Effects Based Transport Costs - Differential Rating Explained

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***Les Dowdle** BForSc, MForSc (Hons)
Transport Logistics Engineer
GHD Limited
Christchurch, New Zealand
tel +64 3 378 0056
fax +64 3 377 8575
email les.dowdle@ghd.co.nz

Steve Abley BE(Hons) NZCE MIPENZ CPEng MICE CEng(UK) IntPE(NZ) MNZIM MInstD
Director
Steve Abley - Chartered Transportation Engineering
Christchurch, New Zealand
tel +64 3 960 9300
fax +64 3 960 9400
email steve@abley.com

*corresponding author

Les Dowdle has four years experience working on a range of transportation projects including one year international experience with London Buses, Transport for London. He holds a Masters Degree with honours in forest transportation logistics from the University of Canterbury with a focus on transportation Geographic Information Systems (GIS-T). Les joined GHD in November 2005.

Steve Abley has been involved in civil engineering since leaving school and now specialises in traffic and transportation engineering. Steve practised in NZ and the UK and runs his own consultancy practice in Christchurch providing professional technical services to national, regional and local governments as well as private developers and non profit groups. He often provides specialist advice to other consultants.

Abstract

The Local Government (Rating) Act 2002 gives Territorial Local Authorities the power to target rates against particular land uses. For road transport costs this means targeting the transport effects a land use might have in terms of the quantity and type of transport movements.

Southland District Council (SDC) commissioned a financial model that compared the differences between various land use sectors and their contribution to road transport costs. The real and existing costs were initially compared over six land use sectors: dairy, forestry, farming, industrial, commercial and residential.

The model initially developed by others was found to be technically sound and credible. However in order to populate the model a number of engineering assumptions were made that were simplistic and which relied on national, rather than regional data sources. This was most notable for industrial and commercial land uses. Consequently GHD was commissioned by SDC to further investigate the quality of input data and its relevance to specific Southland conditions.

In an effort to refine the data Steve Abley was employed to assist GHD to calculate annual vehicle trip rates. SDC provided trip rate surveys and aerial photos that showed some industrial and commercial land uses generate significantly more traffic than others. Further work was carried out to account for the variance identified between high and low trip-generating land uses. Consequently thirteen land use sectors were identified for quantification rather than the original six.

Improved knowledge about the traffic generated effects of each land use sector enable decisions that reflect a fairer contribution towards transport infrastructure. This real world project has assisted SDC to understand what specific land use sectors create the most road transport related effects.

This project has specific relevance to local authorities that may be under significant pressure to increase rates; especially if those increases are due to transport related projects.

Introduction

The Local Government (Rating) Act 2002 gives Territorial Local Authorities (TLAs) the power to explore the link between land-use type and the impact that each land use has on the district's roading infrastructure. For road transport costs this means targeting the transport effects a land use might have in terms of the quantity and type of vehicle movements. In 2004, a financial model was commissioned by Southland District Council (SDC) to assist their consideration of targeted rating (taxation) options for roads.

The land area administered by SDC dominates the Southland Region (Figure 1). SDC has an area of 31,000 km^2 which is 12% of the total land area of New Zealand. The main land use activities in Southland are agriculture (both dairy and pastoral) and forestry. With a total road length of 5,000 km (MWH, 2004), SDC is responsible for the largest road network of any district road controlling authority in New Zealand.

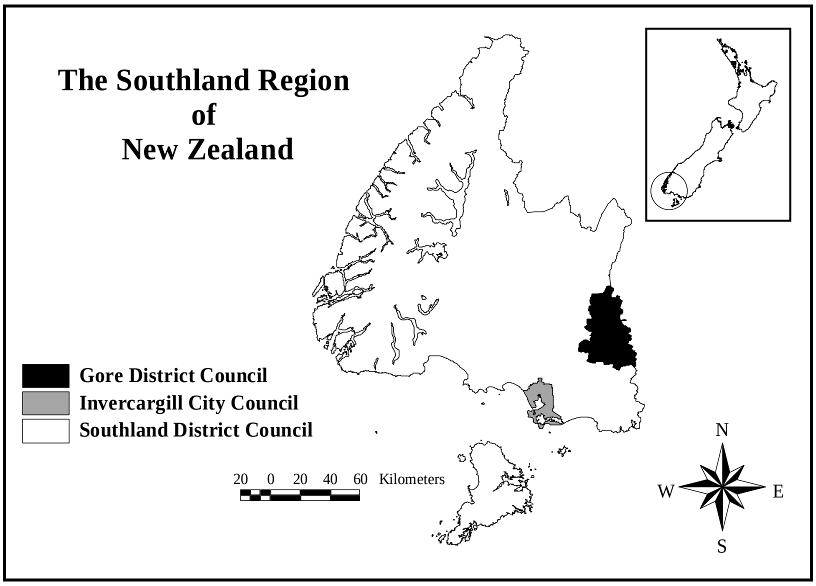

Figure 1 Southland's local administrative boundaries

More than 80% of the SDC road network carries an annual average daily traffic of less than 200 vehicles per day. Southland roads, like most New Zealand roads, predominantly consist of chip seal over an unbound granular base (Arnold, 1999) and 61% of the road network is sealed. Operating costs budgeted for maintaining and enhancing the SDC road network represents just under half of the total cost of services provided by SDC.

Six land-use sectors were designated and evaluated in the original model: dairy, forestry, farming, industrial, commercial and residential. The model attributed road costs to typical light and heavy vehicles that reflected the different vehicle weight, size and axle configurations generally attributable to each land use. The model also included the number of typical trips generated by each land use and a generalised vehicle trip length.

The model that was initially developed by others (PwC/MWH, 2004) was found to be technically sound and credible. However population of the model with data required a number of engineering assumptions that were simplistic and relied on national, rather than specific regional data sources. Furthermore, an overriding multiplier adjustment factor for forestry and dairying was imposed in the model to reflect these sectors' perceived high use on low strength roads and, hence, increased rate of deterioration and cost of maintenance and ultimate replacement. The effect of this adjustment factor in the model increased these sectors' estimated average trip length to a weighted estimate, referred to as the equivalent trip length factor (or trip multiplier factor). The factors proposed by others were '5' for forestry and '3' for dairying. The remaining land uses were unchanged, having a factor of '1'.

GHD with assistance from Steve Abley – Chartered Transportation Engineering were commissioned by SDC to further investigate the quality of the input data and its relevance to specific Southland conditions.

Objectives

The initial objectives of the investigation were to determine:

- if vehicle trip length data from Southland sources compared favourably with the existing national input data used to initially populate the model;
- if additional information for the number of vehicle trips generated for local sources compared favourably with trip rates used in the model.

It was found that some industrial and commercial land uses in Southland generate significantly more traffic than other land uses and the data used in the model, in places, was not representative of SDC. It was recommended that further work should be carried out to account for the variance identified between high and low trip-generating industrial and commercial land uses. The next objectives of the investigation were:

- to group industrial and commercial land uses according to the level of traffic that they generate (high, low and ultra-low generators);
- to recalculate the roading contribution to rates for each land use classification based on a refined model.

It is important to note that there are many factors included in the targeted rating model that ultimately determine rating differentials, such as road cost allocations and land values. This investigation has only focused on the road use section of the existing model that includes refinement of trip length and trip rates for each land use category in Southland.

Validity of input data and analysis

A Working Group was established to assist the review process of the differential road rating issue. Additional information on trip rates and trip length data relevant to Southland was requested from stakeholders represented within the working group.

Dairy

There was no additional information received from the dairy sector. Efforts were made through the consultation process to capture improved input data for the dairy industry in Southland, but none was forthcoming due to issues relating to commercial sensitivity. As a result, the model's input data for dairying remained unchanged (i.e. based on national estimates for trip length and number of trips). There has been considerable national research on traffic generation associated with the dairy industry and it was advised that the input data used in the model for dairying could be used with confidence.

Federated Farmers argued the trip multiplier was not valid and disputed the value applied to dairying. The rating model was modified to recognise this argument and the trip multiplier factor was reduced from ‘3’ to ‘1.3’ (Marshall, 2005).

Farming (non-dairy)

No additional information was received from the farming (non-dairy) sector. The existing data for trip generation and trip length from the farming sector remained unchanged within the revised model.

Forestry

Southland forest owners supplied SDC input data relating to vehicle trip generation from local forestry activities. It was found that there were significant differences between the trip generation assumed in the model when compared to actual forest operations inherent to Southland conditions. The existing model overstated forest volume removals for Southland conditions and consequently the number of heavy vehicle trips in the model was reduced.

The original model used an average trip length of 16.6 km for log trucks on the SDC road network. This assumed a trip length based on the location of the nearest mill by product type. However, in reality forest blocks do not always supply the nearest wood processing facility by log product type. A recent network analysis study determined that the 2004 average haul distance for a log truck in Southland was 27.5 km (Dowdle, 2005). This study measured trip length for the entire haul distance on SDC road network by log truck between forest-gate and mill-gate. A trip length of 25 km was justified for the forest sector in Southland and amended in the revised model.

Southern Wood Council argued the trip multiplier was not valid and disputed the value applied to forestry. The rating model was modified to recognise this argument and the trip multiplier factor was reduced from ‘5’ to ‘1.5’ (Marshall, 2005).

Industrial

All industrial sites were sub-divided according to their particular classification in accordance with VNZ (1995) as listed in Table 1.

Classification	Defintions
IH	Heavy manufacturing
IL	Light manufacturing
IN	Noxious or dangerous industrial uses
IS	Service industrial
IW	Warehousing – with or without associated retailing
IV	Vacant land - when developed will have an industrial use
IX	Other industrial uses or multiple uses

Table 1 Classification of industrial sites

Annual trip rates for these industrial land use classifications were determined by using daily trip rates and plot ratios based on a small number of local surveys. The surveys included information from eight Southland sites and related the number of light and heavy vehicles travelling to and from each site per day.

To verify the trips generated per 100 m^2 Gross Floor Area (GFA), they were compared to the survey rates in the New Zealand Trips and Parking Database Bureau (NZTPDB) Database and reference made to Transfund Research Report 209 (Douglass and McKenzie, 2001). It was found that only the trip rate for IH was significantly different to the rate given in the national data. This was attributed to substantial differences in the type of heavy manufacturing industries examined; three Southland sawmills in the local survey compared to three Auckland industrial units in the national database. It was recommended that the trip generation rate for IH in Southland is 5 trips/100 m^2 GFA i.e. between the Southland and national averages. All remaining industrial sites either matched national data or added to the national database where no trip rate values were provided.

Some industrial sectors generate significantly more traffic than others. Three groupings of industrial land uses were defined to show this variance in traffic generation. These three groupings were industrial high generators (IS and IW), industrial low generators (IH, IL, IN, and IX) and a special classification specific to Southland industrial ultra low generators (IN-F) that represented Southland Freezing Works. Annual trip rates for the three groupings were converted to the expected number of trips to/from all industrial sites by expressing the trip rates in terms of land area in hectares for each of the industrial land use classifications. This reflects the final application of the data to be applied against land area and land value in the SDC rating database.

An analysis of the type of vehicle split from the survey corroborated the national assumption of a 70/30% split of light and heavy vehicles for all trips into and out of industrial sites. Figure 2 shows the impact of grouping industrial land uses according to level of traffic generation.

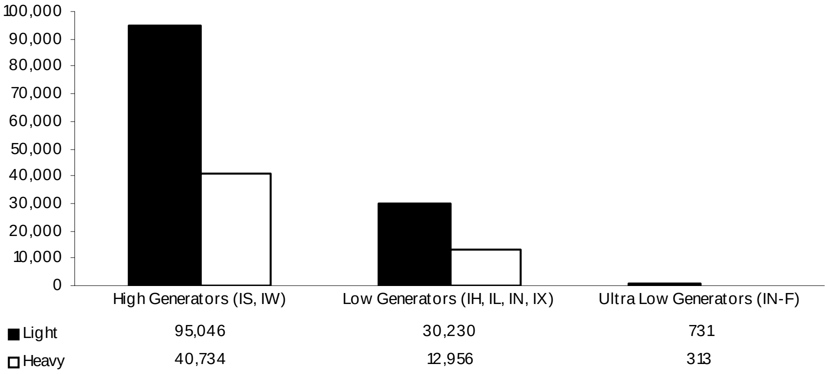

Figure 2 Total annual industrial trips per hectare as per high, low and ultra low generators and type of vehicle

Commercial

Similar to the industrial land uses, the commercial sites were subdivided according to their particular classification in accordance with VNZ (1995) as set out in Table 2.

Classification	Definitions
CA	Commercial accommodation such as motels and hotels etc
CC	Cinema, theatre and public hall type complexes
CE	Homes for the elderly
CL	Liquor outlets including taverns etc
CM	Motor vehicle sales, service etc
CO	Office type use
CP	Parking buildings etc
CR	Retailing use
CS	Service (petrol stations etc)
CT	Tourist type attractions, other amenities including leisure activities of a non-sporting type
CV	Vacant land that when developed will have a commercial use
CX	Numerous commercial uses on one site, or where the use is previously not specified

Table 2 Classification of commercial sites

The local survey data obtained from the SDC included information from six sites relating to the number of light and heavy vehicles that visited those site per day. The surveys contained five sites classed as CR and one site as CS. Using revised plot ratios for commercial properties in Southland, daily trip rates were further refined for these commercial sites.

Again, to verify the commercial trip generation rates, they were compared to those rates presented in the NZTPDB Database. It was found that the CR sites matched national data almost exactly. One can only infer that on average, a supermarket or retail store within the SDC has the same trip generation rate to elsewhere in New Zealand. Trip rates from the national database were applied for the remaining commercial land use classifications, with the exception being CS where national trip rate was obviously too high for Southland. The survey trip rate for CS was applied in the revised model.

Some commercial land use classifications generate significantly more traffic than others. Low generating commercial land uses were separated from the higher generating commercial land uses to show this variance in traffic generation. Commercial high generators (CC, CL, CR and CS) were those land use classifications that had an annual trip generation rate that was greater than the average for all commercial land use classifications. Commercial low generators (CA, CE, CM, CO, CP, CT and CX) had an annual trip generation rate that was lower than the average for all commercial land use classifications. Again, annual trip rates for the three groupings were converted to the expected number of trips to/from all commercial sites by expressing the trip rates in terms of land area in hectares for each of the commercial land use classifications.

National data assumed an 85/15% split of light and heavy commercial vehicles respectively. The survey results revealed a 98/2% split for all trips in and out of all commercial sites. A 95/5% split for light and heavy vehicles was considered a reasonable assumption to apply to Southland. Figure 3 shows the impact of grouping industrial land uses according to level of traffic generation.

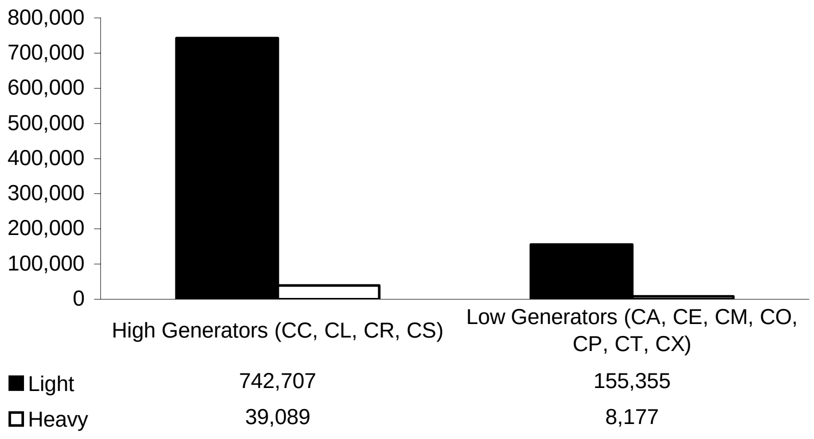

Figure 3 Total annual commercial trips per hectare as per high and low generators and type of vehicle

Residential

No further analysis was undertaken for the residential sector. The values for trip length and number of trips assumed in the existing model were used.

Other land uses

Since the development of the targeted rating model, some subgroups have been analysed as separate land uses in the model. "Lifestyle" is defined as land of variable size but larger than any ordinary residential allotments where the values are in excess of values of comparable farmland (VNZ, 1995). It was assumed "mining" had a traffic generation rate equal to industrial ultra low. Another sub-group was categorised as "other" which encapsulated other land uses not covered by specified categories within the model such as recreational land use.

Results and Discussion

Using improved local input data has increased the trip rates for industrial and commercial land uses. Table 3 shows the result of the analyses for revised model inputs for each land use group compared to the input data used in the original model.

The increase in trip rates for industrial and commercial was not unexpected due to the simplified assumption made in the original rating model. The original model assumed that since a significant proportion of trip generation for industrial and commercial premises would be from customers, a light vehicle trip generation rate per hectare similar to that for the residential sector should be used.

	Original model inputs (trips/ha/yr)			Revised model inputs (trips/ha/yr)		
Land Use Group	**Light**	**Heavy**	**Total**	**Light**	**Heavy**	**Total**
Dairy	29.6	3.5	**33.1**	29.6	3.5	**33.1**
Forestry	0.2	1.5	**1.7**	0.2	0.9	**1.1**
Farming (non-dairy)	13.7	0.4	**14.1**	13.7	0.4	**14.1**
Industrial – All	26,000	7,800	**33,800**			
Industrial - High				95,000	41,000	**136,000**
Industrial - Low				30,000	13,000	**43,000**
Industrial – Ultra Low				731	313	**1,044**
Mining - High				731	313	**1,044**
Mining - Low				731	313	**1,044**
Commercial – All	26,000	3,900	**29,900**			
Commercial - High				743,000	39,000	**782,000**
Commercial - Low				155,000	8,000	**163,000**
Residential	26,000	-	**26,000**	26,000	-	**26,000**
Lifestyle				925	-	**925**
Other				490	-	**490**

Table 3 Comparison of model trip rates (annual trips per hectare)

The revised trip generation rates for industrial and commercial provide a more robust indication of actual road use by these land use categories. Table 4 highlights how industrial and commercial trip rates determined using local surveys and aerial photos compares remarkably well with average annual rates sourced from the NZTPDB Database.

Revised model inputs (trips/ha/yr)		National database (trips/ha/yr)	
Industrial - High	136,000	Industrial - All	164,000
Industrial - Low	43,000		
Commercial - High	782,000	Commercial - All	639,000
Commercial - Low	163,000		

Table 4 A comparison of industrial and commercial trip rates derived using local surveys and NZTPDB data

The dominance of trips generated from commercial land use, and to a lesser extent industrial, gives rise to an interesting conundrum in Southland. There is an obvious disparity between total trips made by some land uses and the existing amount of rates contributed to SDC by these land uses. The percentage of total trips generated by each land use classification and the resulting contributions to rates under three different scenarios is illustrated in Figure 4. These scenarios are:

Scenario A. Contribution to rates using original model inputs (assuming trip multipliers of '3' for dairy and '5' for forestry);

Scenario B. Contribution to rates using current differentials as set by Council for 2005/06 (assuming trip multipliers of '1.3' for dairy and '1.5' for forestry);

Scenario C. Contribution to rates using revised model inputs (assuming trip multipliers of '1.3' for dairy and '1.5' for forestry); and,

Scenario D. Contribution to rates using revised model inputs with no multiplier factors.

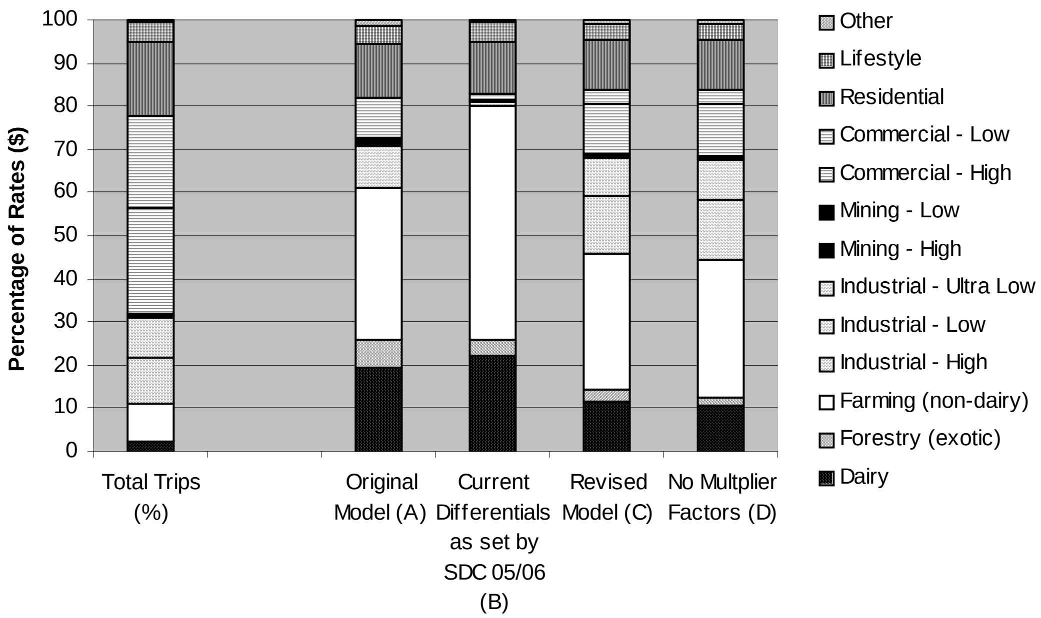

Figure 4 Analysis of differentials applied for rating model

For Scenario B, commercial land use activities generate 46% of vehicle trips per year in Southland but currently only contribute only 1.7% of rates. Conversely, pastoral farming currently contributes 54.2% of rates but generates only 9% of total trips per year.

The revised trip rates determined for each land use category reflect more accurately their generation of traffic per year (Scenario C and D). Farming will continue to contribute the largest proportion of rates to Council due to the quantum of farming land use in but interestingly this land use is one of the lower vehicle trip generating activities.

The analysis determined the revised multiplier adjustment factor applied to dairy and forestry i.e. ‘1.3’ and ‘1.5’ respectively do not significantly change the percentage of rates paid. It was recommended that the multiplier adjustment factor should be removed from the model. The contribution to rates from each land use grouping in the revised model with no multiplier adjustment factors (Scenario D) reflects more accurately the traffic effects generated on the SDC road network.

This project has specific relevance to local authorities that may be under significant pressure to increase rates; especially if those increases are due to transport related projects.

Conclusion

The following can be concluded on the basis of the review of the roading differential rating model:

- commercial land uses, and to a lesser extent industrial, create the most road transport related effects on a per unit area basis in Southland;
- trip rates for commercial land uses compared favourably to those in the NZTPDB Database, indicating that Southland is no different to elsewhere in New Zealand;
- trip rates for industrial land uses did not compare favourably to those in the NZTPDB Database due to the type and specific industries in SDC, and,
- there is a disparity between total trips made by some land uses and the amount of rates currently contributed to SDC.

Improved knowledge about the traffic generated effects of each land use sector should enable decisions that reflect a fairer contribution towards transport rates. This real world project has assisted SDC to understand what specific land uses create the most road transport related effects and it has dispelled a number of earlier perceptions. However, knowledge from this study is only one input that needs to be weighed by a Council when setting rates. Historic impacts and rating practices need to be considered along with the well being of economic, social and cultural impacts.

Further research that would assist transport rating methodology would be an analysis of transport rates against other potentially more reflective variables rather than land values.

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