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Report to:

Central Otago District Council

CENTRAL OTAGO DISTRICT ECONOMIC IMPACT ASSESSMENT: COMMERCIAL WATER USE

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Central Otago District Economic Impact Assessment: Commercial Water Use

Tables

1 Summary:

Economic impact of commercial water use in Central Otago

BERL has prepared this report for the Central Otago District Council. The study provides an estimate of the economic impacts of water used for commercial purposes in the District. This study is an initial step to demonstrate the feasibility of estimating the economic impacts of commercial water use in Central Otago. This work provides a basis for further detailed work at a finer level of industry analysis with updated data and a framework that could be adapted for the comparative assessment of the economic impact of different commercial water uses, and also for non-commercial uses. Within generic uses, it may also be possible to assess the economic impact from different users.

The study involves two main parts:

- it examines the direct implications for industries that use water for deemed or consented uses versus if there were no such commercial water use
- it estimates the impact of commercial water use on the wider regional economy.

The report begins by identifying the major industries in Central Otago reliant on commercial applications of water. The main industries involved are related to primary produce and hydroelectric generation. This information is used to estimate gross output and value added GDP by industry in those industries with and without commercial water use. These gross output figures are then used in a multiplier analysis to identify the wider effects of this output on Central Otago's economy in terms of value added (GDP) and Full Time Equivalent (FTE) employment.

We stress that these are order-of-magnitude estimates to test the feasibility of obtaining the necessary information to estimate the impacts. More detailed investigation of the specific and expanding range of irrigation activity beyond the large public schemes is necessary is research into the specific industry linkages in Central Otago. Study of these smaller irrigation installations and of the small hydro electricity generation facilities will increase the estimates of the total impacts of the commercial uses of water. The more detailed work will also enable sharper comparisons to be made among water uses, and water users.

The indication at present is that the direct and indirect net impact of irrigation is to increase District GDP by approximately $93 million per annum and hydro electric generation increases District GDP by a further $15 to $20 million per annum. This is a total increase by

about $110 million per annum. The total Value Added or GDP in the Central Otago District economy in 2007 was estimated to be $664 million.

The impact of commercial water uses is therefore estimated to contribute at least 16.6% of GDP in 2007.

The net increase in direct and indirect employment generated by the irrigated production analysed is about 1,156 FTEs, and of hydro electricity generation is about 140 FTEs, giving a total of about 1,300 FTEs. The total FTEs employed in Central Otago District in 2007 were 8,433, and so the impact of the irrigation and hydro electricity generation industries is to employ over 15% of those employed in 2007.

While we have used a range of cross-checks to ensure the right order-of-magnitude of these numbers, the levels will undoubtedly increase if detailed fieldwork investigations are undertaken. Exploring specific industry linkages in Central Otago, fieldwork with the smaller irrigation installations and the small hydro electricity generation facilities will increase the estimates of the total impacts of the commercial uses

These analyses show the direct and indirect impact of employment and GDP generated due to the production and service activities required by the water-using industries. However they do not show the additional employment in the social services like education and health and some other services needed because the increased employment brings with it an increase in the total population. This type of employment is important not only as it increases GDP, but also it strengthens to the viability of settlements in Districts because the 'people-servicing' jobs are spread out to all settlements in the District.

BERL analyses have shown that in rural areas and settlements in New Zealand, for every 10 people employed in the 'core driver' industries, there is a further 12 people employed in business services (including infrastructure); private services to people (including retail); and public services to people (mainly health and education).

Table 1.1 Ratios of 'driver' and services industries in Southern settlements

Regions' settlements	Core Drivers	Business Services	Private Services to People	Public Services to People	All Employed
			(Employment ratios)		
Central Otago					
9 settlements: Census 2006	10	4.3	3.2	4.6	22.2
Southland/Otago					
13 settlements: Census 2001	10	3.6	4.4	3.5	21.6
Standard deviation		*(1.2)*	*(1.4)*	*(1.1)*	*(3.3)*

Source: Statistics NZ Census 2001, 2006; BERL analyses

There is variation of the spread of the different groups of jobs among settlements, but the pattern is well-illustrated by 13 settlements in Southland and part of Otago, analysed when assessing the impact of the forest and wood industry on the Southern region. The overall pattern is similar to that of 9 settlements in Central Otago.

We stress that this analysis is not the same as standard multiplier analysis, although the business services industries will largely reflect the upstream indirect employment covered by the multipliers. At the high level, these numbers mean that for every 14 people employed in core driver industries and business services in the settlements in a region there is about 8 people employed in providing private and public services to people. There are probably over 4 of those 8 not accounted for in the multiplier analysis. This means that the total employment would increase by about 20% more than estimated in standard multiplier analysis.

What this implies is that the multiplier analysis has shown that commercial water uses generated an additional 1,300 FTEs estimated with standard multiplier analysis. The additional employment due to the related increase in population could increase this number by 20%, to about 1,560 FTEs. And as we have noted these will be spread around the settlements in the District.

2 Approach

The objectives of this report are to identify the major industries in Central Otago reliant on commercial applications of water; to obtain an order-of-magnitude estimate of their contribution to Central Otago's economy in terms of GDP and employment; and to indicate methods of improving the process of estimating benefits from commercial water uses.

2.1 Characteristics that give water a value

When considered in relation to a region like Central Otago, water has a value, and can generate commercial value due to three main characteristics:

1. Water as the compound H_2O that can be used as a production input in
    a. plant growth (and directly or indirectly animal growth) and production systems;
    b. industrial production including mining, processing and chemical processes.
2. Water as a fluid at altitude that has a potential energy that can be converted to kinetic energy that is used directly, or transmitted as electricity.
3. Water as a flow of fluid, and a neutral chemical compound that has amenity value and/or value for preservation and restoration of the natural environment.

There are some uses that can contribute benefits from two characteristics in a largely non-competitive way, as for example a 'flow of the river' hydro electricity generator in an irrigation canal. There are some situations however where use of one characteristic of a water body renders it unavailable to other uses. In these instances it becomes important to be able to measure the value of the water in the different uses or use-combinations.

2.2 Values of commercial water uses in Central Otago

For the primary produce sector, the area under irrigation and value per hectare by industry were used to determine gross output and GDP by industry. The gross output figures for these uses were then inputted to a multiplier analysis model to identify the effects of this output on Central Otago's economy in terms of GDP and employment.

The economic impact analysis (EIA) for the region is based on identifying the tangible benefits of the commercial water use compared to the output of these industries in its absence. Economic impacts of commercial water use follow from:

- enabling the operation of water-intensive industries, such as hydroelectric generation.
- introducing previously uneconomic land into the production chain.

- increasing the value per hectare of existing land used by some industries, for example, by allowing intensive rather than extensive sheep farming.

In general, commercial water use in Central Otago could contribute to its economy by:

- stimulating activity within the industries directly affected
- increasing spending in upstream industries and output in downstream industries
- creating employment opportunities

In terms of raising output in the area, there are three ways irrigation, for example, can contribute:

- extra direct GDP from a higher quantity of output, of higher value or at lower cost, such as expanding grape production at existing vineyards and expanding hectares under vine.
- indirect and induced impacts for upstream industries supplying the expanded irrigation-using industries, such as increased vine cloning at nurseries.
- downstream impacts for users of the expanded industries' output, such as wineries' use of grapes.

The analysis of the direct impacts of commercial irrigation is done for two scenarios: with and without commercial water use. The difference between these scenarios is used to estimate the additional impact of commercial water use.

Section 3 analyses the activity generated with and without commercial irrigation. It outlines the pattern of land use under irrigation in the large irrigation schemes serving the primary production sector and estimates direct and indirect net increases in GDP and employment.

Section 4 investigates the economic impact on Central Otago of hydro electricity generation in the District. It estimates the direct and indirect GDP and employment by the industry. These two sections use standard multiplier analysis, and an appendix provides background information on the multiplier analysis used in the preparation of this report.

Section 5 discusses the impact on the populations of small settlements of changes in employment in the 'core driver' industries of primary production, processing and manufacturing, and construction. This indicates that the core employment created could be supplemented by more jobs providing private and public services to the additional population in the District.

3 Economic impacts of commercial irrigation

We have built an order-of-magnitude estimate of the impact on Gross Output, GDP and employment of commercial irrigation in Central Otago District. This is not a fully comprehensive estimate as it is based on a 2004 model of land use on the main irrigation schemes. With this information we have updated some of the economic data, as well as allowing for some of the increase in vineyard production and value since that time. However we have not carried out the fieldwork necessary to identify the size and scope of a range of other irrigation activities in the District as for example around Tarras to Queensbury and in the Teviot Valley. These other irrigation activities would include private schemes and separate farm installations like centre-pivots, A-line irrigation units and the like.

3.1 Methodology

The methodology we have used is to determine the pattern of land use on each scheme; to estimate the value of sales (or gross output) per hectare from each land use; then to estimate the GDP per hectare; and finally the employment per hectare for each land use. This enables us to estimate the direct Gross Output, and the resulting GDP and employment generated on the total area, with irrigation. Using multiplier analysis we can estimate the indirect upstream activity generated, and separately we can also estimate the downstream activity generated as for example in the wineries.

These analyses indicate the total GDP and employment generated by the area under irrigated production. We then estimate a 'counterfactual' scenario using an estimate of the productivity per hectare in the area if there was no irrigation at all in the District, and thus all land use would be under extensive livestock grazing.

The difference between the total activity generated with present irrigation in the District and that with extensive livestock grazing is the Net Economic Impact of the irrigation.

3.2 Economic activity with irrigation

3.2.1 Direct and upstream economic activity

The gross output produced directly from the schemes' land area is estimated at $119.9 million per annum, and this generated $49.3 million GDP, and employed 752 Fulltime Equivalent workers (FTEs). Taking into account the upstream indirect activity and workers needed to support this production the total gross output is $205 million per annum, GDP is $88 million and employment 1,300 FTEs.

3.2.2 Downstream economic activity

Central Otago District does not have the downstream processing for the main pastoral products of dairy and meat, however it does for grape-wine production. To illustrate the impact of downstream economic activity we have made a first estimate of the activity of the wineries using employment data from Census figures, production and sales data from the New Zealand Winegrowers Statistical Annual and information from other sources. We estimate the activity as follows:

Downstream impact	**Direct activity**	**Total activity**
Gross output	$22 million	$37 million
GDP	$12 million	$20 million
Employment	25 FTEs	50 FTEs

3.2.3 Total activity with irrigation

Adding the figures for the land use and upstream activity to the downstream activity gives the estimate of total activity with irrigation.

Impact with irrigation	**Direct activity**	**Total activity**
Gross output	$142 million	$242 million
GDP	$61.3 million	$108 million
Employment	777 FTEs	1,350 FTEs

3.3 Economic activity without irrigation

The 'counterfactual' impact is the economic activity on the same area under extensive livestock production. Again we take account of the upstream indirect activity, but there is no downstream activity for these products in Central Otago District.

Impact without irrigation	**Direct activity**	**Total activity**
Gross output	$18.4 million	$31.9 million
GDP	$8.1 million	$15.2 million
Employment	104 FTEs	194 FTEs

3.4 Net economic impact of irrigation

The measure of the net economic impact of the irrigation is the difference between the total activity with irrigation and the counterfactual economic activity without irrigation.

Net impact with irrigation	**Direct activity**	**Total activity**
Gross output	$123.6 million	$210.1 million

GDP	$53.2 million	$92.8 million
Employment	673 FTEs	1,156 FTEs

These figures for the net economic impact of irrigation can be added to the estimates of the impact of hydro electricity to indicate the level of impact of commercial uses of water on the Central Otago district economy.

3.5 Estimation of irrigation activity

The estimation of irrigation activity was based on land use in the main schemes. The main estimation tables are shown in this section.

Table 3.1 Irrigated land use by irrigation schemes and main industry

			Irrigated Landuse (with % irrigated assumption)							Dryland
		Irrigated area	Pastoral	Dairy	Arable	Flowers	Fruit	Nurseries	Viticulture	Pastoral
Waterbody	Scheme	Current	Remainder	95%	66%	100%	100%	100%	100%	Remainder
Taieri	Maniototo	10,000	9,443	445	2					896
Manuherikia	Galloway	1,080	1,027	8			11			275
Manuherikia	Hawkdun/Idaburn	3,500	3,186	54						21387
Manuherikia	Ida Valley	5,000	4,930							5334
Manuherikia	Manuherikia	1,960	1,388		8	8	195	33	144	466
Manuherikia	Omakau	5,780	5,509				20			11266
Clutha	Bannockburn/Burn Cottage/I	640	310				83		230	107
Clutha	Earnscleugh	1,600	873		14	16	546		19	69
Clutha	Hawea Flat	940	907							655
Clutha	Last Chance	980	971							
Clutha	Pisa Flat	1,030	875						58	100
Clutha	Ripponvale	370	213		3		118	1		
Clutha	Tarras/Ardgour/Beggs	1,600	1,501							2141
Clutha	Teviot	1,460	1,154				275			
Other		*550*							*550*	
Otago Scheme totals		36,490	32,287	507	28	24	1,248	34	1,000	42,695

As well as the known scheme areas this table includes an additional 550 hectares of wine grapes. This brings the total area estimated to be in irrigated production to 1,000 hectares of wine grapes. The survey data indicates that there were 1,415 hectares in production in 2007, but the yield figures indicate that a significant area is not at full production. We have therefore taken a conservative estimate that about 1,000 hectares are in irrigated production.

Taking estimates of present-day crop yields and product prices we have estimated the value of sales, or gross output per hectare and thus for each product under irrigated production.

Table 3.2 Value of gross output by irrigation schemes and main industry

	Gross output $/ha	$1,433 Pastoral	$5,342 Dairy	$2,800 Arable	$95,000 Flowers	$30,600 Fruit	$13,333 Nurseries	$8,000 Viticulture	$513 Dryland Pastoral	TOTAL
Waterbody	**Scheme**	Remainder								
Taieri	Maniototo	13,535,800	2,379,035	6,919					459,653	16,381,408
Manuherikia	Galloway	1,471,856	42,393			342,598			141,139	1,997,986
Manuherikia	Hawkdun/Idaburn	4,566,663	286,229						10,977,588	15,830,480
Manuherikia	Ida Valley	7,067,492							2,737,585	9,805,077
Manuherikia	Manuherikia	1,990,324		22,991	754,300	5,957,698	436,040	1,155,536	239,269	10,556,158
Manuherikia	Omakau	7,897,354				601,045			5,782,588	14,280,987
Clutha	Bannockburn/Burn Cotta	443,849				2,547,419		1,836,000	54,825	4,882,094
Clutha	Earnscleugh	1,251,582		40,054	1,557,810	16,701,419		149,656	35,312	19,735,833
Clutha	Hawea Flat	1,300,103							336,224	1,636,327
Clutha	Last Chance	1,391,206								1,391,206
Clutha	Pisa Flat	1,254,304						460,496	51,122	1,765,922
Clutha	Ripponvale	305,964		7,599		3,604,527	13,707			3,931,797
Clutha	Tarras/Ardgour/Beggs	2,151,422							1,099,121	3,250,543
Clutha	Teviot	1,654,184				8,422,313				10,076,497
Other								*4,398,312*		4,398,312
Otago all schemes		46,282,104	2,707,657	77,562	2,312,110	38,177,019	449,747	8,000,000	21,914,427	119,920,625

These estimates of the value of gross output were then adjusted to reflect the actual Value Added, which is the contribution to GDP per hectare. This is shown in the table.

Table 3.3 Value of GDP by irrigation schemes and main industry

	Value added, GDP $/ha	$908 Pastoral	$2,160 Dairy	$1,760 Arable	$48,000 Flowers	$3,130 Fruit	$10,000 Nurseries	$6,000 Viticulture	$163 Dryland Pastoral	TOTAL
Waterbody	**Scheme**	Remainder								
Taieri	Maniototo	8,578,333	962,018	4,349					146,218	9,690,918
Manuherikia	Galloway	932,791	17,142			35,043			44,897	1,029,874
Manuherikia	Hawkdun/Idaburn	2,894,129	115,743						3,492,029	6,501,902
Manuherikia	Ida Valley	4,479,033							870,840	5,349,873
Manuherikia	Manuherikia	1,261,370		14,451	381,120	609,398	327,030	866,652	76,113	3,536,135
Manuherikia	Omakau	5,004,959				61,479			1,839,472	6,905,911
Clutha	Bannockburn/Burn Cottage/E	281,290				260,569		1,377,000	17,440	1,936,300
Clutha	Earnscleugh	793,192		25,177	787,104	1,708,348		112,242	11,233	3,437,295
Clutha	Hawea Flat	823,942							106,955	930,897
Clutha	Last Chance	881,679								881,679
Clutha	Pisa Flat	794,917						345,372	16,262	1,156,551
Clutha	Ripponvale	193,905		4,776		368,698	10,280			577,660
Clutha	Tarras/Ardgour/Beggs	1,363,467							349,636	1,713,103
Clutha	Teviot	1,048,341				861,498				1,909,839
Other								*3,298,734*		*3,298,734*
Total all schemes		29,331,348	1,094,903	48,754	1,168,224	3,905,035	337,310	6,000,000	7,371,604	49,257,178

These estimates of gross output and GDP generated allow us to estimate the employment and the indirect impacts using data from national Input/Output tables (I/O tables).

4 Economic impacts of electricity generation

Electricity generation is a major commercial use of water in Central Otago, and the scope of electricity generation is expected to increase. Use of water for electricity generation by a given generator can be competitive with, or complementary to other uses and other users. To inform potential allocation decisions it is important to be able to estimate the impact of generation by different uses and users on the Central Otago economy.

4.1 Historical perspective

Electricity generation in small schemes has been a valuable economic activity in Central Otago since early in the settlement process. For example the original Lake Onslow dam in what is now the Teviot scheme was built from stone in the 1890s. Small hydro generators were often installed as a part of mining operations. There is a network of small schemes today, some of them being the ten stations in four schemes owned and operated in Central Otago by Pioneer Generation Ltd; the two Paerau schemes recently commissioned (in 1984) by Trustpower in the Maniototo; the Patearoa scheme also in the Maniototo; the East Roxburgh, and others.

Central Otago became a major player in the generation of hydro electricity to provide electric power to the nation, with the commissioning of the Roxburgh hydro dam in 1956. The Roxburgh generators at this site have a capacity of 320 MW. Following development of other hydro schemes in the North Island, the Waitaki River valley, and the South Island Lakes in the 1960s to 1980s, Central Otago had its second major dam built and generation commissioned at Clyde in 1992. The generators at this site have a capacity of 432 MW.

In future it seems likely that a number of smaller schemes will be developed in and around Central Otago. A recent study[1] selected a short list of nine from eighteen schemes identified. Of these nine five are in the Otago area, namely Luggate; Queensberry (sic) Hills, Option 1; Queensberry Hills, Option 2; Beaumont, high dam; and Tuapeka. Contact energy also has consent to install a 17MW generator into the Hawea dam.

4.2 Contribution to the economy:

While the small generators undoubtedly contribute to their local community and economies, their scale is much smaller than the two large generators of Roxburgh and Clyde. The Pioneer Generation stations in Central Otago have a combined capacity of about 23 MW,

[1] *Transmission to Enable Renewables – Potential NZ Hydro Schemes*, Interim Draft Report, Parsons, Brinckerhoff Associates, for Electricity Commission. Wellington, November 2007.

and the Paerau Trustpower generators have a total capacity of 12 MW. These compare with the Roxburgh and Clyde combined capacity of 752 MW.

We have estimated the contribution of electricity generation to the District economy using three main methods.

1. An estimate of the value added (GDP) component of the wholesale value of electricity generated in Central Otago. This is the value to the New Zealand economy of the electricity.
2. An estimate of the value contributed to national GDP based on employment in the electricity generation industry multiplied by the average value added per employee in this industry at national level.
3. An estimate of the core contribution from the electricity generation industry to the Central Otago economy measured as the remuneration of employees in the industry. This base could later be extended to include other economic activity stimulated by the generators in such areas as contract engineering services etc.

4.2.1 National GDP value of electricity generated

Roxburgh and Clyde are both owned by Contact energy, and these are the only hydro generation plants Contact owns at present. Contact provides data on generation by generation type, so we can assume that their present level of hydro generation is the output from Roxburgh and Clyde generators.

We have obtained information on hydro generation from the Contact Energy operational reports for the four years ending June 2005, 2006, 2007 and 2008. This information can show the value of electricity generated, valued at wholesale level. In economic terms, this 'value of sales ($million)' is called Gross Output ($ million). The BERL national Input/Output table for 2005-06 has a separate industry for electricity generation. From this table we can derive the amount of value added from $1 million of Gross Output for this industry.

Table 4.1 Estimated Value Added (GDP) from Roxburgh and Clyde generation

Roxburgh and Clyde	Year	2004-05	2005-06	2006-07	2007-08	4 year Average
Generation per year	GWh	3,980	3,065	3,639	3,504	3,547
Average wholesale price	$/MWh	$48.58	$92.84	$53.70	$106.90	$73.86
Value of electricity output	$ million	$193.3	$284.6	$195.4	$374.6	$262.0
Value Added / $1mn Gross output	$ million	$0.44	$0.44	$0.44	$0.44	
Estimated Value added	$ million	$85.85	$126.34	$86.76	$166.31	$116.3
Utilisation of Max. capacity		60.4%	46.5%	55.2%	53.2%	53.8%

Sources: Contact Energy reports; BERL I/O table 2005-06

This shows that on average over the last four years the Gross Output of electricity from Roxburgh and Clyde was worth $262 million per year at wholesale level. In turn this had a value added component of $116 million, and this is the impact on national GDP per annum.

The smaller generators like Pioneer, Paerau and Patearoa would also contribute to GDP, probably more at the regional level.

A number of generators are operated by Pioneer Generation in Central Otago District. These are the Teviot Scheme (six stations); Roaring Meg (two stations); Falls Station and Fraser Station, a total of 10 stations. A Pioneer Generation fact sheet gives their total generation output as 23.1 MW. This implies an annual maximum generation of 202.5 GWh. The fact sheet gives a range of annual generation for each scheme, which in total gave a range of 103 GWh to 146 GWh. This implies annual generation of 51% to 72% of maximum generation. Assuming an average of 61.5% of maximum, we can estimate the value added or GDP created by these generators per year.

We also have the capacity of the Paerau generators. We have therefore been able to estimate a first approximation of the possible contribution of these two generating groups to national GDP using the pricing parameters and average operating parameters from the Roxburgh and Clyde data.

The estimates in the table indicate that the Pioneer stations in Central Otago may contribute about $4 million per annum to the District's GDP.

Table 4.2 GDP estimate from Pioneer electricity generation

Pioneer Generation Central Otago station estimates		
Generation Capacity	MW	23.1
Annual Max generation	GWh	202.5
Average generation (61.5%)	GWh	124.5
Average wholesale price	$/MWh	$73.86
Value of electricity output	$ million	$9.20
Value Added / $1mn Gross output	$ million	$0.44
Estimated Value added	$ million	$4.08

Sources: Pioneer Generation Fact Sheet; Contact Energy reports; BERL I/O table 2005-06

With the Paerau generators we do not have information on their annual generation so have assumed that their utilisation is about 54% of maximum capacity as with Contact. As with Pioneer he have assumed that the value of electricity is the annual average wholesale price received by Contact in recent years. It is possible that Pioneer or Paerau may be supplying

into the grid or to Trustpower at places or times that give a higher wholesale value than the annual average achieved by Contact.

Table 4.3 GDP estimate from Paerau electricity generation

Paerau Estimates		
Generation Capacity	MW	12
Annual Max generation	GWh	105.2
Assumed generation (54%)	GWh	56.6
Average wholesale price	$/MWh	$73.86
Value of electricity output	$ million	$4.18
Value Added / $1mn Gross output	$ million	$0.44
Estimated Value added	$ million	$1.86

Sources: Contact Energy reports; PBA report 2007; BERL I/O table 2005-06

Using these assumptions, the Paerau generators would contribute about $2 million to the District's GDP.

These are only first approximation of value added by Pioneer and Paerau generators. The main assumptions that require exploring to improve these estimates are the average percentage of generation capacity achieved; the average value of the electricity, valued here at the average wholesale price from Contact; and the value added per $1million of gross output, which may vary significantly with the smaller stations.

There are undoubtedly some other small generators in the district which should be investigated in order to estimate their additional contribution to GDP.

4.2.2 National GDP generated per employee

As a second estimate of the national GDP from the generators in Central Otago, we obtained the number of people employed in electricity generation in Central Otago from 2000 to 2008, from the Statistics NZ-based BERL TLA database. This employment averaged 76 people over the period.

We then obtained an estimate of the value added per Fulltime Equivalent worker (FTE) from the BERL 2005-06 national I/O table. This figure is $1.1 million per annum, and so the value added or GDP generated by these workers averaged $83 million per annum.

Table 4.4 GDP from Central Otago generation workers

Year	Employee Count	GDP (2006$m)
2000	140	$154.6
2001	130	$143.5
2002	55	$60.7
2003	50	$55.2
2004	50	$55.2
2005	55	$60.7
2006	70	$77.3
2007	65	$71.8
2008	65	$71.8
Average	76	$83.4

Source: BERL TLA Database and 2005-06 I/O table

This is somewhat less than our other estimate above, but is a similar order-of-magnitude.

4.2.3 Core contribution to Central Otago GDP

The core contribution of the electricity generation industry to the Central Otago economy is the incomes paid to the employees in the industry. This figure is designated 'Compensation of employees', and is also shown on BERL's 59 industry 2005-06 I/O Table. The average compensation per FTE was $117,000. Since most employees in this industry are fulltime, there will be little error in applying the average compensation per FTE to the total employment count from the TLA database.

This estimate indicates that the electricity generation industry only contributes directly, about $8 million to $9 million per annum to core GDP, i.e. compensation of employees.

Table 4.5 Compensation of Central Otago generation employees

Year	Employee Count	Compensation of employees *($ million)*
2000	140	$16.4
2001	130	$15.2
2002	55	$6.4
2003	50	$5.9
2004	50	$5.9
2005	55	$6.4
2006	70	$8.2
2007	65	$7.6
2008	65	$7.6
Average	76	$8.8

Source: BERL TLA Database and 2005-06 I/O table

The workers in the industry created an estimate of at least $80 million GDP in the overall economy. This will include functions carried out by the generation industry outside the generation regions. These include head office functions, financing etc. Also they will include the upstream and downstream linkages of the generation units to suppliers, contractors etc. located in Central Otago.

Starting from the base of the direct employment in electricity generation it could be fairly straightforward to obtain a reasonable idea of the share of the remaining GDP that is created within Central Otago. The national I/O table indicates that apart from the fuel inputs from the coal, gas and oil industries, the main inputs are from 'other construction' that includes the trades; 'scientific and technical services' and 'other business services'. Some of these services are, or could be obtained from the Central Otago economy.

4.3 Estimate of economic impact of hydro electric generation

The various estimates in the preceding sections indicate that the contribution to the New Zealand economy of the hydro electricity generated in Central Otago could be of the order of $100 million to $125 million per year. Much of the activity around this hydro electric generation is carried on outside Central Otago. We estimate that the direct compensation of employees is about $8 million to $10 million per annum in Central Otago, and a certain amount of the trades and contracting services undoubtedly also are purchased in Central Otago.

As a first estimate and judgement, it is likely that the direct plus indirect payments are at least twice the direct payments. Our first estimate and judgement is that the hydro electric generation industry (including large and small generators) contributes approximately $15 to $20 million to the Central Otago economy and employs approximately 140 people.

4.4 Contribution from potential hydro schemes

The framework of analysis of the linkages from hydro electric generation in the Central Otago economy would allow CODC to estimate the comparative benefits to the economy if a certain water flow was utilised for electricity generation rather than for primary production, amenity or environmental preservation and restoration uses.

5 Settlement population impacts of driver industries

Water-using activities that increase employment in the core industries in the region will indirectly also increase the population of the District. This population increase requires more people to be employed providing social services etc in the settlements in the District

5.1.1 Settlement population impacts of commercial water uses

The first round analysis showed that the water using activities of irrigation schemes and hydro electricity generation added direct employment and indirect employment by the upstream suppliers etc, of over 1,300 FTEs.

Research BERL has completed into the structure of populations in small settlements in Southland/Otago and Central Otago shows that there is a close relationship between the number of people working in 'core driver' industries and those working in commercial services, and in services to the people in the settlements' population.

5.2 Employment ratios to Driver industry employment, Otago-Southland

To find the total effect of increases in employment in the 'core driver' industries across the settlements, we needed to know if there is a 'normal level' of employment in the supporting industries in a settlement for each 10 employees in the core driver industries.

To see if there is such a 'normal level' we obtained 2001 Census employment data by industry for the settlements of interest in the Southern region. Employment has been allocated in each settlement to four types of industry as follows:

1. *'Core driver' industries* of primary, processing, manufacturing and construction;
2. *Business Services and Infrastructure industries* of electricity, gas, water supply, wholesale trade, transport and storage, communications, finance and insurance, and business and property services;
3. *Private Services to People*, retail trade, hospitality, cultural and recreational services, and personal and other services; and
4. *Public Services to People*, education, health and government administration.

We found that there was a very consistent ratio to the core driver industry employed.

The average picture for the 13 settlements was relatively simple. Ten jobs in 'core driver' industries are associated with:

3 to 4 jobs in business services, finance, insurance, real estate;

4 to 5 jobs in private services to people- retail, hospitality, recreation, culture;

3 to 4 jobs in social services – education, health, community services.

We did a similar analysis of 9 settlements in Central Otago from the 2006 Census. The average ratios are compared in the table.

Table 5.1 Ratios of 'driver' and services industries in Southern settlements

Regions' settlements	Core Drivers	Business Services	Private Services to People	Public Services to People	All Employed
			(Employment ratios)		
Central Otago					
9 settlements: Census 2006	10	4.3	3.2	4.6	22.2
Southland/Otago					
13 settlements: Census 2001	10	3.6	4.4	3.5	21.6
Standard deviation		*(1.2)*	*(1.4)*	*(1.1)*	*(3.3)*

Source: Statistics NZ Census 2001, 2006; BERL analyses

The figures for the 9 settlements and areas in Central Otago in 2006 had a greater variation than those from the Southland/Otago 2001 sample of settlements associated with the forest and wood sector. However the average overall was quite similar. In Central Otago for every 10 people employed in the 'core driver' industries there were about 22 total employed people, of whom there were about 4 employed in business services; 3 employed in private services to people; and 4 to 5 employed in public services to people.

Table 5.2 Employment ratios in Central Otago settlements

Workplace	Total Employed	Core Drivers	Business Services	Private Services to People	Public Services to People	All Employed
				(Employment ratios)		
Alexandra	2,041	10	11	6	10	37
Clyde	214	10	6	14	41	71
Cromwell	1,117	10	6	5	4	26
Dunstan	1,351	10	2	1	1	14
Maniototo	658	10	2	1	1	15
Naseby	52	10	5	26	3	43
Ranfurly	277	10	14	16	22	62
Roxburgh	250	10	2	10	21	42
Teviot	406	10	1	1	1	13
Central Otago	**6,286**	**10**	**4.3**	**3.2**	**4.6**	**22.2**
Average 13 settlements Southland /Otago		10	3.6	4.4	3.5	21.6

Source: Statistics NZ Census 2006; BERL analyses

The ratios for Alexandra and Cromwell are reasonably consistent with the ratios we found for the larger settlement, Mosgiel. There are apparently other factors operating to affect the distribution of different servicing functions among the settlements.

Nevertheless it is clear that for every fourteen people employed in core driver industries and business servicing industries there is a further seven or eight people employed around the settlements providing private and public services to the people employed and their families and associates.

While it is difficult to ensure that we are not double-counting any of the indirect employment, this tends to indicate that the additional 1,300 employed directly and indirectly by the water-using industries, could require at least a further 260 people employed providing private and public services to the larger population in the settlements.

6 Appendix

6.1 Multiplier Analysis

This multiplier analysis uses multipliers derived from inter-industry input-output tables for the Central Otago region. The regional input-output tables have been derived from the national input-output tables and other data by Butcher Partners, Canterbury - a recognised source for regional input-output tables and multipliers.[2]

Multipliers allowed us to identify the direct, indirect and induced effects in terms of output (GDP) and Full Time Equivalent (FTE) employment.

Measures

Gross Output Multipliers

Gross output is the value of production, built up through the national accounts as a measure, in most industries, of gross sales or turnover. This is expressed in $ million at constant prices. Gross output is made up of the sum of:

- compensation of employees (i.e. salaries and wages);
- income from self employment;
- depreciation;
- profits;
- indirect taxes less subsidies;
- intermediate purchases of goods (other than stock in trade); and
- intermediate purchases of services.

Value added (GDP) multipliers

Value added multipliers measure the increase in output generated along the production chain, which, in aggregate, totals Gross Domestic Product (GDP). Value added is made up of the sum of:

[2] For a discussion on regional input output tables and the validity and reliability of the Butcher input output tables see *Statistics New Zealand (2003) Regional Input Output Study*.

- compensation of employees (i.e. salaries and wages);
- income from self employment;
- depreciation;
- profits; and
- indirect taxes less subsidies.

Employment Impact multipliers

Employment impact multipliers determine the number of FTE roles that are created for every $1 million spent in an industry for one year. It provides a measure of total labour demand associated with Gross Output.

An FTE is the percentage of time an employee works represented as a decimal. A full-time position is 1.00; a part time position is 0.50.

Direct, indirect and induced effects

The underlying logic of multiplier analysis is relatively straightforward. An initial expenditure (**direct** effect) in an industry creates flows of expenditures that are magnified, or "multiplied", as they flow on to the wider economy. This occurs in two ways:

- The industry purchases materials and services from supplier firms, who in turn make further purchases from their suppliers. This generates an **indirect** effect.
- Persons employed in the direct development and in firms supplying services earn income (mostly from wages and salaries, but also from profits) which, after tax is deducted, is then spent on consumption. There is also an allowance for some savings. These are the **induced** effects.

Hence, for any amount spent in an area (**direct** effect), the actual output generated from that spend is greater once the flow on activity generated (**indirect** and **induced** effects) is taken into account.

Leakages

Generally the more developed, or self sufficient, an industry in a region is, the higher the multiplier effects. Conversely, the more reliant an industry is on supply inputs from outside the region, the lower the multipliers. These outside factors can be referred to as "leakages".

To put this another way, if a house was purchased in Central Otago, and all the materials and labour were sourced in Central Otago, and all the materials and labour that went into making the housing materials were made in Central Otago and so forth, and then the labour spent their wages or salaries in Central Otago, again on goods or services produced solely in Central Otago, then all the multiplier effects would be captured by Central Otago. Where inputs or outputs come from outside Central Otago, leakages are said to exist, and the multiplier effect is reduced.

Limitations of multiplier analysis

Partial equilibrium analysis

Multiplier analysis is only a "partial equilibrium" analysis, assessing the direct and indirect effects of the development being considered, without analysing the effects of the resources used on the wider national and regional economy.

In particular, it assumes that the supply of capital, productive inputs and labour can expand to meet the additional demand called forth by the initial injection and the flow on multiplier effects, without leading to resource constraints in other industries. These constraints would lead to price rises and resulting changes in overall patterns of production between industries.

To assess inter-industry impacts in full would require economic modelling within a "general equilibrium" framework. Applying such models becomes more relevant where the particular development is considered significant within the overall economy.

Additionality

Related to partial equilibrium, using multipliers for economic impact assessments assumes that the event is something that would not have been undertaken anyway and that it will not displace existing activity. That is, the event is additional to existing activity. If it does either of the above, then the economic impact is less than that determined by the multiplier and it would be necessary to subtract both the activity that would have occurred anyway and the displacement effect.

Impact

Again related to "partial equilibrium", multiplier analysis assumes that an event will not have an impact on relative prices. However, in a dynamic environment, it can be assumed that a large event would have an impact on demand and supply and hence prices. Hence, the larger the event and the more concentrated it is in a single industry or region, the more likely it is that the multipliers would give an inaccurate analysis of impacts. For example, if multiplier analysis was used to determine the effect of residential building construction

nationally it would likely be inaccurate as residential building construction accounts for over 6 percent of GDP.

Aggregation

Industries outlined in input output tables are aggregates of smaller sub-industries. Each sub industry has unique inputs and outputs. The higher the level of aggregation the less accurate these inputs and outputs become. Thus, if determining the multiplier effect of a very specific event using highly aggregated data, there will be a lower level of accuracy. Similarly if an event encompasses a range of industries and multipliers from a single industry are applied the accuracy levels will diminish.

Regions and boundaries

The smaller or less defined a region and its boundaries the less accurate the multiplier analysis will be. Similarly, the easier it is to move across boundaries the less accurate the analysis will be. For example, at the national level the multipliers will be very accurate as it is easy to determine the inputs and outputs crossing through the New Zealand borders.

Similarly, it would also be more accurate to determine a north island/south island split. As smaller regions without obvious geographic boundaries are selected, a higher level of assumptions needs to be made and the multipliers become less accurate. For example, an individual could work in the Central Otago region but live in Canterbury and spend a large proportion of his/her recreation money in the Southland region.

For any regional analysis the level of accuracy will have to be accepted. As a rule of thumb, the larger and more defined the region, the more accurate the analysis will be.