significant additional waste.

Chapter 3

Implications for Resourcing Water and Wastewater Infrastructure in Westland

3.1 Introduction

Provision of potable water, disposal of wastewater and disposal of solid wastes are major activities for local government or other providers, requiring major capital investments and significant annual costs. Loucks and Gladwell (1999) provide seven guidelines for the economic and financial management of water and wastewater treatment systems. These guidelines including the following injunctions:

- Fully consider all direct and indirect environmental costs over the full lifecycle of the system's projects.
- Recover all costs of resource development and management projects throughout their lifecycles in an equitable and efficient way.
- Make sure that society supports and is willing to pay for the services provided by the water systems.
- Ensure that sufficient finances are available to operate continuously and monitor the performance of water resource projects.
- Reduce system operating costs, including that for energy, as much as possible.
- Distribute all system costs and benefits equitably within the user community.
- Include costs and benefits related to environmental quality in economic evaluations of engineering activities.

This chapter of the report examines the efficiency and equity of the funding systems for water supply, wastewater and solid waste disposal systems at several Westland locations.

3.2 Ideal Pricing of Water, Wastewater and Solid Waste Disposal systems

Consumption of water typically requires systems to collect and store water (reservoirs), purify the water, deliver to the boundary of properties, connect to the landowners' pipelines, and to monitor usage of water. Disposal of wastewater typically requires a pipe system to transport the wastewater from the edge of the landowners' property, facilities to treat the wastewater by collecting solids and making the liquids suitable for reuse or for disposal into a waterway. This listing of the water and wastewater system components leads naturally to consideration of the costs of each component.

Water reservoirs and pipelines require major capital expenditures but deliver services over many years. Subsequent to their construction they have low maintenance costs. Charges for water supply need to meet both the annualised capital costs of the reservoir and pipelines, and their maintenance costs. Peak loading may mean the capacity of the water supply system is approached. Sustained peak loading may lead to demands for increased capacity and further

capital expenditures. The scale of the reticulation system for water will be influenced by the location of the properties serviced. The more dispersed the properties are, the greater the length of pipeline required and the greater both the capital and running costs. There are costs associated with connecting to each landowner's property, and with monitoring usage of water. Finally there are variable costs associated with the volume of water provided to any property. Charges for water delivered to a property can and often do have four components: capital charge, connection charge, monitoring charge and volume charge (Bailey 1995).

Wastewater systems require major capital expenditures for pipelines and treatment facilities, plus there are smaller annual maintenance costs. Peak loading may mean the capacity of the wastewater supply system is approached. Sustained peak loading may lead to demands for increased capacity and further capital expenditures. The scale of the reticulation system for wastewater will be influenced by the location of the properties serviced. The more dispersed are the properties, the greater the length of pipeline required and the greater the capital and running costs. Wastewater treatment and disposal costs vary with the volume of wastewater provided by property owners. Charges for wastewater produced by a property can, and often do, have two components: a capital charge, and a volume charge.

Solid waste disposal typically involves collection of solid wastes and transport to a transfer station or a disposal site. At a disposal site the major requirements include a space to deposit the waste and systems to prevent escape of material from the site. Modern disposal pits have lined bottoms and sides to prevent release, particularly of toxic chemicals, to the nearby environment. The costs of solid waste disposal to a pit include collection costs, annualised costs of developing the pit and operational costs of the disposal pit. Appropriate charging policies can include fixed charges to cover the annualised costs (fixed costs), plus usage charges to cover collection and operational costs (variable costs).

Multi-part pricing (which differentiates between fixed and variable costs associated with water use and wastewater disposal) is advocated to ensure that users of water, wastewater and solid waste disposal systems meet their share of all costs. Annualising of capital costs ensures that current users contribute to the capital costs of these systems. Location specific charges can ensure that each user pays an amount which reflects the costs of providing the network to their location. Volume charges provide a continuing signal to users to economise on their use of the systems and to search for ways to reduce the load they impose on the systems. Sophisticated pricing systems (as used for electricity and telecommunications) can apply 'time of day charges', which reflect more accurately costs associated with peak loading (Ministry of Commerce, 1999). They can also be used to apply location specific charges which reflect increasing marginal costs of water delivery or wastewater and solid waste collection from distant locations. Siting of headworks may become a political issue if location specific charges are introduced.

3.3 Requirements to Implement Ideal Pricing

Implementation of ideal pricing systems requires accurate costing of capital projects and calculation of annualised charges which are sufficient to meet all costs associated with the investment and its funding during the life of the capital. To achieve this the life of the capital must be estimated accurately at the time of initial investment, a task which in principle is relatively straightforward. Calculation of each property's shares of the annualised costs should take into consideration the scale of their demands on the water and wastewater

systems, and the effects of their location on the annualised costs. Properties which make large demands on the systems should, on grounds of economic efficiency, pay a larger share of the annualised costs than do properties which make smaller demands. Similarly properties located close to water, wastewater and solid waste disposal systems should pay less than do distant properties.

Supplying water to a property requires connection from the main water supply and this imposes costs on the system. These costs can be calculated for each property and collected via annual connection fees.

Delivery of potable quality water requires continual monitoring, quality control, and in many cases treatment of water. These costs can be calculated and recovered by way of an annual monitoring charge.

Metering systems are essential to monitor the volume of water provided to each property. Where meters are installed each property can be levied charges which vary with the volume used per time period. Charges can be varied with time of use of water if the metering system is sufficiently sophisticated. In practice only some New Zealand districts have water meters installed, and few have the ability to record 'time of day' data. There are both capital and variable costs to recording volume, and time of use of water, and these costs are a barrier to widespread installation and use of metering systems. Volume of wastewater discharged from a property to the wastewater system can be crudely estimated by counting numbers of toilet facilities on each property and charges can be related directly to that number. Volumes of solid waste added to the waste stream for disposal can be estimated by count of rubbish bags from households, by count of trailer or carloads, or by weight on trucks or trailers. Charges can be easily related to these units.

The philosophy underlying the ideal pricing system described above is 'the benefit principle'. This advocates that users of a system - beneficiaries - should pay charges in relation to the scale of the benefits they receive. In practice there is sometimes opposition to use of the principle. As well there are sometimes practical considerations which lead to use of simpler pricing systems. One objection raised to use of the benefit principle is that water is essential for survival and no one should be denied access to it because they can not meet the charges which might arise. The objection can readily be countered by noting that food is an essential for survival, and food is sold for a positive price. The key issue is a possible lack of purchasing power by some individuals or families. The most direct response to that problem where it arises is for the state to provide income support to the individuals and families to enable them to purchase food and other essential items. A second means to combat problems of potential lack of access where there are water charges, is to use increasing block pricing systems. This approach to pricing sets zero or low charges for the first tranche of water, and higher charges for subsequent tranches. This approach can be used to ensure that all individuals and households obtain enough water for basic functions at zero charge.

A third reason to deviate from an ideal water pricing system is the costs of implementation of the ideal system. Use of ideal price systems requires information on usage rates by each property owner, and charges for the four separate components. This requires installation of water meters on the pipelines to each property, recording of water usage for each property per time period, and charging for the water used. These additional costs may exceed any benefits from application of the ideal pricing system, and a simpler set of charges may be used instead.

Wastewater and solid waste disposal pricing require means of identifying and charging related to volume provided. This is quite feasible for household and commercial solid wastes. Reaction to charges for solid waste disposal can include flytipping⁷. This is more likely to occur where disposal charges are substantial. In Westland, for example, there are numerous sites available for flytipping, and low probability of apprehension or punishment of offenders. In worst cases charges may be deemed to have too many negative outcomes and access to disposal is free. At sites where there are few or irregular disposal trips, administration costs may exceed revenue collected from charges and hence a burden of the charging system is passed to general ratepayers.

Wastewater volumes are rarely metered directly from each property, but proxies (such as the number of toilets) can be used to estimate volumes added to the wastewater stream. If there is a direct relationship between numbers toilets on a property and volume added to the wastewater stream, rating authorities need to accurately count those facilities to determine the appropriate charge. Use of such proxies may lead to inaccurate charging policies if there is wide variation between properties in the volume of wastewater produced per toilet. Such variations are more likely to occur in future. Overseas, and to a lesser extent in New Zealand, there is increasing interest in and use of, wastewater volume saving devices such as low flush toilets, vacuum toilets, waterless urinals, low volume washing machines and greywater separation (Dakers, 2000). Pricing mechanisms should encourage the adoption of more water and wastewater efficient technologies and management strategies at the source.

An obvious case where there is deviation from application of the benefit principle is zero charge for use of public toilets. Charging for use of toilets is possible, and does occur in some countries, but when it occurs it requires either an attendant or a mechanical system to collect the fee. The possibility that charging for use of toilets will result in people using alternative informal sites is one reason for having zero charges. However that possibility is not a sufficient reason to discard use of charges. Where there is intensive use of a public toilet, collection systems have the best chance of exceeding their cost of operation. Low cost automated systems will increase the likelihood the revenue collected will at least exceed operational costs.

3.4 Funding systems employed by Westland District Council

The Local Government Amendment Act # 3 (1996) requires local governments to ensure that unless there are good reasons, funding should be derived as closely as possible from the individuals or groups who benefit from each particular service. This legislation has forced local governments to consider the types of services they provide and determine appropriate pricing policies.

Westland District Council (WDC) provides a range of services in the district including water supply, sewerage and solid waste disposal (Westland District Council, 2000a). It has defined the types of benefits provided by these services as: direct benefits, general benefits and control of negative effects. Solid waste collection systems are described as providing two types of benefits: direct (avoided need of residents to take material for disposal) and general

⁷ Flytipping is the name given to the practice of unauthorised disposal of wastes at sites such as roadsides.

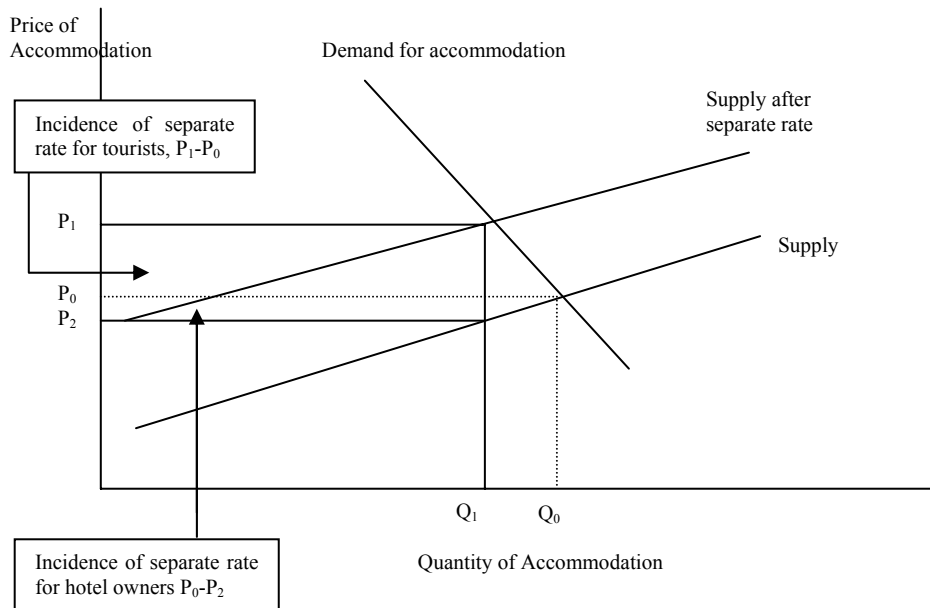
(tidier localities). Similarly water supply and sewerage systems provide both direct and general benefits.

Water supply, sewage and solid waste disposal services provided by WDC are funded by users of these systems. The charges levied are averaged across the District. This ensures that water supply and sewerage charges for property owners in small communities, which would be high if they were based only on their schemes costs, are not excessive. Separate rates are levied on properties for water supply, sewerage, and weekly rubbish collection (Westland District Council 2000b). There are separate rates for water, sewerage and refuse, which vary with locality, whether residential or commercial property, and level of use made of the services. There are user charges for water volume used, and for use of WDC refuse tips. The combined revenue from all separate rates and user charges funds all water supply, sewerage and refuse costs in Westland District. Public Toilets provided by WDC are funded from separate rates and user charges. The tables in the Appendix 1 provide summaries of a range of services provided in Westland District which tourists may use while visiting Westland. Funding arrangements for selected services provided by WDC are included in those tables.

3.5 Incidence of Separate Rates and User Charges

The separate rates and user charges are levied on property owners, but the incidence of these charges requires analysis to determine whether tourists meet their share of water, sewerage and refuse disposal costs. International research literature suggests that tourists may pay up to six dollars out of seven of tourist taxes, with the remainder falling on businesses (Hiemstra and Ismail, 1993). Other authors caution this estimate may be considerably higher than the true situation (Mak, 1988; Hultkranz, 1988; McMahon, 1999). A simple diagram is helpful to explain the possible distributional incidence of these charges. Figure 10 (page 24) shows a demand curve for commercial accommodation in aggregate within Westland District, which is highly inelastic. It also shows a highly elastic supply of commercial accommodation. The impact of the separate rates is a small shift upwards of the supply curve, and a minor reduction in equilibrium level of accommodation purchased. The distributional incidence of the separate rates is predominantly on the tourists who purchase accommodation in Westland District. If this diagram is approximately correct in describing the relative slopes of the demand and supply curves, then the incidence of rates for water, sewerage and refuse disposal on commercial accommodation establishments is largely borne by customers.

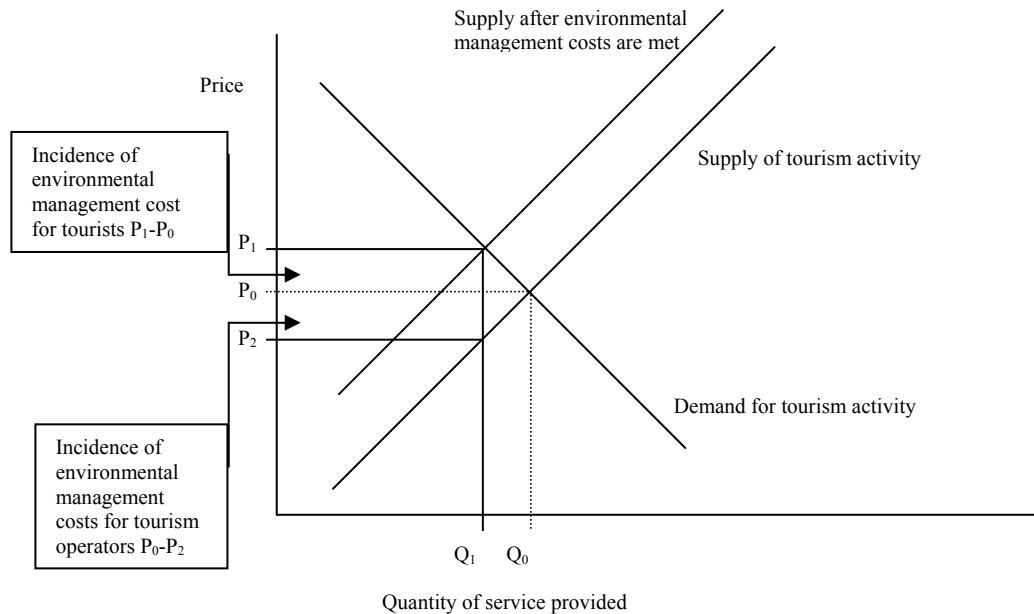
Figure 10
Incidence of Separate Rates for Water or Sewerage



The price elasticity of demand for accommodation in total in Westland District will be much less elastic than will price elasticity of demand for accommodation at any one motel or hotel. There are few alternatives to aggregate accommodation, but there are many alternatives available for any one hotel or motel. The supply curve shown in Figure 10 is a long run supply for aggregate accommodation. The price elasticity of supply is likely be much more elastic in the long run, than in the short run when the supply of beds is fixed.

One further example of price elasticities is worth specifying. If the price elasticity of demand and supply for a service are both of magnitude 1.0, then the distributional incidence of a separate rate on the service will be shared equally between the purchaser and the provider of the service. This may provide a basis for analysing the impact of regulations requiring individual tourism operators to install and operate toilets and meet waste disposal costs. If there is a unit elastic demand for the tourism service, and supply is also unit elastic, half of the costs of environmental management will be met by tourists and half will be absorbed by the tourism operator. Figure 11 illustrates this case.

Figure 11
Distributional Incidence of Separate Rates when Demand and Supply are Unit Elastic



3.6 Department of Conservation Charging Policies

Many tourists travelling through Westland visit Westland National Park, recreation reserves, campgrounds and Department of Conservation visitor centres. Camping fees are charged at Lake Mahinapua, and at Lake Ianthe, but New Zealand legislation prohibits charges for visits to National Parks and Reserves. Visitor numbers to Lake Mahinapua, Lake Ianthe, Franz Josef Glacier, Franz Josef Visitor Centre, and Welcome Flat, are large and rapidly increasing at several of these sites. Visitors require toilets and the Department of Conservation provides them at all of those sites. Provision of toilets requires significant capital expenditures, and often substantial operational costs. Department of Conservation policy is to charge visitors for specific services provided, including use of camping sites, use of huts and purchase of merchandise. There are no charges for use of toilets. The impact of this policy is that their capital and operational costs come from Department of Conservation budgets. The primary source of Department of Conservation funding is from central government. Taxation provides 90 per cent of central government income and provides the bulk of the funding for the Department of Conservation.

In 1999 there were an estimated 869,000 guest nights on the West Coast (Forer et al., 2001). Fifty eight per cent of overnight visitors to the West Coast were international tourists, 42 per cent were New Zealanders (Forer et al., 2001). New Zealand residents pay income tax, GST and several other taxes. Overseas tourists pay GST on almost all purchases they make in New Zealand. In December year 1999 it was estimated that tourists purchased \$120 million worth of goods and services in the West Coast (Sleeman and Simmons, 2001). GST at 12.5 per cent on those purchases amounts to \$15 million. Nationally in March year 1997, domestic and international tourists were estimated to purchase goods and services totalling \$11.6 billion (Statistics New Zealand, 2001). GST on those expenditures amounted to \$851 million. International tourists also pay directly or indirectly for fuel used in their travel by road. Fuel prices include taxes which are used to fund roading. If the GST revenue and fuel

taxes collected directly or indirectly from international tourists meets the cost of all of the public services they consume while in New Zealand (roads, law and order, conservation and other services) it is reasonable to argue that international tourists provide sufficient funding to meet the costs of provision and operation of water supply, toilets and waste disposal in National Parks, reserves, and visitor centres. However taxes collected from international tourists are not tagged solely for provision and operation of services they consume.

Failure to charge for services provided in National Parks, reserves and visitor centres will have some predictable consequences. The provision of services which are 'free to users' encourages usage until the marginal utility obtained equals the marginal cost of usage. The amount of usage will exceed that which would occur if there were charges for use of the services. This greater usage of the service means higher total costs associated with the service must be met by the taxpayers who fund the Department of Conservation.

In many instances use of toilets in National Parks is closely linked to use of huts and the Department of Conservation's charges for use of those huts are supposed to meet the cost of supply and operation of the water supply and toilets as well as the huts. Welcome Flat is a case where visitors stay in huts operated by the Department of Conservation and hut fees collected may be sufficient to meet all of the hut water supply and toilet costs at that site. In those instances users pay directly for the provision and use of water and toilets. The Appendix tables provide some information on selected sites and facilities operated by the Department of Conservation, including their annual revenues and costs of operation.

Among the most heavily visited sites on the West Coast are Franz Josef and Fox Glaciers and the Park Headquarters building in Franz Josef. The Department of Conservation operates the carparks and associated toilet facilities at the glaciers and the Westland National Park Headquarters. There are zero charges for use of these facilities and they are funded directly from the Department of Conservation budget. As the Appendix tables report, a significant amount of donations are collected at the Franz Josef Glacier site.

In some situations the Department of Conservation requires tourism operators in National Parks and reserves to provide toilet and waste disposal systems for use by their clients. Commercial rafting operators are required to fly in chemical toilets and fly out all wastes. White Heron viewing tour operators have been required to construct toilets for their clients. These regulations impose substantial costs on the tourism operators. Again the key issue is the incidence of these costs. Because there are substitutes for these sites or experiences, it is likely they have a relatively price elastic demand. In these instances it is possible that the incidence of these costs will be shared approximately equally between tourists and tourism operators as illustrated in Figure 11.

3.7 Conclusion: Infrastructure Supply and Costing Implications

Westland District Council policies require water supply, sewerage and other services to be self funding (Westland District Council, 2000a). At present across the District and for the three services combined, total revenues from separate rates and charges equal their total costs. However Westland District Council has inadequate solid waste disposal facilities, provides untreated water at some sites, and does not provide a public sewerage system in Harihari. Substantial capital expenditures will be required to improve these facilities to the level required by New Zealand legislation. These costs will require funding and may lead to

increased levels of separate rates and user charges. The most obvious locations where investments are required include Franz Josef and Fox Glacier where tourist numbers are increasing rapidly.

The Department of Conservation is making investments in new facilities at sites such as Lake Mahinapua and is encountering increasing operational costs as tourist numbers increase. Its budget is limited by the funds provided by central government to Vote Conservation. However there is no fixed relationship between visitor numbers and the amount of funding provided to the Department of Conservation. Provision of water, toilet facilities and solid waste disposal in National Parks, reserves and camp grounds is limited by the resources the Department allocates for those tasks. The national policy decision by the Department of Conservation to greatly restrict its solid waste disposal actions was driven primarily by budget constraints it faces. The quality of water supply and toilet systems it can provide at huts, and camping grounds is similarly constrained by the budget it has available.

The ability of the Department of Conservation to collect revenue for services directly from public users, varies greatly between sites. Freedom of entrance to National Parks and Reserves is enshrined in legislation (National Parks Act (1981) and Reserves Act (1977)). Donations can be collected and total \$5,500 per year at the Franz Josef Glacier (Department of Conservation, pers. com. 2001). Fees are charged for services provided, such as use of camping grounds and huts. Reliance on voluntary payment of fees often results in low collection ratios. The fees collected at Lake Mahinapua and Lake Ianthe provide revenues whose annual total is less than 20 per cent of the costs of operating the sites. Hut wardens and camping ground agents are obvious ways to improve collection ratios. Wardens and agents are worthwhile from a financial viewpoint if their costs are more than offset by the additional revenue they collect. Technology might be used to improve collection ratios if the Department of Conservation chose to employ it. Examples include toll toilets, locked huts, meters for use of camp ground facilities.

Chapter 4

Conclusions, Recommendations and Further Research

4.1 Conclusions

The growth of tourism, and its consequent benefits, is dependent on the maintenance, if not enhancement, of the West Coast's unique natural environment. Parts of this same natural environment have been described as ecologically fragile (PCE, 1997). Thus, the design, planning and subsequent management of all engineered activities (for example, roads, dams, buildings, waste and water services, adventure activities and services), require a sound knowledge and sensitivity to the ecosystem within which they are embedded.

This study has focused on specific environmental services and their infrastructure. Environmental services in Westland District are provided by Westland District Council, Department of Conservation and the private sector. Westland District Council's water supplies, are in most instances, below the standard required by New Zealand regulations. As well in several instances the growth of tourism has increased use of sewerage systems to near their design capacity levels. There are many unconsented solid waste disposal sites in Westland District. Substantial expenditures will be needed within the next few years to upgrade and to increase capacity of these WDC environmental services. Westland District will need to consider how those new or expanded facilities are to be funded.

The Councils have set up a regional stakeholders working group to develop a strategy for integrated solid waste management. While the actual quantity of solid waste produced by tourists is likely to be relatively small, tourism activities and the industry within the region do present specific issues that the working group will need to consider. These are:

- The management of roadside waste dumping – the visual, ecological and health impacts.
- The management of building construction wastes.
- Waste minimization educational initiatives and resources for tourists and the tourist industry.

For all four towns in the study (Hokitika, Harihari, Franz Josef and Haast), water supply and wastewater services are under pressure. The impacts of tourism on these services are summarized in Table 12. The table shows clearly that the impacts are more significant on centres with a smaller population of permanent residents.

Table 12
Relative Impacts of Tourists on Water and Wastewater Services

Impacts of tourists on:	Water supply service	Wastewater service
Greatest ▽	Haast Franz Josef Harihari	Franz Haast
Least	Hokitika	Hokitika

Projected tourism flows indicate that several water and wastewater infrastructures will be inadequate within the next few years.

WDC charging policies at present require users to meet the annualised costs of the environmental services provided. The WDC charging policies use proxies such as land value, number of toilet pans, and number of rooms to determine charges for each ratepayer. These proxies ensure sufficient revenue is collected to meet the annual costs of the services but they may provide inaccurate charges to many users. Charges based upon numbers of toilet pans on each property connected to the sewerage system may not detect the variation between properties in the volume of wastewater they produce. Similarly, reliance on property values can be a misleading basis for water charges if there is only a weak relationship between the value of a property and the actual use of the water services (PCE, 2001). Small or efficient water users may be subsidising high or profligate water users.

The Department of Conservation provides water supply, wastewater and solid waste disposal at several key sites in Westland District. Visitor numbers vary greatly between sites, approximately 250,000 people per year visiting the Franz Josef Glacier, and 95,000 per year visiting the National Park Headquarters building in Franz Josef township. At present there are no charges for use of toilet facilities provided at the Franz Josef Glacier, or the Park Headquarters building in Franz Josef Township. At Department of Conservation campgrounds and huts, bundling of services means that some revenue is collected from users to meet part of the costs of water supply, and wastewater systems. Greater use of user charges for water supply, and wastewater systems would reduce the need for general taxpayers to fund these systems.

Private tourism operators who require a concession from the Department of Conservation, have to meet strict requirements relating to waste disposal. A significant proportion of the costs of those waste systems are passed on to the users.

4.2 Recommendations

This study has highlighted two key issues with respect to the impact of tourism on the infrastructure services of potable water supply, wastewater and solid waste systems. The key issues are the adequacy of these services, both present and future, and the appropriateness of the pricing mechanisms for these services.

We recognise that District and Regional Councils with low population numbers and densities, small regional economies, and significant influx of tourists, face real difficulties resourcing the high standard of services demanded by tourism. The West Coast population level and economy are small. Only ten percent of the West Coast land area is rateable.

The Ministry of Health Register of Community Water Supplies clearly identifies that potable water supplies in the Westland District are of a low standard. Additionally this study demonstrates that both present demand and future trends, driven by growth in tourism, will increase the pressure on water supplies, wastewater and solid waste management services, particularly in Franz Josef, Fox Glacier and Haast. The authors acknowledge that Westland District Council is well aware of these problems.

In districts and regions with a high inflow of tourists, these issues are a national problem as much as a regional and district one. We recommend that the Westland District Council and the West Coast Regional Council seek assistance from central government to carry out further research (refer to Section 4.3), and to implement strategies to provide adequate water supply, wastewater and solid waste services to the region.

If the WDC wants to achieve a fairer allocation of costs it needs to investigate whether more accurate charging policies for wastewater, based perhaps on metered water use, can be introduced at acceptable cost, to ensure that users meet their fair share of costs.

New solid waste services are required in many parts of Westland District. WDC should investigate the charging mechanisms available and ensure that users meet their fair share of the costs of new solid waste systems.

The Department of Conservation provides environmental services at several key sites in Westland. In many cases these services are provided free of charge to users. If the Department wants to achieve a fairer allocation of costs it needs to investigate options for charging for use of more of these services to offset their costs of provision.

4.3 Future Research

There are three main areas for future research. These include water consumption and waste production, the development of integrated systems for waste, water and wastewater services, and development of tourist sector pricing structure for water and wastewater services. Each is considered in turn.

4.3.1 Water consumption and waste production

The study has made a number of assumptions about solid waste production, water consumption and wastewater production by tourists. Further research needs to be completed to validate these assumptions. It is recommended that a number of snapshot studies be carried out on selected towns. This research is likely to involve:

- Six two-day studies within a 12 month period.
- Monitoring of water consumption.
- Monitoring of wastewater flow.
- Monitoring solid wastes collected and the categories of wastes.
- Monitoring of power consumption.
- Collection of data on tourist numbers and bed nights from.
 - Accommodation places.
 - Visitor Centre.
 - Public toilets.
- Road counts (Transit New Zealand).

4.3.2 Integrated Systems for waste, water and wastewater services

There have been urgings for some time for a new paradigm for the design and management of water, waste and wastewater services, internationally and more recently in New Zealand. Holistic management not only involves the management of natural systems; it also necessitates co-ordination between a range of human activities which create the demand for water, determine land uses and generate water borne waste products. (Global Water Project, 2000). It is our contention that the current urban water cycle paradigm has resulted in sub-optimal outcomes for both the community and the environment (Kuczera et al., 2001). A recent report by Parliamentary Commissioner for the Environment (2001) gives some direction to this idea. The report identifies the need for integrated urban water systems, and argues that design and management must consider the whole system including extraction from the environment (water, nutrients and other material resources), delivery to the user/industry and back to environmental re-entry. It must also integrate with other services, especially water services such as stormwater and water supply. Additionally the integrated system must employ appropriate community process, and evaluate ecosystem constraints, services and processes.

It is recommended that further research be carried out to determine the benefits to small communities, impacted by tourism, of services designed and managed as integrated systems.

4.4 Development of Tourist Sector Pricing Structure for Water and Wastewater Services

Finally, further research is needed to determine how Councils may be able to implement a fairer and more sophisticated system of pricing for water and waste services. Our reasons for suggesting the need for such research are as follows.

1. Water consumption in hotels (and presumably motels) seems to vary considerably, depending on level of service provided. Recent information from a water supply engineer who has worked with Japanese hotel servicing (Dewhirst, 2001) suggest the following range of water usage occurs:
 - Luxury hotels 575-920 litres/day per bed
 - Business hotels 345-460 litres/day per bed
 - These usage rates can increase by 15% in summer.
2. Domestic water demand can also vary. Twort et al. (2000), report on UK research which indicates daily water consumption per head for a property can vary from 25 to 484 litres. Twort also produces clear evidence of a strong correlation between house value and per capita daily water consumption. For low income properties average in-house water consumption was about 90ltrs/day/person while for high income properties it is about 250ltrs/day/person

The implications of these factors are with respect to wastewater production. Per pan rating systems will not necessarily account for this variation in use of wastewater systems. Permanent residents could argue that they are carrying an unfair cost burden if charges are based upon inaccurate proxies for use of the wastewater system. A simple solution may be to base wastewater charges on metered water consumption for commercial accommodation.

Alternatively a more sophisticated individualized wastewater production model could be developed for tourist facilities.

As well there is a need to explore which charging systems will be appropriate if water supply, wastewater systems and solid waste sites capacities need to be significantly expanded as tourist numbers increase. If there are increasing costs of supply of these services as tourist numbers increase, is it appropriate to average out the costs across all ratepayers? Or should increasing marginal costs be sheeted home to the tourist sector?

Research is recommended to explore, develop and refine the pricing options to achieve equity and economic efficiency in water supply, wastewater and solid waste disposal services.

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Appendix 1 Characteristics of Services for each Key Location

Hokitika

Service	Provider & Investment Funder	Annual Cost & Funding System	Tourist use as % Resident Usage	Revenue, Shares Of Funding %	Capacity Used At Peak Season %	Annual Growth Rate In Usage %	Upcoming Investments Source Of Funds
Water	WDC	\$258,000 (budgeted) Separate rates, user charges	4.5	Water rates and user charges \$288,000	100	unknown	\$200,000, 2004-07 Separate rates, user charges
Sewerage	WDC	\$251,000 (budgeted) Separate rates, user charges	4.1	Sewerage charges \$210,732	100	unknown	
Solid Waste Disposal	WDC	Weekly charges and dump fees	Unknown	Refuse charges \$150,264	unknown	nil	Share of WDC new pit Separate rates, user charges

Note: all \$ are GST exclusive

Lake Mahinapua

Service	Provider & Investment Funder	Annual Cost & Funding System	Tourist use as % Resident Usage	Revenue, Shares Of Funding %	Capacity Used At Peak Season %	Annual Growth Rate In Usage %	Upcoming Investments Source Of Funds
Water	DOC	\$22,000 including grass mowing	100 120,000/yr 693 campers	\$3,500 fees DOC 84% Tourists fees 16%	unknown	unknown	NA
Sewerage	DOC	DOC	100 120,000/yr 693 campers		unknown	unknown	\$50,000 DOC
Solid Waste Disposal	DOC	DOC	100 120,000/yr 693 campers		unknown	unknown	DOC

Wanganui River Commercial Rafting

Service	Provider & Investment Funder	Annual Cost & Funding System	Tourist use as % Resident Usage	Revenue, Shares Of Funding %	Capacity Used At Peak Season %	Annual Growth Rate In Usage %	Upcoming Investments Source Of Funds
Water	-	Tourism Operators	100 100/yr	Operators 50% Tourists via trip fees* 50%	unknown	unknown	NA
Sewerage	Tourism operators	Tourism operators	100 100/yr	Operators 50% Tourists via trip fees* 50%	unknown	unknown	NA
Solid Waste Disposal	Tourism operators	Tourism operators	100 100/yr	Operators 50% Tourists via trip fees* 50%	unknown	unknown	

Note: assuming a 50 per cent incidence of rates, or water and waste costs is passed on to tourists.

Harihari

Service	Provider & Investment Funder	Annual Cost & Funding System	Tourist use as % Resident Usage	Revenue, Shares Of Funding %	Capacity Used At Peak Season %	Annual Growth Rate In Usage %	Upcoming Investments Source Of Funds
Water	WDC	\$11,300 (budgeted) Separate rates	17.8	Total Separate rates \$10 167	unknown	unknown	\$60,000 2000-01
Sewerage	Private	Private	N/A		N/A	unknown	N/A
Solid Waste Disposal	WDC	Separate rates	unknown		unknown	unknown	Share of new WDC pit. Separate rates and user charges

White Heron tours

Service	Provider & Investment Funder	Annual Cost & Funding System	Tourist use as % Resident Usage	Revenue, Shares Of Funding %	Capacity Used At Peak Season %	Annual Growth Rate In Usage %	Upcoming Investments Source Of Funds
Water	Tourism operators	Tourism operators	100	Operators 50% Tourists via trip fees* 50%	unknown	unknown	NA
Sewerage	Tourism operators	Tourism operators	100	Operators 50% Tourists via trip fees* 50%	unknown	unknown	NA
Solid Waste Disposal	Tourism operators	Tourism operators	100	Operators 50% Tourists via trip fees* 50%	unknown	unknown	NA

Note: assuming a 50 per cent incidence of rates, or water and waste costs is passed on to tourists.

Lake Ianthe

Service	Provider & Investment Funder	Annual Cost & Funding System	Tourist use as % Resident Usage	Revenue, Shares Of Funding %	Capacity Used At Peak Season %	Annual Growth Rate In Usage %	Upcoming Investments Source Of Funds
Water	DOC	\$12,900 for the site DOC	100 35,000/yr 650 \$5/night	\$3,250 DOC 77% Tourists 23%	unknown	unknown	NA
Sewerage	DOC	DOC	100	DOC 77% Tourists 23%	unknown	unknown	NA
Solid Waste Disposal	DOC	DOC	100	DOC 77% Tourists 23%	unknown	unknown	NA

Franz Josef Township

Service	Provider & Investment Funder	Annual Cost & Funding System	Tourist use as % Resident Usage	Revenue Shares Of Funding %	Capacity Utilised At Peak Season %	Annual Growth Rate In Usage %	Upcoming Investments Source Of Funds
Water	WDC	\$35,800 (budgeted) Separate rates user charges	63.6	Water charges \$18,900	unknown	unknown	NA
Sewerage	WDC	\$31,800 (budgeted) Separate rates user charges	88.4	Sewerage charges \$38,000	100	unknown	NA
Solid Waste Disposal	WDC	Separate rates and user charges	unknown		unknown	unknown	Share of new WDC pit Separate rates, user charges

Franz Josef DOC Visitor Centre

Service	Provider & Investment Funder	Annual Cost & Funding System	Tourist use as % Resident Usage	Revenue, Shares Of Funding %	Capacity Utilised At Peak Season %	Annual Growth Rate In Usage %	Upcoming Investments Source Of Funds
Water	DOC	DOC	100 92,570/year	\$0 DOC 100%	unknown	unknown	NA
Sewerage	DOC	DOC	100 92,570/year	\$0 DOC 100%	unknown	unknown	NA
Solid Waste Disposal	DOC	DOC	100 92,570/year	\$0 DOC 100%	unknown	unknown	NA

Franz Josef Glacier

Service	Provider & Investment Funder	Annual Cost & Funding System	Tourist use as % Resident Usage	Revenue, Shares Of Funding %	Capacity Utilised At Peak Season %	Annual Growth Rate In Usage %	Upcoming Investments Source Of Funds
Water	DOC	\$11,500 for site DOC	100 250,000/yr	\$5,500 donations DOC 52% Tourists 48%	unknown	unknown	NA
Sewerage	DOC	DOC	100 250,000/yr	DOC 52% Tourists 48%	unknown	unknown	NA
Solid Waste Disposal	Private	Private	100 250,000/yr	NA	unknown	unknown	NA

Note: assuming a 100 per cent incidence of rates, or water and waste costs is passed on to tourists.

Welcome Flat

Service	Provider & Investment Funder	Annual Cost & Funding System	Tourist use as % Resident Usage	Revenue, Shares Of Funding %	Capacity Utilised At Peak Season %	Annual Growth Rate In Usage %	Upcoming Investments Source Of Funds
Water	DOC	DOC	100 N/A	Tourists via fees* 100%	unknown	unknown	NA
Sewerage	DOC	DOC	100 N/A	Tourists via fees* 100%	unknown	unknown	NA
Solid Waste Disposal	Private	Private	100 N/A	Tourists 100%	unknown	unknown	NA

Notes: assuming a 100 per cent incidence of rates, or water and waste costs is passed on to tourists.

Haast

Service	Provider & Investment Funder	Annual Cost & Funding System	Tourist use as % Resident Usage	Revenue, Shares Of Funding %	Capacity Utilised At Peak Season %	Annual Growth Rate In Usage %	Upcoming Investments Source Of Funds
Water	WDC	\$36,200 (budgeted) Separate rates user charges	107	\$20,000 Water charges	unknown	unknown	\$50,000 2001-02 Separate rates and user charges
Sewerage	WDC	\$12,300 (budgeted) Separate rates and user charges	76.4	\$9,500 Sewerage charges	unknown	unknown	\$30,000 public toilet General rates
Solid Waste Disposal	WDC	User charges	unknown		unknown	unknown	Share of new WDC pit Separate rates, user charges