Comparisons of NZ and UK Trips and Parking Rates

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An important note for the reader

Acknowledgements

Abbreviations

GFA: Gross Floor Area
GP: General Practitioner
IPENZ: Institution of Professional Engineers, New Zealand
ITE: Institute of Transportation Engineers
NZ: New Zealand
NZTPDB: New Zealand Trips and Parking Database Bureau
OGV: Ordinary Goods Vehicle
PFS: Petrol Filling Station
RFA: Retail Floor Area
RTA: Roads and Traffic Authority of New South Wales
TDB: Trips Database Bureau
TRICS: Trips Rate Information Computer System
UK: United Kingdom

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3. (cont)

Executive summary

This research project takes the investigation of trip rates and parking demand related to land uses another step through the comparison of surveyed data in New Zealand (NZ) and the United Kingdom (UK). It adds to the overview which was originally provided in 2001. Since that time, the Trips Database Bureau (TDB), formerly named the NZ Trips and Parking Database Bureau, has been involved in extending the research and in collecting survey data on a national basis. The database has been updated regularly as new site data are collected and a file of about 600 surveys is now held in the national database.

By arrangement with TRICS, access has been provided to the equivalent files for sites surveyed in the UK. The UK database lists 5000 sites. A preliminary pilot study showed a reasonable overlap in terms of land use definitions, trip rates and parking information. On this basis, an Expression of Interest was forwarded to Land Transport New Zealand (now the NZ Transport Agency) in 2005. The research project was approved and work has proceeded since that time.

This is a comparative study and for this purpose, average values of survey data have been used in graphs and tables. These 50% average values are significantly less than the 85% satisfaction values that would be used as design trips and parking standards in some circumstances.

Eight land uses (retail centres; service stations, restaurants and fast food outlets; business parks, manufacturing and warehousing; medical centres; sports fields, golf courses and multiplex cinemas; preschools; and residential areas) have been compared in detail, and the results show a reasonably consistent pattern of trip making and parking demand for a wide range of situations in both countries.

Conclusions

It has been necessary to take particular care in the definition of land uses, the compatibility of the surveys and the sorting of the parameters used for defining the trip rates. TRICS have defined some specific activities, e.g. marinas and golf courses, as self-contained land uses. However, a recognisable definition of most land uses (e.g. retail shopping, residential, industrial and 'other') has been achieved.

The key findings of this research are as follows:-

- The comparison of NZ & UK trip making and parking demands by different land uses has been tested successfully and many similarities have been confirmed.
- Comparison and analysis of average trip and parking rates for eight land uses in the UK and NZ has shown that the average and the 85th percentile trip generation and parking demand rates are consistent and similar for equivalent retail activities.
- For retail activities, the scatter diagrams have much in common, with trip rates being similar. Retail parking rates run in parallel; however, the UK parking levels are consistently above their NZ counterparts.

- Similar and consistent trip making patterns also appear for residential activities. However, NZ dwellings generate slightly higher trip rates than their UK equivalents.
- The analysis shows that for half of the land uses that were analysed, relationships between trip generation rates and GFA for both the NZ and the UK data appear to be consistent. It is apparent that similarities exist and practitioners can usefully examine the TRICS database to widen their data sources and give greater confidence in their predictions for NZ trips and parking rates.
- Where similar trips and parking rate trends were not established, this was most frequently caused by lack of NZ data. However, definition issues also contributed to a lack of consistency for some land use activities. For instance, recreational activities relied more heavily upon qualitative parameters. Trips and parking characteristics associated with employment activities relied heavily upon the exact definition of the nature of business occurring on-site.
- The wide scatter in the trip and parking rate data, in both countries, suggests that the capture of additional parameters would improve the technique of predicting trips and parking rates. Examples of additional parameters may include capturing the distinction between private/rented tenure for residential activities, room occupancy levels associated with hotels, and seating capacity and locational aspects for restaurants.
- Future sharing and exchange of basic data on traffic generation, parking and travel information within each country and internationally could be increased to advantage.

Overall, the exercise has achieved its purpose. While the number and variety of sites compared is less than originally envisaged, those investigated give confidence that information is transferable between countries. The professional transportation specialist can benefit from examining the comparable files available from both countries, if he/she treats the results with caution and respect. In what is essentially a community response of travel generation and travel demand, reasonable similarities in the pattern of trip rates for equivalent land uses emerge in both NZ and UK urban areas.

The results of the research and the comparisons give confidence that transportation professionals should seek to gain access to the NZ and UK databases. This will enable them to broaden the basis of comparison and judgement when making decisions about existing and future land use trip generation and parking demand design levels. It is recommended that this work should be ongoing, as the larger the databases become, the greater their value in making appropriate assessments of existing and future developments.

In addition, the research demonstrates the value of studying all modes of access to individual developments. The range of parameters used to describe trip rates should be increased to include such features as employment, seating, beds, etc. as well as GFA. This is essential for analysing future travel. Such descriptions are especially relevant in preparing travel plans and implementing of travel demand management. Both matters

need to be considered in developing future policies and future designs for both land use development and transport infrastructure.

Recommendations

Given that New Zealand, Australia and England all have similar economies and, in terms of trips and parking rates, all appear to belong to 'one transportation planet', the research supports the following recommendations:

- Government agencies, councils and consultants should be encouraged, when they are undertaking trip, parking and land use site surveys, to ensure that information is made available to the TDB as a further contribution to this national trips database.
- Surveys of land use activities that have been identified as being poorly represented in the NZ database should be undertaken and provided to the national TDB database.
- More survey details and the appropriate parameters should be captured in future surveys including parking duration surveys and multi-modal data (potentially through interview surveys).
- Research should continue with a view to developing a combined joint international database of quality information for development-proposal assessment which is accessible to transportation and planning professionals in NZ, the UK, Australia and North America.

Abstract

Trip generation, parking demand, modal split and travel activity related to different land uses are fundamental information for transportation planning and land use planning, now and in the future. While trip generation related to residential, business, tourism, recreation, industry and rural activities has been investigated, these areas have not always been surveyed or analysed consistently or reported in sufficient detail to provide transportation professionals with a robust assessment for planning and design purposes.

This investigation sought to establish whether trip making and parking demand were similar between similar land uses in New Zealand and the United Kingdom. The conclusion is that travel patterns over a wide range of land uses, and especially those related to retail shopping centre activities, are similar in both countries.

The analysis includes retail, service stations, restaurants, fast food, business parks, manufacturing, warehousing, medical centres, preschools and residential activities. Many characteristics are shared. It showed that New Zealand vehicle trip generation rates are marginally higher than the UK's for most sites. However, more surveys are required in New Zealand to give more useful data. Ongoing and parallel surveys in both countries would have good value, as would exchange of information between transportation professionals.

1.   Introduction

1.1   Background

Since the 1930s when the motor vehicle began to dominate the transportation scene, trip rates and parking have been surveyed and analysed. The big difference between travel in recent generations compared to in the 1800s and early 1900s is simply the limited ability of public transport to meet the demands of independent travel by millions of private vehicles to thousands of separate land use addresses. This is in sharp contrast to the earlier reliance on public transport, in all its forms, to service well-defined corridors of travel and city centres.

The poly-centred modern economy also has a dramatically diffuse pattern of origins and destinations. Modern travel to these destinations is dominated by individual travel in ones and twos, in individual vehicles, and this will remain the dominant mode of travel into the foreseeable future. Travel by all the other public and active modes of travel are, of course, still very important for travel by individuals, the provision of infrastructure and public policy making, even though trips by these modes make up less than half the total number of trips.

The practitioner can use and contribute to two basic areas of survey and research:
- major census and home questionnaire surveys, which are essential to government and local government transportation policy making – major comprehensive transportation surveys and studies are particularly important for modelling future travel at the national and regional/district level; and
- micro-surveys and site survey investigations, which show how local areas, groups of land uses and individual activities generate travel, by all modes, cause demand for parking, road space and accessibility generally.

This research focuses on the second area. This area is difficult to manage but is essential for effective and integrated transportation assessment.

In New Zealand (NZ), three significant reports have tackled the trip rate and parking demand related to land uses:
Douglass (1973),
Douglass & McKenzie (2001a), and
Douglass & McKenzie (2001b).

As indicated in Chapter 2 of this report, in addition to the national databases, major surveys and analytical reports have been published in the United States (US) and United Kingdom (UK), and a small number in Australia.

Trip attraction information has not been the subject of the same scrutiny as transport system planning, especially the network planning associated with road networks and other aspects the provision of motorway and arterial route justification.

This lack of interest in trip rates and travel related to individual land use activities is a matter of concern because it is widely understood that the future location and grouping of traffic-attracting land uses (especially shopping centres, industry and recreation facilities) may be of more importance to a sustainable transport system than providing existing and new arterial links in the transport corridors.

Urban growth studies, which have recently been recognised as essential to future urban and transport planning, do not seem to link transport and land use. Given this lack, the question now is how to rank the key land use activities so we can recognise their contribution and assess their implications when approving developments and planning for our future urban and rural areas.

One of the most useful tools for assessing transportation is a very clear understanding of the trips, parking and travel patterns by all modes generated or attracted by different land uses.

This project is designed to help develop of a basic tool which can estimate demand and assess the impacts of individual and groups of activities likely to emerge in the future. Ultimately, theses surveys, analyses and investigations must address all the person trips (not the vehicle trips only) generated and attracted by every land use at any of the host of locations wherever they might occur.

This project is an investigation which takes a small step toward the understanding of the total picture of the integration of land use and transportation planning.

1.2   Report structure and methodology

1.2.1   Methodology

This research consists of six phases:

- Phase 1 reports on key work undertaken since the publication of Douglass & McKenzie (2001a).
- Phase 2 provides a description of the NZ, UK and US trips and parking databases, highlights the key features within each system and illustrates how the NZ database can be enhanced to reflect the evolutions of the UK database.
- Phase 3 compares eight broad land use activities containing 14 land use sub-categories associated with the UK and NZ databases. For each activity type, the issues affecting trip and parking rates for each country are identified and discussed, along with the relevant explanatory variables. This report examines the reliability of the information and the extent to which a valid comparison may be made between the UK and NZ datasets.

  This analysis explores the parameters that provide the strongest explanations of the trips and parking characteristics of each activity in each country. The analysis focuses on comparing the average of the peak trip and parking rates in both databases. The comparative analysis is presented in both graphical and tabular format. This form of presentation allows the reader to ascertain the trends that emerge from the analysis in addition to providing information on the spread of data, the number of data points used, the average values yielded from the data for a given floor area range, and the variation of data around the average points.

  This report also examines the effects of population catchments, size of the town and activity-specific issues, e.g. the effects of a petrol filling station (PFS) within a retail establishment on the trip generation and parking demands.
- Phase 4 provides a review of the variables and identifies where such parameters should be recorded for a particular land use in future surveys to ensure a better match between the NZ and UK databases.
- Phase 5 identifies the land use activities that are poorly represented and need to be surveyed in the future to overcome the database deficiencies.
- Phase 6 identifies the future evolution of the NZ database.

This is a comparative study and for this purpose, average values of survey data have been used in graphs and tables. These 50% average values are significantly less than the 85% satisfaction values that would be used as design trips and parking standards in some circumstances.

1.2.2   Report structure

Chapter 1 of this research report describes the project objective, and also describes the methodology used to identify and refine the descriptive variables.

Chapter 2 looks at the history of trips and parking surveys in New Zealand, Australia, the UK and the USA. It also reviews a key piece of literature and describes the databases of greatest interest. This allowed the authors to focus on understanding the similarities between NZ and the UK in terms of patterns relating to different land uses, trip making and parking demand. This review provided additional issues to be considered when reporting the results of the correlation, such as the implications of travel planning and mixed-use sites. This chapter summarises Phases 1 and 2 of the methodology.

Chapter 3 sets out the eight land use activities within each database that were considered to be comparable for the purposes of analysis. This chapter provides the analysis of and commentary on the correlation exercise for each land use activity that has been tested, provides a summary of the findings of the analysis, and identifies land use activities that are poorly represented within the NZ database. This chapter ties in with Phase 3 of the methodology and also with Phase 5.

Chapter 4 discusses the survey parameters and identifies key variables associated with various land use activities that should be collected in any future NZ and UK surveys to enhance the compatibility between each database. This chapter also highlights the need to collect multi-modal data and techniques to apply when surveying mixed-use sites. This relates to Phase 4 of the methodology.

Chapter 5 draws conclusions to the research and provides recommendations for the use of the report and future data collection, and suggests that research continue with a view to developing a combined joint international database which is accessible to engineering and planning practitioners in NZ and the UK. This is linked with Phase 6 of the methodology.

1.3   Description and research objectives

1.3.1   Objectives and brief

The research project objective is to provide NZ transport practitioners with a greater range and quality of trip and parking prediction information by relating UK data to NZ circumstances.

This research is an effective way to increase the database of the Trips Database Bureau (TDB)[1] and provide increased quality and quantity of information to NZ practitioners. TDB has already undertaken a pilot project demonstrating the effectiveness of these exchanges of information. This has included information from the UK via the Trip Rate Information Computer System (TRICS) and the US via the Institution of Transportation Engineers (ITE). A correlation has now been identified in relation to the residential and retail land use sites. It is apparent the correlation may well exist over many land uses where the modal splits are similar. Initial analysis is promising and this research will refine the descriptive variables to examine the correlations further and establish the validity of the relationships, trip generation and parking demands.

This research extends the work originally commenced by Douglass & McKenzie (2001a). This will be achieved by bringing UK and NZ data together into comparative tables for equivalent land uses. It is, effectively, an analysis to compare equivalent land uses and traffic situations, and to demonstrate the similarities and differences of UK and NZ situations.

The TDB has made good progress in recent years in developing a database of trip generation and parking demand information. Despite this, the database remains comparatively small and this limits the statistical reliability of its information.

By arrangement with TRICS, access has been provided to the equivalent files for sites surveyed in the UK. The UK database lists 5000 sites. A preliminary pilot study showed a reasonable overlap in terms of land use definitions, trip rates and parking information. On this basis, an Expression of Interest was forwarded to Land Transport New Zealand (now the NZ Transport Agency) in 2005 and the research project was approved in and work has proceeded since that time.

The establishment of linkages with the much larger UK TRICS database potentially improves the reliability of forecasting for the assessment of the traffic generation and parking demands associated with developments in NZ. This will be beneficial to a wide range of assessments, including transportation modelling, urban planning, traffic impact assessments and resource consent applications.

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[1] The New Zealand Trips & Parking Database (NZTPDB) was renamed the Trips Database Bureau (TDB) in 2008 with its membership widened to include Australian engineers and planners.

1.3.2   NZ-UK liaison

In addition to the exchanges made by individuals travelling between the UK and NZ, professional traffic and transportation engineers familiar with TRICS have migrated from the UK to NZ over the years. These personal liaisons led to a formal approach in 2006 by NZTPDB to TRICS in London to co-operate with the exchange of information and access to the TRICS database for research purposes.

For this research project, the methodology originally proposed was to return to the raw survey files of the NZ and UK databases in order to make comparisons at the site-by-site or land use group-by-group level. It was found, however, that from a practical point of view, the recording of the files and their comparability was not as simple as originally expected.

It was agreed in July 2007 that a system of listing and linking data from individual sites might be introduced. In the meantime, the original methodology was put to one side. With the co-operation of TRICS, the NZ researchers began to make use of the normal user database's trip rate programmes, and sites were extracted from the normal user files. This was a slower process and resulted in a smaller number of land uses being tested.

These exercises demonstrated that, while NZ paralleled the UK in terms of survey and information gathering, the future TDB quality of survey information would need to be lifted to match that of TRICS. This would enable the two databases to be more closely aligned, allowing users to compare and merge the datasets. This would be on the basis of mutually agreed land use descriptions, compatible definitions for trips and parking, and the range of parameters used to calculate trip generation and parking demand rates.

2.   Background

2.1   History of NZ, Australian, US and UK experience

2.1.1   New Zealand

Throughout the 1970s, a small band of enthusiastic engineers and planners, mostly employed by local government or the Ministry of Transport, were committed to land use/traffic surveys and the sharing of the knowledge gained. The major report at this time was Douglass (1973), which was commissioned by the Road Research Unit.

Throughout the 1980s, only a small number of references were published, mostly related to major shopping centres. Complementing these internal trips and parking reports, a number of consultants' reports were prepared that dealt with the land transport effects of policies regarding road hierarchy, traffic and parking proposed to be included in councils' district plans.

Between 1992 and 1994, the Auckland Territorial Local Authorities undertook a traffic and parking generation study for a total of 113 sites. This provided a useful database which was incorporated into Douglass & McKenzie (2001a). This brought together 540 survey sites and covered the range of issues involved in developing guidelines and databases of trip generation and parking. This led in turn to the establishment of the NZTPDB in 2002, which, as a 'Focus Group' of the Institution of Professional Engineers, New Zealand (IPENZ), is continuing to collect and disseminate the national database.

The need for this information has been further emphasised through the recent publication of the Auckland Regional Transport Authority's integrated transport assessment guidelines (Auckland Regional Transport Authority 2007), and the move for improved content and quality in future integrated transportation assessments as part of the Resource Management Act (New Zealand Government 1991) planning and consent processes.

In New Zealand, American and Australian data were originally used, as these were considered to provide the best guidance for NZ conditions. However, this research and investigation has clearly established that the United Kingdom TRICS survey results, over many land uses, are equally useful for such comparisons.

Hallam.C.E. 1988. 'Land Use Traffic Generation Revisited' in *Proceedings of the 14th ARRB Conference, Vol 14, Part 3*. Melbourne: Australian Road Research Board.

2.1.2   Australia

The Australian experience is reflected through references such as Foley (1987), Hallam (1988) and the well used *Policies, Guidelines and Procedures for Traffic Generating Development* (Roads and Traffic Authority of New South Wales (RTA) 1984), followed by the *Guide to Traffic Generating Developments* (RTA 1993 and 2002). A large number of the references are those produced for the RTA. The revision of the RTA Guide has been an ongoing discussion, including the Parsons Brinckerhoff Revision to the RTA discussion draft in August 2002 and several other review reports. These reports have directed their attention more to Transport Impact Assessments with the current addition of Austroads' *Guide to Traffic Management Part 12*: *Traffic Impacts of Development* (Austroads 2008). The TDB Trips and Parking Database is now being used by a number of Australian practitioners.

2.1.3   United States

In the US, trips and parking survey practice extends back over many years with a central collection of data. The ITE manual *Trip Generation (7th Edition)* (ITE 2003) and its companion volume *Parking Generation (3rd Edition)* (ITE 2004) are well used within the US and internationally. The ITE information is very extensive and produces useful average and graphical information. It does not provide access to individual sites for detailed investigation of similar land use developments. However, the extensive database yields a great variety of land use types and groupings to enable very useful review of the data.

2.1.4   United Kingdom

In the UK, experience stems from both consultant and public authority practitioners, combined with the influence of town planning control by councils and the involvement of several government agencies involved in town planning and transportation. Recent significant reports have included:

- *Planning Policy Guidance Note 13: Transport* (Department for Communities and Local Government 2001)
- *Transport Assessment and Implementation: A Guide* (Scottish Executive 2005),
- *Public Consultation Draft: Transport Assessment: Guidelines for Development Proposals in Northern Ireland* (Department for Regional Development 2005).
- *Guidance on Transport Assessment- Part 4 Trip Generation* (Department for Transport 2007)

All these government publications refer to the need for trips, parking and travel data, and TRICS is recognised as fulfilling that role.

TRICS has its origins in a collaboration in 1987 by several County Councils in Southern England, namely Dorset, East Sussex, Hampshire, Kent, West Sussex and Surrey; Berkshire joined the group in 1989. Originally, the group intended to combine and exchange traffic data for development control purposes, but with the massive amount of data compiled, it soon became necessary to create a database to hold, summarise and collate this information conveniently.

2.2   Douglass & McKenzie 2001a

Douglass & McKenzie (2001a) aimed to produce a comprehensive national database. In doing this, they also provided an opportunity to identify trends that had occurred since the 1970s using equivalent information from an earlier report (Douglass 1973).

The report begins with seasonal factors and design hours. It also considers the seasonal fluctuations of trips and parking from an analysis of commercial centres and also traffic volumes on selected state highways in the three areas: 'metropolitan', 'provincial' and 'tourist resort' centres. The report recommends the continued use of the 30th highest design hour for trips and the 85% satisfaction for parking as the basis for assembling traffic data on visitor-attracting land uses in the future.

The report describes residential trips and parking, which had increased in parallel with car ownership growth during the previous 30 years. Typical trip making had lifted from 6.0 vehicle trips per household per day in the 1970s to 10.4 vehicle trips per household per day in the 1990s, a 73% increase. Over the same period, the average number of cars per household increased from 1.1 to 1.4 (a 27% increase).

The authors identified that the increase in trip movements and parking demand for retail developments was moderate over the 30-year period. Land uses which had changed quite dramatically since the 1970s included:

- educational, with an increased use of cars by both teachers/lecturers and students (at primary, secondary and particularly tertiary levels);
- medical centres, hospitals, rest homes and child-care centres have increased in number and expanded their services;
- recreational uses and stadiums have become more intensively used; and
- the modern larger service station has become the highest trip generating land use by site size and gross floor area (GFA).

The trends in trip generation and parking demand from the 1970s to the 1990s show that, in spite of the 250% increase in total trips being made, at the site level, trip rates and parking demands typically increased by 20–50% over a wide range of uses compared to in the 1970s.

Douglass & McKenzie (2001a) also reported a comparative review of the NZ results alongside those available from the US and Australia. The report concluded with a discussion on the way forward and identified an urgent need to co-ordinate a central address for the future maintenance of this national database.

2.3   NZ, UK and US database descriptions

2.3.1   Description of NZ database

The NZTPDB was established in response to Douglass & McKenzie 2001a. Other TDB research documents, survey methodology, technical notes and similar aids to the understanding of the database are available on request. The TDB database was first published in 2001 as *Trips and Parking Related to Land Use. Volume 2: Trip and Parking Surveys Database* (Douglass & McKenzie 2001b). This original report has been superseded by regular releases and upgrades of the database. The TDB database used for this report (Version July 2007–June 2008)[2] contains approximately 594 sites. The database is supplied to members as a Microsoft Excel spreadsheet on CD which is updated annually. The database is sorted according to nine Land Use Groups in alphabetical order:

- assembly,
- commercial,
- education,
- industry,
- medical,
- recreation,
- residential,
- retail, and
- rural.

Each land use group has between 5 and 12 'land use activities', which are also arranged alphabetically. Each survey entered to the database is numbered consecutively. The database structure and column definitions in summary are as shown in Table 2.1.

Table 2.1   Summary of the layout of the TDB database spreadsheet.

Column number	Information presented
A–D	Description of site
E–H	Land use description
I	Locations: rural/suburban/town centre
J–M	Road hierarchy and traffic flows
N–P	Population details in catchment
Q–R	Pedestrians and public transport
S–U	Survey dates and times
V–Z	Prediction parameters (GFA, sales area, employees etc.)
AB–AK	Parking supply and demand
AL–AW	Vehicle trips surveyed (a.m., p.m., daily
AX–BK	Derived trip rates
BK–BZ	Modes of travel arrival
CA	Notes and comments

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[2] The TDB database (formerly the NZTPDB database) is available to members via the TDB website, http://www.tdbonline.org. Other TDB research documents, survey methodology, technical notes and similar aids to the understanding of the database are available on request.

The fields included in the database are shown in Table A1 of Appendix A. These fields are set out horizontally on an Excel screen and include drop-down information that can be filtered to suit users' survey preferences.

The TDB surveys include car based trips only; multimodal or heavy vehicle trips are not reported[3]. Because the survey information is only a summary, the resulting one-row output per site survey is brief. Some survey information is missing or incomplete.

The TDB contains nine main land use classifications with several land use sub-activities associated with each. Table A2 of Appendix A sets out the full list of these land use categories with the corresponding number of vehicle and parking surveys included in the database.

The database allows the users to select individual sites or a set of survey sites that best suit the user's needs. The majority of the trip rate and parking demand data are presented in daily as well as peak hour units. A full list of land use category definitions is contained in Appendix A.

2.3.2   Description of UK database

TRICS is a database that contains traffic count information for over 2705 sites, 5257 days of survey counts and 110 land use sub-categories. The database was formed in 1989 and had 298 organisations holding licences when TRICS (2008) was issued.

TRICS collects data from individual sites across a diverse range of land use categories. TRICS uses sixteen land use categories to structure the data and these categories are split further into land use sub-categories.

For example, the land use category 'Education' has six land use sub-categories and three land use categories including marinas, tourist attractions and car boot sales are stand-alone activities with land use sub-categories.

A full list of land use categories and survey types is shown in Appendix B, along with a definition of each of the land use categories.

In addition to being a data retrieval package, the TRICS system explains that it is also possible to

> *analyse individual or selected sets of survey counts to produce trip rate*
> *information. To produce selected data sets for trip rate calculation, users can*
> *fine-tune whole land use categories (superstores, offices, schools, residential*
> *developments, a total of 111 separate categories), so that a final selected*
> *data set is shortlisted, based on a wide range of compatibility requirements*

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[3] TDB is now actively encouraging multi-modal trip generation information to be included in accepted surveys to the database.

such as size, location, range of trip rate calculation parameter, etc. (TRICS
2008)

Once a trip rate calculation has been produced, the information can be presented in a
number of ways and used as part of a transport assessment. Also, individual trip rates for
a given time period for a number of surveys can be calculated and ranked in a list,
displaying worst and best case scenarios.

TRICS identifies three types of surveys: manual classified counts, one way automatic
traffic counts and multi-modal counts.

The TRICS (2008) Help files state that:

> *Manual classified counts break down the vehicles entering/exiting the site
> into the 6 standard vehicle types plus pedal cycles. ATC surveys are normally
> unclassified, simply counting vehicles using a machine which cannot break
> the count down into different   vehicle types. In multi-modal surveys there
> are a number of different count types…*

TRICS classifies vehicles into seven types: motorcycles, motor cars, light goods, ordinary
goods vehicles 1 (OGV1), OGV2, public service and taxis. For the multi-modal surveys,
trips undertaken by bicycle, pedestrians, public transport users and vehicle occupants
(passengers) are also counted. Appendix C provides a definition of the vehicle types and
the definition of multi-modal vehicle and people count data.

2.3.3   Description of US database

Although it is not part of this study, it can also be helpful to consider the US database.
The US relies upon ITE's *Trip Generation* (ITE 2003). This is a paper-based (hard copy)
database set out in two volumes that contains more than 4250 trip generation studies.
Data within the database are submitted to ITE by public agencies, developers, consulting
firms and associations. All data presented in the ITE database represent vehicle trip
generation rather than person trip generation. The database continues to be used by
practitioners. Caution is required in using the database, as some survey information dates
back to the 1960s. In November 2004, ITE released the *Parking Generation Manual (3rd
Edition)* (ITE 2004b), which updated the previous 1987 version.

In June 2004, ITE produced an additional resource to offer recommendations on the
preferred application of data in this report. This publication, the *Trip Generation
Handbook (2nd edition)* (ITE 2004a), aims to provide instruction and guidance in the
proper use of data presented in the database and to provide information on supplemental
issues of importance in estimating trip generation for development sites.

2.4   UK and NZ trip rate correlation 2005

Research comparing surveyed trip rates in the United Kingdom and New Zealand was undertaken by the NZTPB in 2005. This made use of the following specific database versions:

- NZTPDB December 2003 – New Zealand,
- TRICS Version 2004(b) – United Kingdom.

In order to compare the trip rates of the similar land use activities contained in both databases, the common points regarding land use and trip rate parameters between the databases were identified. These are shown in Appendix E**.**

Given the difficulties involved in identifying common trip rate parameters and a suitable number of survey sites from both the NZ and UK data, the preliminary study focused only on the five land use activities illustrated in Table 2.2.

Table 2.2   Comparable land uses and trip rate parameters.

NZ		UK		Primary trip rate parameter
Land use	**No. of sites**	**Land use**	**No. of sites**	
Education – preschool	22	Education – nursery	15	GFA (m^2)
Residential – dwelling	17	Residential – various	170	Dwelling units (numbers)
Retail – bar	10	Hotel, food and drink – pub/restaurant	12	GFA (m^2)
Retail – restaurant	14	Hotel, food and drink – restaurant	13	GFA (m^2)
Retail - supermarket	9	Retail – food superstore	230	GFA (m^2)

The report considered that because the TDB database only concerns vehicle trips, the metropolitan UK sites may tend to show lower vehicle trip generation rates, given the availability of public transport or multi-modal transport. To maintain a valid comparison, survey sites in the UK major metropolitan areas were excluded from the analysis.

This hypothesis was further explored in subsequent research (see Section 3.2.3 of this report). Scatter plots with line of best fit (linear regression function) were employed to obtain the relationships between the total peak hour vehicle trips and the trip rate parameter for the respective land use activities listed in Table 2.1. The analysis indicated that strong relationships were found for the land use activity 'Residential – dwelling', with the other land use activities also showing promising correlations. It was, however, concluded that more surveys needed to be added to both the NZ and UK databases to improve the correlations. Further details of the figures can be found in Section 3 of Abley (2005).

3. Land use – transport analysis

3.1 Samples and method of analysis

In seeking to correlate the trip generating and parking characteristics of the NZ and UK databases, it was necessary to ensure that the land use activities were in close agreement. Table 3.1 presents a comparison of the land use definitions used in the NZ and UK databases.

Table 3.1   Comparable land use activities between UK and NZ databases.

NZ land use	NZ land use sub-category	UK land use	UK land use sub-category
Assembly	Cinema	07 – leisure	A – multiplex cinemas
Commercial	Office (park)	02 – employment	B – business park
Education	Preschool	04 – education	D – nursery
Industry	Manufacture	02 – employment	C – industrial unit
	Warehouse	02 – employment	F – warehousing commercial
Medical	Centre	05 – health	E – clinics
			G – GP* surgeries
Recreation	Sports fields	07 – leisure	L – football (five-a-side)
	Golf courses	09 – Golf courses	Golf courses
Residential	Dwelling	03 – residential	A – houses (privately owned)
			B – houses for rent
	Hotel	06 – hotel, food & drink	A – hotel
Retail	Superstore	01 – retail	A – food superstore
	Shopping centre – local shops		I – shopping centre
	–		J – retail park including food
	Service station	13 – petrol filling stations	A – petrol filling stations
	Restaurant/bar	06 – hotel, food & drink	B – restaurants
	Fast food	06 – hotel, food & drink	D – fast food (drive through)

* General Practitioner

As described in Chapter 1, one of the study objectives is to identify land uses that are poorly represented in the databases. From this, resources can be targeted towards collecting data for these land uses so these deficiencies can be rectified. In most situations faced by practitioners, GFA is known but the future number of staff is not. Therefore it is recommended that the relationship established using GFA as the explanatory variable is preferable.

For the purposes of this report, the NZ/UK comparisons focus on the analysis of the average vehicle trip generation and parking rates (in-trips plus out-trips) during peak hours and are expressed as a rate per 100 m^2 GFA, unless otherwise stated.

In instances where the means of two different datasets are compared and when doing so was considered appropriate, statistical tests have been undertaken to determine whether the differences are significant at the 90 percent confidence level. In the tables presented in this chapter, a '*' symbol located next to the mean values indicate that the difference is statistically significant. A '#' symbol has the same meaning for adjacent averages in the same column.

3.2   Comparison of retail centres' trips and parking

3.2.1   Data sources and site selection process

The data used to undertake the comparative assessment were sourced from the latest versions of the TRICS (2008)database and the TDB (2007) database. The purpose was to compare NZ and UK vehicle trips and parking rates for a range of equivalent land uses. Seven different land uses have been analysed to ascertain the compatibility or differences identified between the surveyed results in the two countries.

Although much of the NZ information dates from 1990, no evidence suggests that retail trip rates have changed significantly since that time. A TRICS research report, *Does Historic Site and Survey Data remain Valid to Use?* (TRICS 2004), focused on Friday trip generating habits and concluded that the number of car trips to superstores on a Friday had declined or remained stable over time. It was considered reasonable to include survey information that dated from 1990 for both datasets, thus enabling a larger data sample to be assembled.

The location category within the NZ database is not well defined, but the majority of the sites can be described as being set in a suburban location. The UK site locations appear to be influenced by the type of retail category provided, with shopping centres in excess of 10 000 m^2 GFA being located in 'out of town' sites and the majority of UK supermarkets being located in 'edge of town' sites. For assessment purposes, the UK 'edge/out of town' sites and NZ 'suburban' sites have been assumed to be broadly compatible.

Although most surveys reveal that maximum parking demand is contained on-site, parking demands in excess of on-site parking provision are recorded within each database. Therefore maximum parking demand, including off-site parking demand, has been used for this analysis. This ensures that data from 1990 to 2001 (when minimum parking standards were in operation in the UK) are appropriate and relevant to more recent UK surveys, where maximum parking standards that result in lower on-site parking provision prevail. While this is not stated explicitly within the databases, it is assumed that the off-site trip rates associated with the off-site parking are also included in the trip rates.

The sites selected for this study have not been screened for seasonal variations. Therefore, some extreme data points, which may be attributed to this factor, may appear within the analysis.

In the UK, supermarkets frequently have a petrol filling station (PFS) on site. As demonstrated in Section 3.2.9, these sites tend to display higher trip rates than those that do not have a PFS on site. In contrast to this, no retail sites within the NZ database include a PFS (although this is now becoming more common for new supermarkets). In order to provide a better match of site characteristics between the two datasets, only those UK sites that do not include a PFS were included in comparative analysis.

In both datasets, many sites have been surveyed on several occasions. In order to avoid site over-representation and bias in the dataset, only the busiest surveys (one for a weekday and one for a weekend) for a particular site have been included in the sample.

3.2.2   Retail classification

While the shopping centre survey data in TRICS provides information on site size and GFA of a particular site, no distinction is made between shopping centres of differing sizes. To ensure valid comparisons and to examine the trips and parking generation rates for discrete sizes of retail outlets, the survey data have been grouped as follows:

- Shopping centres up to 4000 m^2 GFA (32 sites),
- Shopping centres between 4001–6000 m^2 GFA (28 sites),
- Shopping centres between 6001–10 000 m^2 GFA (10 sites), and
- Large shopping centres over 10 000 m^2 GFA (10 sites).

The descriptions of the various retail activities vary between TRICS and the NZ database. In the absence of a UK site described as a 'large' shopping centre (over 10 000 m^2 GFA), TRICS surveys relating to retail parks containing a food retail element and exceeding 10 000 m^2 GFA were selected as being a reasonable match to NZ's large shopping centres.

3.2.3 Combining datasets

The small sample size associated with each shopping centre category did not provide a sufficient volume of data to enable a meaningful comparison of the two databases.

While it is noted that supermarkets are classified separately from shopping centres in both databases, through an iterative process of layering the survey results of shopping centres with supermarkets, the differences between these retail activities were not dissimilar in terms of the relationships between traffic generation rates and total floor area[4]. This is illustrated in Figure 3.1 and Table 3.2, which show the trip generation relationships for the UK shopping centre and supermarket activities.
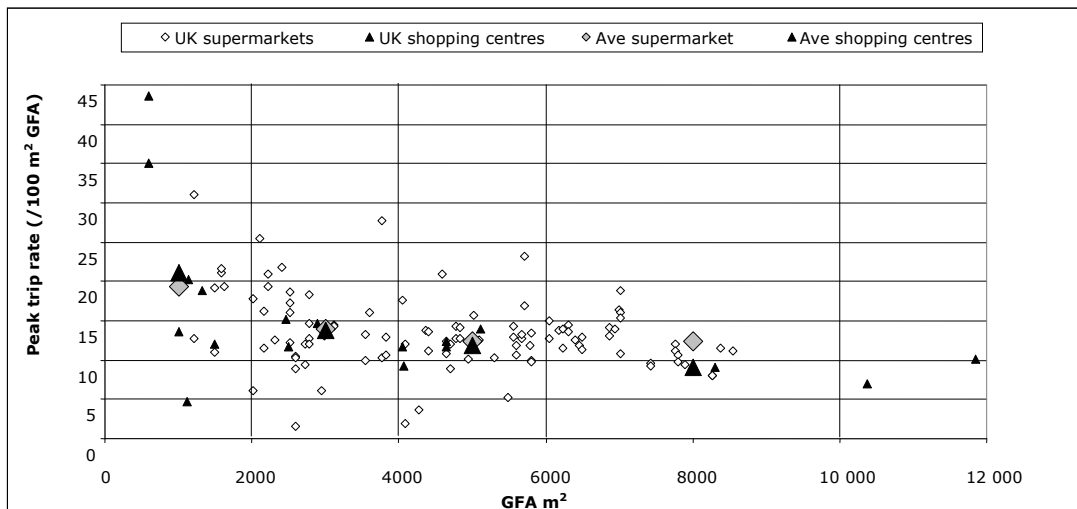
Figure 3.1   Comparison of GFA v. peak trip rates for UK supermarkets and UK shopping centres.

The averages have been calculated for each of the four floor area groupings, and are presented using the following symbols: (◇) and (▲). Where NZ and UK average data are being compared, the larger diamond symbol represents NZ average group data and the larger triangle symbol represents UK average group data.

Table 3.2   Average maximum trip rates – UK supermarkets and shopping centres.

GFA (m²)	UK supermarkets			UK shopping centres		
	n	Ave	Sdev	n	Ave	Sdev
0–2000	7	**19.42**	6.55	7	**21.15**	13.61
2001–4000	35	**13.96**	5.30	3	**13.78**	1.91
4001–6000	33	**12.35**	4.14	5	**11.83**	1.68
6001–10 000	30	**12.43**	2.52	2	**9.121**	–

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4 An emerging view of practitioners in the UK is that Retail Floor Area (RFA) provides a stronger predictor variable than GFA for retail outlets. However, this analysis focuses on GFA as this is the main variable that has been collected in the NZTBDB since it was established. Any new trips and parking surveys of retail outlets presented for inclusion of the TDB are now required to include RFA as part of the survey.

Although practitioners treat the supermarket category as a unique land use activity distinct from shopping centres, Figure 3.1 and Table 3.2 demonstrate that both activities follow the same general pattern of decreasing trip rates with increasing floor area. The low data samples in the extreme floor area ranges may explain the higher variance in trip rates between the two datasets; however, the general trend is similar. Tested at the 90 percent confidence level, the difference between the means of each dataset is not significant. Coupled with the strong overlap of trip generation rates, particularly for retail outlets of between 2000–6000 m^2 GFA, the comparison indicates that the two retail activities can be combined to form a single dataset.

Consistent with the approach adopted in the 2005 study, the UK surveys that related to sites located within the main conurbations were excluded from the dataset. These sites were initially excluded from the analysis because it was assumed that their catchment and travel mode characteristics would differ significantly, for example, as a result of a more concentrated pedestrian catchment and higher public transport accessibility. As a consequence, it was assumed that the vehicle trip generation and parking characteristics of these sites would not be comparable with the other sites, which were predominantly classed as 'edge of town' and 'out of centre' sites and hence equivalent to NZ suburban locations.

The validity of this assumption was tested. Figure 3.2 illustrates the differences in vehicle trip generating characteristics associated with retail sites located in large conurbation sites (36 sites) in comparison to retail sites that lie in suburban areas outside the main UK conurbations (127 sites).
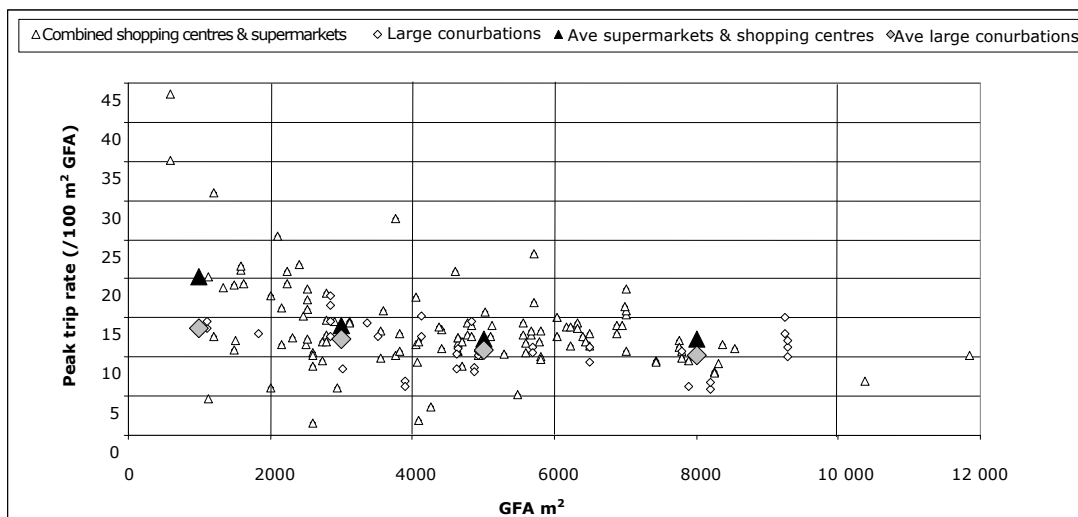
Figure 3.2   Comparison of GFA v. peak trip rate patterns between UK sites and UK large conurbation sites.

Table 3.3   Average peak trip rates for all UK retail sites and for UK retail sites in large conurbations.

GFA (m^2)	Combined UK supermarkets and shopping centre			UK large conurbations		
	n	Ave	Sdev	n	Ave	Sdev
0–2000	14	20.28*	10.3	3	13.72*	0.77
2001–4000	38	13.94	5.10	9	12.27	4.16
4001–6000	38	12.28	3.89	12	10.98	2.20
6001–10 000	32	12.32*	2.55	11	10.15*	2.91

Figure 3.2 shows that the sample of retail sites from large conurbations are evenly distributed among the combined supermarket and shopping centres. The sites from large conurbations nestle within the range of survey points associated with the combined supermarket and shopping centres.

As with the combined shopping centre and supermarket scenario, the variance between the two sets of data is greatest in the 1–2000 m^2 GFA range. Figure 3.2 shows that large conurbation sites over 4000 m^2 GFA exhibit lower trip generation rates, with the differences ranging from 5 trips per 100 m^2 GFA for the retail outlets below 2000 m^2 GFA, and reducing to 1–2 trips per 100 m^2 GFA for the remaining floor area segments. This supports the view that sites in large conurbations have different trip generating characteristics from other UK retailing sites. This may be caused by higher shopper catchments, or higher levels of non-car accessibility. Tested at the 90 percent confidence level, the differences between the means of the trip rates indicated that the difference between the two data groups associated with the 2001–4000 GFA and 4001–6000 GFA ranges was not significant. Given that the mid-range surveys represent the majority of the samples, it is acceptable to add the large conurbation sites to the combined supermarket and shopping centre sub-group for this research.

Figure 3.3 shows the effect of combining the data highlighted in Figure 3.2.
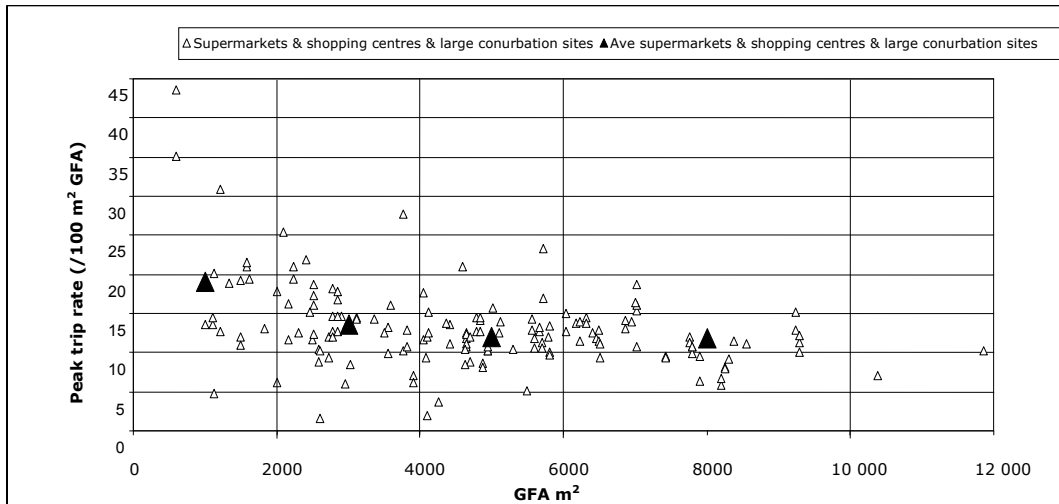
Figure 3.3   GFA v. peak trip rates for all UK retail sites.

Table 3.4   Average peak trip rates for all UK retail sites (combined large conurbation sites, supermarkets and shopping centres.

GFA (m²)	n	Ave	Sdev
0–2000	17	19.12	9.64
2000–4000	47	13.62	4.94
4000–6000	50	11.97	3.58
6000–10 000	43	11.75	2.78

The UK dataset used in the subsequent retail analysis is based on the combined data of Figure 3.3. Figure 3.4 shows the general trends throughout the whole range of UK data.
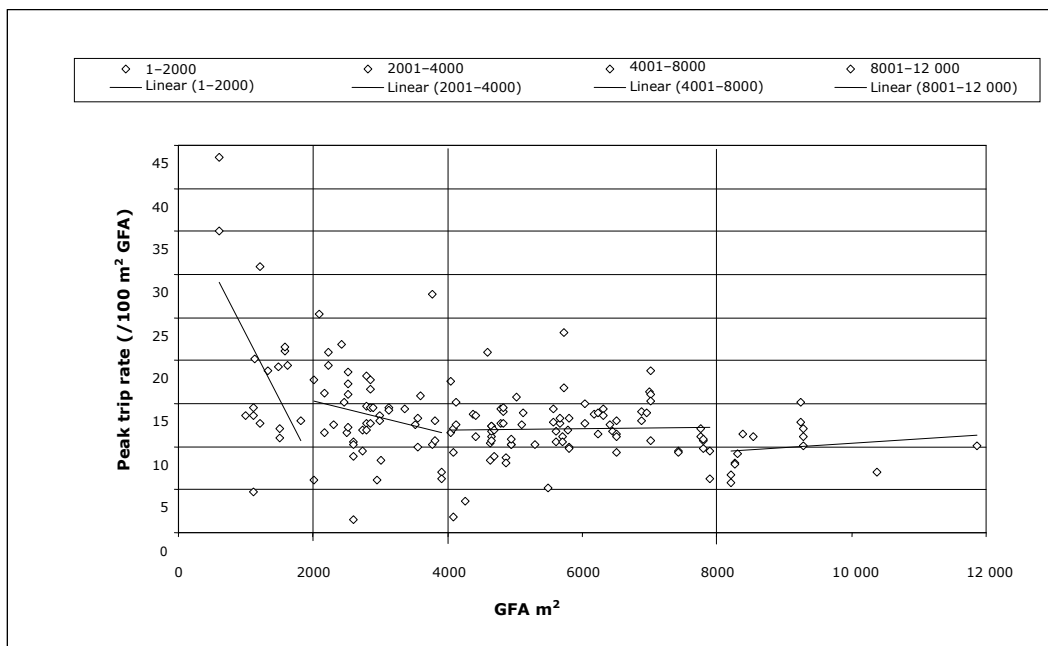
Figure 3.4   GFA v. peak trip rate for the combined UK retail dataset.

30

Following a stepped process of adding one shopping centre sub-group to the next size category, an overall relationship between trip generation and units of GFA emerged. While linear relationships have been established, the group of straight lines, when viewed as a whole, tends to suggest that a log curve relationship could be used to explain the trip generation v. GFA relationship for the whole UK dataset. However, the variance is not consistent throughout the range of points and therefore, a negative exponential curve has not been used here.

3.2.4   Summary of NZ shopping centres

A similar iterative process was applied to the NZ dataset combining the shopping centre data with the supermarket data for this country. Figure 3.5 and Table 3.5 show the relationship between these two retail activities for NZ.
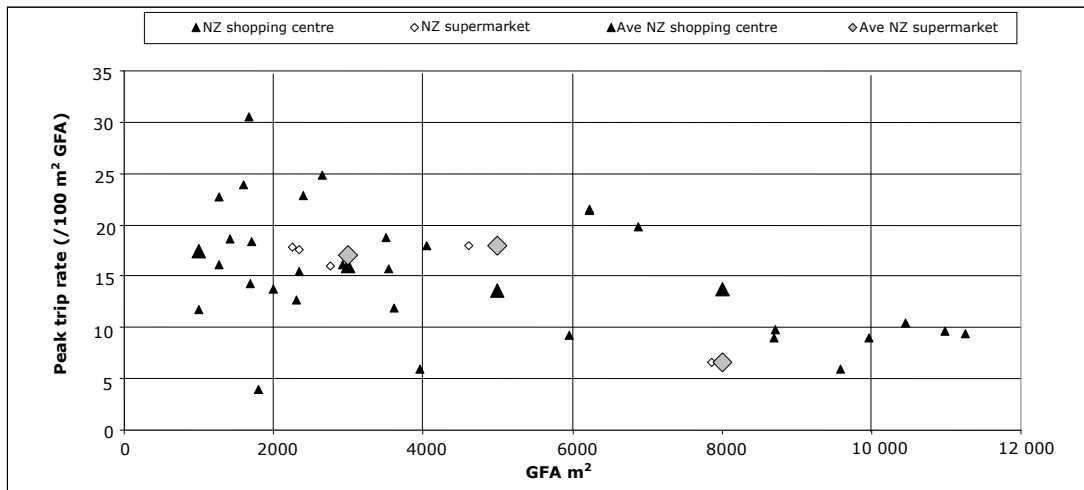
Figure 3.5   GFA v. peak trip rates for NZ shopping centres and supermarkets.

Table 3.5   Average trip rates for NZ shopping centres and supermarkets.

GFA (m²)	NZ shopping centres			NZ supermarkets		
	n	Ave	Sdev	n	Ave	Sdev
0–2000	10	17.40	7.32	–	–	–
2001–4000	9	16.04	4.80	3	17.09	0.99
4001–6000	2	13.60	4.70	1	17.97	–
6001–10 000	6	13.80	1.93	1	6.60	–

The sample size associated with NZ supermarkets is extremely low, with only five sites available, three of which correspond to the 2001–4000 m² GFA range. Figure 3.5 and Table 3.5 show large variance in trip rates associated with the two retail activities in the higher floor area ranges; however, this is because NZ supermarkets are represented by only one survey in each of these ranges. The 2001–4000 m² GFA range contains three NZ supermarket surveys and this shows a close similarity to the other retail activities. Given this and supported by the UK scenarios, the NZ supermarkets and shopping centres have been combined to form a combined NZ dataset, which is illustrated in Figure 3.6.
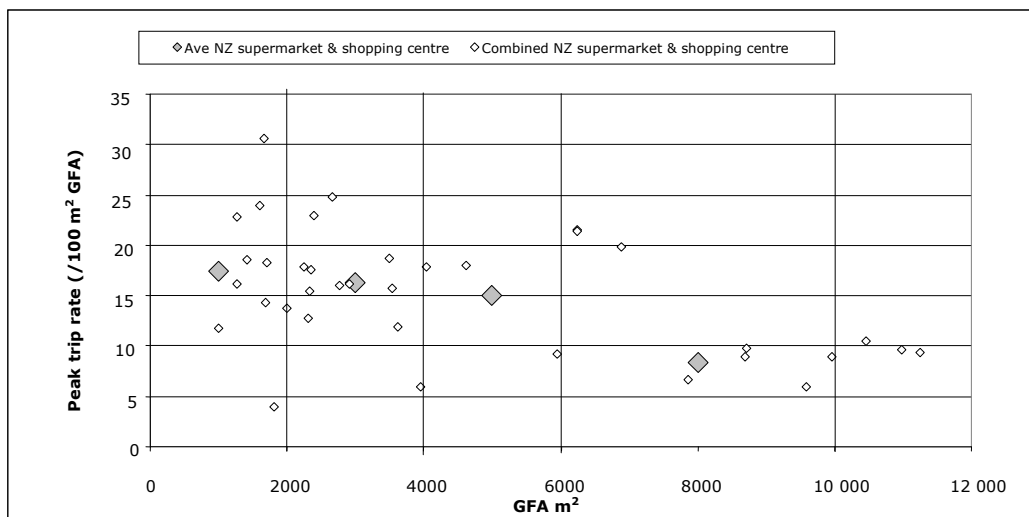
Figure 3.6   GFA v. peak trip rate for the combined NZ retail dataset.

Table 3.6   Average trip rate for combined NZ retail dataset (supermarkets and shopping centres).

GFA (m^2)	n	Ave	Sdev
0–2000	9	17.40	7.32
2001–4000	13	16.30	4.38
4001–6000	3	15.04	4.35
6001–10 000	8	8.42	6.43

The survey data used in the analysis have been screened to remove repeat surveys of particular sites and to ensure that common explanatory variables are applied to each dataset. The following retail analysis is therefore based on a sample of around 200 surveys with 40% of these representing NZ sites.

Figure 3.7 shows that when the NZ surveys are combined, a pattern emerges; albeit not as strong as the UK dataset which suggests that the relationship between peak trip rates and GFA may take the form of a negative exponential curve if more data were available.
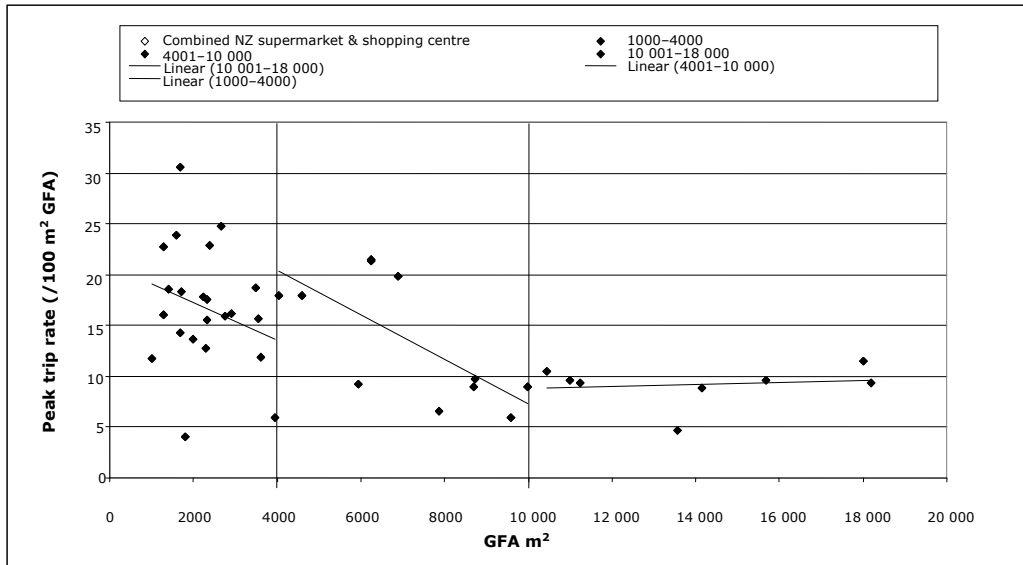
Figure 3.7   Relationship between GFA and peak trip rates for all NZ retail datasets.

3.2.5   Comparison of NZ and UK retail vehicle trips and parking rates

Figure 3.8 indicates the average development peak hour trip generation rates/100 m^2 GFA for NZ and the UK. The key observation from the comparison is that retailing activities show very little difference in trip generating characteristics between these two countries. In each case, a higher variability of trip rates is associated with lower GFAs but, in general, a large proportion of sites between 1000–10 000 m^2 assume a trip rate that lies between 15–10 trips/100 m^2 GFA.
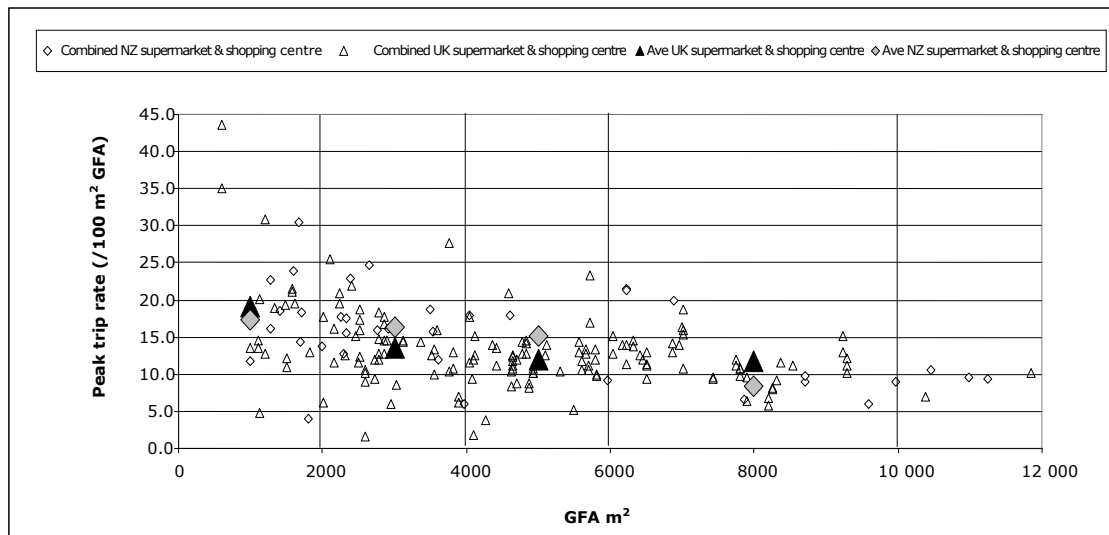
Figure 3.8   Comparison of UK and NZ peak vehicle trip generation rates v. GFA – retail.

Table 3.7   Comparison of UK and NZ peak vehicle trip generation rates – retail.

GFA (m^2)	Combined UK			Combined NZ			Combined UK & NZ		
	n	Ave	Sdev	n	Ave	Sdev	n	Ave	Sdev
0–2000	17	19.12	9.64	9	17.40	7.32	26	18.52#	9.27
2001–4000	47	13.62*	4.94	13	16.30	4.38	60	14.20#	4.91
4001–6000	50	11.97	3.58	3	15.04	4.35	53	12.14	3.70
6001–10 000	43	11.75	2.78	8	8.42	6.43	51	11.23#	3.68
10 001–12 000	2	8.50	2.12	3	9.83	0.58	5	9.3	1.35

Figure 3.8 and Table 3.7 firmly support the view that the retailing trip rate reduces with increasing floor area, and that the rate of change is greatest at the low end of the range of floor space. It can be seen that for four of the five GFA ranges, the difference between the UK and NZ average trip rates is not statistically significant. When the UK and NZ data are pooled, the differences in the trip rates for successive increases in GFA are significantly different in three of the five cases, and the greatest differences are associated with the smaller GFA comparisons.

It should be noted that the maximum trip generation rates associated with the surveyed sites do not always coincide with generally accepted design peak periods. The dataset includes instances where a particular site has two values. This is because the busiest weekday and the busiest weekend survey day from a particular site have been included in the sample.

Figure 3.9 indicates the relationship between the retail parking demands and GFA for NZ and the UK. The parking characteristics of shopping centres and supermarkets were combined to form a single dataset for each country. While not as conclusive as the trip rate and GFA relationship, a comparison of the data showed that the average shopping centre parking demand per 100 m^2 GFA tended to be around 4 vehicles per 100 m^2 GFA for the UK, and 5 vehicles per 100 m^2 GFA for NZ. The supermarket group displayed a range of between 4–6 vehicles per 100 m^2 GFA.

Since the parking demand rate for the shopping centres fell within the range of parking demand rates displayed by the supermarket sub-group, it would be reasonable to combine the two subgroups to form a single dataset for each country. Figure 3.9 and Table 3.8 compare the parking demand rates of the combined shopping categories in the UK and NZ.
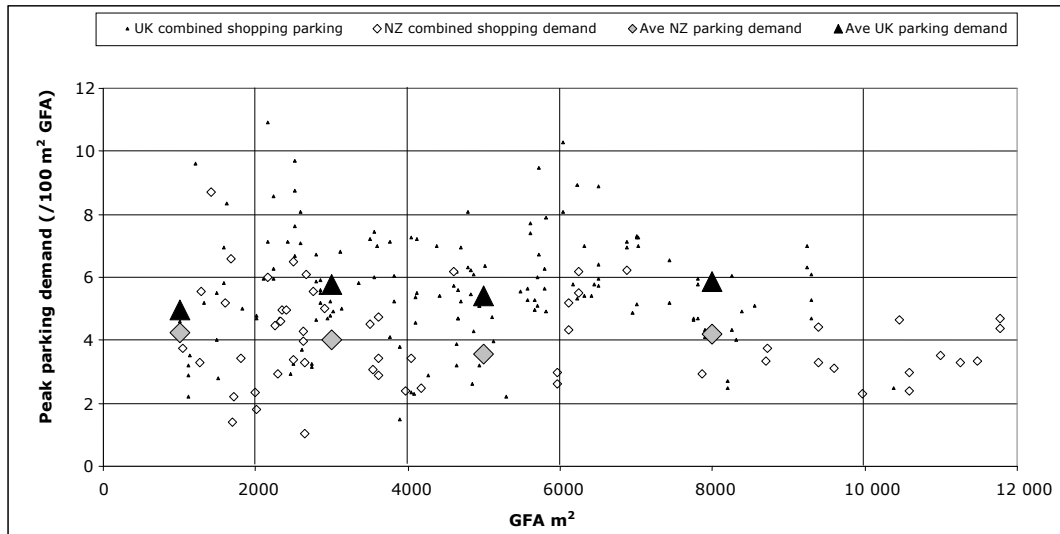
Figure 3.9   Comparison of UK and NZ peak parking rates – retail.

Table 3.8   Average peak trip rates for the UK and NZ.

GFA (m²)	Combined NZ			Combined UK		
	n	Ave	Sdev	n	Ave	Sdev
0–2000	9	4.25	2.25	14	4.98	2.16
2001–4000	23	4.01*	1.42	47	5.78*	1.83
4001–6000	5	3.54*	1.51	48	5.41*	1.59
6001–10 000	12	4.22*	1.31	42	5.88*	1.56

In each floor area segment, the NZ parking demands are lower than the UK retail parking demands. The difference between the parking demands equate to one parked vehicle in the 1–2000 m² GFA range with the difference of around two parked vehicles remaining relatively constant and statistically significant throughout the remaining floor area segments.

The majority of UK sites indicated average parking demands ranging from 5–6 spaces per 100 m², and the NZ sites display an average parking demand that ranges from 3–4 spaces per 100 m² GFA. In general, the UK retailing activities generate a parking demand that is 2 vehicles per 100 m² GFA higher than the NZ retailing activities. This may reflect a tendency to park for longer durations because of a wider variety of activities being available at the UK sites or people using the parking space while visiting adjacent shopping facilities.

3.2.6   General discussion of NZ and UK retail comparison

Figures 3.1 to 3.7 demonstrate that for this 'high level' generalised analysis differentiating between sub-groups of shopping centres and supermarkets is unnecessary because the clusters of survey results for the same size of centres in the UK and NZ appear to overlap greatly, and the two groups are not statistically different.

Figures 3.8 and 3.9 show that for retailing activities, in particular floor area sub-groups, differences in trip rates and parking rates can be identified between the UK and NZ datasets. In both countries, a higher variability in trip rates is associated with the smaller centres of lower GFA compared to the larger centres. A large number of sites between 1000–10 000 m^2 generated average trip rates in the range of 10–15 trips/100 m^2 GFA/peak hour. The analysis confirms the trend of reducing trip generation rates occurring with increasing floor area. It also shows that the rate of change (decline) in trip generation is greatest between the smaller shopping groups less than 2000 m^2 in floor area.

A close relationship also exists between the retail parking demands of NZ and the UK. In contrast to the variation in trip rates, which show a noticeable decline with larger floor areas, the trend associated with the average parking demands remains relatively constant throughout the range of centre sizes in both countries.

A higher parking demand in the UK may be attributed to longer parking durations, which in turn arise from a typically wider range of activities on offer or the proximity of nearby premises. As parking is more limited in the UK, shoppers may be inclined to visit more retail outlets or activities without moving their vehicles.

The parking demands for both the NZ and UK datasets were based on total (on- and off-street) parking. This would, to some degree, limit the variability in parking demands that would occur as a result of limited on-site parking provision. However, it may be fair to assume that shoppers would prefer to park on-site for reasons of convenience and vehicle security, so sites that have lower on-site parking provision may exhibit lower parking demand.

3.2.7   85th percentile analysis

The correlation analysis throughout this report focuses on the average of the peak trips and parking rates associated with the UK and NZ. This analysis indicates that a close relationship between peak trips and parking rates for retailing activities in both countries on the basis of a sample size of 200 retail surveys.

In determining appropriate trip generation estimates, practitioners are advised that if sites with comparable accessibility, scale and location cannot be found when using a standard database system, 85th percentile trip generation rates[5] should be considered as an appropriate initial basis for design purposes. It is noted that in response to instances where a large amount of off-street parking is unused, some territorial authorities seek a parking provision that is less than the 85th percentile demand value. However, the 85th percentile values in this report are used to illustrate the similarities that exist between the UK and NZ trips and parking characteristics of retail outlets. Figures 3.10 and 3.11 illustrate the 85th percentile trip generation and parking rates for sites grouped in GFA increments of 1000 m^2 GFA. The closest fit line represents a log curve, although this relationship is weaker for the 85th percentile parking data because of the variance occurring around the curve.
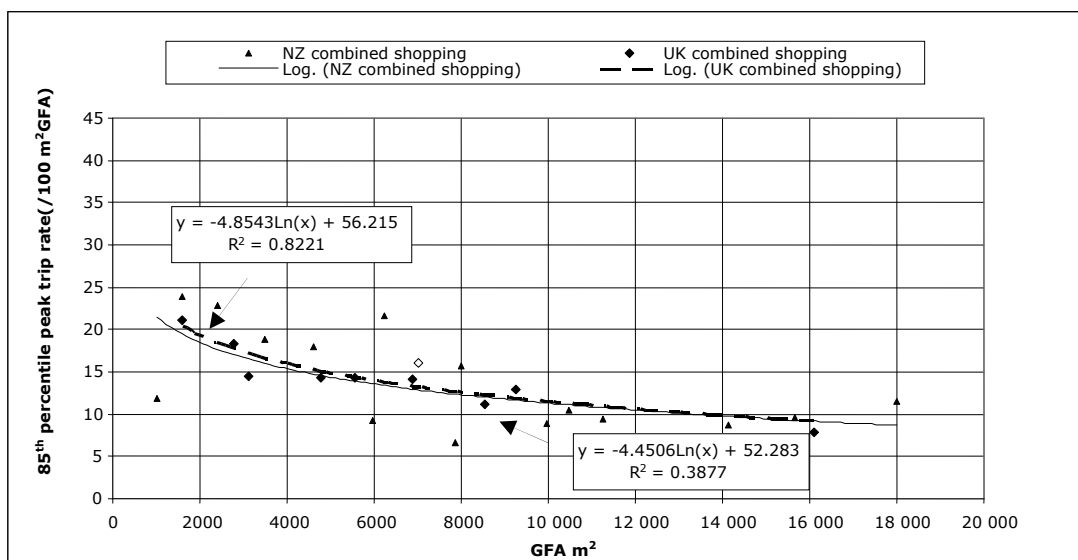
Figure 3.10 Comparison of UK and NZ 85th percentile trip rates – retail.

This 85th percentile analysis provides further evidence regarding the similarity of trip making characteristics between the UK and NZ. Each dataset displays a similar downward trend, indicating that trip generation and parking demand reduces as GFA increases.

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[5] The 85th percentile value relates to the 85th highest data point from a sample of 100 points.
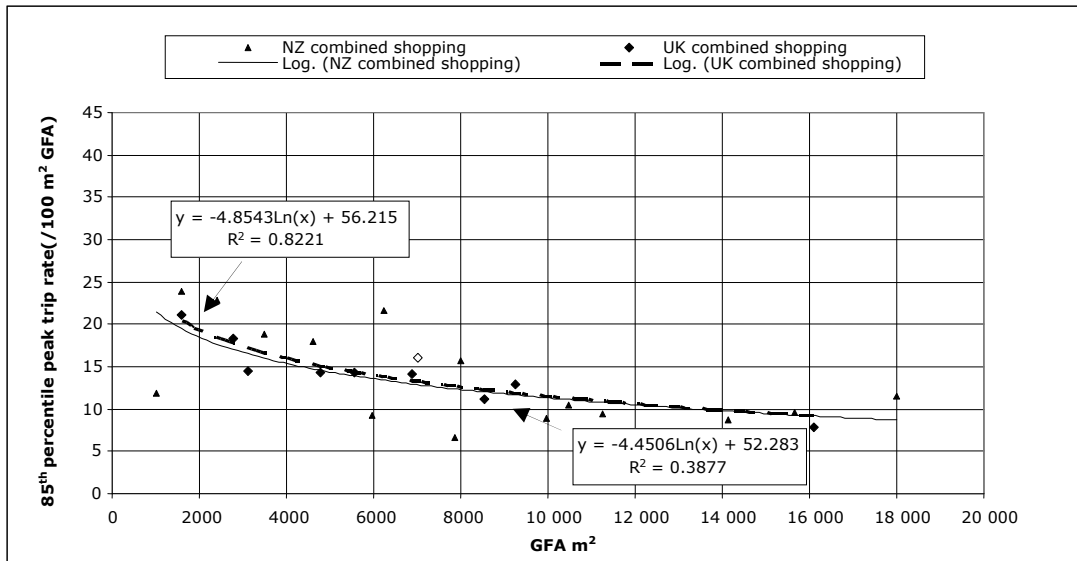
Figure 3.11 Comparison of UK and NZ 85th percentile parking rates – retail.

The differences in 85th percentile parking demand rates between the NZ and UK datasets appear to be reasonably constant and show that the 85th percentile parking rates for the UK are higher (by 2 parked vehicles per 100 m^2 GFA) than the equivalent 85th percentile NZ parking rates, which is consistent with the comparison of the average parking rates.

It should be noted that some of the sample sizes within the 1000 m^2 GFA bands were very small and the 85th percentile parking demand rates used in this assessment should be periodically assessed when new surveys are added to the databases.

3.2.8   Retail trips and parking related to employment

All sites include GFA as the common explanatory variable. Figures 3.1 to 3.11 illustrate that GFA is a good parameter for estimating trips and parking rates for both the UK and NZ. Some sites also have other parameters such as employment, population catchments etc., and these have also been tested for their performance as independent variables.

As an alternative to GFA, numbers of employees were examined to determine whether this can be reliably used for predicting trips and parking rates. The explanatory variable 'employees' was selected because it is reasonable to assume that employee numbers provide a measure of the attractiveness of the shopping activity in terms of business or turnover. Figures 3.12 and 3.13 illustrate the relationship that employee numbers were found to have with retail peak trips and parking rates.
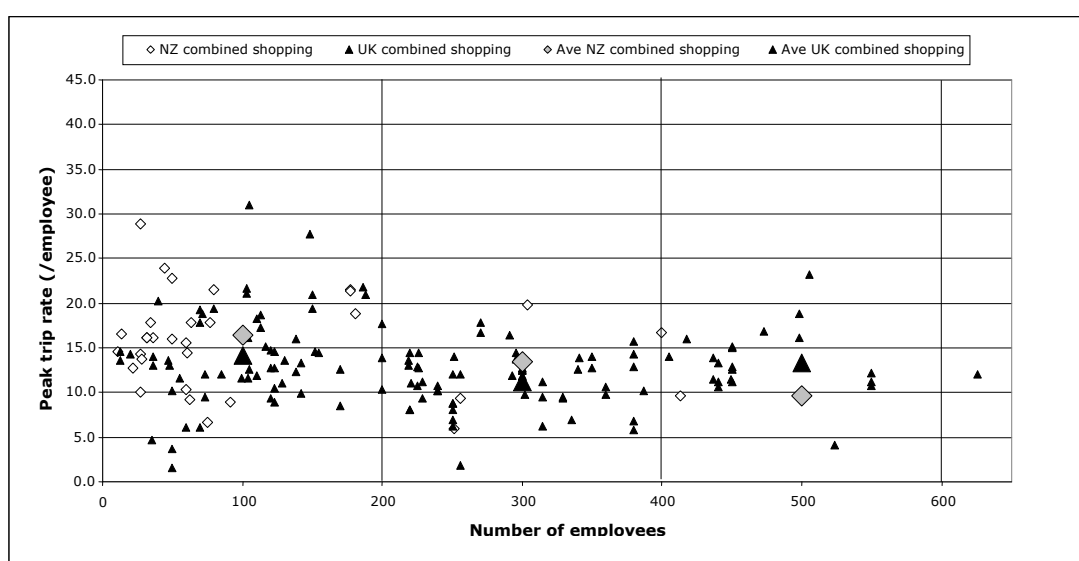
Figure 3.12 Comparison of UK and NZ trip rate per employee – retail.

Table 3.9   Average trip rate per employee for the UK and NZ.

Staff	NZ			UK		
	n	Ave	Sdev	n	Ave	Sdev
1–200	23	16.35*	4.89	55	14.21*	5.34
201–400	3	13.43	6.63	46	11.22	3.06
401–600	1	9.6	–	20	13.36	3.69

As can be seen from Figure 3.12, the use of employee numbers as an explanatory variable results in a comparable relationship of trip rate/100 m^2 v. employee numbers for each country. The figure indicates that NZ retail activities generate around two trips per employee more than the UK sites for outlets that employ up to 400 staff. The different relationship for outlets that have in excess of 400 staff is influenced by the fact that the NZ data include only one site in this segment.

Although the two sets of data share common trends with regard to peak trip rates and employee numbers, it can be seen that the trip rates are relatively constant when related

to the number of staff employed at an outlet. Therefore staff numbers are not good predictors of peak trip generation rates. The relationship between parking demand rate and number of employees is shown in Figure 3.13.

Figure 3.13 Comparison of UK and NZ parking rate v. employees – retail.

Table 3.10   Average parking rates per employee for the UK and NZ.

Employees	Combined NZ			Combined UK		
	n	Ave	Sdev	n	Ave	Sdev
1–100	23	1.91	0.78	20	2.28	1.09
101–300	4	1.62	0.51	70	1.43	0.41
>300	3	0.93	0.44	36	0.8	0.5

The NZ and UK datasets both share a similar pattern of decreasing parking rates with increasing employee numbers. The 1–100 employee range shows that NZ parking rates are around 0.5 parking spaces per employee higher than their UK counterparts for the same employee group. Outlets that employ more than 100 staff show that the UK has marginally higher average parking rates in comparison to NZ. This change in relationship for the larger employee ranges may be caused by a smaller number of NZ sites that relate to establishments employing over 100 staff. The differences between the means of each dataset are not statistically significant.

3.2.9   Effect of size of retail outlet on parking duration

The Steering Group and peer review members suggested that that further surveys that collect additional trip information including visitor-stay duration, modal split, car occupancy, and identification of primary and secondary catchments would result in improved:

- explanation of variations in parking demand,
- selection of explanatory variables, and
- conditions of planning consent for land use developments.

An example of site specific predictive models based on additional site data was illustrated by data collected in 1992 by the Waitakere City Council for a small fruit-and-vegetable outlet, a local mall and a regional mall. Table 3.11 sets out the information collected at these three sites.

Table 3.11   Trips and parking information collected by Waitakere City Council.

Establishment	GFA (m^2)	In-trip+ out-trip (veh/hr/100 m^2)	Visit-duration (min)	Parked (#/100 m^2)
Regional mall	32 740	10.4	60	5.2
Local mall	6,230	21.7	30	5.4
Fruit-and-vegetable	355	48.4	8	3.3

The data show that the greater the size of the establishment, the fewer the trips per GFA and the higher the visit duration. This can be explained by more visitor shopping purposes being satisfied per trip, which leads to more time spent within the site. A link can be established between visit duration, trip generation rates and parking demand.

3.2.10 The effects of an on-site PFS on retail trip rates

During the data selection process, UK sites which included a PFS were excluded from the analysis, since such sites were considered likely to differ significantly from other sites in terms of their overall trip generation rates. The validity of this assumption was tested; Figure 3.14 illustrates the effects that a PFS has on trip generation rates.

Figure 3.14 demonstrates that UK sites which include PFS can be expected to generate higher trip rates per 100 m^2 GFA. For UK sites with a PFS, trip rates may be as much as 5 trips per 100 m^2 GFA more than non-PFS sites and typically 2 trips per 100 m^2 higher than the NZ sites. The figure also shows that the difference in trip rates reduces as GFA increases and establishes that in future databases, retail facilities with PFS should be considered as a different land use from retail facilities which do not have an associated PFS.
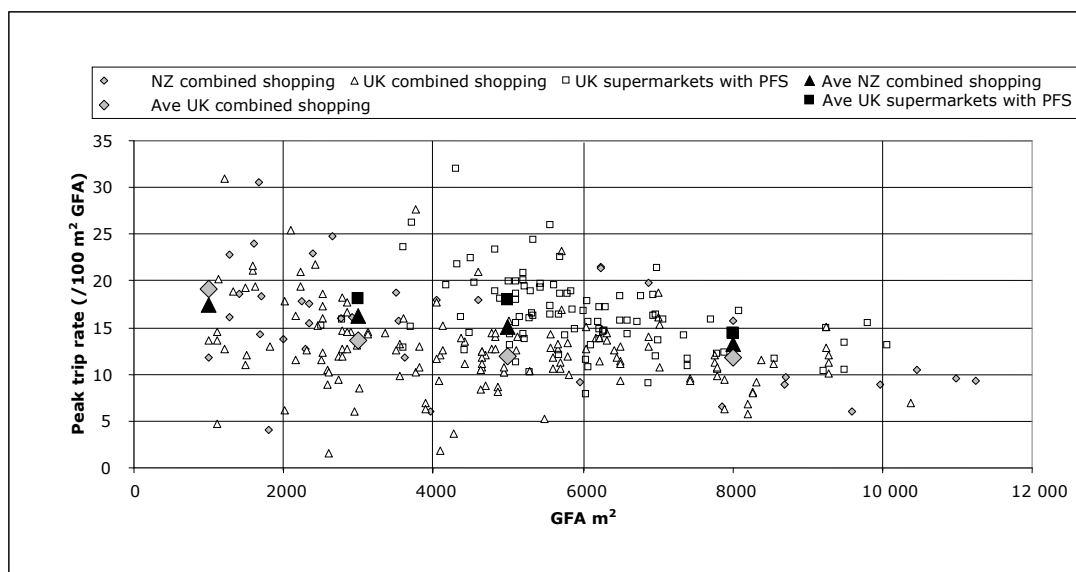
Figure 3.14 Comparison parking trip rates of UK retail sites, UK retail sites with a PFS and NZ retail sites.

Table 3.12   Average trip rates for NZ retail sites, UK retail sites and UK outlets with a PFS.

GFA (m²)	NZ			UK			UK + PFS		
	n	Ave	Sdev	n	Ave	Sdev	n	Ave	Sdev
1–2000	9	17.40	7.32	17	19.12	9.64	6	–	–
2001–4000	13	16.3	4.91	47	13.62	4.94	6	18.14	5.41
4001–6000	3	15.04	5.02	50	11.97	3.58	47	17.96	3.98
6001–10 000	8	13.19	6.43	43	11.75	2.78	40	14.37	2.83

3.2.11 The effects of population catchment on vehicle trip rates

Population catchments are included in the TRICS database. Therefore, it was possible to assess the influence of population catchment within a one-mile radius of each UK site on average trip rates. This was undertaken by determining an average trip rate associated with a particular population band, as illustrated in Figure 3.15.

The assessment indicated that the majority of sites associated with a population catchment of 5000–10 000 tended to be higher trip generators per unit of floor area, while the majority of sites associated with a population catchment of 1000–5000 and 5000–100 000 people tended to be lower trip generators.

With regards to the other population catchments, no pattern emerges that can assist in determining whether population within a one-mile radius is a reliable explanatory variable for overall rates of trip generation. Population catchments within a lower band such as a 500-metre radius may be more instructive, as this walking distance may be more acceptable to shoppers.

Although not tested in this report, other factors such as local demographics, proximity to competing outlets, parking availability, road accessibility and road network capacity would probably have an influence on the trip generation rates associated with each retail outlet.
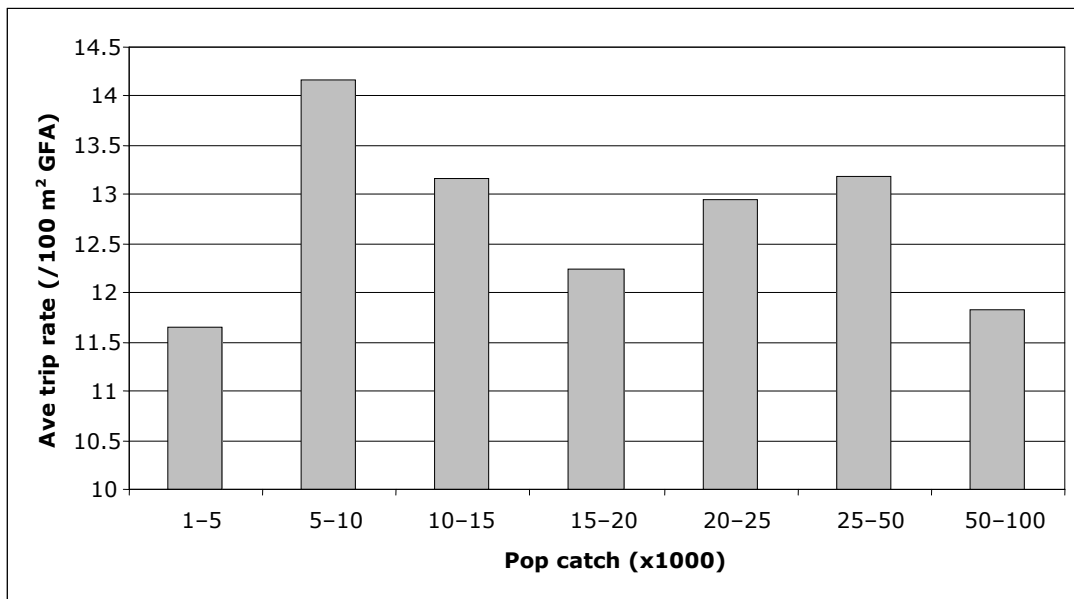
Figure 3.15 Average trip rate by population within one mile of retail outlet.

3.2.12 General observations on retail analysis

The results of comparing NZ and UK shopping centres indicates the following:

- Overall, trip generation rates and parking demand patterns tend to coincide between the UK and NZ datasets.
- This observation applies to analyses based upon both the average and 85th percentile values.
- No statistically significant difference in mean trip rates is seen between shopping centres and supermarkets; hence, these two retail groups can be combined.
- Both combined UK and NZ datasets indicate a greater degree of variability in trip generation rates for smaller centres.
- Trip rates consistently decline with increasing floor area, with the rate of decrease being greatest for the smaller shopping facilities.
- The UK retail outlets appear to generate higher trip rates then the NZ sites for outlets of between 2000 m^2 GFA and 6000 m^2 GFA;
- In general, UK sites in large conurbations generate marginally lower trip rates than retail sites located elsewhere in the UK. However, the difference in the average trip rate is not statistically significant between the 2000 m^2 GFA and 6000 m^2 GFA range.
- The analysis confirms the trend of reducing trip generation rates occurring with increasing floor area. It also shows that the rate of change (decline) in trip generation is greatest between the smaller shopping groups less than 2000 m^2 in area.
- A comparison between GFA and parking demand indicates a close relationship between the retail parking demands of NZ and the UK. In contrast to the variation in trip rates, which decline significantly with larger floor areas, the average trend lines for parking demands remain relatively constant throughout the range of centre sizes in both countries.

- In general, the UK's retailing activities generate a parking demand that is two vehicles higher than the NZ retailing activities; this difference is statistically significant. This difference could be attributed to the UK centres accommodating a wider range of activities, or to the fact that parking is more limited in the UK than in NZ – shoppers in the UK park up and undertake a visit to more than one retail outlet or undertake other business in combination with their retail trip.
- The parking demands associated with both NZ and UK were based on total on- and off-street parking associated with the surveyed sites. This addresses any differences in parking demand associated with sites having a limited on-site parking provision.
- The use of maximum standards in the UK may have some influence in the parking rate differences between the two countries. However, on-site and off-site parking demand associated with each retail outlet was recorded and used in the analysis, thus limiting this as a factor that influenced the differences observed.
- Retail outlets that include a PFS display higher trip rates than retails sites with no PFS.
- The relationship between trip rate and the size of population within a one-mile radius of a retail outlet is not strong, potentially because of other key influences, such as demographics, proximity to competing outlets and ease of access by car to the sites.

3.3   Service stations, restaurants, fast food outlets.

3.3.1   Service stations: sample size

The service stations used in the analysis are stand-alone fuel sale establishments that are not integral with a larger retail activity. Typically, these outlets are characterised by the brands of fuel sold, e.g. Shell and BP.

The explanatory variable used in this land use is number of filling bays. This is defined as a position where an individual vehicle can refuel. Typically, two filling bays can be occupied in relation to one pump.

The maximum trip generation rates associated with each site have been sought from both datasets to ensure a like-for-like comparison. The initial UK sample size was around 32 surveys. However, to eliminate any bias, only the busiest surveys from a particular site were selected. This reduced the sample for the UK sites to 26, collected between 2002 and 2006.

The NZ database contains ten site surveys conducted between 1992 and 1996. Applying the same selection criteria to the NZ dataset resulted in a total of eight sites being available for the analysis. The NZ surveys are more dated than the selected UK surveys and in recognition of the introduction of convenience retail and coffee/snack sales attached to filling stations, a check on the difference in trip generation over time was made. Using an eight-bay forecourt format, which is the most common layout, and selecting UK surveys that dated between 1992 and 2006, no discernible difference in trip

generation rates was noted for this land use over time. Therefore, in the absence of NZ data that contradict this trend, it has been assumed that trip rates for filling stations over time have remained constant in NZ and it was considered appropriate to include the older NZ data in the comparisons with the more recent UK surveys.

It was found that sites used particular forecourt layouts generally operating on formats of 8, 10 or 12 filling bays. When analysing the relationship between the number of filling bays and the corresponding trip generation rates, it was found that the trip rate values would cluster around the corresponding number of filling bays, resulting in a series of points that formed vertical columns within the chart. This is illustrated in Figure 3.16.
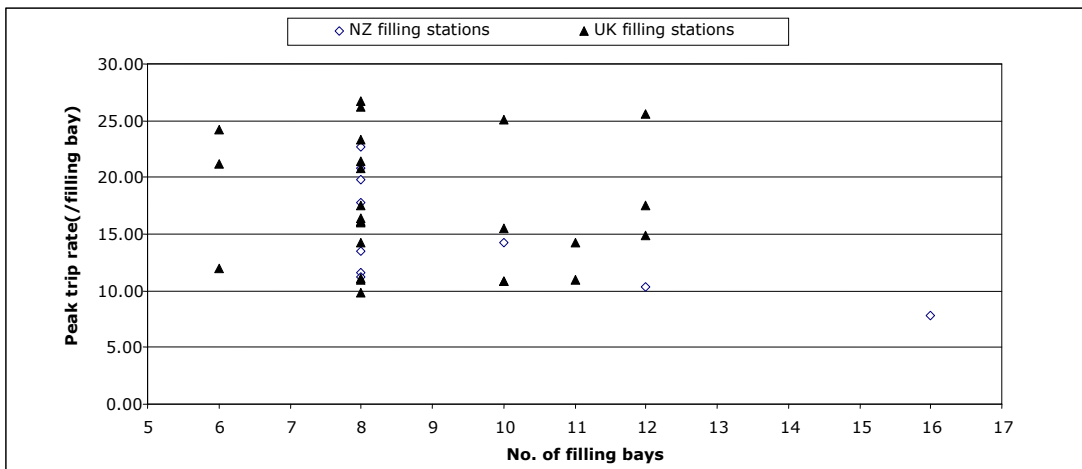
Figure 3.16 Comparison of UK and NZ peak trip rates at service stations.

While this highlighted the variability of trip rates associated with a particular forecourt layout, it was necessary to average the trip rates corresponding to the number of filling bays to enable trends to be established and compared.

For both the UK and NZ, an eight-bay format was the most common layout, representing over 55% of the dataset. The 12- and 16-bay layouts associated with the NZ dataset are represented by only one site each.
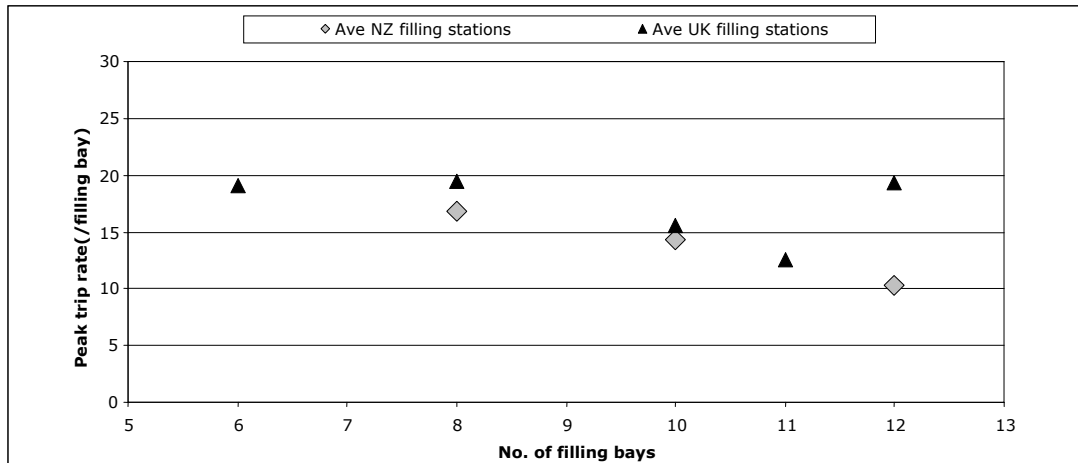
Figure 3.17 Comparison of UK and NZ average peak trip rates – service stations.

Figure 3.17 shows the relationship between the average trip generation rate and the corresponding number of filling bays for both the UK and NZ sites. The figure shows that for both sets of data, in general, an increase in the number of filling bays corresponds to a reduction in the peak trip rate per filling bay, which appears to be logical as the demand for the fuel pumps is spread over more filling bays. The exception to this appears to be the UK 12-bay arrangement, which shows an increase in trip generation rates compared to filling station formats that have fewer filling bays.

The figure also shows that generally, the relationship between trip rates and the number of filling bays for the NZ data is linear. Around 17 trips per filling bay are associated with the most common eight-bay format for NZ and around 19 trips per filling bay for the equivalent UK eight-bay format. With the exception of the eight-bay format, the relationships and average values shown should be treated with caution, given the low sample sizes used.

The high turnover nature of filling stations is such that a maximum parking demand cannot be deduced from the arrival/departure profile that the UK database provides. The NZ dataset contains three sites that include on-site parking demand ranging from 11–23 parked vehicles. However, it is not clear whether these are associated with vehicles dwelling at the filling bays paying for fuel or purchasing other goods.

3.3.2   Restaurants

Following screening for relevant variables and selection of only the busiest survey from each site, six NZ sites, surveyed between 1993 and 1995, were included in the analysis. These sites were included in the 'bar and restaurant' land use category and characterised by establishments such as Pizza Hut, Sizzlers and other brands.

Ten sites were selected from the UK TRICS database based on the same selection procedure. These included establishments such as Pizza Hut, TGI Fridays, and Thai and Chinese restaurants. One UK site (Jefferson's Restaurant, Solihull WM-06-B-01) was excluded because of its exceptionally high parking provision and subsequent usage.
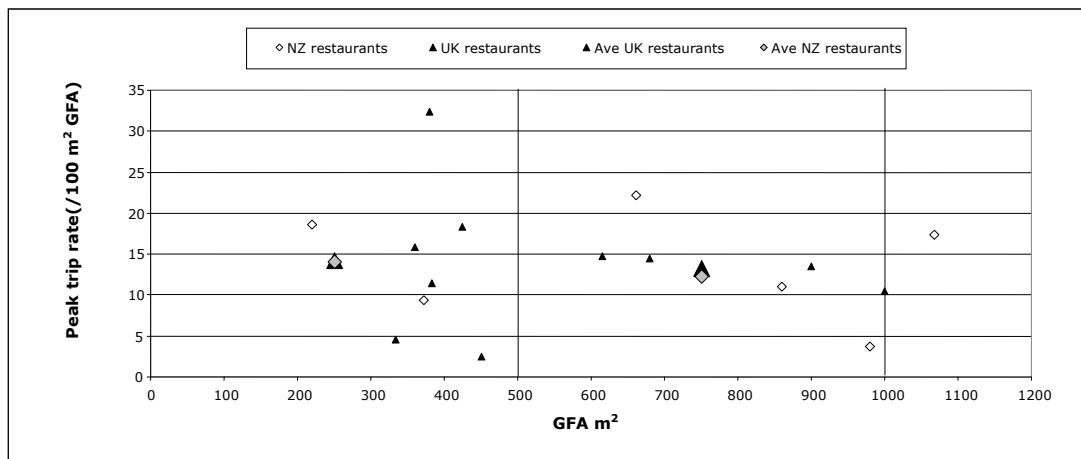
Figure 3.18 Comparisons of NZ and UK restaurant vehicle trip rates.

Table 3.12   Average peak retail trip rates for UK and NZ.

GFA (m^2)	NZ			UK		
	n	Ave	Sdev	n	Ave	Sdev
1–500	2	14.00	6.51	6	14.16	10.86
501–1000	3	12.30	9.32	4	13.29	1.94

Figure 3.18 shows a close comparison between the datasets for this land use activity, with a peak hour trip rate that lies between 14 and 16 trips per 100 m^2 GFA for both NZ and the UK. This is based on data that are evenly spread throughout the GFA range of 200–1000 m^2. A marginal decrease in the average peak trip rate values can be seen in relation to an increase in GFA, and a higher variability of trip rates is associated with the lower GFA sites in the UK. The difference between the means is not significantly different at the 90 percent confidence level.
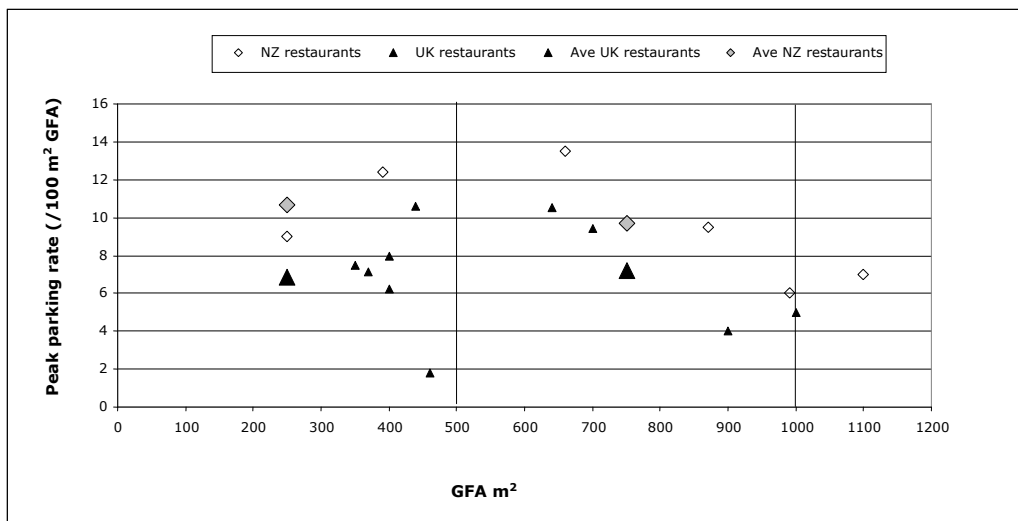
Figure 3.19 Comparison between UK and NZ parking rates for restaurants.

Table 3.13   Average peak parking rates for UK and NZ restaurants.

GFA (m²)	NZ			UK		
	n	Ave	Sdev	n	Ave	Sdev
1–500	2	10.70	2.40	6	6.87	1.66
501–1000	3	9.67	3.75	4	7.23	3.20

Figure 3.19 shows that the majority of sites display peak parking demand rates that lie between 6 and 10 spaces per 100 m². Figure 3.19 and Table 3.13 show that the NZ sites display parking demand rates that are generally higher than the UK sites. This difference in parking rates is around 4 parked vehicle per 100 m² GFA for sites under 500 m² GFA and reduces to a difference of around 2.5 parked vehicles per 100 m² GFA for sites over 500 m² GFA. A statistical test indicates that the difference between the means of each dataset is not statistically significant. The sites selected range in size from around 200 m² to around 1100 m² GFA, with the NZ sites fairly evenly distributed throughout the dataset. The majority of the UK sites tend to lie within the lower GFA range.

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3.3.4   **Fast food outlets**

Screening of the survey sites for appropriate variables resulted in only four NZ surveys
recorded between 1993 and 1995, and nine UK sites collected between 1999 and 2007
being used for the analysis. These sites are characterised by establishments such as KFC
and McDonalds in New Zealand, and predominantly McDonalds in the UK. All the sites
included had a counter, a drive–through, and some restaurant tables and seating. The
number of visits to these types of 'service' is not recorded.
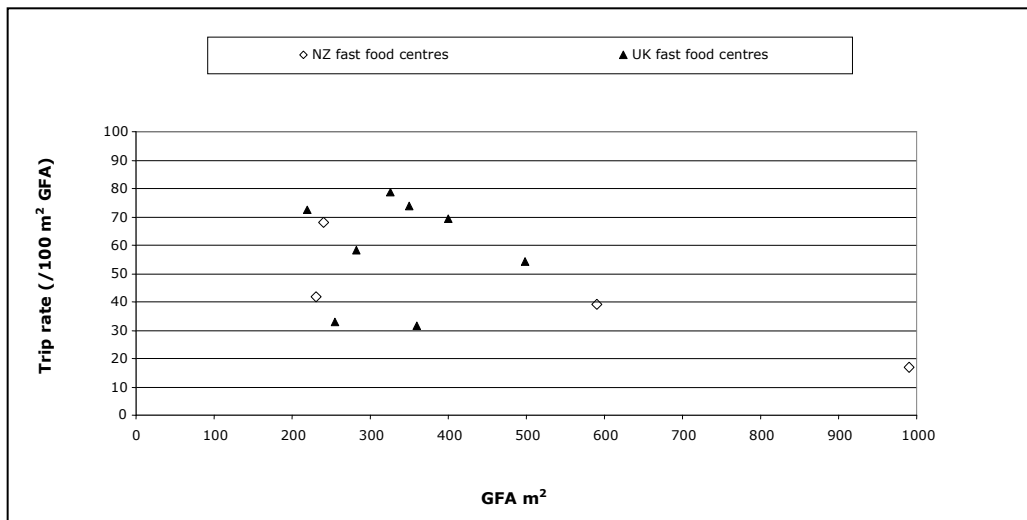
Figure 3.20 Comparison of NZ and UK trip rates v. GFA for fast food outlets.

Figure 3.20 shows that both datasets share a common negative trend of decreasing trip
rates as GFA increases. UK sites display trip generation rates that are generally higher
than the NZ sites, and this difference is maintained throughout the range of GFAs. Most of
the sites lie in the range of 200–500 m^2 GFA. It should be highlighted that the
comparisons are based on low sample sizes and therefore the relationships illustrated in
Figure 3.20 may not be reliable.

The peak parking rates associated with fast food outlets have also been examined and are
illustrated by Figure 3.21.
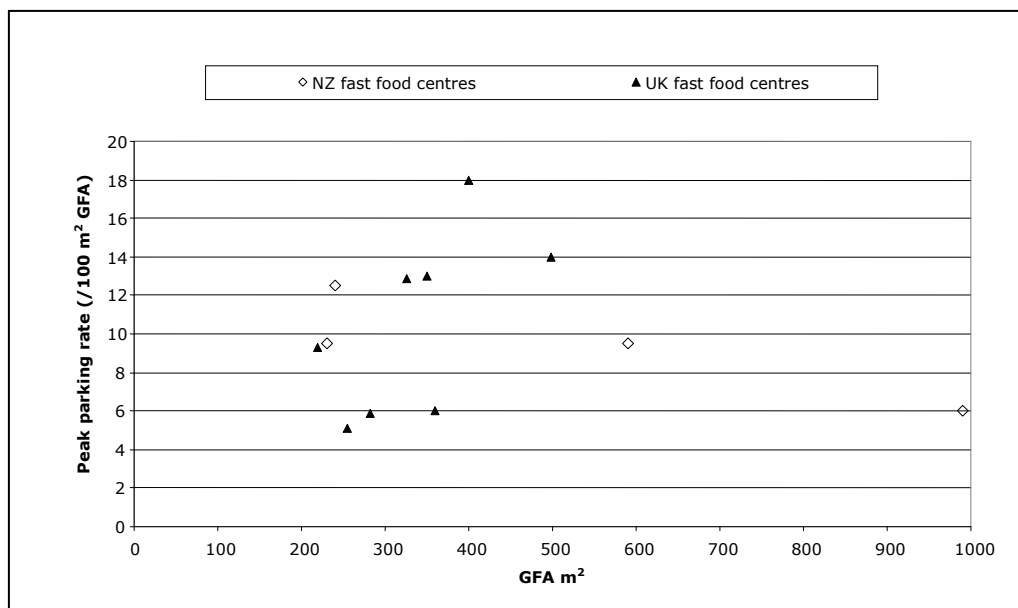
Figure 3.21 Comparison of NZ and UK parking rates v. GFA for fast food outlets.

This suggests that the parking demand rates associated with the two datasets have nothing in common. This arises from the low sample sizes and differences between the characteristics of these fast food outlets in both countries.

3.3.5   General observations on parameters

Restaurants: GFA per 100 m^2 was used as the explanatory parameter for the restaurant and fast food trips and parking rates. This variable was common to both the NZ and UK databases. Given that trip rates change little in relation to GFA for both sets of data, it can be concluded that GFA is not a strong predictor of trip rates for this land use. Average trip generation rates from each country overlap greatly, with a large variability around these average points. It would therefore be instructive to compare the datasets using variables such as number of employees or number of seats; these variables could be consistently collected for these land use activities in the future.

PFSs: The number of filling bays also appears to be a reasonable parameter for estimating peak hour trip rates for service stations, with the eight-bay format representing the most common layout, which generates between 17–19 peak hour trips per filling bay for both countries. However, service stations may also include a variety of car-related product sales, food/grocery items and, in some instances, internet facilities. The proportion of area dedicated to these ancillary services should also be recorded in future surveys.

Fast foods: The analysis of the fast food outlets indicates the UK sites generally have higher peak trip rates. This difference may be generated by the popularity of such facilities in the UK, coupled with denser population catchments and higher pass-by traffic flows. Different types of fast food outlets appear in the survey, with some including drive-through facilities and others operating more in the style of a café/restaurant. These

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differentiating features and characteristics need to be identified in future surveys, with seat numbers and GFA recorded within the survey results.

The analysis of the restaurant and fast food outlets in particular are based on small sample sizes and 'flag' the need to undertake more surveys for these land use activities.

3.4   Business parks, manufacturing and warehousing

3.4.1   Business parks

In TRICS, a large dataset is available for the 'Business Park' classification. This includes details with respect to the GFA, employee numbers, parking provision, trip generation and parking demand. After the removal of duplicate sites and old (pre-1994) data, observations relating to 21 sites remained. Of these, 19 included information on GFA, employee numbers and parking provision, and two included GFA information exclusively.

For the NZ dataset, six surveys with associated trip rates were classified as Office Parks. Following the removal of duplicate surveys, four sites were available for the analysis. The resulting peak hour trip rate correlation is shown in Figure 3.22.
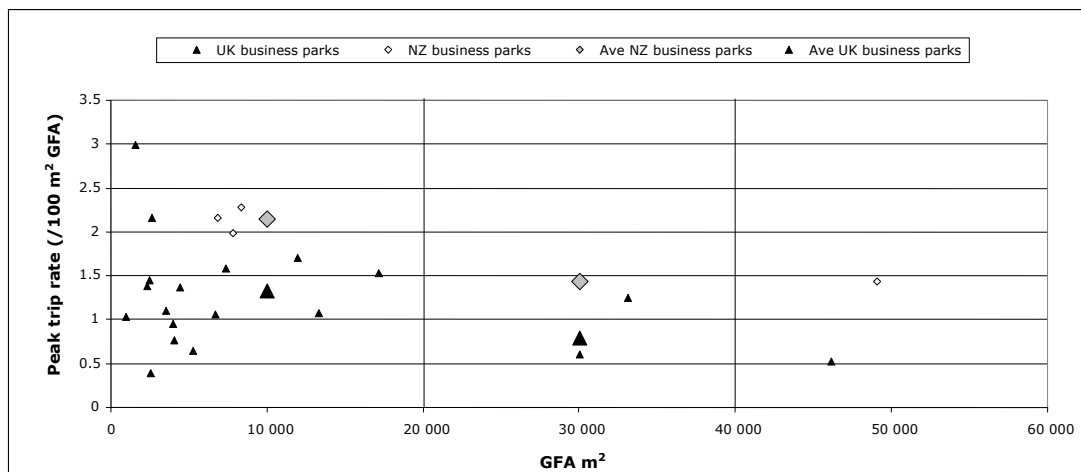
Figure 3.22 Comparison of NZ and UK trip rates v. GFA for business parks.

Table 3.14   Average peak trip rates for UK and NZ business parks.

GFA (m^2)	NZ			UK		
	n	Ave	Sdev	n	Ave	Sdev
1–20 000	3	2.14	0.15	16	1.32	0.62
20 001–60 000	1	1.44	–	2	0.79	0.40

Although the NZ data are limited, it is apparent from Figure 3.22 that both sets of data share a similar trend and that peak trip rates for business parks in NZ are higher than their UK counterparts by a factor of around 0.8 trips per 100 m^2 GFA.

While it is recognised that the NZ data are limited, the relationship between the two datasets suggests that it may be appropriate for NZ practitioners to accept UK trip

generation rates (increased by a factor of +0.8 trips per 100 m² GFA) for sites in excess of 5000 m² GFA as a guide to average trip rates for this activity in NZ. For design, an 85th percentile figure should be calculated from TRICS and the TDB database.

Parking demand data for the NZ business parks are further limited, with only two NZ sites included within the database that include parking demand data. A comparison cannot therefore be undertaken for the NZ data. However, Figure 3.22 sets out the relationship between parking demand rates and GFA for the UK data, and includes the parking demand rates associated with the limited NZ data.
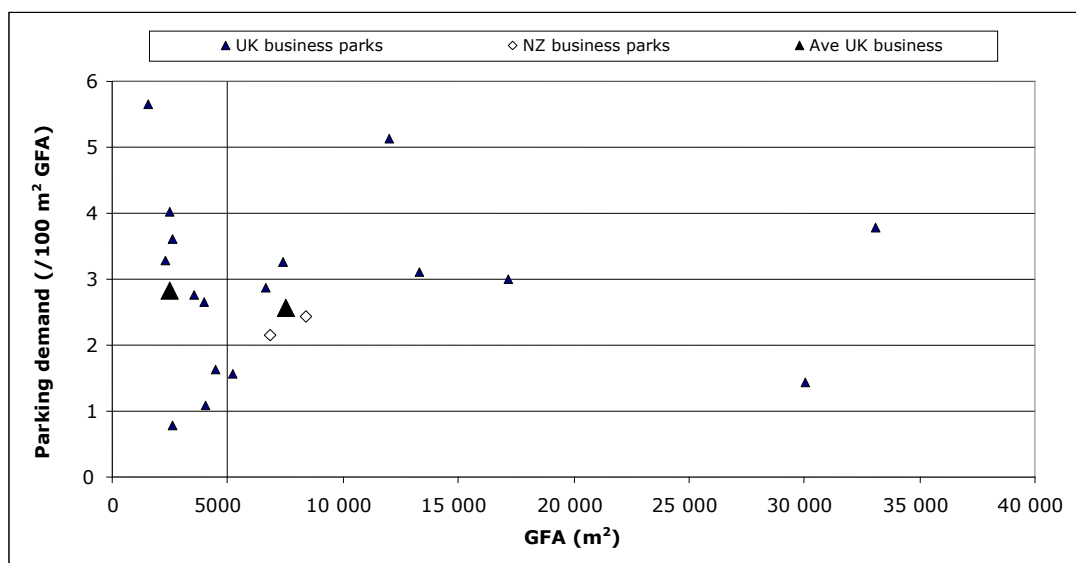
Figure 3.23 Comparison of NZ and UK parking rates v. GFA for business parks.

Table 3.15   Average UK parking rates for business parks.

GFA (m²)	Ave	Sdev
1– 5000	2.83	1.54
5001–10 000	2.56	0.89

Figure 3.23 shows that the NZ sites are nestled within the range of data points associated with the UK data. Given this and the similarities in trip making patterns illustrated in Figure 3.22, it may be justifiable to extrapolate the UK data to predict the parking demand rates associated with business parks in NZ. Again, with more surveys, a stronger relationship could be shown. However, given the low number of data samples, caution should be used in the application of the TRICS information to predict NZ circumstances. This analysis clearly shows that more data are required for this land use activity within NZ.

3.4.2 Alternative parameters

Figures 3.24 and 3.25 illustrate the relationship between trips and parking rates using employee numbers as a parameter.
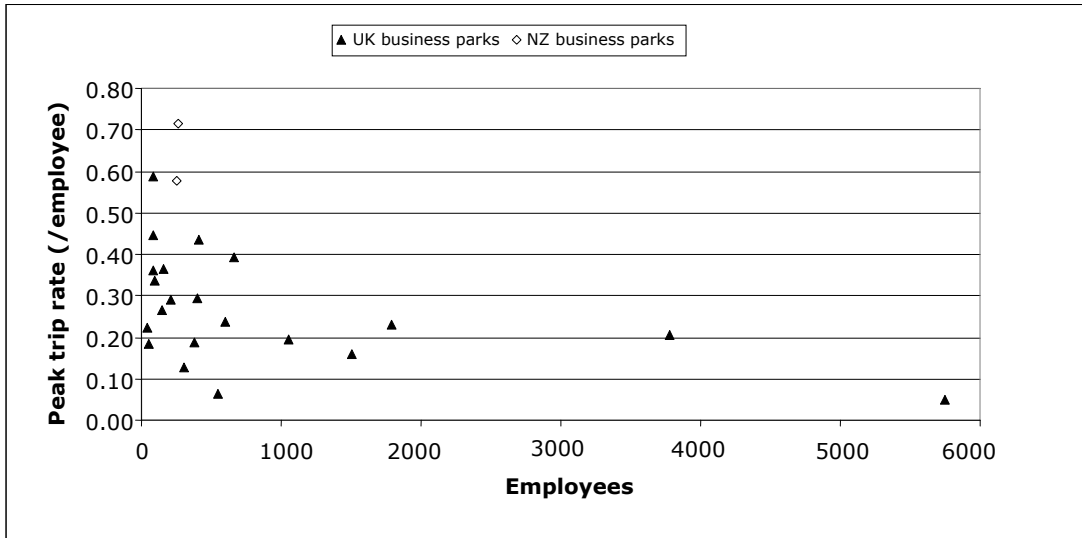
Figure 3.24 Comparison of NZ and UK trip rates v. employees for business parks.
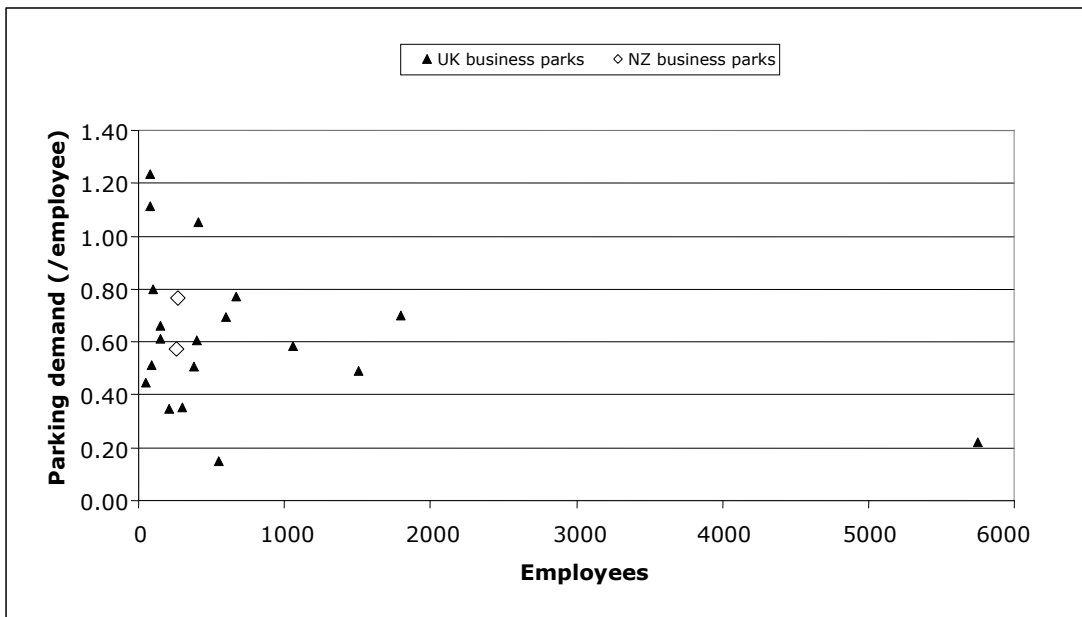
Figure 3.25 Comparison of NZ and UK parking rates v. employees for business parks.

The use of employee numbers as a parameter for establishing both trips and parking rates does not improve the results established from GFA. Clearly, more NZ data are required to be able to establish and compare the trip generating and parking characteristics with UK equivalents. In most situations faced by practitioners, GFA is known but the future number of staff is not. Therefore it is recommended that the relationship established by using GFA as the explanatory variable is preferable.

3.4.3   Manufacturing

TRICS does not have an individual manufacturing classification. Instead, the 'industrial unit' category was used. This refers to single-building industrial premises but does not include storage or warehousing. The industrial unit category included data on the GFA, number of employees, parking provision, parking demand and trip rate. A total of 19 entries were found, of which 17 had employee and parking provision data. The UK sites range in size from 600 to 44 000 m^2 GFA.

After duplicate survey sites were removed, 11 NZ manufacturing sites were available for the analysis. Two of the sites displayed extremely high trip rates and, on closer inspection, these sites were located within close proximity to Auckland International Airport and were identified as being service establishments for airport activities. It was considered that this had a significant influence on the operation and trip generation of these sites, so they were subsequently excluded from the analysis. The similar trip and parking trends for NZ and UK manufacturing shown in Figures 3.26 and 3.27 illustrate that GFA can represent a reasonable parameter for this land use. The NZ sites range in size from 280 to 5000 m^2 GFA. A significant proportion of the UK sites exceed 5000 m^2 GFA.

Given the variation on GFA for each database, for clarity, the scale on the x axis has been reduced to a maximum of 10 000 m^2 GFA in Figure 3.26.
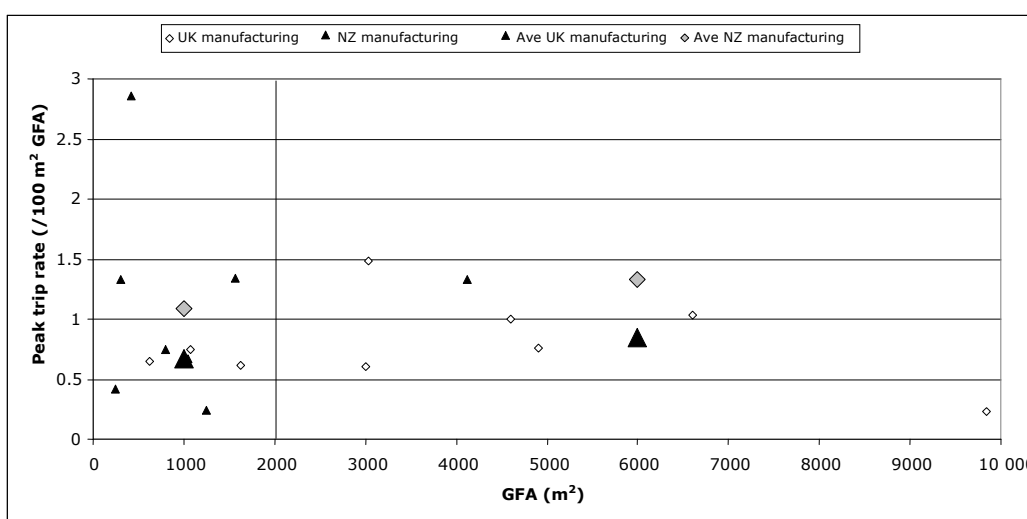
Figure 3.26 Comparison of NZ and UK trip rates v. GFA for manufacturing.

Table 3.16   Average NZ and UK trip rates for manufacturing.

GFA (m^2)	NZ			UK		
	n	Ave	Sdev	n	Ave	Sdev
1–2000	7	1.09	0.89	3	0.67	0.07
2001–10 000	1	1.33	–	7	0.85	0.43
>10 000	–	–	–	10	0.41	0.38
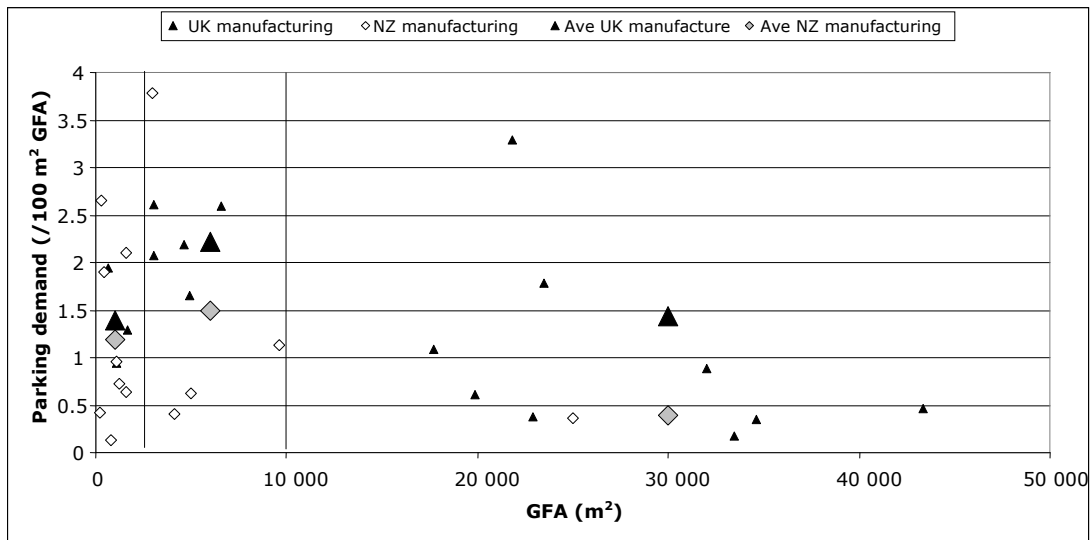
Figure 3.27 Comparison of NZ and UK parking rates v. GFA for manufacturing.

Table 3.17   Average NZ and UK parking rates for manufacturing.

GFA	NZ			UK		
(m²)	n	Ave	Sdev	n	Ave	Sdev
1–2000	8	1.19	0.91	3	1.39	0.51
2001–10 000	4	1.49	1.38	5	2.22	0.40
>10 000	2	0.40	0.04	9	1.44	1.01

Figures 3.26 and 3.27 indicate a degree of comparability, with the NZ manufacturing sites displaying trip rates that are generally 0.5 trips per 100 m² GFA higher than the UK counterparts. The parking rates are higher for the UK data. The trip rate for NZ manufacturing ranges from 1.0 to 1.5 trips per 100 m² GFA, while that for UK manufacturing ranges from 0.5 to 1.0 trips per 100 m² GFA. The NZ parking rate for manufacturing ranges from around 0.5 to 1.5 spaces per 100 m² GFA, with the corresponding range for the UK parking rate being around 1.5 to 2.0 spaces per 100 m² GFA.

An alternative parameter variable of 'employee numbers' was also tested. However, this did not give an improved relationship for either trip generation or parking rates. This could be because of the significant variations in the extent to which differing manufacturing processes are labour or capital intensive.

3.4.4 Warehouses

TRICS has two different warehousing provisions – commercial and storage. The commercial category was selected, as the NZ data appear to relate to commercial warehousing and not to simple individual storage facilities. Fifteen sites were found in TRICS (after rejecting repetitions), ten of which had employee and parking data available.

Five similar sites were found in the NZ data base with all of them including parking provision, employee and GFA data. The comparison between these and the TRICS data is shown below in Figures 3.28 and 3.29.
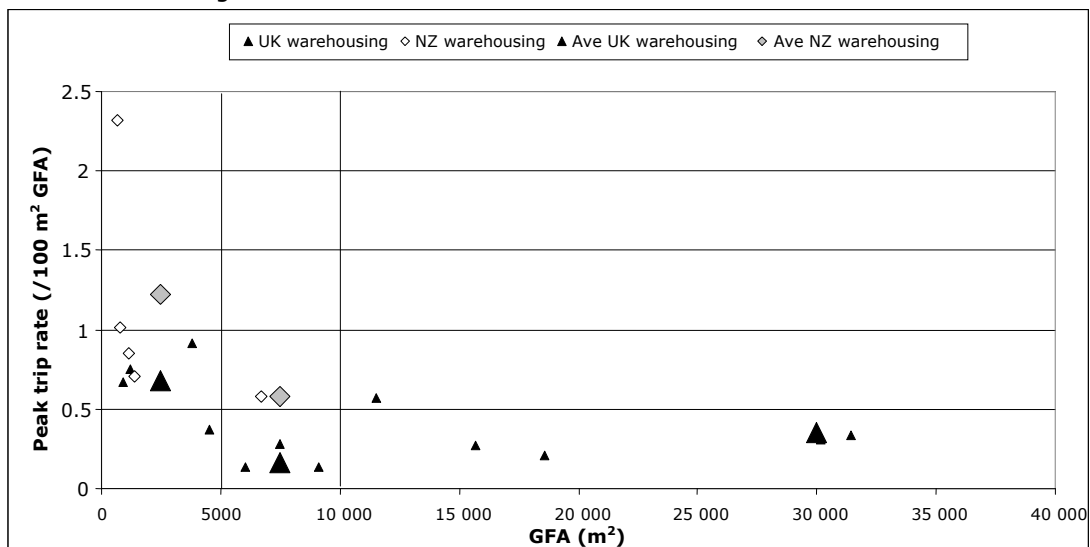
Figure 3.28 Comparison of NZ and UK trip rates v. GFA for warehousing.

Table 3.18   Average NZ and UK trip rates for warehousing.

GFA	NZ			UK		
(m²)	n	Ave	Sdev	n	Ave	Sdev
1–5000	4	1.22	0.74	4	0.68	0.23
5001–10 000	1	0.58	–	5	0.16	0.07
>10 000	–	–	–	7	0.35	0.14

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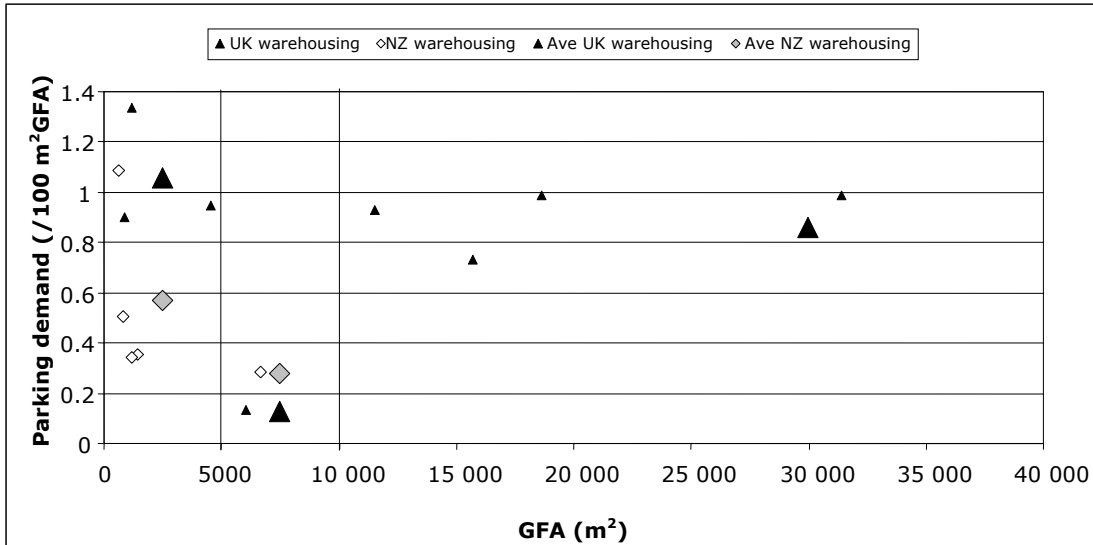
Figure 3.29 Comparison of NZ and UK parking rates v. GFA for warehousing.

Table 3.19   Average NZ and UK parking rates for warehousing.

GFA (m²)	NZ			UK		
	n	Ave	Sdev	n	Ave	Sdev
1–5000	4	0.57	0.35	3	1.06	0.24
5001–10 000	1	0.28	–	1	0.13	–
>10 000	–	–	–	5	0.86	0.15

As can be seen, the differences in floor areas of the NZ and UK datasets are substantial, with the NZ data showing a maximum floor area of just over 5000 m² GFA, while the UK data contain sites in excess of 10 000 m² GFA. This difference in floor area is likely to reflect the different type of warehousing operations. Figures 3.28 and 3.29 indicate a degree of comparability, with the NZ warehousing sites displaying trip rates that are generally one trip per 100 m² GFA higher than the UK counterparts. The average values of the peak parking rates for NZ and UK do not display any obvious similarities. Given the small sample sizes associated with both datasets, it is inappropriate to make any comparisons between them.

No apparent comparable relationship was established by using employees as an alternative explanatory variable.

3.4.5   General observations on employment analysis

Some similarity can be seen in the relationship between peak trip generation rates and GFA for NZ and UK business parks and, to a lesser extent, for warehouses for both countries. Parking similarities were less well defined, although the manufacturing analysis illustrated a similar relationship between peak trip generation and GFA occurring between the two countries.

No strong evidence suggested that employee numbers provide a suitable explanatory variable. The other comparisons can neither be confirmed nor dismissed, according to the datasets available. This is primarily because of the small dataset that was available (both in size and range of GFA) from the NZTPD.

In general, where sufficient data exist, the comparison indicates that NZ has higher trip rates but lower parking demand rates than the UK sites for the land use activities tested in this section. The lower parking demand rates may be attributed to lower parking provision and/or a different mode split in the UK. However, further analysis would be required to verify this.

3.5   Medical centres

In TRICS, a medical centre is defined as a 'clinic'. Sites falling within this definition included data on GFA, employee numbers, trip rate and parking demand. Parking provision or supply was not recorded. This resulted in a total of six sites for comparison. General Practitioners' (GP) surgeries were also considered to form part of the dataset for medical centres.

The NZ 'medical centres' category also has six sites. All but one also included the number of employees and parking demand. The comparisons are shown in Figures 3.30 and 3.31.
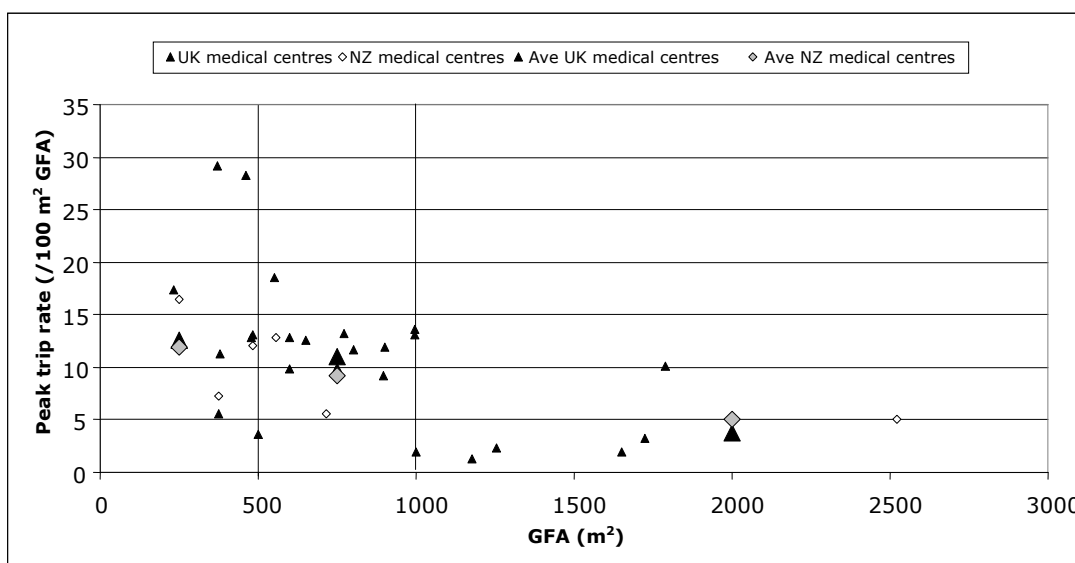
Figure 3.30 Comparison of NZ and UK trip rates v. GFA for medical centres.

Table 3.20   Average NZ and UK trip rate for medical centres.

GFA (m²)	NZ			UK		
	n	Ave	Sdev	n	Ave	Sdev
1–500	3	11.87	4.6	8	12.58	7.67
501–1000	2	9.18	5.07	12	11.08	4.19
>1000	1	5.07	–	5	3.78	3.61
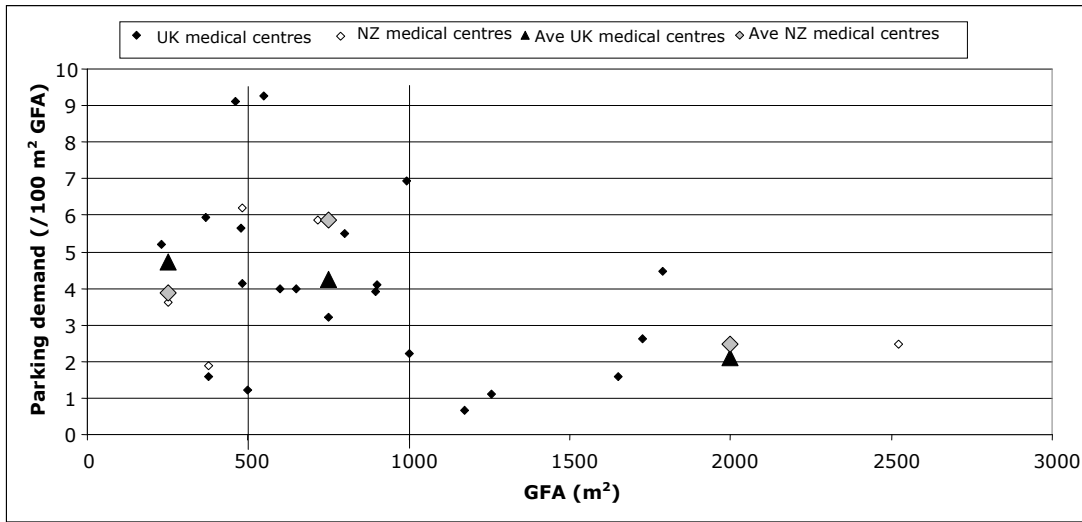
Figure 3.31 Comparison of NZ and UK parking rates v. GFA for medical centres.

Table 3.21   NZ and UK average parking rates for medical centres.

GFA (m²)	NZ			UK		
	n	Ave	Sdev	n	Ave	Sdev
1–500	3	3.89	2.19	7	4.73	2.97
501–1000	1	5.87	–	8	4.23	1.43
>1000	1	2.46	–	5	2.09	1.51

For the trip rate comparison, some similarity exists between the two sets of data, with both exhibiting a trend of declining peak trip rates with increasing floor area. Figure 3.30 indicates that the UK medical centres exhibit marginally higher trip generation rates for sites below 1000 m² GFA. However, it is recognised that the analysis is based on a small sample size. Some similarity in parking rates can be seen for each country but again, given the small sample size, it is not appropriate to speculate upon why the differences exist and the results need to be treated with caution.

Figures 3.32 and 3.33 illustrate the trips and parking rates per employee using employee numbers as the explanatory variable.

Figure 3.32 Comparison of NZ and UK trip rates per employee for medical centres.

Table 3.22   NZ and UK average trip rates per employee for medical centres.

Staff	NZ			UK		
	n	Ave	Sdev	n	Ave	Sdev
1–15	4	5.20	1.60	4	4.07	3.50
16–30	1	1.74	–	9	3.89	1.75
>30	1	2.51	–	11	1.67	0.81

Acknowledging that the data are limited, Figure 3.32 indicates that NZ vehicle trip generation rates are higher for smaller medical centres, and these rates decline as the number of employees increases.

Figure 3.33 shows that both countries overlap somewhat in parking demand rates per employee for medical centres that employ up to 30 staff.

Given the small sample sizes, no firm conclusion can be drawn with regards to the similarities between the datasets or whether the use of employees represents a more appropriate explanatory variable than GFA.

60
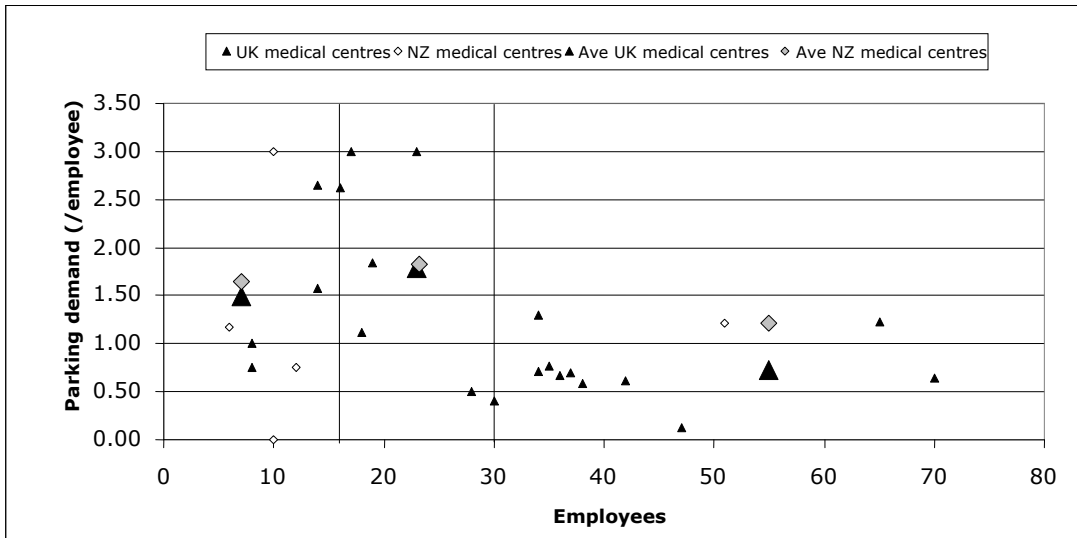
Figure 3.33 Comparison of NZ and UK parking rates per employee for medical centres.

Table 3.23   NZ and UK average parking rates per employee for medical centres.

Staff	NZ			UK		
	n	Ave	Sdev	n	Ave	Sdev
1−15	3	1.64	1.20	4	1.49	0.84
16−30	1	1.83	−	7	1.78	1.13
>30	1	1.22	−	10	0.73	0.33

A factor contributing to the differences in trip generation and parking rates between UK and NZ could be because in the UK, people are assigned a GP in relation to what catchment they live in, resulting in a higher proportion of patients living within walking distance of the GP's practice or medical centre. This is in contrast to the NZ system, which is privately organised and allows a patient to choose where to go for medical advice, potentially resulting in longer travel distances and higher use of vehicles.

3.6 Sports fields, golf courses and multiplex cinema

3.6.1 Sports fields

This analysis of sports fields has proved problematic because of the difficulties in defining this category. Issues related to this include:

- type of sports activities taking place,
- whether the facility is indoors or outdoors,
- whether several activities take place on one site.

The small number of available sites in both countries also means that a meaningful comparative analysis is not possible for this activity category as a whole.

3.6.2 Golf courses

The analysis of golf courses has also been inconclusive. This is primarily because of lack of NZ data but again, definitional issues arose, such as whether a course was:

- nine- or 18-hole,
- private or public,
- included/excluded a driving range,
- of good reputation – a well-established course may attract players from some distance.

The establishment of a reliable explanatory variable is problematic. An initial analysis indicates that, for the UK data, the number of holes or the geographic size of the course are poor descriptors of traffic activity and parking demand. This is not surprising, since the number of holes is fixed within each category and golf courses vary widely in their geographic extent.

The popularity of any specific golf course is more likely to be a function of its proximity to other golf courses, population, accessibility, social facilities available and reputation. These are mostly qualitative variables which have not been collected.

The lack of any recent or reliable NZ data means that it is not possible to undertake a valid comparison with the UK dataset. Regardless, data for golf courses is site specific, being governed by a wide range of qualitative factors for which information has not yet been collected.

3.6.3   Multiplex cinemas

The term 'multiplex cinema' relates to a facility typically providing several smaller theatres, rather than one large one.

The main issue for this category is the co-location of such facilities as an integral part of shopping centres; it is unusual for multiplex cinema facilities to be free-standing in NZ. As such, parking resources are shared with the parent building, and vehicle trips may be made for both shopping and cinema-going together. This can make it difficult to differentiate those vehicle movements and parking demands which are solely attributable to the multiplex cinema.

Also for cinemas, the films on show at the time of the survey will strongly influence rates of patronage. Popular films just after release can attract many more patrons than less popular films which have been shown for some time. During school holidays, cinemas may also show a greater range of films orientated towards children, resulting in more visits by family groups.

The TRICS database holds data for 13 sites, though two of these relate to duplicate locations (but at different times). The data cover the period 1990–2007. Only one site is classified as 'free-standing', with all of the others classified as 'suburban' or 'edge of town'. Most appear to have a high level of public transport provision based on the information provided within the TRICS system.

The NZ database holds data for only three sites, all of which are in the Auckland area. All were surveyed in the period 1993–1994. Of the three surveys, two relate to a Saturday and one to a Friday.

The assessment has been undertaken for a Saturday only, as the single NZ data point for a Friday would not provide a meaningful comparison with the UK data. Because of the limited NZ data, no regressions have been calculated for this data group.

Figures 3.34 and 3.35 show the relationship between the NZ data points and the UK data points using GFA as the parameter for estimating peak trip rates and parking rates.
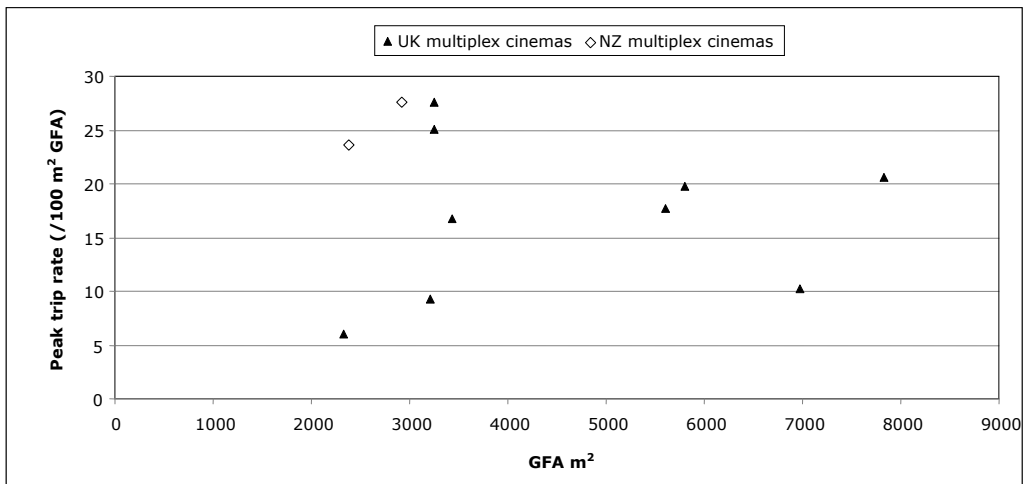
Figure 3.34 Comparison of NZ and UK trip rates v. GFA for multiplex cinemas.
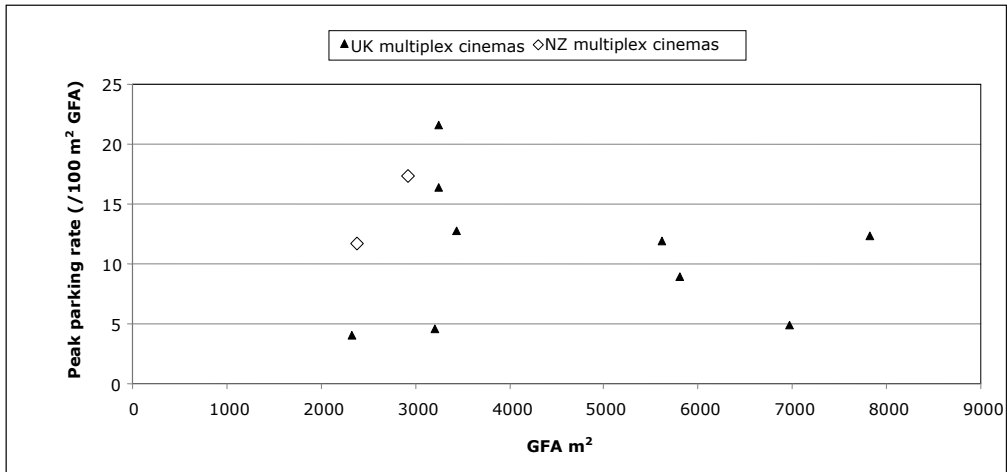
Figure 3.35 Comparison of NZ and UK parking rates v. GFA for multiplex cinemas.

Figure 3.34 and Figure 3.35 show that NZ multiplex cinemas tend to lie in the lower GFA range compared to the UK dataset. It is evident that more NZ data are required for a definitive analysis to be undertaken. Figures 3.36 and 3.37 illustrate the use of seats as an alternative trip rate and parking rate parameter.
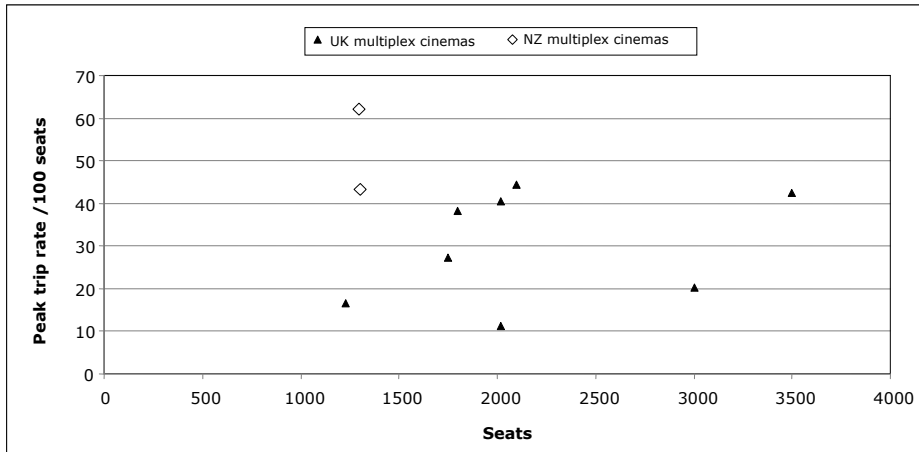
Figure 3.36 Comparison of NZ and UK trip rates v. seats for multiplex cinemas.
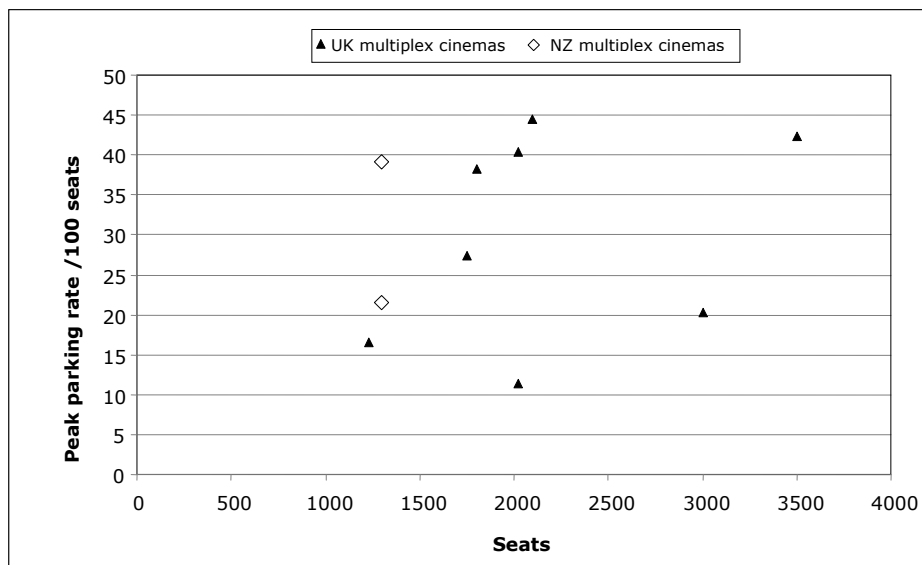
Figure 3.37 Comparison of NZ and UK parking rates v. seats for multiplex cinemas.

The limited NZ data make it difficult to draw any firm conclusions with regards to the most appropriate trip and parking rate variable.

3.6.4 General observations on recreation activities

The limited sample sizes, definitional issues and site variability, and unquantifiable factors such as the popularity of a particular site mean that a meaningful comparative analysis of sports fields and golf courses is not possible. Collecting more surveys of these activities in both NZ and UK, in addition to collecting more parameters that affect trip and parking for recreational land uses, is required in the future.

A number of differences can be seen between the UK and NZ, mainly with respect to public transport availability and hence the propensity to use a vehicle for trips to multiplex cinemas. For this reason, the UK data appear to have a wider spread of trips and parking rates, and may not provide a reliable basis upon which to estimate levels of vehicle trips for NZ facilities.

Care is required in estimating vehicular activity and parking demands where multiplex cinemas form an integral part of a larger development, with trips serving more than one purpose and a shared parking resource. The limited NZ data on multiplex cinemas make it difficult to make the appropriate comparisons.

However, it has been illustrated that the NZ trips and parking data sit within the general patterns established for the UK sites. Clearly, the focus in NZ should be upon expanding and updating the dataset including information relating to GFA in addition to seat numbers. More and new site parameters are required over the full range of recreational uses to improve practitioners' ability to select equivalent sites for comparison.

3.7   Preschools

The term 'preschool' relates to facilities provided for the care of children of up to 5 years of age prior to primary school. As such, this is assumed to include a range of facilities which are variously described as nurseries, kindergartens, playschools, crèches and child-care centres, even though some of these may distinguish between the 0–2 and 3–5 age groups.

In the TRICS database, the only category available is 'nursery', for which 24 sites are reported across the UK, covering the period 1997–2007. However, TRICS warns that owing to legislative changes in this sector, data prior to 1998 may not be representative of more recent conditions. The elimination of pre-1998 data reduces the number of 'valid' sites to 18.

The UK data do provide the number of vehicle arrivals and departures, from which parking accumulations could be calculated. However, this information is only available for one-hour periods. The nature of traffic activity associated with schools means that a large number of arrivals and departures can take place within a one-hour period, with the short-term parking demand being considerably higher than that implied by applying the accumulation data. For this reason, maximum parking accumulations have not been calculated for the nursery data.

The NZ database contains data for 25 preschools, of which almost all are in the Auckland area. The data relates to the period since 1992, with most of the information from the mid-1990s.
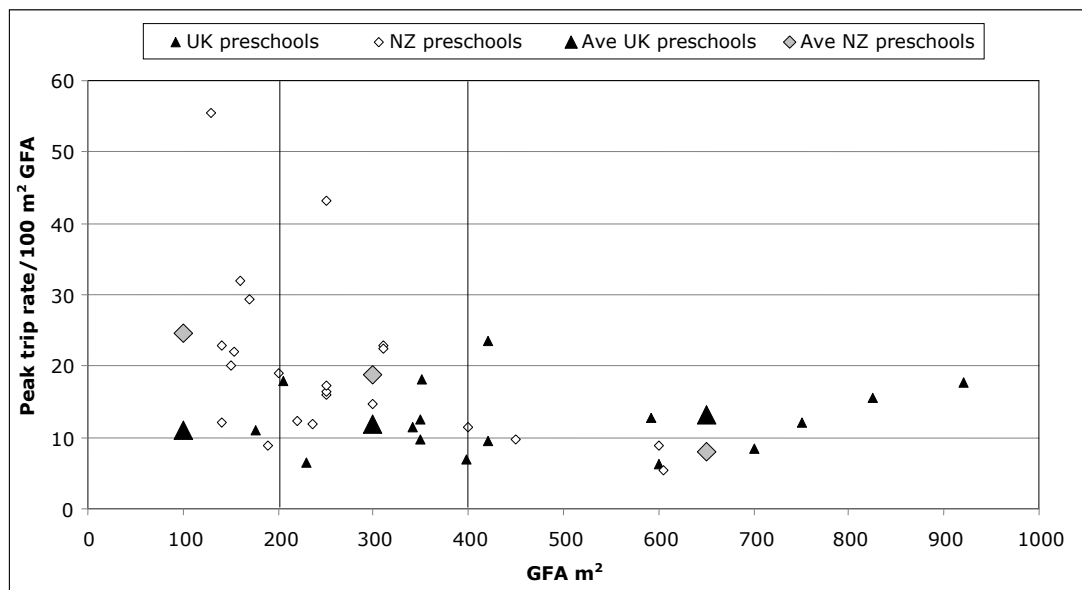
Figure 3.38 Comparison of NZ and UK trip rates v. GFA for preschools.

Table 3.24   NZ and UK average trip rates for preschools.

GFA (m²)	NZ			UK		
	n	Ave	Sdev	n	Ave	Sdev
1–200	9	24.63	13.63	1	10.92	–
201–400	8	18.85*	9.45	8	11.87*	4.73
>400	3	7.97*	2.37	8	13.22*	5.60

Figure 3.38 shows that pre-school facilities in NZ are typically smaller, and at the lower end of the range of facility sizes seen in the UK. NZ preschool facilities also demonstrate a higher level of peak period traffic activity for sites up to 400 m² GFA. The trip generation rates associated with the UK data tend to take a flatter profile throughout the range of GFA.

Figure 3.39 and Figure 3.40 illustrate the peak trip generation rates using pupils and staff numbers as alternative explanatory variables.
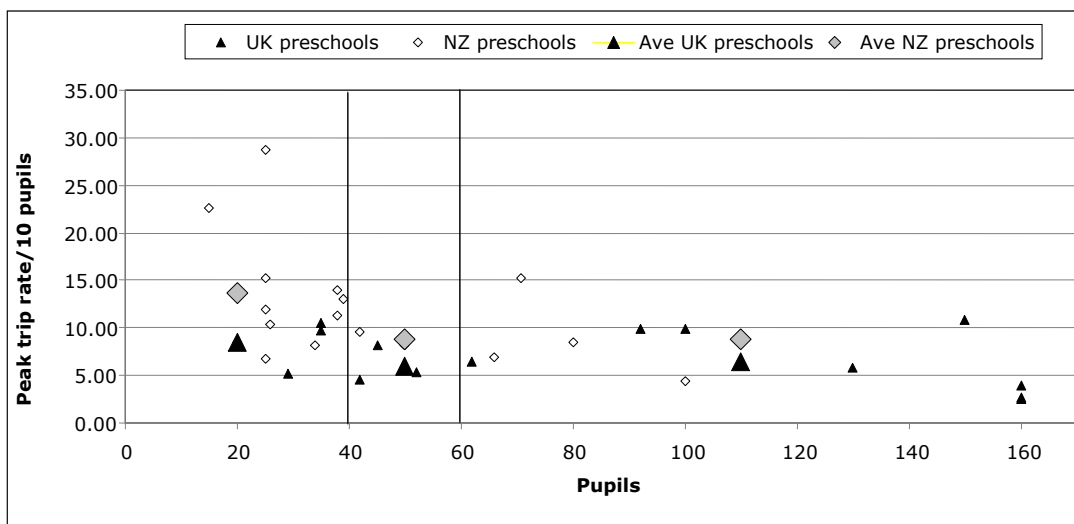
Figure 3.39 Comparison of NZ and UK trip rates v. pupils for preschools.

Table 3.25   NZ and UK average trip rate per 100 pupils for preschools.

Pupils	NZ			UK		
	n	Ave	Sdev	n	Ave	Sdev
1–40	10	13.72*	6.60	3	8.49*	2.91
41–60	2	8.84*	0.66	3	5.99*	1.87
>60	4	8.78	4.64	7	6.50	3.36
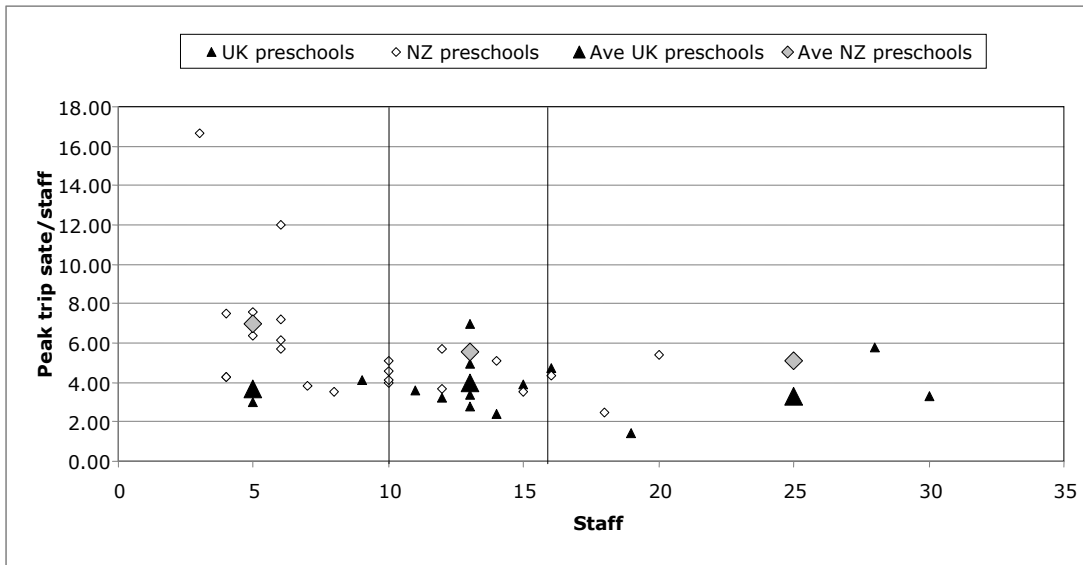
Figure 3.40 Comparison of NZ and UK trip rates v. staff for preschools.

Table 3.26   NZ and UK average trip rates v. staff for preschools.

Staff	NZ			UK		
	n	Ave	Sdev	n	Ave	Sdev
1–10	6	6.99	4.81	3	3.65	–
11–16	10	5.53	2.77	9	4.00	1.38
>16	7	5.10	1.49	4	3.28	1.84

Figures 3.39 and 3.40 show that using pupil and staff numbers as predictors produce similar NZ trends, with similar relationships to the UK data. Both alternative trip rate parameters provide slightly better explanatory variables than GFA. It is apparent that regardless of the explanatory parameter used, NZ preschools generally generate higher vehicle trip rates than their UK counterparts.

These patterns may be caused by a greater propensity for parents in NZ to use private vehicles for transporting children, rather than walking or using public transport.

For both the UK and NZ datasets, the number of staff is the most reliable explanatory variable for the number of daily and peak vehicle movements. The floor area is a poor explanatory variable, because such facilities frequently do not occupy purpose-built buildings and hence the available floor area is more a function of the available building rather than the number of pupils or staff in the facility.

A comparison of maximum parking demand for the preschool activities has not been undertaken because the UK database does not provide a direct record of this, and uses a calculated accumulation based on the net effects of vehicle arrivals and departures. The short but intense peak traffic activities associated with this land use make the accumulation method inappropriate in this instance. Direct vehicle counting is the only practical way of obtaining the parking information.

It has been found that similarities in trip generation exist, with the number of staff representing the best trip rate parameter. The analysis suggests that the NZ preschools generated higher vehicle trip rates than their UK counterpart.

A reasonable body of information is already available which is specific to NZ facilities and hence the focus should be upon expanding this dataset with emphasis in future surveys on modal split and collecting information relating to staff and pupil numbers in addition to floor area.

3.8   Residential – dwellings and hotels

3.8.1   Dwellings

The term 'dwelling' in this analysis relates to a traditional detached dwelling house. This is the predominant type of dwelling found in the NZ database. Care has been taken therefore to select detached dwelling houses (as distinct from other types of housing) from the TRICS database to ensure a like-for-like comparison. The relationship between total peak hour trips and household units for both the UK and NZ datasets was found to be strong and as such, 'households' was used as the trip rate parameter.

It was noted that only trip rates can be correlated between the NZ and UK databases, given that parking information is not available for all the NZ suburbs surveyed. It was considered that the most comparable locational definitions would be UK sites located in neighbourhood centres and suburban areas, with NZ sites located in suburban locations identified as 'intermediate' sites.

The UK database contains a large amount of information relating to residential activities, and includes both privately owned and rented dwellings. The NZ data do not make this distinction, so for this analysis, it has been assumed that the NZ data included a mix of both privately owned and rented dwellings.

Figure 3.41 illustrates the difference in trip generation characteristics between privately owned and rented households in the UK, with 20 rented dwellings and 140 privately owned dwellings.
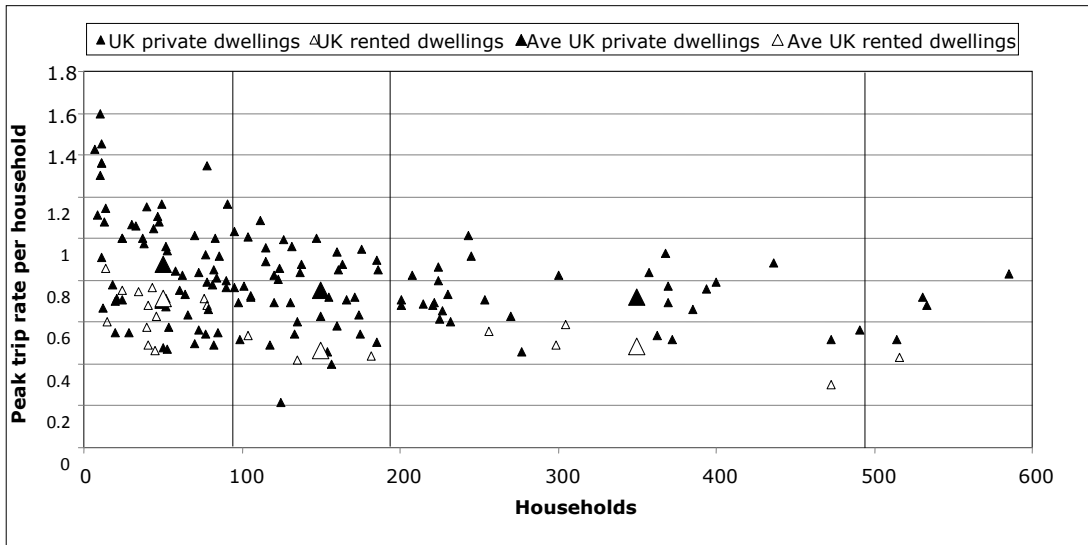
Figure 3.41 Comparison of private and rented UK peak hour trip rates per household.

Table 3.27   UK average trip rate for private and rented dwellings.

Households	UK rented			UK private		
	n	Ave	Sdev	n	Ave	Sdev
1–100	13	0.72*	0.22	63	0.88*	0.26
101–200	3	0.47*	0.06	36	0.75*	0.20
201–500	4	0.48*	0.13	30	0.72*	0.13

Figure 3.40 shows that private and rented dwellings in the UK differ in trip rates by around 0.2–0.3 trips per household. This difference, which is statistically significant, is likely to reflect the socioeconomic characteristics of the types of households, with the privately owned households displaying higher car ownership.

UK private and rented dwellings cannot, therefore, be combined as a single dataset. Figure 3.42 illustrates the comparisons between the NZ data and the two UK sets of data for residential dwellings.
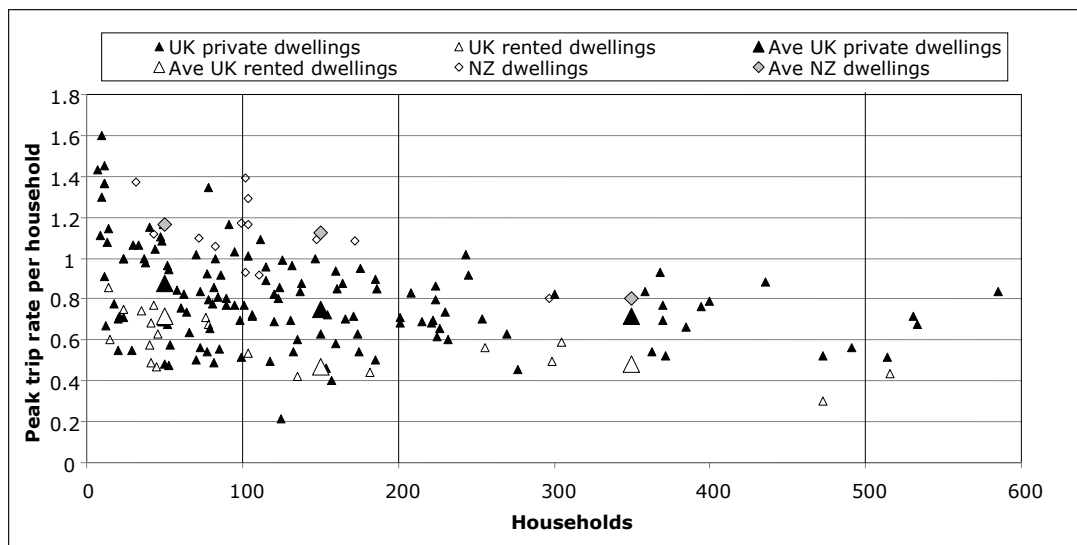
Figure 3.42 Comparison of NZ and UK trip rates for all dwellings.

Table 3.28   Average NZ and UK trip rates for all dwellings

Households	NZ			UK rented			UK private		
	n	Ave	SDev	n	Ave	SDev	n	Ave	SDev
1–100	5	**1.16**	0.12	13	**0.72**	0.22	63	**0.88**	0.26
101–200	7	**1.12**	0.20	3	**0.47**	0.06	36	**0.75**	0.20
201–500	1	**0.8**	–	4	**0.48**	0.13	30	**0.72**	0.13

Figure 3.42 shows that the NZ dataset is more closely aligned with the UK private
dwellings data. Despite a limited amount of NZ data in comparison to the UK sample size,
Figure 3.42 clearly shows that a similar trend is associated with the three sets of data,
and illustrates that NZ residential vehicle trip generation rates are 0.4 trips per hour per
household greater than their UK (privately owned) counterparts for sites that contain up
to 200 dwellings. For sites in excess of 200 dwellings, the difference in trip rates drops to
around 0.1 trip per hour per dwelling, with NZ sites producing higher trip rates per
household. The peak hour rate is normally between 7.30 a.m. and 8.30 a.m. The full 12-
hour daily flows are generally ten times these peak hour rates.

3.8.2   Hotels

The 2007–2008 TDB database contains four hotel sites, of which three were selected for the analysis, as these had total peak hour vehicle trips recorded. Twenty-six hotel sites were extracted from the TRICS database.

Because of the limited NZ data, no comparative average values have been calculated for this data group. Figure 3.43 and Figure 3.44 illustrate the peak vehicle trip rates for the UK and NZ using GFA and bedrooms as trip rate parameters.
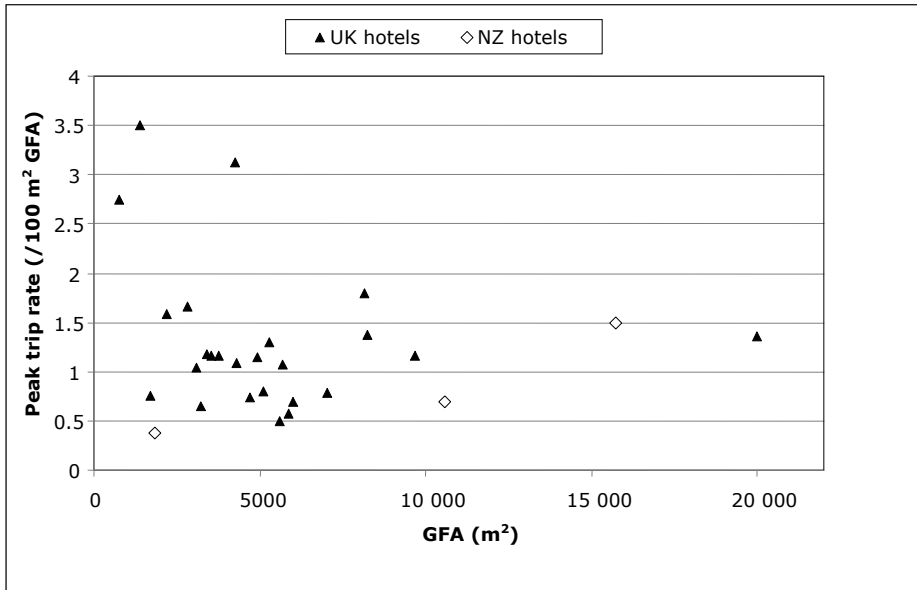
Figure 3.43 Comparison of NZ and UK trip rates v. GFA for hotels.
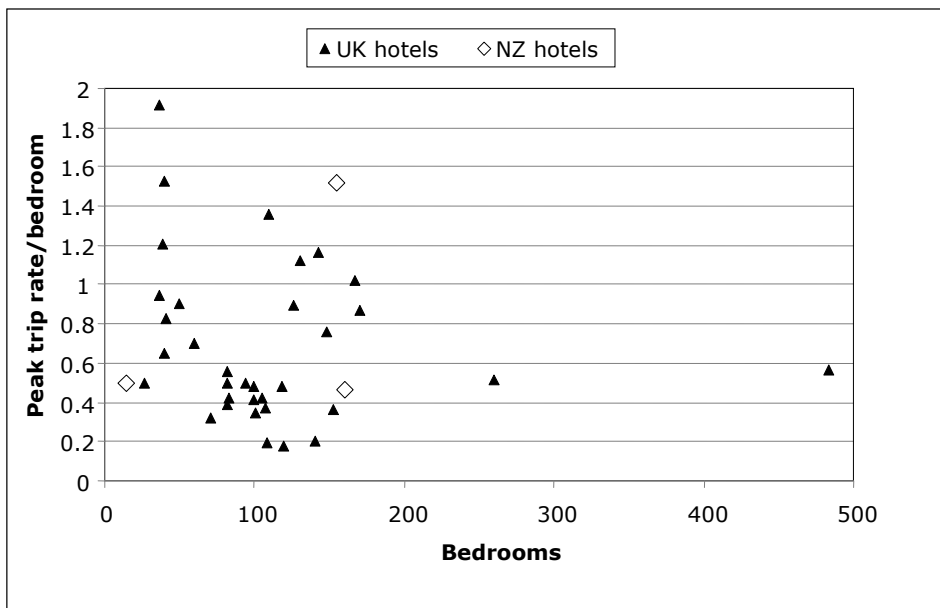
Figure 3.44 Comparison of NZ and UK trip rates v. bedrooms for hotels.

From Figures 3.43 and 3.44, it can be seen that for the UK, in general, trip generation rates tend to decline in relation to the size of the establishment. When GFA is used as a parameter, it can be seen that the NZ data points lie on the lower edge of the range of the UK data.

Room occupancy levels have a key influence on hotel trip generation rates, and this variable should be considered with any future analysis. The charts demonstrate that GFA and bedrooms are equally valid trip rate parameters, but in addition to these variables, occupancy rates should also be determined and included within each site in the database.

3.8.3 General observations on residential activities

The results of the residential investigation indicate the following:

- The analysis shows that the form of the relationship between peak hour vehicle trip rates and number of households is similar for NZ and UK.
- The NZ database contains sites that comprise of up to 300 units. However, the UK data include sites that contain up to 600 units. Given the close relationship of average trip rates, practitioners may be able to extrapolate from the UK trend line with an appropriate NZ adjustment when seeking to predict residential trip rates for localities in excess of 300 units.
- In general, the analysis shows that NZ residential vehicle trip generation rates are approximately 0.4 trips per household greater than their UK counterparts during peak hours for sites that contain up to 200 dwellings.
- NZ hotel data are limited and need to be increased in the future.
- The analysis indicates that for hotels, the GFA and the number of bedrooms are equally valid trip rate parameters. In addition to these variables, occupancy rates should also be determined and included within each database in the future.

3.9   Review of analysis and schedule of results

3.9.1   General findings

Table 3.29 provides a summary detailing each of the different land uses analysed in this report. This summarises the sample sizes, key parameter variables and land use activities which correlated well between the UK and NZ, and identifies the land use activities which are currently poorly represented.

Table 3.29   Summary of number of surveys and parameters used.

Land use	Trip rate data samples		Trip rate comparison by parameter							Parking rate data samples		Parking rate comparison by parameter					Future surveys required
	UK	NZ	GFA	Employees	Pupils	Seats	Beds	Pumps	Households	UK	NZ	GFA	Employees	Pupils	Seats	Beds	
Retail																	
Superstore/ Shopping centre	160	42	✓	✓						160	66	✓	✓				
PFS	26	8						✓		–	–						
Restaurant	10	6	✓							10	6	✓					
Fast food	7	3	✓							8	2						✓
Commercial																	
Business parks	21	4	✓							19	2						✓
Industrial																	
Manufacture	9	9	✓							17	14	✓					
Warehousing	12	5								8	5						✓
Health																	
Medical centres	6	6	✓	✓						6	6	✓	✓				✓
Recreation																	
Sports fields	–	–								–	-						✓
Golf courses	–	–								–	-						✓
Education																	
Preschools	18	25			✓					14	18						
Assembly																	
Multiplex cinemas	9	2								9	2						✓
Residential																	
Residential dwellings	163	13							✓	–	–						
Hotels	35	3								–	–						✓

Table 3.29 also shows a number of land use activities that are poorly represented within the NZ database. The development of new sports fields, golf courses and multiplex cinemas is likely to be low in comparison to the non-leisure related land uses summarised in Table 3.2. It is more useful to transport engineers and planners that priority should be given to the collection of data relating to business parks, medical centres, warehousing, fast food outlets and hotels. However, surveys of all land use activities require to be increased in order to maintain the relevance and usefulness of the database to practitioners.

The key observations associated with each land use tested are presented in separate subsections.

3.9.2   Retail

- A strong relationship of trips and parking rates can be seen between the food superstores and shopping centres reported in TRICS and TDB.
- In each size range of retailing activities, generally, no significant difference appears in trip generating characteristics between the UK and NZ.
- As floor area increases, trip generation rates decrease.
- In the larger UK conurbations, trip generation rates are marginally lower.
- Maximum trip generation rates associated with the surveyed sites do not always coincide with the generally accepted design peak.
- A close relationship exists between the retail parking demands of NZ and UK despite the UK's use of maximum parking provision and NZ's use of minimum parking requirements.
- Generally, UK retailing activities generate a parking demand that is two vehicles higher than NZ retailing activities, which has been shown to be statistically significant.
- GFA per 100 m^2 was used as the parameter for estimating the restaurant and fast food trips and parking rates, and is generally a good explanatory variable.
- The number of filling bays is a reasonable trip rate parameter for PFSs.
- The UK generates higher trip rates for fast food outlets.
- Additional NZ surveys are required for fast food outlets.

3.9.3   Commercial

- Comparable trends in trip rates can be seen between NZ and UK business parks, which may allow extrapolation of UK data in some circumstances.
- Additional NZ surveys are required for this land use.

3.9.4   Industrial

- Trends in trip rates for manufacturing are comparable.
- Trends in parking demand rates for manufacturing activities are also comparable.
- No strong evidence supports the use of employee numbers as an alternative explanatory variable.

- Where sufficient data exist, NZ sites have higher trip rates but lower parking demand rates than the UK sites for employment activities.
- Additional NZ surveys are required for warehousing activities.

3.9.5   Health

- Based on the limited data available, some similarities are apparent between the NZ and UK trip generation rates.
- NZ medical centres generate higher trip and parking rates than the equivalent UK medical centres.
- Additional NZ surveys are required for medical centres.

3.9.6   Education

- In general, NZ preschools generate higher vehicle trip rates than their UK counterparts.
- Pupil and staff numbers provide a more robust trip rate parameter than GFA.
- Direct vehicle counting is the only practical way of obtaining the parking information for this land use.

3.9.7   Assembly

- Data on NZ multiplex cinemas are limited.
- The limited NZ data sit within the general patterns established in the UK sites, potentially offering practitioners the ability to extrapolate from the UK data.
- Additional NZ surveys are required for multiplex cinemas.

3.9.8   Residential

- Trends in trip rates between NZ and UK associated with family dwellings are comparable, using households as an explanatory variable.
- NZ residential peak hour vehicle generation rates are approximately 1.5–2 trips per household greater than in the UK.
- Because NZ data are limited, a correlation cannot be established. However, GFA and number of bedrooms are equally valid trip rate parameters for hotels.
- Additional NZ surveys are required for hotels.

4. Discussion of survey parameters

4.1 TDB

This section describes the most frequently used parameter associated with the individual land use activities contained in the NZ and UK databases. The most up-to-date version of the TDB database (version July 2007–June 2008) contains approximately 564 surveys. The detailed survey information has been reduced and this is distributed to TDB members as a spreadsheet. Some of the surveys are re-surveys of earlier sites. The land use categories and explanatory variables used in the database are listed in Table 4.1.

Table 4.1   TDB land use classifications and parameters.

Site	Parameter																Number of surveys
	GFA	RFA	Seating capacity	Attendance	No. of employees	No. of students	Rooms	Site area	No. of beds	No. of consultants	Holes	Driving bays	Courts	Household units	Pumps	Berths	
Assembly																	26
Church	✓		✓	✓													23
Cinema	✓		✓														3
Commercial																	16
Banks	✓				✓												1
Office	✓				✓			✓									15
Education																	50
Preschool	✓				✓	✓											25
Primary	✓				✓												6
Secondary	✓					✓		✓									5
Tertiary	✓				✓	✓											10
Integrated						✓											4
Industry																	50
Contractor	✓				✓			✓									7
Manufacture	✓				✓			✓									19
Storage	✓				✓			✓									23
Transport	✓				✓			✓									1
Medical																	22
Centre	✓				✓					✓							8
Hospital	✓				✓				✓								12
Veterinary	✓				✓												2

Table 4.1 (cont.)   TDB land use classifications and parameters.

Site	GFA	RFA	Seating capacity	Attendance	No. of employees	No. of students	Rooms	Site area	No. of beds	No. of consultants	Holes	Driving bays	Courts	Household units	Pumps	Berths	Number of surveys
Recreation																	31
Aquatics/pool	✓				✓												2
Courses											✓	✓					2
Gymnasia	✓				✓												2
Marinas																✓	2
Outdoor courts													✓				1
Other	✓																1
Sports fields	✓																5
Stadium				✓													16
Residential																	81
Dwelling														✓			48
Home				✓			✓		✓								18
Hotel	✓				✓		✓										4
Motel	✓						✓										11
Retail																	286
Bar	✓																21
Bulk	✓				✓												17
Discount	✓																4
Fast food	✓		✓														15
Garden centre	✓				✓												8
Market	✓																3
Produce	✓	✓			✓												5
Restaurant	✓		✓		✓												14
Service station	✓														✓		16
Shop	✓				✓												19
Shopping centre	✓				✓			✓									152
Supermarket	✓				✓												12
Rural																	3
Vineyard	✓							✓									2
Horticulture																	1
Total surveys																	564

Section 2.1 of Douglass & McKenzie (2001a) describes the independent variable predictors:

While it is accepted that one of the most important aspects of predicting trip generation and parking demand is the choice of independent or predictive variables, the survey information available necessarily limits the type of variable that can be used.

These variables range from the physical scale and type of activity through to the number of patrons at a cinema, employees or other staff engaged in activities within the site, the number of doctors at a medical centre, or the number of beds in a hospital. The four most common variables used for this purpose are:

- *Gross floor area - the generally accepted definition of gross floor area (GFA) is the area within the external walls of a building, excluding any area dedicated for parking of vehicles but including all common areas shared by customers of joint retail areas.*
- *Site area - the total area of a site associated with the activity surveyed, including areas used for parking and landscaping.*
- *Employees - the number of staff employed or engaged at the site. The new trends in employment structures require a degree of caution to be exercised when using total employee numbers, as the increasing use of part-time or shift workers creates increased trips and parking demand at shift change over times. For some sites, specialists (e.g. doctors at a medical centre) can be a useful variable.*
- *Activity units - used where the particular activity is best expressed in terms of units related to the function or activity (e.g. restaurant seats, service-station filling positions, number of pupils, sports courts or hospital beds, seating capacity in halls or cinemas).*

4.2   TRICS

The 2008(a) version of TRICS that this research has investigated contains traffic count information for over 2705 sites, 5257 days of survey counts and 110 land use sub-categories. The database was formed in 1989 and had 298 organisations holding licences when TRICS (2008) was issued. A full list of TRICS land use categories and parameters is shown in Table 4.2.

A comparison of the parameters illustrated in Tables 4.1 and 4.2 shows that GFA, employee numbers and site area are extensively applied to a wide range of land uses in both databases when calculating trip or parking rates.

Where data were sufficient, Table 4.2 indicates that GFA and employee numbers provide a reasonable basis for correlating trips and parking rates between each database for a range of land use activities. In addition to these parameters, the analysis revealed that some activity units provided better similarities between the NZ and UK datasets, such as number of pupils or staff numbers for preschools, and number of filling bays for service stations.

Table 4.2   TRICS land use classifications and parameters.

Land use categories and sub-categories	GFA	RFA	Parking spaces	No. of employees	Site area	No. of households	Housing density	No. of residents	No. of caravans	No. of units	No. of pupils	No. of beds	No. of doctors	No. of patients	No of bedrooms	No. of seats	Number of lanes	Rink size	Number of courts	Number of berths	Number of holes	Number of ranges	Number of pitches	Number of bays	Filling bays	Use class	Location	Population <1 mile	Population <5 miles	Car ownership <5 miles	Public transport	Petrol station
01: Retail																																
A: Food superstore	✓	✓	✓																							✓	✓	✓	✓	✓	✓	✓
B: Cash & carry – wholesale and clubs	✓	✓	✓																							✓	✓	✓	✓	✓	✓	✓
C: Discount food stores	✓	✓	✓																							✓	✓	✓	✓	✓	✓	✓
D: DIY superstore with garden centre	✓	✓	✓																							✓	✓	✓	✓	✓	✓	✓
E: DIY superstore without garden centre	✓	✓	✓																							✓	✓	✓	✓	✓	✓	✓
F: Motorist DIY	✓	✓	✓																							✓	✓	✓	✓	✓	✓	✓
G: Other individual non-food superstore	✓	✓	✓																							✓	✓	✓	✓	✓	✓	✓
H: Garden centre	✓	✓	✓																							✓	✓	✓	✓	✓	✓	✓
I: Shopping centre – local shops	✓	✓	✓																							✓	✓	✓	✓	✓	✓	✓
J: Retail park including food	✓	✓	✓																							✓	✓	✓	✓	✓	✓	✓
K: Retail park excluding food	✓	✓	✓																							✓	✓	✓	✓	✓	✓	✓
L: Builders' merchants	✓	✓	✓																							✓	✓	✓	✓	✓	✓	✓
M: Mixed shopping malls	✓	✓	✓																							✓	✓	✓	✓	✓	✓	✓
N: Factory outlet centre	✓	✓	✓																							✓	✓	✓	✓	✓	✓	✓
O: Convenience store	✓	✓		✓																						✓	✓	✓	✓	✓	✓	
P: Factory shop	✓	✓	✓	✓																						✓	✓	✓	✓			
Q: Market					✓																						✓	✓	✓	✓		
02: Employment																																
A: Office	✓		✓	✓																						✓	✓	✓	✓	✓	✓	
B: Business park	✓		✓	✓																						✓	✓	✓	✓	✓	✓	
C: Industrial units	✓		✓	✓																						✓	✓	✓	✓	✓	✓	
D: Industrial estate	✓		✓	✓																						✓	✓	✓	✓	✓	✓	
E: Warehousing (self-storage)	✓		✓	✓																						✓	✓	✓	✓	✓	✓	
F: Warehousing (commercial)	✓		✓	✓																						✓	✓	✓	✓	✓	✓	
G: Parcel distribution centres	✓		✓	✓																						✓	✓	✓	✓	✓	✓	
H: Quarry			✓	✓	✓																						✓	✓	✓	✓		

Table 4.2 (cont.)   TRICS land use classifications and parameters.

Land use categories and sub-categories	Main parameters																									Optional parameters						
	GFA	RFA	Parking spaces	No. of employees	Site area	No. of households	Housing density	No. of residents	No. of caravans	No. of units	No. of pupils	No. of beds	No. of doctors	No. of patients	No of bedrooms	No. of seats	Number of lanes	Rink size	Number of courts	Number of berths	Number of holes	Number of ranges	Number of pitches	Number of bays	Filling bays	Use class	Location	Population <1 mile	Population <5 miles	Car ownership <5 miles	Public transport	Petrol station
03: Residential																																
A: Houses privately owned					✓	✓	✓																			✓	✓	✓	✓	✓	✓	
B: Houses for rent					✓	✓	✓																			✓	✓	✓	✓	✓	✓	
C: Flats privately owned					✓	✓	✓																			✓	✓	✓	✓	✓	✓	
D: Flats for rent					✓	✓	✓																			✓	✓	✓	✓	✓	✓	
E: Institutional hostels			✓		✓			✓																		✓	✓	✓	✓	✓	✓	
F: Sheltered accommodations					✓	✓	✓																			✓	✓	✓	✓	✓	✓	
G: Student accommodation					✓			✓																		✓	✓	✓	✓	✓	✓	
H: Nurses' homes			✓		✓			✓																		✓	✓	✓	✓	✓	✓	
I: Caravan parks (non-holiday)					✓				✓																	✓	✓	✓	✓	✓	✓	
J: Holiday accommodation			✓		✓					✓																✓	✓	✓	✓	✓	✓	
K: Mixed private housing					✓	✓	✓																			✓	✓	✓	✓	✓	✓	
L: Mixed non-private housing					✓	✓	✓																			✓	✓	✓	✓	✓	✓	
M: Mixed private/non-private housing					✓	✓	✓																			✓	✓	✓	✓	✓	✓	
N: Retirement flats					✓	✓	✓																			✓	✓	✓	✓	✓	✓	
04: Education																																
A: Primary	✓		✓								✓															✓	✓	✓	✓	✓	✓	
B: Secondary	✓		✓								✓															✓	✓	✓	✓	✓	✓	
C: College/University	✓		✓								✓															✓	✓	✓	✓	✓	✓	
D: Nursery	✓		✓								✓															✓	✓	✓	✓	✓	✓	
E: Residential School	✓		✓								✓															✓	✓	✓	✓	✓	✓	
F: Community education	✓		✓		✓																					✓	✓	✓	✓	✓	✓	
05: Health																																
A: General hospital – with casualty	✓		✓									✓														✓	✓	✓	✓	✓	✓	
B: General hospital – without casualty	✓		✓									✓														✓	✓	✓	✓	✓	✓	
C: Special (e.g. neurological)	✓		✓									✓														✓	✓	✓	✓	✓	✓	
D: Private hospital	✓		✓									✓														✓	✓	✓	✓	✓	✓	
E: Clinics	✓		✓																							✓	✓	✓	✓	✓	✓	
F: Nursing homes			✓	✓				✓																		✓	✓	✓	✓		✓	
G: GP surgeries	✓		✓										✓													✓	✓	✓	✓		✓	
H: Hospice			✓	✓																						✓	✓	✓	✓		✓	
I: Teaching hospital	✓			✓								✓														✓	✓	✓	✓	✓	✓	
J: Dental surgery	✓			✓																						✓	✓	✓	✓	✓	✓	

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Table 4.2 (cont.)   TRICS land use classifications and parameters.

Land use categories and sub-categories	GFA	RFA	Parking spaces	No. of employees	Site area	No. of household	Housing density	No. of residents	No. of caravans	No. of units	No. of pupils	No. of beds	No. of doctors	No of patients	No of bedrooms	No. of seats	Number of lanes	Rink size	Number of courts	Number of berths	Number of holes	Number of ranges	Number of pitches	Number of bays	Filling bays	Use class	Location	Population <1 mile	Population <5 miles	Car ownership <5 miles	Public transport	Petrol station
06: Hotel, food & drink																																
A: Hotels	✓		✓												✓											✓	✓	✓	✓	✓	✓	
B: Restaurants	✓		✓													✓										✓	✓	✓	✓	✓	✓	
C: Pub/restaurant	✓		✓																							✓	✓	✓	✓	✓	✓	
D: fast food – drive-through	✓		✓																							✓	✓	✓	✓	✓	✓	
E: Roadside food (e.g. Little Chef)	✓		✓													✓										✓	✓	✓			✓	✓
F: Motorway service areas (res/PFS/mot)*	✓		✓																							✓	✓	✓	✓	✓	✓	
G: Takeaway shops (e.g. fish bars)	✓		✓																							✓	✓	✓	✓	✓	✓	
H: Pub/restaurant + hotel	✓		✓													✓										✓	✓	✓	✓	✓	✓	
I: Public house	✓			✓																						✓	✓	✓	✓	✓	✓	
07: Leisure																																
A: Multiplex cinemas	✓		✓													✓										✓	✓	✓	✓	✓	✓	
B: Bowling alleys	✓		✓														✓									✓	✓	✓	✓	✓	✓	
C: Sports centres	✓		✓		✓																					✓	✓	✓	✓	✓	✓	
D: Swimming pools	✓		✓																							✓	✓	✓	✓	✓	✓	
E: Skiing																																
F: Ice rink	✓		✓															✓								✓	✓	✓	✓	✓	✓	
G: Tennis clubs			✓		✓														✓							✓	✓	✓	✓	✓	✓	
H: Bingo halls			✓													✓										✓	✓	✓	✓	✓	✓	
I: Art galleries/ museums/exhibitions	✓		✓																							✓	✓	✓	✓	✓	✓	
J: Equestrian centres			✓		✓																					✓	✓	✓	✓	✓	✓	
K: Sports clubs	✓		✓		✓																					✓	✓	✓	✓	✓	✓	
L: Football (five-a-side)			✓		✓																		✓			✓	✓	✓	✓	✓	✓	
M: Country parks			✓		✓																					✓	✓	✓	✓	✓	✓	
N: Mixed leisure complex	✓		✓		✓																					✓	✓	✓	✓	✓	✓	
O: Leisure park	✓		✓																							✓	✓	✓	✓	✓	✓	
P: Watersports centre			✓		✓																					✓	✓	✓	✓	✓	✓	
Q: Community centre	✓		✓		✓																					✓	✓	✓	✓	✓	✓	
R: Casino	✓		✓		✓																					✓	✓	✓	✓	✓	✓	
S: Exhibition centre	✓		✓	✓	✓																					✓	✓	✓	✓	✓	✓	
T: Place of worship	✓			✓	✓																					✓	✓	✓	✓	✓	✓	
U: Play centre	✓		✓	✓	✓																					✓	✓	✓	✓	✓	✓	
V: Library	✓			✓																						✓	✓	✓	✓	✓	✓	
W: Theatre	✓			✓												✓										✓	✓	✓	✓	✓	✓	
08 Marinas			✓		✓															✓						✓	✓	✓	✓	✓	✓	

* e.g. restaurant/pfs/motel

Table 4.2 (cont.)   TRICS land use classifications and parameters.

Land use categories and sub-categories	GFA	RFA	Parking spaces	No. of employees	Site area	No. of household	Housing density	No. of residents	No. of caravans	No. of units	No. of pupils	No. of beds	No. of doctors	No of patients	No of bedrooms	No. of seats	Number of lanes	Rink size	Number of courts	Number of berths	Number of holes	Number of ranges	Number of pitches	Number of bays	Filling bays	Use class	Location	Population <1 mile	Population <5 miles	Car ownership <5 miles	Public transport	Petrol station
09 : Golf																																
A: Private nine-hole course			✓		✓																✓					✓	✓	✓	✓	✓	✓	
B: Private 18-hole course			✓		✓																✓					✓	✓	✓	✓	✓	✓	
C: Private >18-hole course			✓		✓																✓					✓	✓	✓	✓	✓	✓	
D: Municipal nine-hole course			✓		✓																✓					✓	✓	✓	✓	✓	✓	
E: Municipal 18-hole course			✓		✓																✓					✓	✓	✓	✓	✓	✓	
F: Municipal >18-hole course			✓		✓																✓					✓	✓	✓	✓	✓	✓	
G: Driving range			✓		✓																	✓				✓	✓	✓	✓	✓	✓	
H: 'three-par' course			✓		✓																✓					✓	✓	✓	✓	✓	✓	
10: Tourist attraction																																
11: Car boot sales			✓		✓																		✓			✓	✓	✓	✓	✓	✓	
12: Civic amenity																																
A: Recycling centres					✓																			✓		✓	✓	✓	✓	✓	✓	
B: Household waste					✓																			✓		✓	✓	✓	✓	✓	✓	
C: Landfill					✓																			✓		✓	✓			✓	✓	✓
13: Petrol																																
A: PFS					✓																				✓	✓	✓	✓	✓	✓	✓	✓
B: PFS with retail					✓																				✓	✓	✓	✓	✓	✓	✓	✓
14: Car show rooms	✓		✓		✓																					✓	✓	✓	✓	✓	✓	
15: Vehicle services																																
A: Vehicle repair garage	✓		✓		✓																					✓	✓	✓	✓	✓	✓	
B: Motorist centre	✓		✓		✓																					✓	✓	✓	✓	✓	✓	
C: Car hire centre	✓				✓																					✓	✓	✓	✓	✓	✓	
16: Mixed																																
A: Miscellaneous																																
B: Mixed use	✓		✓		✓																					✓	✓	✓	✓	✓	✓	
C: Farm diversification			✓		✓																					✓	✓	✓	✓	✓	✓	

4.3   Specific parameters for particular activities

In order to enhance the synergy between the NZ and UK databases, thus allowing practitioners to add support to their NZ trips and parking rate predictions with applicable UK data, the additional parameters set out in Table 4.3 should be collected in any future surveys.

Table 4.3   Parameters to be included in future surveys.

Land use	Additional parameters to be included in future surveys	
	NZ	UK
Retail	RFA	Maximum parking demand
	Site area	Number of employees
	500 m pedestrian catchment	500 m pedestrian catchment
	Parking duration	
Service stations	Nature and GFA of ancillary facilities	Nature and GFA of ancillary facilities
Preschools	Site related off-site parking	Site related off-site parking
Restaurants	Seating capacity	
Hotel	Room occupancy	Room occupancy
Residential	Number of residents	
	Private/rented tenure	
	Housing density	
	Beds and parking provision (care homes)	
Multiplex cinemas	Number of seats	
	Number of screens	

In addition to the parameters listed in Table 4.3, parking provision and parking demand should be recorded for all land uses in any future NZ surveys. Other useful parameters that allow a closer match between sites contained in the TDB and sites that may be the subject of potential development include population and car ownership within one and five kilometres from a survey site location.

As stated in Section 2.3.1, the TDB is seeking to inform practitioners of trip generation rates associated with all modes of transport. Future surveys should seek to capture as much multi-modal data as is practical to assist practitioners and consolidate the relationship with the UK database.

A recent development of TRICS is the capturing of data in relation to site travel plans. This has some benefit to practitioners in two obvious ways. Firstly, the effectiveness of travel plans over a wide range of land uses over time can be tracked and conclusions drawn on the general effectiveness or effective enforcement of travel plans can be established. Secondly, where a sufficient number of sites with travel plans are included in the database, this information may support the practice of reducing trip generation and parking rates on the basis of the expected effects of a travel plan.

Activity units associated with playing fields and golf courses should be collected. However, because of the site-specific nature of these land use activities, deriving 'typical' or 'average' trip generation and parking rates is likely to be be problematic, and any results should be

interpreted and applied with caution. Given the variability that can occur at golf courses, seeking to align UK and NZ trips and parking rates may be of use to the transport planning industry.

The effects of mixed-use development on trip generation and parking rates have been reported in Ho & Anderson (2005), Pedler (2003) and ITE (2004b). This latter document provides a method for making adjustments to trip generation rates to account for the effects of trip internalisation.

ITE (2004b) also provides advice on the techniques of surveying mixed use development. This advice states that where sites are considered to form part of a mixed-use development, data collection should consist of on-site in-person interviews coupled with a complete cordon count of the site. This advice is also applicable to the NZ mixed-use sites.

This analysis concentrates on the trip generation associated with the site access. When considering the wider network effects of trip generation associated with different land use activities, practitioners will be required to adjust the trip generation rates to reflect the various trip types such as primary, pass-by and diverted trips. Such adjustments should only be undertaken where trip type proportions can be supported by reference to relevant research and site-specific data.

4.4   Database evolution

In NZ, the earlier databases were recorded manually and were not easily investigated, and they tended to be unmanageable. The report by Douglass & McKenzie (2001a) led to details of the 550 sites recorded being placed on a simple spreadsheet. Successive editions have included progressive refinements including 'drop down boxes' for ease of access and selection on key variables such as Land Use Group or Activity.

With the advent of the TRICS website access for UK members and the interactive nature of this facility, with the assistance of our UK colleagues, this should follow for the TDB. In the meantime, more effort is being channelled into harvesting survey information, and ensuring that relevant research is being undertaken and the database extended.

The website can usefully be enhanced as a link for TDB members, and act as an exchange and information resource. In addition, it will be a suitable location to hold useful papers on trip generation and other transportation technical data.

The TDB now includes about 100 members with around 20 from Australia, 60 from NZ and a small number of English members. All receive the annual database and have equal access to the website (http://www.tdbonline.org).

5. Conclusions and recommendations.

5.1 General conclusions

This research project has justified the effort to investigate the TDB (NZ) and the TRICS (UK) trips and parking databases. This research investigated the two datasets, from opposite sides of the world, to discover how similar and consistent their trips and parking demands have become. As it was a general comparison, it has involved grouping travel surveys, and comparing average values of trip rates and parking rates. It has been a broad study and has not attempted to predict design levels of trips or parking for individual sites.

Eight general conclusions can be drawn:

- The comparison of NZ and UK trip making and parking demands by different land uses has been tested successfully and many similarities have been confirmed.
- Comparison and analysis of average trip and parking rates for eight land uses in the UK and NZ has shown that the average and the 85th percentile, trip generation and parking demand rates are consistent and similar for equivalent retail activities.
- For retail activities, the scatter diagrams have much in common, with trip rates being similar. Retail parking rates run in parallel; however, the UK parking levels are consistently above their NZ counterparts.
- Similar and consistent trip making patterns also appear for residential activities. However, NZ dwellings generate slightly higher trip rates than their UK equivalents.
- The analysis shows that for half of the land uses that were analysed, relationships between trip generation rates and GFA for both the NZ and the UK data appear to be consistent. It is apparent that similarities exist, and practitioners can usefully examine the TRICS database to widen their data sources and give greater confidence in their predictions for NZ trips and parking rates.
- Where similar trips and parking rate trends were not established, this was most frequently caused by lack of NZ data. However, definition issues also contributed to a lack of consistency for some land use activities. For instance, recreational activities relied more heavily upon qualitative parameters. Trips and parking characteristics associated with employment activities relied heavily upon the exact definition of the nature of business occurring on-site.
- The wide scatter in the trip and parking rate data, in both countries, suggests that the capture of additional parameters would improve the technique of predicting trips and parking rates. Examples of additional parameters may include capturing the distinction between private/rented tenure for residential activities, room occupancy levels associated with hotels, and seating capacity and locational aspects for restaurants.
- Future sharing and exchange of basic data on traffic generation, parking and travel information within each country and internationally could be increased to advantage.

5.2   Recommendations

Given that NZ, Australia and England all have similar economies and, in terms of trips and parking rates, all appear to belong to 'one transportation planet', the research supports the following recommendations:

- Government agencies, councils and consultants should be encouraged, when undertaking trip, parking and land use site surveys, to ensure that information is made available to the TDB as a further contribution to this national database.
- Further surveys of land use activities that have been identified as being poorly represented in the NZ database should be undertaken and provided to the TDB for inclusion in their database.
- More appropriate parameters and more survey details should be captured in future surveys, including parking duration surveys and multi-modal data, potentially through interview surveys.
- Research should continue with a view to developing a combined joint international database of quality information for development proposal assessment which is accessible to transportation and planning professionals in NZ, the UK, Australia and North America.

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Appendix A TDB Database structure and land use categories

A1   Database structure

Table A1 presents the data collected for one site in the TDB database (TDB 2007). In the original database, these data would form one single row in a spreadsheet. For space reasons, this format has been changed so the reader has an idea of the type of data held for each site. Some cells have a drop-down function to allow the database user to filter the results; these cells are highlighted in pale grey.

Table A1   TDB database structure, illustrated by one site.

Cell number		Parameter	Example
A		Site No.	519
B		Source of data	DCS Ltd
C		Territorial Local Authority	CCC
D		Suburb or locality	Huntsbury
E		Activity name	Huntsbury shopping centre
F		Land use group	Retail
G		Land use activity (primary)	Shopping centre
H		Land use activity (description)	–
I		Location environment	–
J	Frontage road hierarchy and daily traffic volume	Major arterial (vpd*)	
K		Minor arterial (vpd)	8500
L		Collector road (vpd)	
M		Local road (vpd)	
N	Population details	Within 1 km	
O		within 5 km	
P		Total population of urban area	
Q		Pedestrian activity	
R		Public transport accessibility	
S		Date of survey	12/12/2006
T		Time of survey	08:30–17:30
U		Day of survey	Tuesday
V		GFA (m^2)	2300
W		Site area (m^2)	5600
X		Employees	28
Y		Other size (please specify value)	
Z		Other unit (please specify unit, e.g. seats, rooms, beds, pumps)	

* vehicles per day

91

Table A1 (cont.)   TDB database structure, illustrated by one site.

Cell number		Parameter		Example
AA			Comments	20 full time and 8 part time employees
AB			Parking spaces provided on-site	45
AC			Other parking spaces on-street and off-site	36
AD			Maximum on-site parking demand	45
AE			Maximum off-site parking demand	25
AF			(at time)	17:00
AG	Peak total parking demand rates		GFA (spaces/100 m^2 GFA)	3.04
AH			Site area (spaces/100 m^2 site area)	1.25
AI			Employees (spaces/employee)	2.50
AJ		Other	Spaces/other units	
AK			Other unit (if applicable)	
AL	Surveyed arrival/departure flow	A.M. peak (vpd)	In	54
AM			Out	63
AN			In + out	117
AO			At time	11:00–12:00
AP		P.M. peak (vph*)	In	66
AQ			Out	97
AR			In + out	163
AS			At time	16:00–17:00
AT		Daily (vph)	In	
AU			Out	
AV			In + out	1497
AW			At time	08:30–17:30
AX	Trip generation rates	GFA (in + out) (vph or vpd/100 m^2 GFA)	A.M.	5.09
AY			P.M.	7.09
AZ			Daily	65.09
BA		Site area (in + out) (vph or vpd/100 m^2 site area)	A.M.	2.09
BB			P.M.	2.91
BC			Daily	26.73
BD		Employees (in + out) (vph or vpd/ employee)	A.M.	4.18
BE			P.M.	5.82
BF			Daily	53.46
BG		Other unit (in + out) (vph or vpd/ other unit)	A.M.	
BH			P.M.	
BI			Daily	
BJ			Other unit	

*vehicles per hour

Table A1 (cont.)   TDB database structure, illustrated by one site.

Cell number	Parameter		Example
BK	Travel mode (trips)	Car driver	1428
BL		Car passenger	335
BM		Goods driver	69
BN		Goods passenger	17
BO		Pedestrian	124
BP		Cyclist	103
BQ		Bus passenger	14
BR		Total	2090
BS	Travel mode (percentage)	Car driver	68.3
BT		Car passenger	16.0
BU		Goods driver	3.3
BV		Goods passenger	0.8
BW		Pedestrian	5.9
BX		Cyclist	4.9
BY		Bus passenger	0.7
BZ		Total	100.0
CA		Notes and comments	GFA of 2300 m^2 includes tavern/restaurant (400 m$^{2)}$, Gardenways (400 m^2 + outdoor yard 500 m^2). Development also comprises [sic] a grocery shop and six other shops. Twenty-five off-street car parks are provided. The site is located in South Christchurch and there are two large centres 2 km away. Centaurus Rd is a busy ringroad.

A2 TDB classifications

Table A2   TDB 2007–2008 land use classifications and survey types (TDB 2007).

Land use	Land use sub-category	Vehicle count surveys	Parking count surveys
Assembly	Church	6	23
	Cinema	3	3
	Gallery	–	–
	Museum	–	–
	Theatre	–	–
	Visitor – tourist attractions	–	–
Commercial	Banks	1	1
	Business park	6	6
	Office	2	2
	Services	–	–
Education	Campus	–	–
	Community	–	–
	Library	–	–
	Preschool	25	22
	Secondary	2	5
	Tertiary	3	6
Industry	Contractor	7	7
	Manufacture	13	14
	Storage	15	6
	Transport	1	1

Table A2 (cont.)   TDB 2007–2008 land use classifications and survey types.

Land use	Land use sub-category	Vehicle count surveys	Parking count surveys
Medical	Centre	7	5
	Clinics	–	–
	Hospital	5	12
	Veterinary	1	1
Recreation	Aquatic	2	1
	Courses (golf, driving range, polo)	1	2
	Gymnasium	2	2
	Indoor courts	1	1
	Marina	0	1
	Outdoor courts	1	1
	Ski fields	–	–
	Sports fields	3	4
	Stadium	0	6
	Tourist	–	–
Residential	Dwelling	47	1
	Home	5	11
	Hostel	–	–
	Hotel	3	4
	Motel	4	4
	Multi-unit	–	–
	Townhouse	–	–
Retail	Automobile	–	–
	Bar	10	18
	Bulk retail	16	6
	Car sales	–	–
	Fast food	8	4
	Garden centre	7	4
	Hardware	–	–
	Market	3	3
	Motor vehicle	–	–
	Restaurant	10	8
	Roadside sales	–	–
	Service station	4	3
	Shop	18	14
	Shopping centre	82	146
	Supermarket	11	12
Rural	Factory	–	–
	Farming	–	–
	Horticulture	–	–
	Primary processing	–	–
	Stalls	–	–
	Vineyards	2	2
Total		341	382

A3 Land use definitions

Table A3   **TDB definitions of the land use sub-categories.**

Land use	Land use activity
Assembly	**Church:** traditional church buildings as well as other religious and spiritual meeting places. The actual building may fall within another activity grouping (e.g. community centre/hall) but at certain times of the week, it caters for church-based activities.
	Cinema: including traditional single-screen, stand-alone facilities, and multi-screen multiplex cinemas.
	Community centre/hall: providing generally for the assemble of the public and community groups. These may also involve ancillary activities, e.g. Citizens' Advice Bureau.
	Conference: venues, either separate or part of a hotel or other complex.
	Gallery: all public and private art and exhibition spaces.
	Museum: public and private facilities displaying items of general and specific interest, ranging from small community facilities through to the national museum (Te Papa).
	Theatre: places of live performance, which may also have café/bar facilities on-site.
	Visitor – tourist attractions: indoor visitor attractions with a variety of display and entertainment activities.
Commercial	**Banks:** including financial institutions and mail centres with direct service to the public.
	Business park: a collection of office buildings in a free-standing location, with a variety of organisations sharing access and services.
	Office: government and corporate administrative and professional services.
	Services: office operations where personal services such as insurance, accounting, real estate and other personal professional services (excluding medical) are provided.
Education	**Campus:** extensive military camps, training establishments, business schools, Outward Bound, health and recreation camps in rural and urban settings.
	Community: independent specialist education activities such as WEA offices, career training consultants and other training facilities.
	Library: public libraries and institutes including university archives, research libraries and research laboratories.
	Preschool: including kindergartens, nursery schools, crèches, Kohanga Reo, and Montessori facilities.
	Primary: state and independent schools, including intermediate schools, catering for Years 1 to 8.
	Secondary: catering for Years 9–13.
	Tertiary: university and polytechnic institutions, as well as the increasing range of 'education providers' offering Qualifications Authority-approved tertiary courses.

Table A3 (cont.)   TDB definitions of the land use sub-categories.

Land use	Land use activity
Industry	**Contractor:** activities where a range of construction and manual services are undertaken off-site.
	Manufacture: production sites where raw materials, goods and services are further processed and then distributed.
	Storage: including warehousing, container storage, repacking and storage facilities for consolidation for forward transport (e.g. containers, couriers, mail centres and storage units).
	Transport: activities where vehicles for the transport of people or goods are based, but the site itself is not used for storage or processing, and also terminals for road, rail, ports and airports.
Medical	**Centre:** broad category of general and specialist medical facilities, further defined according to the number of medical professionals engaged within the centre.
	Clinics: specialist chambers, free-standing or associated with a hospital, which may include minor routines and X-ray.
	Hospital: all public and private hospital facilities providing both day and overnight surgery and care. These could be further defined by size and functions in the third field.
	Veterinary: facilities dedicated to the care and treatment of animals, and involving the sale of pet- and animal-related products.
Recreation	**Aquatic:** the range of facilities from stand-alone swimming pools to the modern aquatic centre which provides water based activities of may kinds and caters for a wide age range.
	Courses: facilities such as golf courses, and possibly polo fields or similar, and also driving ranges.
	Gymnasium: facilities for sports and fitness training, either as stand-alone commercial operations or attached to other facilities such as a university or school.
	Indoor courts: including the traditional range of racquet and ball sports.
	Marina: involves the berthing, launching, repair and storage of boats, and associated social activities.
	Outdoor courts: for sporting activities generally requiring a hard surface, such as netball and tennis.
	Ski fields: maintained locations of commercial and club fields, and including ice-skating rinks.
	Sports fields: outdoor sporting facilities with primarily grass or artificial turf surfaces for summer and winter team sports, but not associated with major audience stands and facilities.
	Stadium: indoor or outdoor seated venues catering for both sporting and cultural events.
	Tourist: includes, for example, outdoor tourist attractions, mazes, bungy jumping and historic villages.

Table A3 (cont.)   TDB definitions of the land use sub-categories.

Land use	Land use activity
Residential	**Dwelling:** traditional detached dwelling-house, with one or two household units per site.
	Home: the range of residential and care facilities for the elderly and other age-groups, sometimes providing on-call and full-time medical and hospital care.
	Hostel: communal residential facilities catering for students, institutional workers such as nurses or project construction workers, for example, and also prisons and other residential institutions.
	Hotel: travellers' accommodation which include restaurant and bar facilities on-site, and sometimes also catering and conference facilities such as seminar rooms.
	Motel: travellers' self-contained kitchen and bathroom accommodation catering for vehicle-based travel, typically without on-site drinking or restaurant facilities.
	Multi-unit: residential units attached and grouped together and numbering more than ten individual household units collectively.
	Townhouse: groups of attached and semi-detached households, generally one or two storeys high, and with ten or fewer units per site.
Retail	**Automobile:** new sales, parts, service centre, second-hand sales, tyres and rental cars.
	Bar: a wide range of drinking facilities, from small licensed cafés/wine bars to the more traditional taverns and pubs.
	Bulk retail: a recent addition to the range of NZ retailing facilities, covering larger retail activities selling bulky goods including whiteware and home furnishings.
	Car sales: car sales yards, showrooms, auctions and rental cars.
	Fast food: activities involving the preparation and sale of food with/without restaurant, sometimes with drive-through and pick-up.
	Garden centre: typically an indoor storage and display area in conjunction with an outdoor area, sometimes including other on-side facilities such as a café.
	Hardware: a full range of building materials, and household and garden hardware; DIY stores such as Placemakers, Mitre 10, Bunnings, etc.
	Market: an area either formally or informally arranged to provide for the wholesale or direct selling of fruit, vegetables and other items, e.g. wholesale fruit and vegetable market/auctions, and community markets held in parks, public squares and schools.
	Motor vehicle: car sales display areas, buildings and yard.
	Restaurant: eat-in sit-down restaurant facilities, excluding fast food and takeaway outlets.
	Roadside sales: primary product roadside food stalls, and other food and vegetable retailers.
	Service station: a site providing primarily for the sale of petrol and other fuels, often including other motoring accessories and services such as car grooming and car washes. On-site food and other retail facilities are also expected from most modern service stations.
	Shopping centre: a collection of retail shops and services where joint facilities are shared, such as parking and access. Typically includes a grocery, a pharmacist's, hairdressers, bookshops, fruiterers, tailors, dress shops, furniture stores, etc., which may be surveyed together or separately.
	Supermarket: an establishment with a wide range of food and other retailing operations, ranging from the larger convenience store (e.g. Star Shop) to the grocery warehouse (e.g. Pak 'n' Save), and including discount operators such as The Warehouse, K-Mart and Briscoes.
Rural	**Factory:** farming sites where stock and poultry are housed and managed in factory farm facilities.
	Farming: primary production which includes extensive grazing, raising of livestock, agriculture and/or growing of field crops for animal or human consumption.
	Horticulture: orchards, market gardens and intensive agriculture, including glasshouses and hydroponics.
	Primary processing: primary production yards, timber mills, cheese factories, milk processing plants, fertiliser plants, wineries, packing sheds, etc.

	Stalls: see retail
	Vineyards: where grapes are grown and processed, often also providing wine sales, tasting and sometimes restaurant facilities, normally including a winery.

Appendix B   TRICS land use categories, survey types and definitions

B1   Classifications and survey types

Table B1   TRICS (2008) land use classifications and survey types.

Land use	Land use sub-category	Vehicles		Multi-modal count surveys
		Manual count surveys	ATC* surveys	
01: Retail	A: Food superstore	515	136	30
	B: Cash & carry – wholesale and clubs	33	7	0
	C: Discount food stores	53	4	7
	D: DIY superstore – with garden centre	79	18	4
	E: DIY superstore – without garden centre	99	10	2
	F: Motorist DIY	10	9	0
	G: Other individual non-food superstore	66	3	5
	H: Garden centre	65	6	1
	I: Shopping centre – local shops	31	0	9
	J: Retail park – including food	48	26	12
	K: Retail park – excluding food	124	93	10
	L: Builders' merchants	15	0	0
	M: Mixed shopping malls	19	0	1
	N: Factory outlet centres	15	0	2
	O: Convenience store	5	0	5
	P: Factory shop	8	0	0
	Q: Market	5	0	0
02: Employment	A: Office	120	28	29
	B: Business park	49	50	18
	C: Industrial units	23	0	15
	D: Industrial estate	111	97	15
	E: Warehousing (self-storage)	12	0	0
	F: Warehousing (commercial)	47	9	4
	G: Parcel distribution centres	15	1	2
	H: Quarry	3	7	0
03: Residential	A: Houses (privately owned)	144	232	50
	B: Houses for rent	19	20	7
	C: Flats (privately owned)	23	6	9
	D: Flats for rent	29	1	16
	E: Institutional hostels	7	0	1
	F: Sheltered accommodation	35	21	3
	G: Student accommodation	15	13	8
	H: Nurses' homes	2	0	1
	J: Holiday accommodation	35	13	0
	K: Mixed private housing	34	26	14
	L: Mixed non-private housing	21	0	3
	M: Mixed private/non-private housing	35	31	10
	N: Retirement flats	9	0	2

Table B1 (cont.)   TRICS (2008) land use classifications and survey types.

Land use	Land use sub-category	Vehicles		Multi-modal count surveys
		Manual count surveys	ATC surveys	
04: Education	A: Primary	32	0	4
	B: Secondary	29	17	11
	C: College/university	35	7	20
	D: Nursery	31	0	2
	E: Residential school	7	0	0
	F: Community education	7	0	3
05: Health	A: General hospital – with casualty	33	52	7
	B: General hospital – without casualty	18	7	4
	C: Special (e.g. neurological)	15	0	5
	D: Private hospital	23	0	4
	E: Clinics	9	7	2
	F: Nursing homes	20	8	3
	G: GP surgeries	33	0	9
	H: Hospice	10	0	2
	I: Teaching hospital	3	0	0
	J: Dental surgery	8	0	2
	K: National Health Service walk-in centre	0	0	0
06: Hotel, food & drink	A: Hotels	89	67	18
	B: Restaurants	32	0	3
	C: Pub/restaurant	46	0	8
	D: Fast food – drive through	29	0	0
	E: Roadside food (e.g. Little Chef)	35	0	0
	F: Motorway service areas (res/PFS/mot*)	18	7	0
	G: Takeaway shops (e.g. fish bars, etc.)	4	0	0
	H: Pub/restaurant + hotel	25	7	4
	I: Public house (without restaurant)	6	0	3
07: Leisure	A: Multiplex cinemas	30	3	3
	B: Bowling alleys	24	0	3
	C: Leisure centres	74	35	13
	D: Swimming pools	26	4	6
	E: Skiing	0	0	0
	F: Ice rink	18	0	2
	G: Tennis clubs	17	0	4
	H: Bingo halls	20	0	4
	I: Art galleries/museums/exhibitions	20	2	10
	J: Equestrian centres	8	0	0
	K: Fitness clubs (private)	23	0	6
	L: Football (five-a-side)	12	0	1
	M: Country parks	20	47	0
	N: Mixed leisure complex	4	0	0
	O: Leisure park	17	1	4
	P: Watersports centres	12	0	0
	Q: Community centre	5	0	5
	R: Casino	3	0	1
	S: Exhibition centre	4	0	0
	T: Place of worship	4	0	1
	U: Play centre	8	0	2
	V: Library	7	0	6
	W: Theatre	4	0	2

* res/PFS/mot = restaurant/PFS/motel

Table B1 (cont.)   TRICS (2008) land use classifications and survey types.

Land use	Land use sub-category	Vehicles		Multi-modal count surveys
		Manual count surveys	ATC* surveys	
08: Marinas	A: Marinas	42	26	0
09: Golf courses	A: Private nine-hole courses	16	21	0
	B: Private 18-hole courses	51	34	0
	C: Private >18-hole courses	19	0	0
	D: Municipal nine-hole courses	12	0	0
	E: Municipal 18-hole courses	17	0	0
	F: Municipal >18-hole courses	8	0	0
	G: Driving range	16	0	0
	H: 'Three-par' courses	5	0	0
10: Tourist attractions	A: Tourist attractions	0	0	8
11: Car boot sales	A: Car boot sales	25	2	0
12: Civic amenity sites	A: Recycling centres	54	13	0
	B: Household waste	17	70	0
	C: Landfill	20	0	0
13: PFS	A: PFS	123	12	0
	B: PFS with retail	52	0	1
14: Car show rooms	A: Car show rooms	62	1	0
15: Vehicle services	A: Vehicle repair garage (slow fit)	9	0	0
	B: Motorist centre (fast fit)	32	6	0
	C:Car hire centre	5	0	1
16: Mixed	A: Miscellaneous	47	1	7
	B: Mixed use	32	4	10
	C: Farm diversification	8	7	3
Sum	**110**	**3607**	**1335**	**512**

B2   Land use definitions

B2.1   Retail

- **Food superstores** (use class A1[6]): A single food superstore with or without a PFS as part of the site. May be part of a retail park, but site details and survey will only include the food superstore element. Small shop units may also be part of the site. However, if the small shop units constitute more than 15% of the total GFA of the site, the site should be classified as 01/I, 01/J or 01/M. Trip rates are calculated by GFA, RFA, employees or parking spaces.
- **Cash & carry (wholesale and clubs)** (use class A1): A single cash & carry store which requires membership. Trip rates are calculated by GFA, RFA, employees or parking spaces.
- **Discount food store** (use class A1): A single discount food superstore offering customers cheaper food, often sold in bulk packaging. May be part of a retail park, but site details and survey will only include the discount food store element. Trip rates are calculated by GFA, RFA, employees or parking spaces.
- **DIY superstore (with garden centre)** (use class A1): Non-food retail store specialising in DIY goods, which include a garden centre sharing the same car park. May be part of a retail park, but site details and survey will only include the DIY superstore element. Trip rates are calculated by GFA, RFA, employees or parking spaces. For both GFA and RFA, the appropriate internal and external floor area of the garden centre (excluding landscaping) should be included.
- **DIY superstore (without garden centre)** (use class A1): Non-food retail store specialising in DIY goods, with no garden centre present. May be part of a retail park, but site details and survey will only include the DIY superstore element. Trip rates are calculated by GFA, RFA, employees or parking spaces.
- **Motorist DIY** (use class A1): Non-food retail store specialising in motorist DIY goods. May be part of a retail park, but site details and survey will only include the motorist DIY store element. Trip rates are calculated by GFA, RFA, employees or parking spaces.
- **Other individual non-food superstore** (use class A1): All other single retail superstores not listed above. May be part of a retail park, but site details and survey will only include the individual store element. Trip rates are calculated by GFA, RFA, employees or parking spaces.
- **Garden centre** (use class A1): Individual garden centre. Trip rates are calculated by GFA, RFA, employees or parking spaces. Both internal and external areas (excluding landscaping) should be included as appropriate in the GFA and RFA.
- **Shopping centre (local shops)** (use class A1): A collection of small local shops within close proximity, with shared parking facilities. Would include a large superstore with accompanying small shops if the small shops exceed 15% of the total floor space

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[6] Use Class classifications are based on the UK Town and Country Planning (Use Classes) Order 1987 and its subsequent amendments.

of the site. If the shops are within one building, include as 01/M. If the separate shops are superstores, include as 01/J or 01/K. Trip rates are calculated by GFA, RFA or employees.

- **Retail park (including food)** (use class A1): The same as sub-category 01/K, but includes major food retailing as at least one unit. Includes the 'duo store' sites (e.g. Marks & Spencer next to a Tesco). Trip rates are calculated by GFA, RFA, employees or parking spaces.
- **Retail park (excluding food)** (use class A1): Mixed site comprising 01/D, 01/E, 01/F and 01/G sub-categories (and occasionally 01/H). If significant units at the site are not retail, then include as 16/B. Trip rates are calculated by GFA, RFA, employees or parking spaces.
- **Builders' merchant** (use class A1): Individual store specialising in builders' equipment and supplies. Trip rates are calculated by GFA, RFA, employees or parking spaces. Both internal and external areas (excluding landscaping) should be included as appropriate in the GFA and RFA.
- **Mixed shopping malls** (use class A1): A collection of shops within a single building, with shared parking facilities. Would include a large superstore with accompanying small shops if the small shops exceed 15% of the total floor space of the site. If the shops are not all within one building, include as 01/I. If the separate shops are superstores, include as 01/J or 01/K. Trip rates are calculated by GFA, RFA or employees.
- **Factory outlet centre** (use class A1): Number of factory outlet retail units at a single site, with shared parking facilities. Trip rates are calculated by GFA, RFA, employees or parking spaces.
- **Convenience store** (use class A1): Small 'corner shop' style store, selling various items which may include groceries, newspapers and magazines, confectionery and household products. Trip rates are calculated by GFA, RFA or employees.
- **Factory shop** (use class A1): Shop selling the produce of a factory, usually with the factory attached to the site (but not included as part of the survey). Trip rates are calculated by GFA, RFA, employees or parking spaces.
- **Market**: Indoor or outdoor grouping of market stalls. Excludes livestock auctions, car auctions, etc. Also excludes car boot sales, which can be found under 11/A. Trip rates are calculated by site area or number of stalls.

B2.2 Employment

- **Office** (use class B1): Single office building. May include a number of different organisations within the same building. If more than one building is involved, then only include it if the buildings belong to the same organisation. If separate organisations are housed in separate buildings, then include as 02/B. Trip rates are calculated by GFA or employees.
- **Business park** (use class B1): Collection of office buildings hosting separate organisations. If all buildings belong to one organisation, then include as 02/A. Also include as 02/A if only one building hosts a number of separate organisations. Trip rates are calculated by GFA, employees or parking spaces.
- **Industrial unit** (use class B1 or B2): Single industrial building, used by one organisation. May be light or general industry. If predominantly warehousing, include as 02/E or 02/F. If predominantly office then include as 02/A. Trip rates are calculated by GFA, employees or parking spaces.
- **Industrial estate** (use class B1 or B2): A number of industrial buildings at the same site. If predominantly warehousing then include as 02/E or 02/F. If predominantly office, include as 02/B. If the estate contains significant retail generators, then include as 16/B. Trip rates are calculated by GFA, employees or parking spaces.
- **Warehousing (self-storage)** (use class B8): Non-retail warehousing for customer self-storage. Trip rates are calculated by GFA, employees or parking spaces. Both internal and external storage areas should be included as appropriate in the GFA.
- **Warehousing (commercial)** (use class B8): All commercial warehousing. If predominantly office then include as 02/A or 02/B. If predominantly industrial then include as 01/C or 01/D. Trip rates are calculated by GFA, employees or parking spaces. Both internal and external storage areas should be included as appropriate in the GFA.
- **Parcel distribution centre** (use class B8): Single parcel distribution or mail sorting developments. Trip rates are calculated by GFA, employees or parking spaces.
- **Quarry** (use class B2): All types of extraction facility, excluding mines. Trip rates are calculated by site area, employees or parking spaces.

B2.3   Residential

- **Houses (privately owned)** (use class C3): Housing developments where at least 75% of units are privately owned. Of the total number of units, 75% must also be houses (sum of 'non-split' terraced, detached, semi-detached, bungalows, etc), with no more than 25% of the total units being flats. Includes properties that are privately owned and then privately rented. Trip rates are calculated by site area, households, housing density or total bedrooms.

- **Houses for rent** (use class C3): Housing developments where at least 75% of units are non-privately owned. Of the total number of units, 75% must also be houses (sum of 'non-split' terraced, detached, semi-detached, bungalows, etc.), with no more than 25% of the total units being flats. 'Non-privately owned' may be council rented or housing association rented/part-owned. Trip rates are calculated by site area, households, housing density or total bedrooms.

- **Flats (privately owned)** (use class C3): Housing developments where at least 75% of households are privately owned. Of the total number of units, 75% must also be flats (sum of flats in blocks and 'split' houses), with no more than 25% of the total units being 'non-split' houses. Includes properties that are privately owned and then privately rented. Trip rates are calculated by site area, households, housing density or total bedrooms.

- **Flats for rent** (use class C3): Housing developments where at least 75% of households are non-privately owned. Of the total number of units, 75% must also be flats (sum of flats in blocks and 'split' houses), with no more than 25% of the total units being 'non-split' houses. 'Non-privately owned' may be council rented or housing association rented/part-owned. Trip rates are calculated by site area, households, housing density or total bedrooms.

- **Institutional hostels** (use class C1): An institutional hostel comprising one or more buildings. Trip rates are calculated by site area, residents or parking spaces.

- **Sheltered accommodation** (use class C3): Sheltered accommodation for elderly people. Not to be confused with nursing homes. Trip rates are calculated by site area, households or housing density.

- **Student accommodation** (use class C3): Includes halls of residence, student flats, etc. If sharing a site with an educational land use, only the accommodation element should be included in the site and survey details. Trip rates are calculated by site area or residents.

- **Nurses' homes** (use class C3): A building or collection of buildings housing nurses. If sharing a site with a health land use, only the accommodation element should be included in the site and survey details. Trip rates are calculated by site area, residents or parking spaces.

- **Caravan parks (non-holiday)** (use class C3): Permanent residential caravan parks, not used for holiday purposes. Trip rates are calculated by site area or number of caravans.

- **Holiday accommodation:** Includes bed & breakfast accommodation, guest houses, caravan/camping parks, holiday villages, holiday camps. All types of unit

(caravans/chalets/pitches, etc.) are included in the total for the site. Trip rates are calculated by site area, units or parking spaces.

- **Mixed private housing** (use class C3): Housing developments where at least 75% of units are privately owned. Of the total number of units, less than 75% must be houses (the sum of 'non-split' terraced, detached, semi-detached, bungalows, etc.) and less than 75% must be flats (the sum of flats in blocks and 'split' houses). Trip rates are calculated by site area, households, housing density or total bedrooms.
- **Mixed non-private housing** (use class C3): Housing developments where at least 75% of units are non-privately owned. Of the total number of units, less than 75% must be houses (the sum of 'non-split' terraced, detached, semi-detached, bungalows, etc.) and less than 75% must be flats (the sum of flats in blocks and 'split' houses). 'Non-privately owned' may be council rented or housing association rented/part-owned. Trip rates are calculated by site area, households, housing density or total bedrooms.
- **Mixed private/non-private housing** (use class C3): Housing developments where less than 75% of units are privately owned, and less than 75% of units are non-privately owned. 'Non-privately owned' may be council rented or housing association rented/part-owned. Trip rates are calculated by site area, households, housing density or total bedrooms.
- **Retirement flats** (use class C3): Housing developments built specifically for the retired, where at least 75% of units are privately owned. Of the total number of units, 75% must also be flats (sum of flats in blocks and 'split' houses), with no more than 25% of the total units being 'non-split' houses. Trip rates are calculated by site area, households, housing density or total bedrooms.

B2.4 Education

- **Primary** (use class D1): Primary schools, including 'middle' schools and 'prep' schools. Trip rates are calculated by GFA, pupils or employees.
- **Secondary** (use class D1): Secondary schools, not including 'middle' schools. Trip rates are calculated by GFA, pupils or employees.
- **College/university** (use class D1): Includes colleges, universities or sixth form centres. Trip rates are calculated by GFA, students or employees.
- **Nursery** (use class D1): Preschool centres. Trip rates are calculated by GFA, pupils or employees.
- **Residential school** (use class C2): Schools where a significant number of pupils are boarders. If a very low number are boarders, include as 04/B. Trip rates are calculated by GFA, pupils or employees.
- **Community education** (use class D1): Specialist centres offering educational classes as well as leisurely pursuits and training. If more of a college/university, include as 04/C. Trip rates are calculated by site area, GFA or employees.

B2.5 Health

- **General hospital (with casualty)** (use class C2): General hospital with an Accident and Emergency department. Trip rates are calculated by GFA, beds or employees.
- **General hospital (without casualty)** (use class C2): General hospital without an Accident and Emergency department. Trip rates are calculated by GFA, beds or employees.
- **Special (e.g. neurological)** (use class C2): Specialist non-private hospital (e.g. neurological, geriatric, psychological, etc.). Trip rates are calculated by GFA, beds or employees.
- **Private hospital** (use class C2): Fee paying or BUPA-type hospital (BUPA –British United Provident Association). Trip rates are calculated by GFA, beds, employees or parking spaces.
- **Clinic** (use class D1): Health centres covering specialist care, not to be confused with GP surgeries. Trip rates are calculated by GFA or employees.
- **Nursing home** (use class C2): Supervised residential homes for the elderly, not to be confused with sheltered housing. Trip rates are calculated by residents or parking spaces.
- **GP surgery** (use class D1): Doctors' surgeries, not to be confused with clinics or dental surgeries. Trip rates are calculated by GFA, doctors or employees.
- **Hospice** (use class C2): Hospice building or buildings. Trip rates are calculated by employees, patients or parking spaces.
- **Teaching hospital** (use class C2): General hospital, with or without an Accident and Emergency department, with an emphasis on teaching. Trip rates are calculated by GFA, beds or employees.
- **Dental surgery** (use class D1): Dental surgeries, excluding sites shared with GP surgeries or clinics. Trip rates are calculated by GFA or employees.
- **National Health Service (NHS) walk-in centre** (class D1): Medical centre run by the NHS which allows patients to walk in and receive treatment without the need to book appointments. Trip rates are calculated by GFA or employees.

B2.6 Hotel, food and drink

- **Hotel** (use class C1): Hotel sites excluding guest houses, and bed and breakfast accommodation (which should be included as 03/J). Trip rates are calculated by GFA, bedrooms or employees.
- **Restaurant** (use class A3): Single restaurants. If a pub/restaurant, include as 06/C. If a roadside food supplier such as Little Chef, include as 06/E. If the site includes a drive-through facility, include as 06/D. Trip rates are calculated by GFA, seats, employees or parking spaces.
- **Pub/restaurant** (use class A4): Combined public house and restaurant site (e.g. Beefeater, Brewers Fayre, etc). If accommodation for the public is included, include as 06/H. Trip rates are calculated by GFA, employees or parking spaces.
- **Fast food (drive-through)** (use class A5): Single fast food outlets with a drive-through facility, with or without restaurant facilities. May be within a retail/leisure park, but the site details and survey should only include the fast food outlet (both drive-through and other facilities). Trip rates are calculated by GFA, employees or parking spaces.
- **Roadside food (e.g. Little Chef)** (use class A3): Restaurant outlet designed for passing motorist trade, often as part of a motorway service area. If in such an area, the site details and the survey should only include the restaurant element. Trip rates are calculated by GFA, seats, employees or parking spaces.
- **Motorway services (e.g. restaurant/PFS/motel):** Motorway service area including a number of different service elements. If service station is on both sides of the motorway, development details should specify if both directions have been included in the count. Trip rates are calculated by GFA, employees or parking spaces.
- **Takeaway shops (fish bars etc.)** (use class A5): Single shops selling hot food, without a drive-through or a restaurant element. Trip rates are calculated by GFA or employees.
- **Pub/restaurant + hotel:** Combined public house and restaurant site with accommodation available for the public. Trip rates are calculated by GFA, bedrooms, employees or parking spaces.
- **Public house (without restaurant):** Public house without a separate restaurant (although site may sell bar food) or overnight accommodation for the public. Trip rates are calculated by GFA, employees or parking spaces.

B2.7 Leisure

- **Multiplex cinema** (use class D2): Multi-screen cinema building. If the cinema is within a leisure park then ensure that the site details and the survey only include the cinema element. If the site building includes a significant amount of other leisure uses (with the parking being shared) then include as 07/N or 07/O. Trip rates are calculated by GFA, seats, employees or parking spaces.
- **Bowling alley** (use class D2): Multi-lane bowling alley building. If the bowling alley is within a leisure park then ensure that the site details and the survey only include the bowling alley element. If the site building includes a significant amount of other leisure uses (with the parking being shared) then include as 07/N or 07/O. Trip rates are calculated by GFA, lanes, employees or parking spaces.
- **Leisure centre** (use class D2): Leisure centre without private membership, usually owned by the local authority. Trip rates are calculated by site area, GFA or employees.
- **Swimming pool** (use class D2): Includes traditional pools, and modern sites with flumes and other facilities. However, if significant other leisure facilities take place at the site then include as 07/C or 07/K. If the swimming pool is within a leisure park then ensure that the site details and the survey only include the swimming pool element. Trip rates are calculated by GFA or employees.
- **Skiing** (use class D2): Snow or dry ski slope centres.
- **Ice rink** (use class D2): Single ice rink buildings. If the ice rink is within a leisure park then ensure that the site details and survey only include the ice rink element. Trip rates are calculated by gross floor area, rink size or employees.
- **Tennis club** (use class D2): Multi-court tennis clubs. If the site includes a significant amount of other leisure uses (with the parking being shared) then include as 07/C, 07/K, 07/N or 07/O. Trip rates are calculated by site area, courts, employees or parking spaces.
- **Bingo hall** (use class D2): Single building for bingo facilities. Trip rates are calculated by seats or employees.
- **Art gallery/museum/exhibition** (use class D1): Single art gallery, museum or exhibition building. May include a combination of these three leisure types. Trip rates are calculated by GFA or employees.
- **Equestrian centre** (use class D2): Horse riding centre/stables. Trip rates are calculated by site area, employees or parking spaces.
- **Fitness club (private)** (use class D2): Private membership-only fitness club. Trip rates are calculated by site area, GFA, employees or parking spaces.
- **Football (five-a-side)** (use class D2): Site containing five-a-side football pitches. If significant other leisure facilities are at the site then include as 07/C or 07/K. Trip rates are calculated by site area, pitches, employees or parking spaces.
- **Country park** (use class D2): Country parks and open nature reserves. Trip rates are calculated by site area, employees or parking spaces.
- **Mixed leisure complex:** Usually a single building containing a range of leisure facilities (e.g. combined nightclub, theatre, bar, swimming pool, library, etc.). Not to be confused with leisure parks. Trip rates are calculated by site area, GFA, employees or parking spaces.

- **Leisure park:** Separate leisure buildings contained within a shared area (e.g. multiplex cinema, bowling, restaurant, etc.), usually with shared parking facilities. Not to be confused with mixed leisure complexes. Trip rates are calculated by GFA, employees or parking spaces.
- **Watersports centre** (use class D2): Waterski, jetski, canoeing, sailing or rowing clubs in a self-contained measurable site (e.g. a lake). Trip rates are calculated by site area, employees or parking spaces.
- **Community centre** (use class D1): Dedicated centre for community activities (non-educational). Trip rates are calculated by GFA, site area, employees or parking spaces.
- **Casino** (use class D2): Licensed gambling centre. Trip rates are calculated by GFA, site area or employees.
- **Exhibition centre** (use class D1): Dedicated centre for hosting exhibitions and conferences. Trip rates are calculated by GFA, site area, employees or parking spaces.
- **Place of worship** (use class D1): A religious, communal place of worship. Trip rates are calculated by GFA, site area or employees.
- **Play centre** (use class D2): Purpose-built indoor play centre. If included as part of pub/restaurant then classify as 06/C or 06/H. Trip rates are calculated by GFA, site area, employees or parking spaces.
- **Library** (use class D1): Local authority or privately-owned library. In addition to book hire, may include additional facilities such as internet use, etc. Trip rates are calculated by GFA or employees.
- **Theatre** (use class D2): Indoor theatre for one or more types of performance. Trip rates are calculated by GFA, seats or employees.

B2.8 Marinas

- **Marinas** (use class D2): Boating-dominated marina site possibly containing facilities such as chandlery, shops and accommodation, although if levels of non-boating activity are significant, the site should be included as 16/B. Trip rates are calculated by site area, berths or parking spaces.

B2.9 Golf

- **Private nine-hole course** (use class D2): Privately-run nine-hole golf course with membership scheme. Trip rates are calculated by site area, holes or parking spaces.
- **Private 18-hole course** (use class D2): Privately-run 18-hole golf course with membership scheme. Trip rates are calculated by site area, holes or parking spaces.
- **Private >18-hole course** (use class D2): Privately-run golf club (with a total of over 18 holes) with membership scheme. Trip rates are calculated by site area, holes or parking spaces.
- **Municipal nine-hole course** (use class D2): Local authority-run nine-hole golf course. Trip rates are calculated by site area, holes or parking spaces.
- **Municipal 18-hole course** (use class D2): Local authority-run 18-hole golf course. Trip rates are calculated by site area, holes or parking spaces.
- **Municipal >18-hole course** (use class D2): Local authority-run golf club (with a total over 18 holes). Trip rates are calculated by site area, holes or parking spaces.
- **Driving range** (use class D2): Driving range for golf practice. If it includes a golf course, then include as 09A-F, as appropriate. Trip rates are calculated by site area, ranges or parking spaces.
- **'Three-par' course** (use class D2): Golf course where all holes are rated as three-par. Trip rates are calculated by site area, holes or parking spaces.

B2.10   Tourist attractions

- **Tourist attractions** (use classes D1 and D2): Includes theme parks, zoos, visitor centres, stately homes, National Trust Centres, etc. Any tourist attraction that does not fit into another land use category.

B2.11   Car boot sales

- **Car boot sales**: Sites at which car boot sales are conducted. Trip rates are calculated by site area, pitches or parking spaces.

B2.12   Civic amenity sites

- **Recycling centre:** Civic amenity sites that are predominantly used for recycling materials rather than depositing household waste. Trip rates are calculated by site area or bays.
- **Household waste:** Civic amenity sites that are predominantly used for the depositing of household waste rather than recycling materials. Trip rates are calculated by site area or bays.
- **Landfill**: Sites for landfill disposal of waste. Trip rates are calculated by site area.

B2.13   PFS

- **Petrol filling station (PFS):**- 'Traditional' PFS with only a small shopping element such as a newsagent-type store. Trip rates are calculated by site area or filling bays.
- **PFS with retail:** PFS with a significant retail element, possibly a smaller version of a branded supermarket or a fast food facility. Trip rates are calculated by site area or filling bays.

B2.14   Car show rooms

- **Car show rooms:** Sites where the sale of motor vehicles takes place. May also include vehicle servicing etc. Trip rates are calculated by site area, GFA or parking spaces. The GFA should also include external sales areas.

B2.15   Vehicle service

- **Vehicle repair garage – slow fit** (use class B2): Vehicle repair and service garages, with work not undertaken on an 'as you wait' basis. Does not include sites where the sale of vehicles takes place. Trip rates are calculated by GFA, site area or parking spaces.
- **Motorist centre – fast fit** (use class B2): Garages which fit tyres, exhausts and brakes etc. to vehicles on an 'as you wait' basis (e.g. Kwik Fit). Does not include sites where the sale of vehicles takes place. Trip rates are calculated by GFA, site area or parking spaces.
- **Car hire centre** (use class A1): Vehicle hire centres for business or personal use. Trip rates are calculated by GFA, site area or parking spaces.

B2.16   Mixed

- **Miscellaneous:** Any single-use site that does not fit into any other land use category. Trip rates cannot be calculated for this land use category, given the diverse nature of the sites.
- **Mixed use:** Any sites that do not fit into any other land use category and which consist of more than one development type. Trip rates cannot be calculated for this land use category, given the diverse nature of the sites.
- **Farm diversification:** Farm sites that have since been converted into one or more different development types. May include an element of active farm operation. Trip rates cannot be calculated for this land use category, given the diverse nature of the sites.

Appendix: C TRICS vehicle and multi-modal count data definitions

Table C1   Definitions of TRICS standard vehicle types.

Vehicle type	Definition
Motorcycle	Includes mopeds, scooters, motorcycles and motorcycle combinations, as a percentage of all vehicles included in the count shown.
Motor car	All cars including estates and light vans with side windows to the rear of the driver's seat, as a percentage of all vehicles included in the count shown. Also includes three-wheeled cars.
Light goods	Consists of all goods vehicles up to 30 CWT (1.5 Tonnes) [unladen weight] as a percentage of all vehicles included in the count shown. Included in this category are car-type delivery vans, and standard 'Transit' or 'Sherpa' vans, but not vehicles with twin rear wheels.
OGV(1)	All commercial vehicles with two axles and twin rear wheels, and all vehicles with three axles, as a percentage of all vehicles included in the count shown.
OGV(2)	All goods vehicles with four or more axles, as a percentage of all vehicles included in the count shown.
Public service	All buses and coaches with 13 or more seats carrying capacity, as a percentage of all vehicles included in the count shown.

Table C2   TRICS multi-modal vehicle and people count data definitions.

Count types	Definition
Vehicles	All vehicles entering and exiting the site at any access point, excluding pedal cycles. May also include vehicles dropping off/picking up people outside the site as both arrivals and departures, and vehicles parking off-site for use of the site (if such trips are relevant).
Cycle	Pedal cycles entering and exiting the site at any access point.
Public service vehicle	All public service vehicles (see Table C1) entering and exiting the site at any access point.
OGV	All OGVs (see Table C1) entering and exiting the site at any access point. It is assumed that each OGV has one occupant.
Pedestrians	All people walking in and out of the site at any access point who do not use a pedal cycle, vehicle, a bus/tram or a train. People who get off a bus within 400 m of the site access point and then walk to the site are recorded as bus passengers. People who get off a train within 1000 m who the walk to the site are recorded as train passengers. The same applies to outbound trips.
Public transport users	This is the public transport users count, and is the total of the separate bus/tram passenger, train passenger and coach passenger counts.
People	This is the sum of Cycle, Occupants, Pedestrians and Public transport users. Essentially all 'people' trips to and from the site.
Occupants	All occupants of cars, motorcycles and light goods vehicles entering and exiting the site at any access point, or being dropped off by a vehicle outside or near the site if appropriate. Excludes taxi drivers and drivers of other vehicles dropping off/picking up passengers inside or outside the site.
Taxis	All taxi and minicabs entering the site at any point. Included in the Total Vehicles count. May also include taxis dropping off/picking up people outside the site as both arrivals and departures.

Appendix D   Common parameters between the NZ and UK databases

Land use activity group		NZ – TDB Number of survey sites	Primary	#	Secondary	#	Tertiary	#	Comments	Land use	Sub-category	UK – TRICS Number of survey sites	Primary	Secondary	Tertiary	Number of trip rate predictor matches
Assembly	Church	18	GFA	18	Attendance	18	Seats	18								
	Cinema	3	GFA	3	Seats	3	Employees	3		Leisure	Multiplex cinemas	13	GFA	Parking spaces	Seats	2
Commercial	Bank	2	GFA	2	Employees	2	Site area	1								
	Business park	6	GFA	2	Employees	2				Employment	Business park	21	GFA	Parking spaces	Employees	21
	Office	13	GFA	6	Employees	5	Site area	5			Office	115	GFA	Parking spaces	Employees	2
	Preschool	25	GFA	24	Employees	23	Students	16			Nursery	24	GFA	Parking spaces	Employees	2
Education	Primary	6	Students	6	GFA	3	Employees	5		Education	Primary	32	GFA	Parking spaces	Students	2
	Secondary	5	Students	5	GRA	4	Site area	2			Secondary	32	GFA	Parking spaces	Students	2
	Tertiary	10	Students	3	Employees	3	GFA	2			College/Uni	36	GFA	Parking spaces	Students	2
	Integrated	4	Students	4												
Industry	Contractor	7	GFA	7	Site area	7	Employees	6								
	Manufacture	19	GFA	19	Site area	16	Employees	11		Employment	Manufacture	7	GFA	Parking space		16
	Warehousing	5	GFA	7	GFA	5	Employees	5			Warehousing (commercial)	12	GFA	Parking spaces	Employees	2
	Storage	22	GFA	22	Site area	20	Employees	10								
	Centre	8	GFA	6	Employees	6	Consulting rooms	1			GP Surgeries	29	GFA	Parking spaces	Consultants	29
Medical	Hospital	12	Beds	12	Employees	11	GFA	9		Health	General hospital (with casualty)	36	GFA	Parking spaces	Beds	2
											General hospital (without casualty)	17	GFA	Parking spaces	Beds	2
											Clinic	6	GFA	Parking spaces	Employees	6
											Private hospital	16	GFA	Parking spaces	Beds	2
	Veterinary	2	GFA	1	Employees	1										

Table D1   Parameters common to TDB and TRICS.

SECTIONS

		NZ - TDB							UK - TRICS						
Land use activity group	Number of survey sites	Trip rate predictor Primary	#	Secondary	#	Tertiary	#	Comments	Land use	Sub-category	Number of survey sites	Trip rate predictor Primary	Secondary	Tertiary	Number of trip rate predictor matches
Pool/aquatic	2	GFA	1	Employees	1				Leisure	Swimming pools	24	GFA	Parking spaces		1
Golf courses	2	Holes	2	Employees	1				Golf	Private nine-hole golf courses	12	Parking spaces	Site area	Holes	1
										Private 18-hole golf courses	32	Parking spaces	Site area	Holes	1
										Private >18-hole golf courses	11	Parking spaces	Site area	Holes	1
										Municipal nine-hole golf course	7	Parking spaces	Site area	Holes	1
										Municipal 18-hole golf course	9	Parking spaces	Site area	Holes	1
										Municipal >18-hole golf course	4	Parking spaces	Site area	Holes	1
										Driving range	7	Parking spaces	Site area	Holes	1
										Three-par course	3	Parking spaces	Site area	Holes	1
Gymnasium	2	GFA	2	Employees	2										
Marina	3	Berths	1					No information for either site	Marinas		30	Parking spaces	Site area	Berths	1
Outdoor courts	1	Courts	1												
Other	2	Bays	1												
Stadium	16	Attendance	16												

(Land use activity group section: Recreation)

Table D1 (cont.) Parameters common to TDB and TRICS.

Land use activity group	NZ - TDB Number of survey sites	Trip rate predictor Primary	#	Secondary	#	Tertiary	#	Comments	Land use	Sub-category	UK – TRICS Number of survey sites	Trip rate predictor Primary	Secondary	Tertiary	Number of trip rate predictor matches
Residential — Dwelling	48	Household units	48						Residential	Houses (privately owned)	176	Household units	Site area	Residents	1
										Houses for rent	21	Household units	Site area	Residents	1
										Mixed private housing	35	Household units	Site area	Residents	1
										Mixed private/ non-private housing	32	Household units	Site area	Residents	1
Home	18	Beds	7	Rooms	6	Employees	8			Retirement flats	9	Household units	Site are	Residents	1
Hotel	4	Rooms	4	GFA	4	Employees	8		Hotel, food & drink	Hotel	77	GFA	Parking spaces	Rooms	2
Motel	11	Rooms	11	GFA	2	Employees									
Bar	11	GFA	10	Members	3				Hotel, food & drink	Pub/restaurant	26	GFA	Parking spaces		1
Bulk	8	GFA	8	Site area	4	Employees	4	All same store							
Discount	4	GFA	4					All same store							
Fast food	11	Seats	8	GFA	6				Retail	Fast food	19	GFA	Parking spaces		1
Garden centre	6	GFA	4	Employees	4					Garden centre	33	GFA	RFA	Parking spaces	1
Market	3	GFA						All same market							
Produce	2	GFA	2	RFA	2	Employees		Two more sites without info							
Restaurant	11	GFA	18	Seats	7	Employees	6		Hotel, food & drink	Restaurant	18	GFA	Parking spaces	Seats	2
Retail — Service station	14	Pumps	4	GFA	3			Eight sites without predictor units	Petrol	PFS without retail	72	Site area			0
										PFS with retail	30	Site area			0

Table D1 (cont.) Parameters common to TDB and TRICS.

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Land use activity group		Number of survey sites	Trip rate predictor						Comments	Land use	Sub-category	Number of survey sites	Trip rate predictor			Number of trip rate predictor matches
			Primary	#	Secondary	#	Tertiary	#					Primary	Secondary	Tertiary	
Retail	Shop	18	GFA	18	Employees	13										
	Shopping centre	115	GFA	114	Employees	42			61 sites without info							
	Supermarket	7	GFA	7	Employees	5			One more site without info	Retail	Food superstore	239	GFA	RFA	Parking spaces	1
Rural	Vineyard	2	GFA	2	Site are	2										
Total # sites		493									**Total # sites**	1336				

NZ - TDB / UK – TRICS

Table D1 (cont.) Parameters common to TDB and TRICS.

Notes to Table D1:
a: Grey highlight indicate common land uses that were assessed for trip rate comparison.
b: Retail: shopping centres in NZ were of a different scale to shopping centres in TRICS (e.g. NZ data included the Hamilton CBD). Comparisons could not be drawn.
c: 'Number of survey sites' is the number of sites with relevant information, not the gross number of sites in each database.