Generation of walking, cycling and public transport trips: pilot study

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Abbreviations and acronyms

ARTA	Auckland Regional Transport Agency
CAPI	computer assisted personal interviews
FHWA	US Federal Highway Administration
GFA	gross floor area
HTS	household travel survey
IPENZ	Institution of Professional Engineers, New Zealand
ITE	Institute of Transportation Engineers, USA
MoT	Ministry of Transport
NZGPS	New Zealand Government Policy Statement on Land Transport Funding 2010
NZTA	New Zealand Transport Agency
PT	public transport
RTA	Roads and Traffic Authority, New South Wales
TDB	Trips Database Bureau (New Zealand)
TIA	transport impact assessment
TOD	transit orientated development
TRICS	Trip Rate Information Computer System

Contents

Executive summary

The stated goal of this research project was to:

> *Establish the data required and develop survey techniques to enable the calculation of trip rates for walking, cycling and public transport trips to a variety of activities.*

This research focused on developing a survey methodology for capturing non-car travel modes. An initial survey method was chosen and then, through a series of pilot surveys undertaken in 2010, developed and refined until a method was obtained that matched the research goal. Other factors, such as floor areas, were not measured but would be required subsequently to calculate trip rates. The multi-modal trip rates will most likely be adopted by the New Zealand Transport Database Bureau.

It was decided early on, and from the literature review, that the way forward for capturing non-car trips to obtain the travel modes would be through face-to-face questionnaire surveys. However, to find out if these were the most cost-efficient option, the decision was made to include observer as well as face-to-face surveys in the initial stages and compare accuracy.

A site selection form was developed. Having a site selection form formalises the process and makes site selection more consistent. When developing the site selection form much of the data needed for site selection is relevant to any subsequent database that may contain not only the collected non-car data, but also information about the site surveyed.

The site selection process was specific in order to satisfy the following objectives:

1 There was a need to ensure the initial sites were likely to be busy enough to provide meaningful feedback and results, but not too busy to cause surveyor frustration and the inability to use the proposed face-to-face questionnaire methodology.

2 The site selection needed to ensure each site was self-contained and there was a single activity at the one location. More than one activity could result in numerous answers to one question which would be unhelpful in assessing the success of the face-to-face questionnaire methodology.

3 Site users had to be able to use public transport, or walk or cycle as a means of transportation to the site. There would be little point undertaking a multi-modal transport survey of a site that was only accessible by car.

4 If people arrived by public transport they needed to be observed doing so.

In addition to the observer and face-to-face questionnaire surveys, it was necessary to keep a tally of all people entering and leaving the site to establish the capture rate of the survey.

Observer surveys consistently underestimate the number of people using car or bus to get to a destination while overestimating the number of people who walk there. Where the mode split is biased towards cars, and these cars are observable, an observer survey method is reasonably accurate compared with face-to-face questionnaire surveys for estimating car mode. However, where the mode split is less for cars, and a large percentage of these cars do not park on-site and therefore cannot be observed, an observer survey method is much less accurate and tends to overestimate the number of people walking to their destination.

Consequently, although observational surveys require less staffing and are consequently cheaper, face-to-face questionnaire surveys were the preferred method for the research due to improved levels of accuracy and hence cost effectiveness.

Subsequent surveys concentrated on the face-to-face questionnaire methodology and developing it further. It was also clear from the initial surveys that interviewing in both directions was reliable for the inbound direction but not the outbound direction. The surveyors mentioned that people leaving were less inclined to answer the questions because they had been stopped on the way in. For the next series of surveys one direction only was chosen.

Given that the vast majority of sites are attractors and people travel there for a specific purpose, it was decided to interview the outbound direction only. Then, to capture the other direction (inbound), interviewees would be asked what time they arrived. It was considered most people would have a good idea of when they arrived or how long they had been somewhere. It was also considered the answers would be sufficiently accurate to within 15 minutes, which is typically the time interval used when considering peak-hour periods.

Given the simplicity of the face-to-face questionnaire, there was little likelihood the answers would be inaccurate due to misunderstanding the question, or that the surveyor would not understand the answers. However, as the literature review had determined face-to-face questionnaire surveys were always better when undertaken by people familiar with such survey methods, there would be opportunities for clarification should that be necessary.

The face-to-face questionnaire survey proved to be reliable although some key data, such as the time of the interview (the person's departure time) or when the person arrived was often missing. These two pieces of information are critical when deriving trip rates as trip rates are time dependent, ie trip rates are typically quoted not just for the whole survey period but also for peak periods within a survey period. The instructions needed to ensure that surveyors knew they had to note the number of people who refused a request to take part. The time of arrival should always be noted.

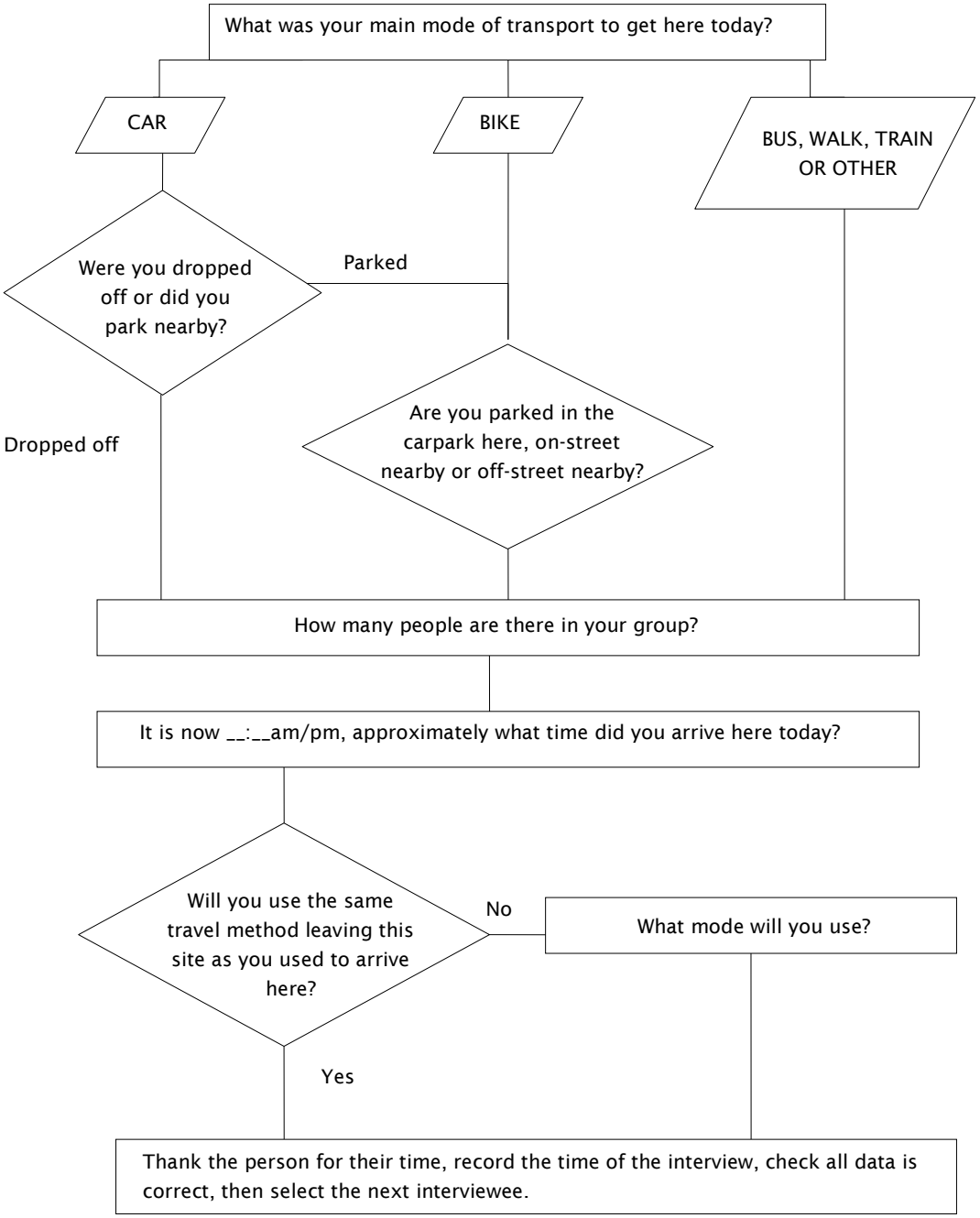
Some surveyors had several refusals while others had none. An anonymous questionnaire about the survey method was sent to the surveyors to obtain some feedback – all thought the survey had gone well. However, as there were variations in the quality of the data, with some of it missing, this was clearly not the case. There needed to be some refinement to the survey to make sure basic information was being gathered.

Once this was done, the updated survey methodology and surveyor instructions resulted in a greater level of accuracy, not only in terms of the eventual mode splits but also in noting non-responses.

Some consideration was given to the method by which the survey might be applied to residential activities. Residential sites are mainly trip generators rather than trip attractors and the 'inbound' part of the journey could happen the night before. Consequently getting a realistic answer to the question 'What time did you arrive?' might be problematic. As a result, it was decided for residential land-use activities, the only course of action would be to interview in both directions. It was considered the capture rate and respondent rate resulted in a good survey methodology and, as such, the two-way method should be adopted for residential developments.

The face-to-face questionnaire survey asked what mode someone chose, and if the answer was 'car', there was a subsequent question: 'Was the person dropped-off or did they park?' If the answer was 'parked' they were then asked if they parked on-site, on-street nearby or off-street nearby. As an aside, if the interviewee said they cycled, they were also asked where they parked. They were asked how many people were in their group, what time they arrived at the site and if they would use the same mode to leave the site as they used to arrive. That completed the survey, but surveyors then made a note of the time of the survey, which related to the interviewee's departure time.

The survey sheet on which the surveyor noted the answers was simple in design and followed the questioning process. The following flowchart identifies the steps for requesting the information.



It is recommended the face-to-face questionnaire survey method identified in this research be applied to a greater range of land-use activities and that actual trip rates are calculated. This could be applied initially to sites that have direct access to/from the state highway and are therefore within the NZ Transport Agency's control. Applying this survey method further would add more credence to the results of the research.

Abstract

This research investigated a method for collecting data relating to walk, cycle and public transport trips to land-use activities.

A method needed to be developed that would require a short questionnaire to ensure higher sample rates, while also providing reliable and consistent results. This data could subsequently be used in calculating trip rates for walk, cycle and public transport trips, when combined with trip rate units such as floor area.

Multi-modal trip data has been collected for some time in the UK. The survey method developed in this research was simpler than the UK method by interviewing in only one direction for the vast majority of land uses, apart from residential where the recommended method was to interview in both directions.

A face-to-face questionnaire method was developed over a series of different site surveys in Auckland, Wellington and Christchurch during 2010. The research also identified that collecting non-car mode trip information through purely observer methods was not sufficiently accurate and that simple questionnaire surveys were necessary with clear instructions from the survey organiser to ensure all relevant information would be collected.

1 Introduction

1.1 Background

New Zealand's transport sector has an important part to play in contributing to the government's goal of economic transformation and energy conservation for New Zealand, and therefore needs to increase its level of innovation and implementation. Research is central to achieving this, as it is at the core of knowledge that informs and supports public policy and decision making.

The New Zealand Transport Agency (NZTA) research approach seeks to fund applied research that delivers strategic outcomes for the land transport sector. This research approach is guided by a number of strategy documents that provide broad context and high-level direction for specific areas of research by setting out the government's vision, priorities and intended outcomes for transport in the short term and into the future. The following principles apply to research funded by the NZTA:

- Results are widely disseminated, free of charge.
- Results are applicable to multiple end users.
- Results are applicable to interventions that can be applied in New Zealand in the short-to-medium term for longer-term impacts.

1.2 Research objective

While methods for surveying the generation of motor vehicle trips are well established, there are few established procedures for accurately measuring, and subsequently predicting, the generation of walking, cycling and public transport trips to and from an activity.

Household travel surveys and census results are of limited use, as the former takes insufficient samples of a particular activity, and the census is focused on work trips only and even then on only one day every five years.

It is envisaged that the procedures will be used by a wide range of practitioners in the course of undertaking integrated transportation assessments and planning tasks. The establishment of industry adopted procedures will then facilitate the data collection process, enabling feedback of results into a central database. In subsequent research, these results can be supplemented as necessary and analysed to determine:

- walking, cycling and public transport trip generation rates for the design of facilities
- a baseline of mode share as a basis for measuring success in accordance with the Land Transport Management Act 2003.

Collection of non-car mode trip rates has been ongoing in the UK for some time by the Trip Rate Information Computer System (TRICS). For example, in 2008, TRICS counted approximately 270 sites, with two-thirds of these being multi-modal surveys. As such, the UK's knowledge base of non-car trips is expanding. Given the following policies and desired outcomes, it is imperative that action is taken now to explore ways to improve our knowledge and the ways in which the industry works.

Given increasing demands on New Zealand's transport infrastructure, consequential environmental impacts and the need for the transport industry to more fully account for all transport modes through policy and legislation, there is an ever increasing need to be cognisant of non-car modes when

undertaking any kind of transport assessment. This need is also driven by demands from inside an evolving transport planning industry.

The Land Transport Management Act 2003 and the *Government policy statement on land transport funding 2009/10–2018/19* (GPS) (MoT 2009) recognise that the development of transport infrastructure and urban form has been tending towards an unsustainable and undesirable path. With the reversal in direction toward more sustainable development and associated transport outcomes, as an integral part of current policy, there is an urgent need for practical tools to assist practitioners designing and objectively assessing both land development and transport infrastructure projects.

This research was, therefore, framed around addressing these policy objectives and determining the most efficient and appropriate methods of data collection. It is the first step in a longer research-based process that will take at least two years to complete. In the interim, engineers and planners are currently relying on their own judgement and best practice guides, neither of which is based on quantitative data. Such processes are inefficient with respect to professional time, and do not facilitate objective assessment.

The procedures developed within this stage of the research will provide an enduring guide to best practice for measuring trip generation. The ultimate results, the trip rates themselves, which will derive from the recommended future research phase, should be reviewed as travel behaviour changes. In this way, the research methodology will provide an ongoing tool to practitioners, as have Transfund NZ research reports 209 and 210 (Douglass and McKenzie 2001a; 2001b).

This research is wholly consistent with, and contributory to, the above policy documents. It has the potential to provide practitioners with additional tools that will eventually enable better planning for, and provision of, facilities for walking, cycling and public transport.

1.3 Research goal

The stated goal of this research project was to:

> *Establish the data required and develop survey techniques to enable the calculation of trip rates for walking, cycling and public transport trips to a variety of activities.*

Other aspects to this research identified in the research proposal included answering the following questions:

- Is there a need to collect non-car mode trip data in New Zealand?
- What data collection methods are available for collecting this data?
- Which data collection method is the most cost effective?
- Should methods of data collection be 'standardised' across the industry and if so, why?
- Who needs to use this data and why?
- What is the most effective way of making this data accessible?

1.4 Potential future research

The research complemented much of the work already being undertaken in New Zealand and overseas. However, there was a need to ensure that data used in New Zealand was relevant to New Zealand. Not only did the research explore relevance, it also defined if this required only new data to be collected in New Zealand or if existing overseas data was also relevant and applicable. The research determined the

most efficient and appropriate methods of data collection, and was the first step in a process that is likely to take at least two years to complete. The second subsequent phase research is recommended to concentrate more on determining:

- walking, cycling and public transport trip generation rates for the design of facilities
- how these rates vary in response to variables such as residential density and distance from public transport routes, as a tool for analysing how proposed developments contribute to sustainable urban form
- a baseline of mode share as a basis for measuring success in accordance with the Land Transport Management Act 2003.

The end result of the potential further research is likely to be a database similar to that established in the widely used Transfund NZ research reports 209 and 210 (Douglass and McKenzie 2001a; 2001b) which relate to car traffic generation and parking, and its ongoing management by New Zealand Trips Database Bureau (TDB).

2 Literature review process and summary

2.1 Process

A literature review was undertaken as an initial step of this research project to identify existing best practice relating to the generation of walking, cycling and public transport trips. This is included as appendix A. Data relating to these modes has been collected for many years, but mainly on an area-wide or corridor basis for transport modelling or monitoring purposes; not necessarily relating specifically to individual land-use activities.

The review provided a basis for designing the pilot surveys and gathering an understanding of the issues involved in collating data relating to these trips, specifically when connected to forecasting future trip patterns for individual land uses rather than for general monitoring.

The only existing major data source for multi-modal trips associated with developments is TRICS, which is a UK-based trip rate database. For this reason, NZTA research report 374 'Comparisons of NZ and UK trips and parking rates' (Abley et al 2009) is an important document and its findings have had a strong influence on the literature review. In New Zealand, practitioners tend to refer to the Roads and Traffic Authority (RTA), New South Wales (2002a) *Guide to traffic generating developments*, the Institute of Transportation Engineers (ITE), USA (2008) *Trip generation* and the *TDB database user guide* (TDB 2009), but these have limitations particularly about non-car modes.

It was also necessary to review other areas that affect trip rates, such as those covered in *Land Transport NZ research report 327*. Part 1. 'Transport impact guidelines for site development' (Collins et al 2007a) as these inform what practitioners should consider when assessing individual land uses and their transport impacts.

2.2 Summary

Countries around the world are recognising the need to take into account non-car modes when calculating trips to and from land-use activities. However, the way in which they undertake this, or intend to do so, differs.

New Zealand's guidance on assessing the transport impacts of developments is becoming more multi-modal in nature and compares reasonably well with UK and USA practice.

Observational, face-to-face questionnaire or self-completed written surveys are all ways in which trip data can be collected. The literature review identified that survey methods need to be simple and of a short duration to ensure information is gleaned from individuals, as well as capturing sufficient numbers of survey respondents to provide quality results. Face-to-face questionnaire surveys are better at capturing data than self-completed questionnaires (either pre-paid paper or online questionnaires). Generally, a limited amount of good quality data for a given budget is better than a large amount of poor quality data. However, the quality of the data depends on the survey type and method adopted. Survey design should be governed by qualitative, not quantitative outcomes.

The type of travel mode chosen by an individual is clearly affected by many external factors relating to site location and local demographics, such as the availability of parking spaces at the destination, accessibility by public transport and car ownership. Current trip rate calculations do not provide direct correlation between the trip rates and these factors.

The RTA in New South Wales, Australia is updating its widely adopted and recognised *Guide to traffic generating developments* (RTA 2002a), a document widely used throughout Australia as well as in New Zealand. The RTA has chosen to take a different approach from the UK. Rather than survey all modes to a site and calculate trip rates for these modes, they propose adopting a two-stage process. The first stage is to calculate an appropriate car trip rate. The second stage is to reduce this using derived factors that take into account the availability of non-car modes. The RTA approach does not, however, have the ability to calculate the number of non-car trips directly.

In the USA, the ITE (2009) has been researching how to better understand trip-generation characteristics of infill development. They propose to derive a method of applying these to existing trip rates that do not take into account non-car modes. However, this methodology has not yet been determined. Further consideration will be made when the information becomes available.

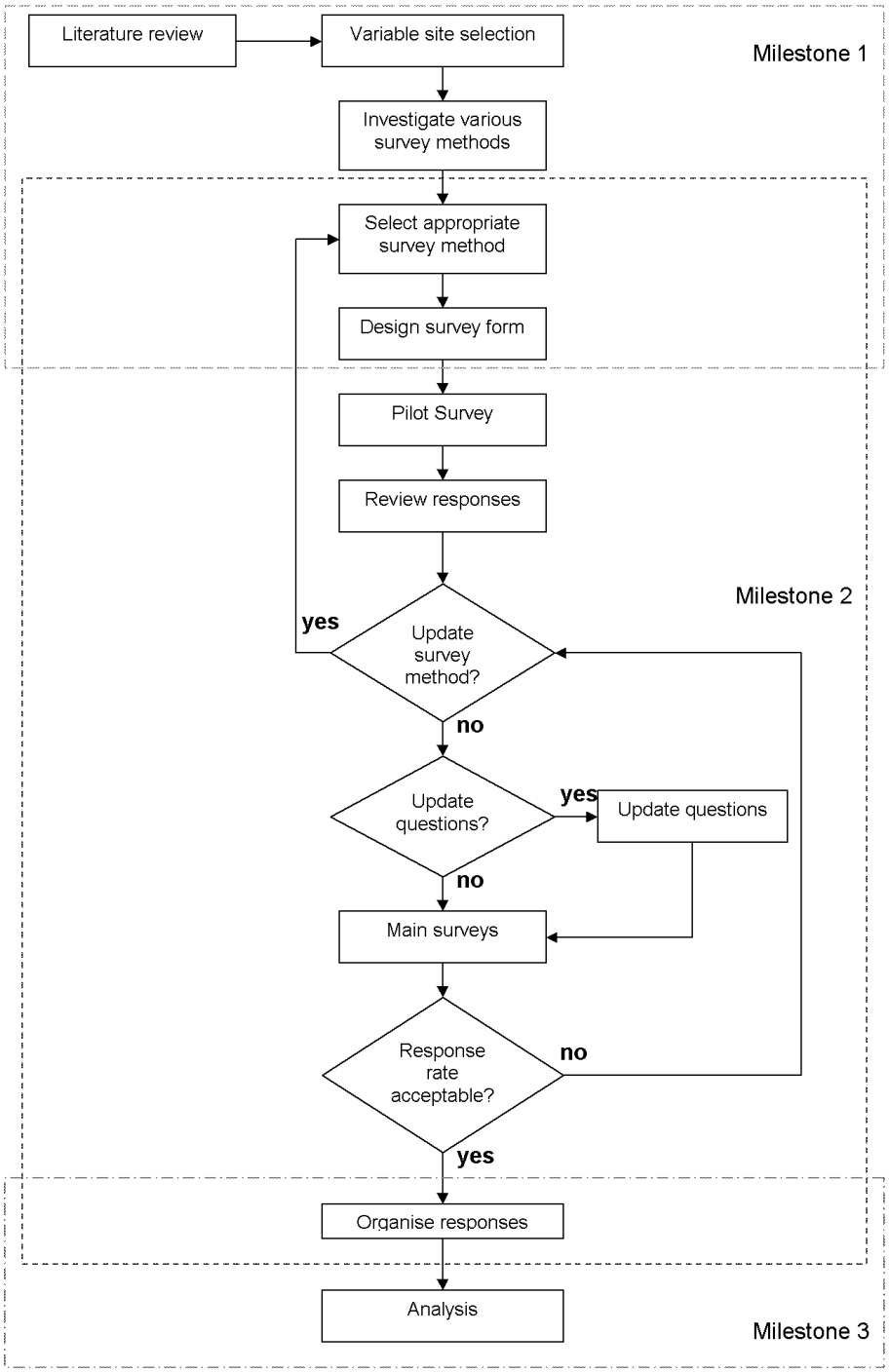
The UK has adopted what appears to be a simplistic approach whereby all trips to a land use are recorded and trip rates for each mode are subsequently calculated. TRICS currently has the largest database of trip-related data, including multi-modal trip information. There also appears to be a correlation between TRICS data in the UK and TDB data in New Zealand (and also RTA data in Australia to some extent). This would indicate there are possibilities for such data to be used collectively in the future. However, the UK research has only covered a small part of each database and so the need to collect specific New Zealand data still remains. TRICS standardises their survey methodology to maintain and manage consistency and reliability of survey results. New Zealand surveys should follow this procedure.

Given the strong links with TRICS, it therefore made sense, for the purposes of this research project, to adopt the TRICS survey methods (JMP 2009) as a first step in assessing pilot surveys. Ongoing monitoring of the ITE methodology was maintained throughout the research and should be continued in subsequent research.

3 Methodology

The research focused on developing a survey methodology for capturing non-car travel modes. This involved choosing an initial survey method and then, through a series of surveys, developing and refining it further until a method was obtained that closely reflected the research goal. The process adopted for developing this research is broadly outlined in figure 3.1.

Figure 3.1 Survey development methodology



The research was broken down into four milestones. Milestone 1 was a literature review. Milestone 2 involved data collection. Milestone 3 was data analysis and milestone 4 (not shown in figure 3.1) is represented by this research report. As the research progressed, it became clear that milestones 2 and 3 were not mutually exclusive as data collected in milestone 2 needed to be analysed to inform the subsequent process and revise the survey methodology before further surveys could proceed.

4 Survey method

4.1 Observer v face-to-face questionnaire surveys

It was decided early on, and from the literature review, that the way forward for capturing non-car trips to obtain the travel modes that could not be directly observed would have to be via face-to-face questionnaire surveys. However, to find out if this was indeed the best option in terms of cost effectiveness, the decision was taken to include observer surveys as well as face-to-face questionnaires in the initial surveys to see if there was any difference in accuracy. Although the outcome was generally understood beforehand, it was considered the research would need to address this matter directly. Therefore, for the initial site selection, sites were independently observed and face-to-face questionnaire surveys were undertaken at the same time. This helped to decide which survey procedure was the most cost effective.

4.2 Developing the initial face-to-face questionnaire

As stated in the literature review, a survey method needed to be developed that was simplistic and of short duration. Face-to-face questionnaire surveys were considered and found from the literature review to be better than self-completed surveys for capturing data.

The TRICS methodology was a good starting point for this research. That is, all trips to a land use were recorded and trip rates for each mode calculated subsequently. However, it was not known how TRICS achieved this.

Therefore, a short face-to-face questionnaire survey capturing all trips was the desired outcome from the pilot surveys. To find out if interview surveys were the best method, it was decided to undertake independent observer surveys at the same time.

For the initial surveys, it was considered appropriate to have a survey period that would be of sufficient duration to enable conclusions to be reached from the results, as well as providing a variety of land uses to find out if the same survey method could be used for different activities. In addition, given that observer surveys were also being undertaken, it was desirable to have survey sites where people could be seen arriving by public transport, walking or cycling, as well as by car.

4.3 Site selection

To derive appropriate sites a site selection form was provided. This prompted the site selector to consider a range of different issues that needed to be considered when selecting a site. Having a site selection form formalises the process and makes site selection more consistent. Much of the data needed for site selection would also be relevant for any subsequent database that might contain not only the collected non-car data, but also information about the site surveyed. For example, information about on-site parking and potential for the use of non-car modes were important considerations – there is little point surveying a site that does not have any non-car opportunities when the particular interest is in capturing non-car mode trips. In addition, a site with obvious non-car opportunities, such as having a bus stop right outside, would be relatively easy to survey using an observer technique, whereas a site with non-car opportunities separate from the site would probably be harder to survey using only observer techniques.

As the data collected by the selected research survey method was extremely likely to be collated in some form or other, most likely within the current TDB database or a variation of it, the TDB's own site data

sheet (TDB 2009) was used as a basis for the site selection form. Using the TDB form as a basis for the pre-survey site selection form would also prove useful if subsequent multi-modal trip rate data was added to the TDB database or a variation of it.

The TDB site survey summary sheet ('TDB form') (see appendix B) provides a 'one-stop-shop' of relevant background information about the site being surveyed. The information includes data on the survey itself (date, time and weather), information about the site location (name, activity type, geographic location and size, general pedestrian and public transport activity), and information relating to parking provision and trip rate results.

Although this latter piece of information is useful, this should be obtained from the database to which the raw data has been supplied. Providing a trip rate on a summary form does not give sufficient information to provide transparency, which requires the trip data associated with the trip rate (the units of the trip rate being part of the survey summary sheet).

Significant portions of the TDB form were not required specifically for selecting sites, ie trip generation. The form was therefore simplified, although it still contained data that was not required for site selection purposes (such as gross floor area) but could be useful subsequently for other purposes.

In addition, information about the parameters on which a site trip rate is based (ie floor area, number of restaurant patrons, number of staff) needs to be consistent if it is to be included in the TDB database or similar. For this reason, it was retained on the site selection form. However, as the research focused on the data collection exercise and not on actual trip rate calculations, this information was not specifically collected as part of the research.

For site selection, the parameters which were considered critical included:

- activity type
- likely level of public transport opportunities (there would be little point testing a survey trying to capture non-car modes if non-car modes were unlikely to occur)
- likely level of pedestrian activity (same reason as above)
- being able to observe people arriving by bus or train, or people parking off-site
- total number of access points (required to understand how many surveyors might be required).

For subsequent analysis of trip rates (beyond the scope of this research) it may be helpful to outline other variables that could influence the non-car trip rates, such as the:

- distance to bus stop
- frequency of bus services
- distance to schools/universities
- distance to shops
- residential density
- footpath/walking route amenity level.

In addition, it was decided that it would be beneficial to add photographs of the site: one being an aerial view to place the proposed survey site within the context of its surroundings, and the other a street view to get an understanding of how the site is accessed or where surveyors might be positioned. No survey should be undertaken without actually visiting the site and making observations of the required parameters so using only a street view would be a last resort.

Contact details of people responsible for the site and a section allowing the number of surveyors to be estimated were also added.

As part of the initial surveys, it was proposed to test whether or not it would be possible to simply observe how people arrived at an activity. Observing is likely to require fewer surveyors, be cheaper than interviewing, involve less organisation and preparation, and be achieved relatively simply; hence the need to include whether or not people using these modes could be observed doing so.

4.4 Number of sites

The research proceeded initially on the basis that survey periods should be short to make sure the survey method was designed appropriately before it was used on longer-term surveys. As such, the initial surveys were for two-hour periods only. These were long enough to see if the survey method worked or not but short enough to make sure time was not being wasted if they turned out not to be a worthwhile method.

Three two-hour surveys were selected initially, enabling all surveys to be undertaken on the same day by the same people. This provided an opportunity for any refinement and feedback because the same people were involved in each survey.

4.5 Activity mix

Three different land-use activities were identified and selected, one for each of the surveys. Each land use brought different challenges in terms of survey results. The land uses surveyed were an office, a retail site and a medical centre. They were all located close to the research team's main Auckland office to provide greater flexibility in terms of direct supervision.

From a practitioner's point of view, a large proportion of transport impact assessments are undertaken for office and retail uses. This helped to determine that these land uses should be surveyed. It was also clear from both the ITE trip rates (ITE 2008) and TDB trip rates (TDB 2009) that these were also the predominant land-use activities when evaluating car trip rates for urban land-use activities. This also swayed the decision process towards these activity types.

4.6 Locations

The site selection process was specific in order to satisfy the following objectives:

1 There was a need to ensure the initial sites were likely to be busy enough to provide meaningful feedback and results, but not too busy to result in surveyor frustration and the inability to use the proposed face-to-face questionnaire methodology.

2 The site selection needed to ensure each site was self-contained and there was a single activity at the one location. More than one activity could result in numerous answers being given to a question which would be unhelpful in assessing the success of the face-to-face questionnaire methodology.

3 There had to be the possibility for site users to use public transport, or walk or cycle as a means of transportation to the site. There would be little point undertaking a multi-modal transport survey of a site that was only accessible by car.

4 If people arrived by public transport, they could be observed doing so.

4.7 Site selection form

As part of the site selection process, it was decided there could be merit in producing a pre-survey site selection form (see appendix C).

The following pre-survey information pertinent to site selection for this research was considered worth collecting:

- level of PT opportunities (nil, low, moderate or high)
- level of pedestrian activity (nil, low, moderate or high)
- ability to observe off-site parking
- ability to observe bus trips (yes, no or not applicable)
- ability to observe train trips (yes, no or not applicable)
- total number of access points (vehicular only, pedestrian only or shared).

Clarification was sought about the differences between nil, low, moderate and high for the first two items on the above list. These were not meant to be definitive, but merely suggest the extent of each activity. They took into account the proximity of public transport opportunities, such as bus stops or train stations, the number of passing pedestrians, the number and frequency of services and a broad indication of the network penetration of these services into the surrounding areas. These were used as a guide for site selection. The actual amount of PT or number of pedestrians was determined by the surveys.

It was desirable to have an aerial photo of the site prior to undertaking a site visit. This helped to place the site in context and reveal things that might be concealed during a site visit, such as a car park at the rear of the property with a different access. It also helped to establish if the property was self-contained and isolated from others, which would enable a more focused survey.

In addition, a street-level photo was helpful for putting the site within context of its surroundings, enabling access points to be verified and assisting in deciding where surveyors needed to be positioned. A street-level photo should ideally be taken during a site visit as street-level photos on the web could be out of date.

Count specification was helpful to understand the number of surveyors required. However, in some instances this proved to be difficult to estimate as will be demonstrated.

Contact details were helpful. The surveys for this research required interviewing people using a site. This was invariably undertaken at the entrance to a building on the actual property. Authorisation from the building's occupants was required for the face-to-face questionnaire surveys. This was also a courtesy as the survey might affect visitors to a site more than staff and regardless of who was being interviewed, there could be concern within the building about the survey. By informing the building's occupants, people could either be forewarned or at least be given information about the surveys on the day.

Once a contact had been made and authorisation given, the contact details were helpful for the organisation of the survey, such as understanding how the site worked, or asking the site occupant when their busiest periods occurred.

The TDB site survey summary sheet includes space for data once the survey has been completed and analysed. This was not relevant for the purposes of site selection. However, it might be helpful post-survey.

A period of a few hours was selected for the first tranche of surveys as this was considered long enough to capture sufficient data to provide feedback on the methodology.

5 First tranche survey method

The initial surveys were undertaken simultaneously by observers and surveyors with face-to-face questionnaires.

The observer process involved a surveyor observing how people arrived and departed each survey site. If someone walked to the site, they were observed walking to or from bus stops, if possible, but if not, they were simply observed as pedestrians.

Face-to-face questionnaire surveys covered both directions in and out of the location to capture all trips, with the surveyor noting the direction of the interviewee on the survey form. Answers were noted on the survey form as the survey progressed.

There was a lot of discussion about the questions to be asked. The initial concept was to capture every person and ask how they travelled. However, when considering the logistics of such an approach it became clear this could prove difficult to achieve. If people arrived in groups, this put pressure on the surveyors to capture all these people while not overly delaying the whole group. Second, asking a person how they arrived at a site was in itself subject to interpretation. A person arriving by bus and walking say 500m to the front door, when asked how they arrived might consider the answer to be walking. In reality, that person's mode was bus. Third, it must be assumed the surveyors had no idea how someone arrived at a site, regardless of whether they saw them park their car or not. Someone who parked their car on-street or off-site and walked to the site should not be assumed to be a pedestrian – it was still necessary to find out how that person travelled.

Given the above, the opening question, after pleasantries, would be:

> *Q1 What was your main mode of travel here today?*

It was important to emphasise 'main mode' in this question. If need be, the surveyor could expand on it by adding 'What mode did you use for the longest portion of the journey?' or alternatively relating the main mode to the most recent trip from the interviewee's most recent origin, eg work, home, school. Distance was relevant here, not time. A short car ride could cover a great distance.

There were several options for recording a person who arrived by car. First, they might have been dropped off by someone, in which case parking space was not required. If the person arrived by car but was not dropped off (as they were the car driver or a passenger) the car could be parked on-site or off-site. Although not strictly necessary, the off-site was split into on-street and off-street.

Hence, if the answer was car, they were asked a supplementary question:

> *Q1a Is the car you travelled in parked nearby or were you dropped off?*

If the car was parked nearby, a supplementary question was:

> *Q1b If the car is parked nearby, is it parked on-site here, on-street nearby or off-street nearby?*

As stated above, it would have been great to capture everyone via the face-to-face questionnaire survey but this was impracticable, especially if people arrived or departed in groups. Therefore, the last question asked was the number of people in the group.

> *Q2 How many people are there in your group that visited here today?*

This was deemed a necessary question. First, there was no point in trying to interview everyone using a facility, especially if they were part of the same group as they were all very likely to have the same arrival

and departure modes. Second, when undertaking multi-modal trip rate calculations, it was the number of people which was important, not the number of vehicles. For example, current car trip rates inform us about the number of cars arriving at a destination. When calculating multi-modal trips, there was no benefit in calculating the number of buses, nor could this be achieved. Instead, it was the number of *people* who chose bus as a mode which was important. As such, group size was deemed the most efficient way of establishing the number of people using each mode.

If the person said they were surveyed previously (ie someone on the way out was interviewed on the way in) this was noted and the interview stopped.

The surveyor would then thank the person for their cooperation. The time of the interview was noted.

The result of this face-to-face questionnaire method should be a record of trips entering and leaving the facility and the time these trips occurred.

The face-to-face questionnaire was given to an independent person to audit. They were told the purpose of the surveys and asked for feedback on the questions asked. The overall response was that the process had been well thought out and the survey sheet easy to use. The following issues were raised and the responses noted below:

- Car occupancy: if (for example) a car driver and a car passenger were surveyed, there would not be enough information to determine if they travelled in the same car or separate cars, and hence whether the two survey entries were associated with one or two trips. It was considered the likelihood of this being the case would be minimal and hence no alterations were made.
- Was it necessary for the 'surveyed previously' entry on the survey sheet to be recorded? This information became redundant as the method was refined.
- How was the sample rate quantified? This would be done using an independent count.
- There was concern the information about whether a person parked their vehicle on-site or off-site could be used inappropriately (eg assessing parking demands, concluding that developments did not provide enough parking on-site). It was explained that this information helped in comparing the face-to-face questionnaire results with the observer survey results and in better defining the question to the interviewee. If they parked on-street nearby and walked they might think their mode was walking, but if given the option of saying they parked a car on-street, this would help them realise their mode was by car.
- In situations where a person was dropped off by car, was there a need for a definition of group size, ie was the group size the number of people entering the activity or the number of people in the car? It was considered that group size alone was sufficient without further complication.
- Should there be a question to identify trip linking or chains? This would be an extremely difficult question to ask in both non-technical terms and in a quick easily understood way. It was considered not to be relevant for most of the time (car trip rates do not take into account if the car trip is part of a chain and hence there would be inconsistencies with current data).

In addition to the observer and face-to-face questionnaire surveys, it was necessary to keep a count of all people entering and leaving the site to establish the capture rate of the survey. It was clear that although the research focused specifically on capturing non-car modes, cars could not be excluded from the surveys otherwise the multi-modal results would not be fully representative of trips to and from a facility. Therefore all cars entering and leaving a facility were counted and the number of people in each vehicle was also noted. In addition, the total number of people observed arriving by bus or train (where

observable) was noted, as well as the number of pedestrians or cyclists. These statistics would be used to determine the accuracy of the face-to-face questionnaire samples.

The initial three survey sites were an office, a retail unit and a medical centre. See appendix D for details of these surveys.

6 First tranche results

6.1 Interpreting the results

All three sites were compared to determine if there were any inconsistencies, and if so, possible reasons for these. In addition, given that the face-to-face questionnaires asked people about their travel habits rather than just providing observations which could result in assumptions, face-to-face questionnaire results were used as the basis for comparing the accuracy of each method.

6.2 Summary of outcomes

Each site was expected to provide sufficient respondents and enough data for interpretations to be made. Given the bus stop and train station locations, it was considered that using observer techniques only would work well for site 1, but less so for sites 2 and 3. It was also expected that respondents to the face-to-face questionnaire would provide truthful answers. There was no reason why this should not be the case for the initial tranche of surveys.

Table 6.1 shows a summary of the response rates for each site.

Table 6.1 Overall site response rates – all users

	In			Out			Two-way		
Site	**Total persons**	**Interviewed**	**%**	**Total persons**	**Interviewed**	**%**	**Total persons**	**Interviewed**	**%**
Office	34	15	44.1%	6	1	16.7%	40	16	40.0%
Retail	137	94	68.6%	130	20	15.4%	267	114	42.7%
Medical centre	102	34	33.3%	114	15	13.2%	216	49	22.7%

Table 6.1 shows the total number of people observed using the site against the numbers interviewed. This seems to indicate the response rate varied markedly between the three sites. Even the office, with a low number of people arriving and departing, seems to have a low percentage capture rate with only 40% of those arriving and departing being interviewed. It was expected that this site and activity would have a better capture rate. However, it became clear that all was not what it seemed. Both the office and medical centre have dedicated car parks, and each has a separate entrance into the respective buildings: the office has a rear entrance from the car park to the building; and the medical centre has a lift and stairs from the underground car parking directly into the medical centre. Therefore, a significant proportion of visitors, who were accurately counted as they drove in and out of the site, did not pass the surveyors doing the interviews.

The response rates for those people who did not enter or exit the sites by car are shown in table 6.2.

Table 6.2 Overall site response rates – pedestrians

	In			Out			Two-way		
Site	**Total persons**	**Interviewed**	**%**	**Total persons**	**Interviewed**	**%**	**Total persons**	**Interviewed**	**%**
Office	15	15	100.0%	1	1	100.0%	16	16	100.0%
Retail	105	94	89.5%	128	20	15.6%	233	114	48.9%
Medical centre	51	34	66.7%	19	15	78.9%	70	49	70.0%

Table 6.2 portrays a better response rate, particularly for the office and medical centre. Also, the response rate for those arriving at the retail unit was improved, but the response rate for people leaving the store was still low at only 15.6%, which resulted in the two-way capture rate also being low at just below 50%.

As stated previously, the surveyors mentioned that people leaving the store were less inclined to answer the questions because they had been stopped on the way in. With nearly 90% being captured on the way in, and a high refusal rate, it is not surprising that almost 85% of people were not captured on their way out. This was extremely disappointing and cause for concern. There would be little point spending money on surveys in both directions if the result of interviewing in the inbound direction resulted in refusals in the outbound direction.

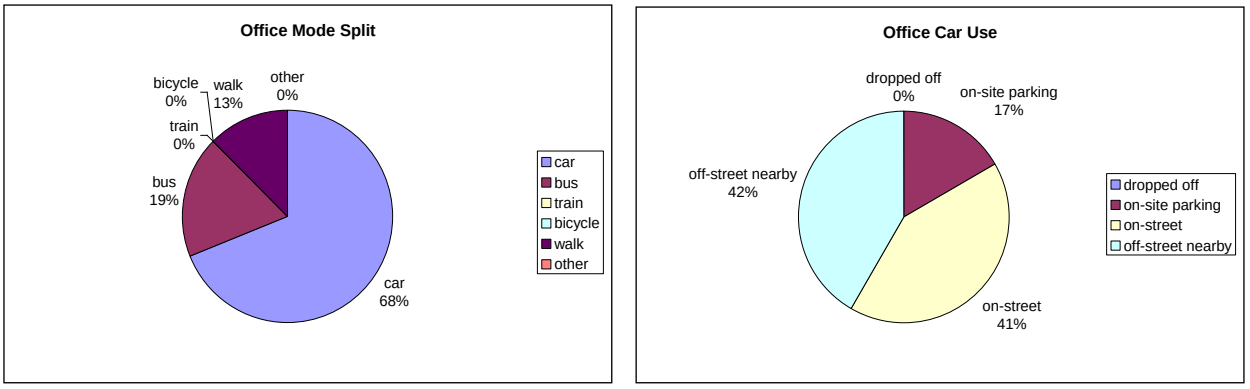
Comparison of the graphs in appendix D, sections D1.4, D2.4 and D3.4 also reveals a pattern in the differences between the face-to-face questionnaire and the purely observer surveys.

Observer surveys consistently under-estimated the number of people using car or bus to get to the destination while over-estimating the number of people who walked to the destination. To understand why, it was necessary to examine the mode splits and how car users arrived at each of the sites and activities.

6.2.1 Office

Figure 6.1 shows the mode split and car usage at the office site.

Figure 6.1 Office mode split and car usage



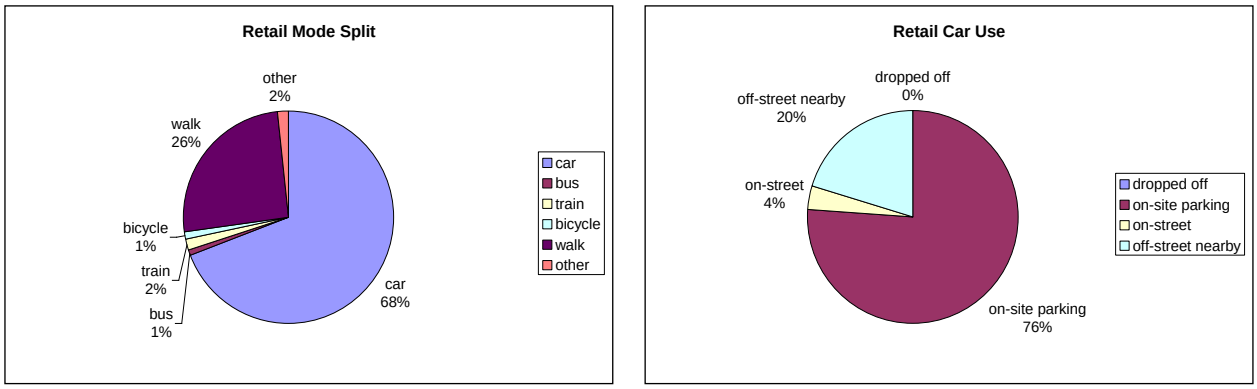
From the face-to-face questionnaire survey, it was determined that 68% arrived by car and 19% by bus (a total of 87%), with only 13% walking to the site. Figure D.1 (appendix D) shows the observer method suggested approximately 45% walked and 55% arrived by car or bus. So, walking was overestimated by about 30% and car and bus under-estimated by 30%. Interestingly, of those who said they arrived by car, only 17% used the on-site parking and therefore would have been observable. The rest parked on-street or

off-street nearby. These people would have been observed walking to the site instead of actually being car users. This is a failing of the observer survey method.

6.2.2 Retail site

Figure 6.2 shows the mode split and car usage results for the Dick Smith Electronics retail site.

Figure 6.2 Retail mode split and car usage

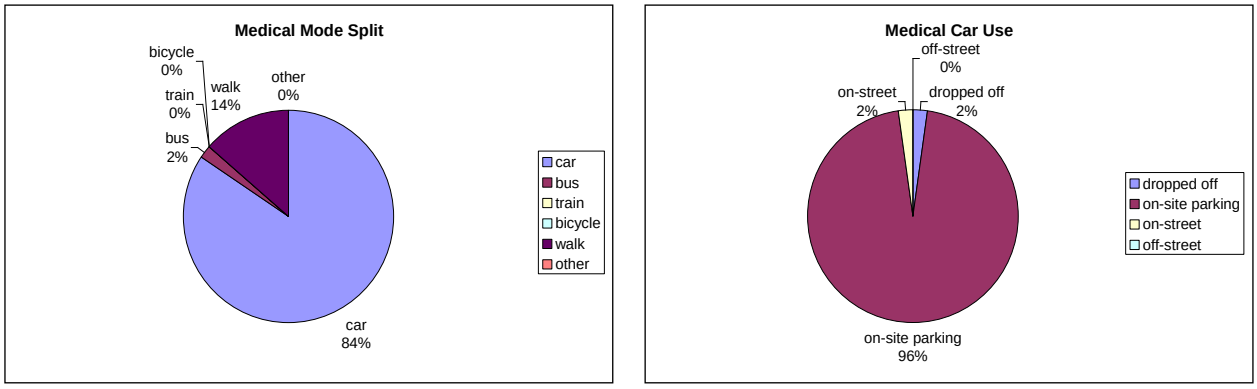


From the face-to-face questionnaire survey, it was determined that 68% arrived by car and only 3% by bus or train, with a significant 26% walking to the site. Figure D.2 (appendix D) shows the observer method suggested approximately 51% walked and 48% arrived by car, with none observed using bus or train. So, walking was overestimated by about 25% and car was under-estimated by 20%. Interestingly, of those who said they arrived by car, a high level of 76% used the on-site parking and therefore would have been observable. The rest parked on-street or off-street nearby.

6.2.3 Medical centre

Figure 6.3 shows the mode split and car usage results for the medical centre.

Figure 6.3 Medical centre mode split and car usage



From the face-to-face questionnaire survey, it was determined that 84% arrived by car and only 2% by bus, with 14% walking to the site. Figure D.3 (appendix D) shows that the observer method suggested approximately 18% walked and 80% arrived by car, with none observed using bus or train. So, walking was overestimated by about 4% and car was under-estimated by 4%. Interestingly, of those who said they arrived by car, a high level of 96% used the on-site parking and would therefore have been observable. The rest parked on-street or off-street nearby.

6.2.4 Conclusions

Where the mode split is biased towards car, and those cars are observable, an observer survey method is reasonably accurate compared with face-to-face questionnaire surveys for estimating car mode. However, where the mode split is less for car, and a large percentage of these cars do not park on-site and therefore cannot be observed, an observer survey method is much less accurate and tends to over-estimate the number of people walking to the site.

It is assumed the results obtained from face-to-face questionnaire surveys were more representative of actual trip patterns as people were interviewed in the course of their travel. When comparing observer survey methods with the face-to-face questionnaire survey, the former under-estimated public transport use at all sites. Even at the office site, which had bus stops immediately outside, bus use was under-estimated (face-to-face questionnaire responses were around 19% and observed only 3%). Therefore, the observer method was poor at capturing non-car modes, even if non-car modes could be reasonably observed.

This supports the view that observer surveys are typically less accurate than face-to-face questionnaire surveys. Therefore, although purely observational surveys are less costly due to less intensive staffing requirements, face-to-face questionnaire surveys are more cost effective due to obtaining better results.

6.3 Validity and reliability of results

Given the simplicity of the face-to-face questionnaire, there was little likelihood the answers given were not accurate due to misunderstanding the question. In addition, given the simplistic nature of the potential answers, it was unlikely the surveyor would not understand the answers given. However, given that the literature review determined face-to-face questionnaire surveys were always better undertaken by people familiar with such survey methods, this meant there would be opportunities for clarification should that be necessary.

All questions were considered necessary for the survey. It seemed odd at first that a survey specifically aimed at capturing non-car modes seemed to be ‘car-heavy’ up front, with questions about where the person who came by car had parked. However, people might have parked off-site and walked to the site. These people were not pedestrians to the site but car users and hence this question was relevant. The face-to-face questionnaire was successful in terms of capturing the mode of travel to the site.

The face-to-face questionnaire survey was shown to be reliable for the inbound direction but not the outbound direction.

The observer method was, by comparison, shown to be unreliable.

6.4 Scope and limitations

It would have been better if the office site had generated more traffic and hence provided a greater sample size. However, the variety of the three sites in terms of on-site parking, public transport accessibility and usage did provide sufficient data to come to the conclusions set out in this chapter.

This first tranche of surveys provided valuable information that led to the development of the second tranche of surveys.

7 Second tranche survey method

As the initial tranche of surveys revealed that observer surveys were not as reliable as face-to-face questionnaire methods, the former were dropped as a way of undertaking multi-modal surveys. It was also clear that surveying in both directions was unreliable, with the inbound direction providing the greatest capture rate. The reason both directions were interviewed was to calculate two-way trip rates. By interviewing in just one direction, only one-way trip rates would be captured.

Initially, it was thought there might be a way of linking someone's arrival with their departure. If they had been captured on the way in, and it was assumed they used the same mode for their departure, then two-way trips would be known. However, unless someone had a photographic memory, there would be no way of linking someone leaving a site with their arrival. A basic way of doing this might be to 'tag' people in the inbound direction and note their 'tag' in the outbound direction, but this would not be practical.

Due to the findings of the initial surveys, the inbound direction was initially chosen as the survey direction. Apart from residential land uses, the vast majority of activities are trip attractors, ie people travel to a location for a specific reason, such as work, attending an appointment or shopping, then leave. If the survey is in the inbound direction only, how are outbound trips captured? The only way this could be done would be to ask the person what time they were leaving. Unfortunately, most people do not know this. Even someone with an appointment may not know how long that appointment will take or if it will start on time. Workers are typically flexible about when they will actually leave an establishment. Capturing both directions of travel was an issue for the surveys.

The decision was then taken to change the interview direction to the outbound direction only. In order to capture the other direction (inbound), interviewees would be asked what time they arrived. It was considered most people would have a good idea of when they arrived or how long they had been somewhere. It was also considered the answers would be sufficiently accurate to within 15 minutes, which is typically the time interval used when considering peak-hour periods.

When developing this method further a potential flow was identified – how would the survey technique link the travel mode of the person for both directions? The outbound direction survey previously asked interviewees what their travel mode would be when they left. However, to focus people on their arrival (which would help when asking what time they arrived) people in the outbound direction would instead be asked how they arrived at this destination. They would then be asked the other questions about where they parked if they arrived by car etc. Following a question about their group size, they were asked:

Approximately what time did you arrive here today?

They were then asked:

How will you travel from this destination today?

If it was the same mode as for their arrival, this was noted, but if not, the mode was recorded. If the interviewee responded with 'a different mode' they were asked what mode they would use and this was noted.

This formed the second tranche survey method.

Given that the first tranche provided valuable feedback, especially regarding the appropriateness of the interview technique questions, it was decided to extend the survey period to provide a greater sample size.

In addition, the new survey sites chosen were deliberately not in Auckland to check that the survey method could be adopted by people who had not previously been involved in the research surveys.

When selecting the sites, the purpose and style of surveys needed to be conveyed to the survey organisers. Typically, surveys are organised for a specific location and purpose. For this research, surveys were organised for a specific purpose but not a specific location. Survey organisers were therefore left to their own devices in terms of site suitability. Various sites were provided to the research organiser who then had to choose which sites might provide the greatest benefit to the research.

The survey organisers were tasked with the following:

- site selection (probably one each of office, retail and another land use)
- obtaining agreement from the site occupants/operators to participate in the survey
- organisation of surveys
- undertaking the survey
- tabulation of data and data analysis.

A pre-survey site selection form and survey questionnaire were supplied.

Organisers were given the following instructions:

- The surveys needed to include a count of all users (persons) of the site during the survey.
- Ideally sites would have one entrance in/out for people. They might have a separate car entrance, so this would need to be surveyed separately (typically by the same person doing the count). Car survey (if undertaken) needed to note the number of people in each vehicle.
- Surveys would be half-day duration.
- Site owners/operators should not be approached at the start. Pre-survey data sheets should first be completed as much as possible and then used to select appropriate sites. Site owners could then be approached.
- Feedback on the survey process must be requested.

Potential sites in Christchurch included a video rental store, a library or an office with seven different organisations in it. The library had one main entrance but two vehicular entrances and was calculated to need four surveyors. The office building had two entrances: a main entrance and a rear entrance. It had only a few on-site parking spaces but parking was available across the road. There were about 10 bus stops within the vicinity of the building which meant PT opportunities would be high but the person counting would record these as pedestrians. The video store was assessed as having excellent PT opportunities due to the town centre location and would be easy to survey having only one entrance. The site selected was the video store.

Potential sites in Wellington included a Commonsense Organics store, a New World supermarket and a church. Upon further consideration of survey logistics, the church was assessed as being somewhat more difficult to survey especially at the end of the service with the majority of people likely to leave in a relatively compressed time period. The Commonsense Organics store closed at 7pm and this site was selected so the survey could capture movement at the end of the day.

See appendix E for data on the two survey sites.

8 Second tranche results

8.1 Interpreting the results

Both sites were compared to check any inconsistencies and possible reasons for these.

8.2 Summary of outcomes

It was expected each site would provide sufficient numbers of responses to allow meaningful interpretations of the survey data. Given the city centre locations surveyed it was also expected public transport opportunities would be high.

Table 8.1 shows a summary of the response rates for each site.

Table 8.1 Overall site response rates – all users

	Outbound only						
Site	**People counted**	**Interviewed**	**%**	**Refused**	**%**	**Missed**	**%**
Video store	360	283	78.6%	50	13.9%	27	7.5%
Organics food store	186	161	86.6%	-	-	25	13.4%

Table 8.1 shows the total number of people observed using each site against the numbers interviewed. This indicates the response rate varied between the two sites. The surveyors at the organics food store did not record refusals but missed 13% of people using the site. The surveyors at the video store had 14% refusals but only missed 8% of people using the site. Surveyors at the organics food store did not specifically identify people who refused to answer the face-to-face questionnaire – people who refused or were simply missed were identified as one type.

In both instances, the actual capture rate of people interviewed was very high at 79% for the video store and 87% for the organics food store.

Refusals can be an issue and may result in non-response bias. There is little that can be done to change this other than possibly incentivising a response, for example by offering a reward for answering the question, such as a food voucher. However, the response rates achieved in the survey were still very good and at this stage incentives were considered unnecessary.

8.3 Validity and reliability of results

As indicated in appendix E, the organics food store results included a very high proportion of walkers (48%) and a relatively low level of bus or train passengers, to an extent that the results fell outside the anticipated ranges. Further investigation identified that the actual question asked was:

How did you travel to the food store today?

Rather than

*What was your **main** mode of travel to the food store today?*

This highlights the importance of asking for the main mode, as discussed earlier in this report.

There is however, a need for a distinction between whether the mode of the trip to the store is actually walking, or is part of a longer trip with the main mode being by car.

TRICS methodology (JMP Consultants 2009) suggests that if the trip to a site is part of a trip chain incorporating more than one site, then it is the mode used to get to the original destination that needs to be noted. However, there needs to be a distinction made between a trip chain and a trip tour. The US Federal Highway Administration (FHWA) has developed an operational definition of a 'trip chain' as a sequence of trips bounded by stops of 30 minutes or less. As stated in *Trips, chains, and tours – using an operational definition* (McGucklin 2004), 'a stop of 31 minutes or more defines the terminus of a chain of trips, and that chain of trips is considered a tour'.

Therefore, if a trip to a survey site is part of a series of activities each lasting less than 30 minutes, then the mode used to reach the first of these activities is the mode of interest. If, however, the previous activity lasted for more than 30 minutes then the mode used between these two activities is the one of interest. For example, if someone on their way home drives to a retail area and spends more than 30 minutes in a store then arrives by foot to the food store, their mode to the food store would be foot because of the time spent at the previous activity. If they spent only 15 minutes at the previous store then their mode would be car, as they drove from work to that store. This would need some consideration when developing the face-to-face questionnaire further.

Given the simplistic nature of the potential answers, it was unlikely the surveyor would not understand the answers given. However, given that the literature review determined face-to-face questionnaire surveys were always better when undertaken by people familiar with such survey methods, there would be opportunities for clarification should that be necessary.

All questions were considered necessary for the survey.

The face-to-face questionnaire survey was shown to be reliable although some data was missed, such as the time people arrived. It is crucial to record this if two-way trip rates are to be developed later.

8.3.1 Statistical confidence

A statistical check was undertaken for each survey. This provided an indication of the survey accuracy in terms of the potential range of accuracy per mode (confidence limits) for a particular survey population (the total number of people using a site) and the total number of people interviewed within that population.

The standard formula for calculating the confidence intervals is:

Confidence interval = $\delta \sqrt{(1-(n/P) * p(1-p)/n}$

δ = confidence level (95% confidence, $\delta = 1.96$)

n = sample size

P = population

p = proportion of people giving that answer, 5% p=0.05, 50% p= 0.5)

It is widely accepted that a 95% confidence limit is a good measure of accuracy and hence $\delta = 1.96$.

8.3.1.1 Video store

The capture rate is given in table 8.1. The confidence limits for each answer are shown in table 8.2. These take into account the population (total number of people counted) as being 360 (P) and the captured sample being 286 (n).

Table 8.2 Confidence limits for video store survey

Mode	Number	P	Interval	Confidence limits	
				Lower	Upper
Car	236	82.5%	2.1%	80.5%	84.6%
Bus	14	4.9%	1.2%	3.7%	6.1%
Bicycle	8	2.8%	0.9%	1.9%	3.7%
Walk	24	8.4%	1.5%	6.9%	9.9%
Other	4	1.4%	0.6%	0.8%	2.0%
Total	**286**	-	-	-	-

8.3.1.2 Organics food store

The capture rate is given in table 8.1. The confidence limits for each answer are shown in table 8.3. These take into account the population (total number of people counted) as being 186 (P) and the captured sample being 161 (n).

Table 8.3 Confidence limits for organics food store survey

Mode	Number	P	Interval	Confidence limits	
				Lower	Upper
Car	77	26.9%	2.5%	24.4%	29.4%
Bus	9	3.1%	1.0%	2.2%	4.1%
Bicycle	4	1.4%	0.7%	0.7%	2.1%
Walk	68	23.8%	2.4%	21.4%	26.2%
Train	2	0.7%	0.5%	0.2%	1.2%
Other	1	0.3%	0.3%	0.0%	0.7%
Total	**161**	-	-	-	-

Both tables 8.2 and 8.3 demonstrate the confidence levels that can be expected given the population size, the number of people surveyed and the percentage of each mode given as an answer. The variation between upper and lower limits is not significant. If the results related to a life-threatening situation, then variations of ±2.5% would probably be considered too great. It was therefore the importance given to the results that was critical for the confidence levels and as such the levels obtained were considered acceptable for understanding the mode of travel.

In general terms it appears from these results the sample size of at least 20 interviews would be sufficient to achieve confidence levels of the travel mode of ±2.5%.

8.4 Scope and limitations

The second tranche of surveys revealed that the instructions needed to ensure that surveyors knew they had to note the number of people who refused a request to take part. The time of arrival always needs to be noted.

This second tranche of surveys provided valuable information that led to the development of the survey procedure.

9 Third tranche survey method and results

9.1 Method

Given the general success of the survey method developed thus far, and the relatively minor modifications required, it was considered appropriate to extend the survey period to a full day.

The second tranche surveys confirmed that surveying in the outbound direction only was an acceptable means of capturing trips, and resulted in a high capture rate and reliable confidence levels.

To test the survey over a whole day, it was decided to use a supermarket for the test site as this would be likely to have activity throughout the day, whereas an office or retail unit might only have activity in the mornings, lunchtimes or evenings.

See appendix F for the survey site data.

9.2 Results

The figures in the preceding chapters demonstrate the depth of data gathered by a relatively simple survey.

Table 9.1 Group-related sample rates

	Group counted	Interviews attempted	%	Successful interviews	%	Refused	%	Missed	%
Countdown supermarket	1964	765	39.0%	665	86.9%	78	11.7%	1299	66.1%

Table 9.1 shows the sample rate for groups at the supermarket was lower than the less busy sites. Interviews were attempted with 39% of all groups with a success rate of 89%. Overall, 66% of groups were missed. However, it is worth putting these into perspective in terms of statistical significance. Assuming a confidence level of 95%, the following are the confidence limits, as calculated using the formula set out in section 8.3.1.

Table 9.2 Person-related confidence limits

Mode	Number of people	P	Interval	Confidence limits	
				Lower	Upper
Car	818	93.4%	1.340%	92.04%	94.72%
Bus	7	0.8%	1.380%	-0.58%	2.18%
Bicycle	7	0.8%	1.380%	-0.58%	2.18%
Walk	43	4.9%	1.170%	3.74%	6.08%
Other	1	0.1%	0.170%	-0.06%	0.28%
Total	**876**	-	-	-	-

The previous surveys resulted in a maximum confidence interval of ±2.5%. This survey, encompassing over 870 responses, resulted in a confidence level of ±1.4%, a much more significant result. Many of the answers for mode of travel were low in terms of percentage of response, such as bus and bicycle mode, and as a result the lower confidence level became negative, which in reality would mean zero. The

variance of 0.8% compared with 2.2% was relatively large, but a confidence interval of 2.2% overall was still small compared with other percentage values.

The survey therefore resulted in high levels of confidence and a good sample rate. However, there still seemed to be issues with the data. These mainly related to surveyors not making a note of the time of the interview (the person's departure time) or when the person arrived. These two pieces of information are critical when deriving trip rates as these are time dependent, ie trip rates are typically quoted not just for the whole survey period but also for the peak periods within a survey period. It seemed that some surveyors had several refusals while others did not. An anonymous questionnaire about the survey method was sent to the surveyors to obtain some feedback – all thought the survey went well. Clearly, with the variations found in the quality of data with some of it missing, this was not the case.

There needed to be some refinement to the survey to make sure all basic information was being gathered.

10 Fourth tranche survey method and results

10.1 Method

Given the accuracy of the results obtained thus far, the survey method was considered appropriate. However, there needed to be some refinement of the process undertaken by the surveyors so that basic information was not missed. Given the survey method, nearly all the information was mandatory, which simplified the instructions. The only information that was not mandatory was 'how people arrived by car' and 'parked the car', which was only mandatory if their travel mode was by car and was not relevant in all other cases.

The instructions were modified and a flowchart produced to represent the survey method. The survey sheets were also modified with the mandatory fields shaded to again reinforce the fact that this data needed to be collected. These are illustrated in appendix E.

To test the new survey method, it was decided to repeat the all-day survey of the Countdown supermarket.

As part of assessing the survey method, consideration was given to its applicability to all land-use activities. As previously identified, surveying in the outbound direction only was an acceptable means of capturing trips and resulted in a high capture rate and reliable confidence levels.

See appendix G for the site survey data.

10.2 Results

The aim of this survey was to test the refined instructions provided to the surveyors and the resulting data in terms of making sure data was entered.

The instructions and the survey sheet are included as appendix H.

For this new survey, surveyors were instructed that should they have a refusal, this needed to be noted along with the time the interview was attempted. All other data fields were mandatory, including the estimated time the person arrived as well as the time the interview took place.

Below is a comparison of the counts, interviews and refusals between the previous survey and the new survey.

Table 10.1 Group-related sample rates

	Groups counted	Interviews attempted	%	Successful	%	Refused	%	Missed	%
Previous survey	1964	765	39.0%	665	86.9%	78	10.2%	1299	66.1%
New survey	1954	1147	58.7%	839	73.1%	306	26.7%	1115	57.1%

The total number of groups was similar in the two surveys. However, the number of interviews attempted was considerably higher the second time around (1147 compared with 765). As a result, although the sample rate was lower (73.1%), the actual number of successful interviews was higher (839). The number of refusals was higher but this may have been due to:

- more diligence in approaching a random selection of people, rather than targeting people who looked more likely to participate
- more diligence in recording refusals.

An analysis of the survey accuracy is shown in table 10.2.

Table 10.2 Person-related confidence limits

Mode	Number	P	Interval	Confidence limits	
				Lower	Higher
Car	1063	92.52%	1.13%	91.39%	93.65%
Bus	7	0.61%	0.34%	0.27%	0.95%
Walk	78	6.79%	1.09%	5.70%	7.88%
Other	1	0.09%	0.13%	-0.04%	0.22%
Total	**1149**	-	-	-	-

The previous survey resulted in a confidence level of ±1.4%, which was considered extremely good for a travel mode survey. Although the new methodology noted more refusals, it also had more successful interviews as shown in table 10.1. This resulted in the confidence limits reducing further to only ±1.1%. As a result of the accuracy of results, the level of refusals at 27% was considered to be acceptable.

Given that the eventual mode splits identified in both surveys were very similar for the same site, it is likely that the results were significant enough for the purposes of calculating mode split to this site.

It is considered the updated survey methodology and surveyor instructions resulted in a greater level of accuracy not only in terms of the eventual mode splits, but also in noting non-responses.

11 Fifth tranche survey method and results

11.1 Method

The survey method was now considered to be well defined with clear instructions for the surveyors. Feedback from the steering group indicated some interest in how this survey method would be rolled out to all land uses.

As discussed in section 7, apart from residential land uses, the vast majority of activities are trip attractors, ie people travel to their destination for a specific reason then leave. Hence the outbound direction only was surveyed. Some consideration was then given to how this survey method might be applied to residential activities. Clearly, with a site being mainly a trip generator rather than a trip attractor, the 'inbound' part of the journey could happen the night before and hence getting a realistic answer to the question 'What time did you arrive?' might be problematic.

Should the interview direction for residential destinations therefore be switched to the inbound direction only? As previously discussed, the problem with only interviewing in the inbound direction means people need to be asked 'When will you be leaving?' and this can be extremely inaccurate. As a result, it was decided that for residential land-use activities, the only course of action would be to interview in both directions.

The vast majority of trips to and from suburban residential land uses nowadays are by car. These can be observed. Similarly, trips on bicycles can also be observed. However, public transport trips are unlikely to be observed. It was therefore decided to undertake a final survey to specifically test the two-way method for residential activity.

See appendix I for the site survey data.

11.2 Results

A total of 396 people were counted entering a residential cul-de-sac over the survey period and 288 people were counted leaving the site. Of these, 114 people walked in and 65 people walked out, a total two-way flow of 179 pedestrians.

The total number of pedestrians captured by the interview surveys was 167, a very high capture rate of 93%. No refusals were noted.

Two surveyors, one on each footpath either side of the main entrance into the site, carried out the interviews. The site also had an additional surveyor who took a count of all people entering and leaving by vehicles.

Of the interview surveys, 100% responded that their mode was walking. None responded that their mode was public transport. Of everyone passing the survey point, the mode split was 73.8% by car and 26.2% walking. No other modes were recorded.

Many of the questionnaire respondents mentioned they were residents who did not own a car. A few were using the route as a short cut to another residential development.

The location was across the road from Westfield St Lukes retail centre. As such, it is likely many pedestrian trips were associated with trips to/from this centre.

It was considered the capture and respondent rates resulted in a good survey methodology and as such the two-way method should be adopted for residential developments.

12 Conclusions

The goal of this research was to:

> *Establish the data required and develop survey techniques to enable the calculation of trip rates for walking, cycling and public transport trips to a variety of activities.*

As such, the research was not about the calculation of actual trip rates, but more focused on the required data and survey techniques needed to collect this data for calculating trip rates.

12.1 Summary

The research began with a literature review to find out the current best practice for the collection of non-car mode trip-related data. TRICS (JMP 2009) was the most established, having developed their methodology over a 20-year period. Although Australia and the USA both recognise the importance of non-car trip data, they are still undertaking research into how this can be accounted for. It is also likely that any data collected in New Zealand will be part of the existing TDB database, and site-related information currently collected for this database should be included within multi-modal surveys.

Essentially, the data at its most basic level is the mode used to get to/from an activity. There is also a need to know what time trips are made, so these can be used to calculate the peak periods which are typically used when deriving trip rates. Anything more than this would be surplus to the needs of calculating trip rates, but could be necessary for other data-related reasons.

The first requirement was to ensure trips to a site by any mode could be observed, or if some form of interactive surveys would be required. Initial pilot surveys were established at three sites where people arrived by car as well as by other transport modes. Observer as well as independent interactive (face-to-face questionnaire) surveys were used at each site. These initial pilot surveys indicated that where the predominant transport mode was by car, and these could be observed, the observer method was relatively accurate in determining the mode split compared with face-to-face questionnaire surveys. However, observer surveys consistently underestimated public transport trips and overestimated pedestrian trips, even when public transport stops were directly outside a site. For this reason, it was determined that observer surveys were unreliable and the most accurate method of capturing people's travel habits was through face-to-face questionnaire surveys.

The initial surveys also indicated that interviewing in both the inbound and outbound directions resulted in a relatively high number of refusals in the outbound direction, as people were reluctant to answer the face-to-face questionnaire again. This led to the conclusion that only one direction should be interviewed. The outbound direction was chosen as interviewees could be asked what time they arrived, whereas if the interview was in the inbound direction interviewees would need to be asked what time they were going to leave, which would be difficult to answer accurately.

The second tranche of surveys was much more successful in providing larger sample rates. These surveys also showed excellent confidence limits at 95% confidence level and were considered to be an accurate way of obtaining mode information. The survey method was then tested on a full-day survey at a busy supermarket.

During the survey period of 9am to 6.30pm, some 2000 groups of people were counted visiting the store. This resulted in 39% of the groups being asked to take part in the survey and of these 87% were successfully interviewed with only 13% refusing. Consequently, there was a total of 665 successful interviews with groups of people.

Closer inspection of the results highlighted that some critical pieces of information, such as the time of the interview, were missing. It also seems some surveyors had more refusals than others. There needed to be greater consistency in the information recorded by individual surveyors and so revised instructions were prepared to emphasise the importance of data collection and form completion.

The all-day survey was repeated with the new instructions. The survey day had an almost identical number of groups counted entering and leaving the supermarket. The number of interviews recorded as attempted was higher, as was the number of refusals. However, the total number of successful interviews was higher too.

12.2 Discussion

The face-to-face questionnaire is an excellent way to obtain mode share data and should be more widely adopted within the transportation profession as a means of quantifying non-car modes. Given the simplistic questions asked and the limited responses available, the survey is considered to measure comprehensively and logically. Standardisation of the procedure would provide consistency of answers and make it easier to include survey results in a New Zealand database.

Comparison was made between observer and face-to-face questionnaire surveys. Observer surveys require less staff and therefore cost less. However, when compared with each other, and assuming face-to-face questionnaire surveys are inherently more representative as a baseline, observer surveys were found to miss certain types of trips, assuming them to be walk trips. Therefore, although more costly initially, it was considered that face-to-face questionnaire surveys were more cost effective.

The time required for each survey interview during the research was short in duration enabling a relatively high level of sampling. Response rates were poor in the outbound direction when inbound was also used. As such, it was deemed more appropriate to use only the outbound direction of travel for interviews and ask respondents what time they arrived.

Data to be collected in the outbound direction only is:

- time of the interview
- mode of transport used to arrive at the site
- if a car-user was dropped-off or they parked the vehicle and if so where
- how many people are in their group
- approximate time they arrived at the site
- mode of travel from the site.

This applies to all sites other than residential. Residential require information in both directions of travel.

One of the main issues emanating from the pilot surveys was not regarding the survey method or questions, but about the surveyors and how they were instructed. Clear and unambiguous instructions are key to ensuring quality of data being gathered. Virtually all aspects of the face-to-face questionnaire are critical to ensuring a complete record is made. This needs to be emphasised.

It is also clear that the type of person undertaking the survey is important. Some surveyors had a naturally friendly disposition that resulted in higher positive response rates than others. Some were very focused on the task asking lots of people, but also getting a higher refusal rate, while others appeared more laid back and person friendly. The latter did not necessarily ask everyone who passed them and as a result had a lower sample rate and also a lower refusal rate. Other surveyors, even after clear instructions, clearly had difficulty noting all the required data. Feedback from the survey organisers suggested that the most

suitable people for undertaking face-to-face questionnaire surveys could depend on the site location, site type or ethnicity of the area's population. Younger interviewers were preferable to older experienced ones. It was felt that younger surveyors listened more attentively to instructions whereas older ones might think they knew what to do and then vary what was being asked as a result. To help with this, when briefing the surveyor it should be explained how the data will be used, and therefore why each question asked is important, particularly with regards to time.

Surveyors should also be instructed to ensure they follow a random selection process and do not introduce bias into their respondent approaches, eg selecting every 5th or 10th person rather than the person who 'looks as if' they might be easy to survey or is not in a hurry.

The data collected, although simplistic in itself, can provide a lot of additional information that may not necessarily be directly related to trip rates, for example 'how group size varies throughout the day'. Such data may be of interest to the site occupants in terms of operational management.

Other outcomes from the research were as follows:

- Although there is some correlation between the data contained in the TRICS database and the TDB database, research comparing the two systems is not extensive and there is still a need to collect specific New Zealand multi-modal trip data.
- Methods for collecting multi-modal data include observer, face-to-face interview and self-completing surveys. The research compared face-to-face questionnaire surveys with solely observer surveys and proved that face-to-face surveys, although more costly due to more intensive staff resourcing, were the more cost effective method for collecting multi-modal trip data. The literature review confirmed that face-to-face surveys were better at capturing data than self-completed questionnaires, either pre-paid paper or online questionnaires.
- Industry adopted procedures facilitate the data collection process, enabling the feedback of results into a central database. It is likely that data collected from these surveys will become part of the TDB database. As with TRICS in the UK, it is advisable to standardise the survey procedure in order to maintain quality of results and to have confidence in them.
- Given increasing demands on New Zealand's transport infrastructure, consequential environmental impacts and the need for the transport industry to more fully account for all transport modes through policy and legislation, there is an ever increasing need to be cognisant of non-car modes when undertaking any kind of transport assessment. Consequently, multi-modal trip data will increasingly be used by transport practitioners on a day-to-day basis.
- Including multi-modal data as part of the TDB database will make this data accessible to all New Zealand practitioners, as TRICS does for UK practitioners.

12.3 Comparison with the TRICS methodology

As stated in the literature review, the TRICS methodology (JMP 2009) is well established. It was not until the end of the research surveys that a TRICS survey method was made available. As such, the method developed in this research was completely independent from the TRICS methodology. When comparing the two methods, it became clear that the questions asked in the TRICS method were very similar to the method developed for the research. Table 12.1 shows a comparison of the two methods.

TRICS suggests asking in both directions of travel. We recommend one direction of travel – outbound to reduce potential refusals. However, residential land uses are a special case and both directions are suggested for these.

TRICS' question about the vehicle being parked or dropped off relates to a drop-off resulting in a vehicular two-way trip for that person's arrival or departure.

Table 12.1 Comparison between TRICS and research methodology

TRICS	Research
Inbound: 'For this particular journey, has your main method of transport been vehicle, cycle, walking, bus or train?' If the answer is 'vehicle' then the type of vehicle needs to be determined by interview. The following question will then need to be asked: 'Have you parked, or were you dropped off?' If the answer is 'parked' then record the vehicle as a vehicle arrival, and also record the appropriate number of vehicle occupant arrivals. If the answer is 'dropped off' then record the vehicle as both an arrival and a departure, and record the appropriate number of vehicle occupant arrivals. If the answer is anything other than vehicle, note the mode.	No inbound survey
Outbound: 'For this particular journey, will your main method of transport be vehicle, cycle, walking, bus or train?' If the answer is 'vehicle' then the type of vehicle needs to be determined by interview. The following question will then need to be asked: 'Have you parked, or are you being picked up?' If the answer is 'parked' then record the vehicle as a vehicle departure, and also record the appropriate number of vehicle occupant departures. If the answer is 'picked up' then record the vehicle as both an arrival and a departure, and record the appropriate number of vehicle occupant departures. If the answer is anything other than vehicle, note the mode.	Outbound: Q1 'What was your main mode of travel here today?' If anything other than car note the mode and proceed to question 4. If by car, ask the following: Q2 'Is the car you travelled in parked nearby or were you dropped off?' If dropped off go to question 4, otherwise ask: Q3 'If the car is parked nearby, is it parked on site here, on-street nearby or off-street nearby?' Q4 'How many people are there in your group that visited here today?' Q5 'What time did you arrive here today?'

It is reassuring to see there is little difference between the two methods. This means the data collected would be compatible with data collected through the TRICS method (JMP 2009), should such a database be adopted.

Another piece of data required to calculate trip rates is the unit on which the trip rates are based. As suggested when the site survey sheet was designed, given the likelihood that data gathered using this methodology would eventually become part of the TDB database (TDB 2009), it made sense that the units used in that database were adopted as the units for multi-modal trip rates. As such, the land-use definitions should be the same as well as the units. Therefore, the land-use groups and land-use activities listed in table 3.1 of the TDB user guide should be adopted. Land-use parameters listed in section 4.3 and summarised in table 4.1 of the user guide should be applied. The TDB database is the most effective way of making data collected as part of multi-modal trips accessible.

This research was undertaken to establish a method by which the data required to calculate trip rates could be collected. The aim was to make it as simple as possible while providing reliable results and hence being cost effective. This was achieved which means adoption of this method should result in reliable data which can then be included in a central database.

13 Recommendations

Based on the findings of this research, it is recommended that the face-to-face questionnaire survey method identified in appendix H be applied to a greater range of land-use activities with the calculation of actual trip rates. Extending the application of this survey method will add more credence to the results of the research.

This research focused on capturing trips to calculate trip rates. There was no investigation into how trip rates varied for different locations. The literature review identified the relevance of parking availability or public transport accessibility. At its coarsest level, the recent development of a public transport accessibility audit process in NZTA research report no.417 'Auditing public transport accessibility in New Zealand' (O'Fallon and Sullivan 2010) goes some way towards this, as does the public transport accessibility level assessment process developed in New Zealand by Abley Transportation Engineers Limited (2010). However, there are much wider issues and socio-economic and demographic factors that have not yet been accounted for such as car ownership, household income, age, gender or work status. It is recommended that further research be undertaken to investigate if socio-economic or demographic factors influence trip rates to various land-use activities.

14 Bibliography

Abley, S (2005) NZTPDB, UK TRICS, US ITE database comparison of variables. *NZTPDB research report 1/2005.*

Abley, S, M Douglass (2008) National travel profiles. Part A: description of daily travel patterns. *Land Transport NZ research report no.353.*

Abley, S, M Douglass and A Milne (2009) Comparisons of NZ and UK trips and parking rates. *NZ Transport Agency research report no.374.*

Abley Transportation Engineers (n.d.) Limited public transport accessibility project sheet. Accessed 1 December 2010. *www.abley.com/publicdocs/ABLEY_Cap_Profiles_pta.pdf*

Alta Planning + Design (n.d.) National bicycle and pedestrian documentation project. Accessed 25 September 2009. *www.altaplanning.com/national+bicycle+and+pedestrian+documentation+project.aspx*

Ampt, S, A Meyburg and A Richardson (1995) *Survey methods for transport planning*. Eucalyptus Press.

Auckland Regional Transport Authority (ARTA) (2007) *Integrated transport assessment guidelines & supplementary documents*. Auckland: ARTA.

Bunker, J, L Ferreira and D Muley (2008) Conducting visitor travel survey for a TOD – case study from South East Queensland. *Proceedings 31st Australian Transport Research Forum*.

Collins, Z, N Fuller and P Weller (2007a) Transport impact guidelines for site development. *Land Transport NZ research report no.327*. Part 1. 37pp.

Collins, Z, N Fuller and P Weller (2007b) Transport impact guidelines for site development: literature review. *Land Transport NZ research report no.327*. Part 2.

Dasgupta, M. N Raha and K Sharman (1996) *Review of trip generation studies*. TRL.

Douglass, M (1973) *Trips and parking related to land uses.* Volumes 1–3. Wellington: Road Research Unit National Roads Board.

Douglass M and D McKenzie (2001a) Trips and parking related to land use. Volume 1: Report. *Transfund NZ research report no.209.*

Douglass M and D McKenzie (2001b) Trips and parking related to land use. Volume 2: Trip and parking surveys database. *Transfund NZ research report no.210.*

European Transport Conference (2009) Proceedings of seminar: Applied methods in transport planning. Accessed 27 October 2009. *www.etcproceedings.org/seminar/applied-methods-in-transport-planning-4*

Greater London Council (1985) Traffic generation: user's guide and review of studies. 2nd ed. *Review and studies series no.25*. London: Greater London Council.

Institute of Transportation Engineers (ITE) (2008) *Trip generation*. 8th edition.

Institute of Transportation Engineers (ITE) (2009) Trip generation – other resources sponsored by the ITE Transportation Planning Council (TPC). Accessed 25 September 2009. *www.ite.org/tripgen/otherresources.asp*

JMP Consultants (2009) *TRICS multi-modal methodology 2009*. TRICS.

McGuckin, N (2004) *Trips, chains and tours – using an operational definition*. Submission for National Household Travel Survey Conference paper.

Ministry of Transport (MoT) (2009a) *Government policy statement on land transport funding 2009/10–2018/19*. Wellington: MoT.

Ministry of Transport (2009b) *How New Zealanders Travel.* Wellington: Ministry of Transport.

New South Wales Government (2004) *Planning guidelines for walking and cycling*. New South Wales Government.

O'Fallon, C and C Sullivan (2006) Increasing cycling and walking: an analysis of readiness to change. *Land Transport NZ research report no.294.*

O'Fallon, C and C Sullivan (2009) Trend in trip chaining and tours: analysing changes in New Zealanders' travel patterns using ongoing New Zealand household travel survey' *NZ Transport Agency research report no.373.*

O'Fallon, C and C Sullivan (2010) Auditing public transport accessibility in New Zealand. *NZ Transport Agency research report no.417.*

Patton, R, S Raborn, R Schneider and J Toole (2005) *Pedestrian and bicycle data collection in United States communities: quantifying use, surveying users, and documenting facility extent*. US Department of Transportation

Roads and Traffic Authority (RTA) (2002a) *Guide to traffic generating developments*. Version 2.2. RTA.

Roads and Traffic Authority (RTA) (2002b) *How to prepare a bike plan*. RTA.

Roads and Traffic Authority (RTA) (2002c) *How to prepare a pedestrian access and mobility plan*. RTA.

San Diego Municipal Code (2003) *Trip generation manual*. San Diego.

Sunseri, S and D Walton (2007) Impediments to walking as a mode choice. *Land Transport NZ research report no.329.*

Transit Cooperative Research Program (TCRP) (2006) Web-based survey techniques. *TCRP synthesis 69*. Washington DC: Transportation Research Board.

Transit Cooperative Research Program (TCRP) (2008) Effects of TOD on housing, parking and travel. *TCRP report no.128*. Washington DC: Transportation Research Board.

Transport Data Centre, NSA Department of Transport (1997) Review of data collection methods for a continuous survey of personal travel *Australian Transport Research Forum Conference*.

Trips Database Bureau (TDB) (2009) *TDB database user guide*. Christchurch: TDB.

US Department of Transportation Bureau of Transportation Statistics (2000) *Bicycle and pedestrian data: sources, needs & gaps*. Washington DC: US Department of Transportation.

Appendix A: Literature review

A1 Introduction

A literature review was undertaken as an initial step of this research project to identify existing best practice relating to the generation of walking, cycling and public transport trips. Data relating to these modes has been collected for many years, but mainly on an area-wide or corridor basis for transport modelling or monitoring purposes; not necessarily specifically relating to individual land-use activities.

The review provided a basis for designing pilot surveys and gathering an understanding of the issues involved in collating data relating to these trips, specifically when connected to forecasting future trip patterns for individual land uses rather than for general monitoring.

The only existing major data source for multi-modal trips associated with developments is the Trip Rate Information Computer System (TRICS), which is a UK-based trip rate database. For this reason, *NZTA research report no.374* 'Comparisons of NZ and UK trips and parking rates' (Abley et al 2009) is an important document and its findings have had a strong influence on the literature review. In New Zealand, practitioners tend to refer to the Roads and Traffic Authority (RTA), New South Wales (2002) *Guide to traffic generating developments*, the Institute of Transportation Engineers (ITE), USA (2008) *Trip generation* and the *TDB database user guide* (TDB 2009), but these have limitations particularly in relation to non-car modes.

It was also necessary to review other areas that affect trip rates, such as those covered in *Land Transport NZ research report 327*. Part 1. 'Transport impact guidelines for site development' (Collins et al 2007a) as these inform what practitioners should consider when assessing individual land uses and their transport impacts.

A2 Literature review – New Zealand

Title: Transport impact guidelines for site development. *Land Transport NZ research report 327. Part 1.*
Author(s): Z Collins, N Fuller and P Weller
Publisher: Land Transport NZ
Date: 2007

This report provides summary guidelines for undertaking a transport impact assessment (TIA) of development proposals in New Zealand.

It discusses vehicle trip generation for existing site conditions as well as for proposed development, specifically in relation to the neighbourhood area TIA; that is, the immediate vicinity or no more than 100m from the site.

A local area TIA may be required when the generated effects of the proposed development are greater than a threshold, typically set by the territorial authority, and might extend up to a kilometre from the site. When considering the local area TIA the guidelines suggest taking person trip generation into account rather than vehicle trip generation. This is done by calculating the mode share of existing journeys. However, with committed developments, only vehicles need to be considered. For the proposed development, consideration should be given to both vehicle and person trips, with new trips offset by existing trips to derive net trip generation. Trip types should also be assessed, namely: new, linked, transferred, pass-by and diverted trips.

A wide area TIA is needed for a large development and involves the use of a transport model. As with local area assessments, the report suggests generation rates should be used for daily as well as for network and site peak periods, sub-categorised by land use.

The report also recommends developers should provide an estimate of likely person trips to sites as well as trip type and suggests these can be calculated based on traffic counts or trip generation rates from similar sites, but does not suggest individual sources.

Title: Transport impact guidelines for site development: literature review. *Land Transport NZ research report no.327. Part 2.*
Author(s): Z Collins, N Fuller and P Weller
Publisher: Land Transport NZ
Date: 2007

Some countries, such as New Zealand, the USA and the UK have databases of trip generation data for use by transport professionals. Other countries either have published rates based on similar data, as in the case of the Australian RTA guide (RTA 2002), or developers/transport professionals are required to obtain their own data through surveys.

The availability of good quality and comprehensive trip generation data is important in preparing transport impact assessments. Proper use of the information is also important and care must be taken to use data from sites similar to those whose impact is being assessed. In this respect, the UK data in the TRICS database is likely to be the best available, especially since the data includes multi-modal trips. While the New Zealand data has a similar level of detail about each site, the number of sites within the database is limited and this restricts its usefulness.

This report suggests data in the RTA and ITE guides should be used with caution, due to the difficulty in ensuring it relates to similar sites. Calibration of the UK data to the New Zealand situation may provide the best means of accurately measuring the impact of sustainable developments while the existing New Zealand database continues to be expanded. Calibration of the UK data is being undertaken by other NZTA research (namely Abley et al 2009).

Data availability in New Zealand – Trip generation and parking data for New Zealand was published in 'Trips and parking related to land use. Volume 1: Report' and 'Trips and parking related to land use. Volume 2: Trip and parking surveys database' (Douglass and McKenzie 2001a; 2001b). The New Zealand Trips Database Bureau (TDB) has subsequently been set up to further the aims and objectives of the initial research and provide a database to be used by practitioners in New Zealand, as TRICS is used in the UK.

Data availability in Australia – The RTA (2002) guide is commonly used by transport professionals. Trip generation data provided in the RTA guide is only expressed in vehicle trips and consequently assumptions or additional survey data are required to calculate trips by other travel modes.

Data availability in Hong Kong – Hong Kong has a database of trip rates although investigation has shown this is now out of date.

Data availability in Singapore – Singapore does not have a published database of trip generation rates.

Data availability in the UK – TRICS database is the most commonly used trip generation data in the UK, and contains over 2000 individual sites across the UK and almost 5000 survey dates. The description of each site is highly detailed, allowing transport professionals to choose sites that closely match development proposals. During the past five years, an increasing amount of multi-modal trip data has been included in the database. Accessibility to the database is limited, and the licensing of the system and access to it is costly.

Data availability in the USA – The ITE in the USA has published detailed reports into trip and parking generation data for a number of years. These are updated periodically and the reports are now in their 8th edition. Despite the inability of the ITE data to identify individual sites, the ITE data is commonly used in New Zealand and in many cases the statistical information can provide confidence that there is little variation in trip generation. The volume of data in the ITE documents is also attractive to transport planning professionals in New Zealand. Land-use controls, although somewhat different than in the New Zealand situation, has often followed similar patterns of development and this may indicate some potential for alignment of walking and cycling trip making.

'Transport impact guidelines for site development: literature review' focuses on transport impact assessment (TIA) procedures, not the use of databases, and therefore the recommendations of the report relate to the provision of better TIA guidelines and do not refer to the availability of databases.

Title: Comparisons of NZ and UK trips and parking rates. ***NZ Transport Agency research report no.374***
Author(s): S Abley, M Douglass and A Milne
Publisher: NZ Transport Agency
Date: 2009

This is the most recent comparison of such data, the previous one being undertaken in 2001. It compares average (50th percentile) trip rates and parking rates for eight land-use classes between TRICS in the UK and the TDB in New Zealand.

The report concludes that trip generation rates are broadly similar for retail land uses, although parking rates in the UK are above those in New Zealand. Trends in trip rates are similar for commercial and industrial land uses. Residential land use has similar rates, although New Zealand generates more trips than in the UK. Health, education and assembly land uses have differences which are mainly attributed to limited data availability but also relate to lack of consistency of some land-use activities. Collection of more New Zealand data is recommended for all land uses.

Survey data parameters to be used for trip generation are discussed and tabulated in this report. Additional parameters for future surveys are suggested, including population and car ownership within one and five kilometres.

The report suggests the wide scatter of trip and parking rates may mean that in order to improve prediction of trips and parking rates, additional parameters could be collected (eg distinction between private/rented residential activities, room occupancy levels at hotels and seating capacity and locational aspects for restaurants).

The research recommends, among other matters, that:

- Surveys of land-use activities that have been identified as poorly represented in the New Zealand 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 New Zealand, the UK, Australia and North America.

Title: *TDB database user guide*
Author: Trips Database Bureau
Published by: TDB
Date: 2009

When describing multi-modal data collection, the *TDB database user guide* suggests site survey data sheets can include the percentage arrivals to a site by the following modes:

- car drivers
- car passengers
- goods drivers
- goods passengers
- pedestrians
- cyclists
- bus passengers.

The user guide states that these should be collected by field survey observations or interview/face-to-face questionnaires of employees and visitors. Rail as a mode is not mentioned.

Trip rates are calculated within the user guide on the basis of gross floor area (GFA). Other parameters considered appropriate, such as the number of bedrooms in a hotel, are also recognised in addition to GFA to calculate trip rates. Other parameters include employment, people, residences and parking supply, with more specific parameters being residential units, beds in hospital, doctors at a practice, berths in a marina, holes of a golf course or courts for tennis, all of which depend upon the land use being surveyed.

Mode split is provided for the whole survey period, typically being 12 hours. Although peak period trip rates are calculated within the user guide and supplied on the survey sheets provided, peak period mode splits are not recorded.

A3 Literature review – Australia

Title: *Survey methods for transport planning*
Author(s): S Ampt, A Meyburg and A Richardson
Published by: Eucalyptus Press
Date: 1995

This document describes (in broad terms):

- tasks to be addressed when planning a survey
- types of surveys available with the advantages and disadvantages of each
- procedures for assessing sample size, error and bias
- the design of surveys and techniques for recording information
- reasons for conducting pilot surveys and the iterative design process for surveys
- data capture, processing and analysis, sample size and weighting
- data cleaning, data reports and presentation.

Travel is considered to be a 'derived demand' – that is travel, in itself, has no inherent value; it is useful only in that it enables participation in other activities. The quality and quantity of the transport system which connects land uses plays a major role in the amount of travel between these. This document focuses on surveys that ask people how, where and why they travel; particularly household surveys.

The document suggests five reasons for a transport survey:

- to provide a description of existing conditions at a given time and quantify magnitude for various transport phenomena
- to provide causal explanations at a given time to help explain transport system behaviour
- to provide a basis for predicting future transport conditions
- to provide a basis for measuring the effects of a change to the transport system
- to provide historic records to monitor changes in transport system characteristics or behaviour over a long period.

It then provides a useful description of the typical transport survey process from preliminary planning through to the presentation of results with important steps that were considered as part of the research described in the main body of this report.

Survey methods for transport planning states it is better to collect a limited amount of good quality data for a given budget than a large amount of poor quality data; however, the quality depends on the survey type and method adopted. For example, a survey with a few short questions and a very high sample rate may be considered to be representative of a population (ie a land use) simply because everyone's responses were captured. Conversely, a higher quality survey with a smaller sample size may be considered to be more representative of the population by virtue of the quality of answers given to well-considered questions with less opportunity for errors/misinterpretation. Indeed, the document postulates that marginal increases in survey quality outweigh the benefits of increased costs associated with increased sample size. Survey design should be governed by qualitative, not quantitative outcomes.

Title: Review of data collection methods for a continuous survey of personal travel
Author: Transport Data Centre, NSA Department of Transport
Published by: 1997 Australian Transport Research Forum Conference
Date: 1997

This 1997 report represents a review of three survey methods available for the purposes of household travel surveys (HTS), such as face-to-face interviews, drop off/mail back and mail out/mail back. These are listed in ascending order of response rate typically obtained – face-to-face interviews had the smallest sample size of 84 households (HH); drop off/mail back had a sample size of 91 HH and mail out/mail back had a sample size of 120 HH.

Travel and activity diaries were tested for each of the three survey types. The activity diary had to be modified as the respondents resisted the increased burden of identifying 'waiting for train' and 'on the train' as two separate activities. The activity diary was therefore modified so that these activities would be considered part of the whole train activity.

The response rates are summarised in table A.1.

Table A.1 Comparison of response rates (fully responding households)

	Travel diary	Activity diary
Face-to-face method	45.2%	43.9%
Drop off/mail back	40.4%	49.4%
Mail out/mail back	40.7%	39.5%

The face-to-face method, however, did not consistently have the highest response rate and even for the travel diary, the difference between the other methods was not significant. This was due to poor interviewer training; even though the interviewers were experienced interviewers, two of the six had never undertaken household surveys. Also, all the interviewers had to learn two different travel diary methods for the purposes of the test. Higher response rates would be expected when the diary format was predetermined and more comprehensive training given.

This research defines unlinked trips as being the individual stages of walking to the bus stop (one trip), taking the bus (second trip) and walking from the bus stop to destination (third trip), while an equivalent linked trip is the whole journey of arriving at the destination using the bus and walking (one linked trip). For purposes of flexibility, all unlinked trips should be recorded. Hence, linked trips can be determined from this information, but the reverse is not true.

Interestingly, if the walk time from a car to destination was two minutes or more, this was considered to be a separate walk trip, as two minutes equates to approximately 100 metres, with this being the threshold used to define a trip using the face-to-face interview.

Additionally, the costs of each method were compared within the research, taking into account the cost of editing, querying and data validation to achieve the same quality from self-enumerated methods to those of face-to face-interviews. The costs are compared in table A.2 below.

Table A.2 Estimates marginal survey cost per household

	Travel diary	Activity diary
Face-to-face method	$139	$149
Drop off/mail back	$147	$158
Mail out/mail back	$139	$168

Table A.2 shows there may be no significant difference in marginal costs between face-to-face and written questionnaires. The activity diary is more costly than the travel diary method.

The choice between face-to-face and written questionnaires comes down to two principles: (i) the level of response and quality that is affordable; and (ii) the number and complexity of the data items required. The former relies on end-user demands. If end users are happy to accept a lower level of data quality then self-completed (written) methods are likely to be less expensive than face-to-face questionnaires. However, if high-quality data is required, then face-to-face questionnaires are likely to be the better option as written questionnaires require more post-survey adjustments. The latter issue centres on the complexity of the survey. If a large amount of information is required, face-to-face questionnaires provide a greater opportunity to collect this.

The research concluded that face-to-face questionnaires using a travel survey method is the most suitable for a HTS as this provides the highest response rate, data quality and range of items for a similar cost to other methods.

Title: Conducting visitor travel survey for a TOD – case study from South East Queensland.
Proceedings 31st Australian Transport Research Forum.
Author(s): J Bunker, L Ferreira and D Muley
Published by: 31st Australian Transport Research Forum
Date: 2008

Transit-oriented developments (TOD) are typically mixed use and may consist of residential, commercial/retail, office, recreational and educational premises. As such, they are likely to generate trips within, as well as to and from, the TOD. This research aimed to determine a suitable methodology for collecting the travel data of visitors to a TOD which could later be used for travel demand modelling.

A step-by-step methodology for conducting travel surveys was developed.

Internet methods were used for professional employees, whereas computer-assisted personal interview surveys (CAPI) were used for shoppers and for shopping centre employees (as the latter have less internet access and tend to have variable working hours).

Socio-economic and demographic information was collected as well as travel-specific information. Different survey forms were designed for each group of visitors, but they all collected the same information.

Shoppers did not respond well to a pilot survey that took 10–15 minutes. The survey was then reduced to only five questions. Educational employees using the web-based survey suggested the layout and design was sufficient. The retail employee survey was shown to employers to obtain permission to conduct it. Surveys originally intended to take up to 15 minutes were taking up to 45 minutes as employees were serving customers at the same time. The number of questions was reduced and the survey method reverted to 'pen and paper' instead of CAPI, thereby reducing the survey time to five minutes.

Educational employee response rate was 10%, shopping employee response rate was 31%, while shopper response rate was 68%. These were all considered sufficient for determining travel characteristics.

Data was analysed for demographics, mode share and trip length for each of the shopper, employee and visitor surveys.

Details about car occupancy and the public transport routes were obtained from the respondents. The results are summarised below.

Table A.3 Visitor travel survey for a TOD

	Shoppers	Employees	
Mode		**Retail**	**Professional**
Car	27%	58%	48%
Public transport	23%	21%	31%
Walk	44%	21%	10%
Bike	4%	0%	9%
Motorcycle	2%	0%	2%

Pie charts were used to indicate the above percentage mode shares. Public transport relates to both bus and train. The high proportion of car use for retail employees is attributed to odd working hours (early morning or late evening) and the poor availability of alternative modes during these times.

Observations/experiences from this research included:

- multiple choice questions were more effective than 'rating' scores

- the shopper survey needed to be short and on a one-sided A4 form
- a written questionnaire for retail employees obtained a higher response rate, as did personal interviews compared with send-back surveys
- an internet-based survey was suitable for professional employees as they have internet access, although this was dependent on interviewee age and profession
- personal contact was the best way to approach respondents.

A4 Literature review – UK

Title: TRICS multi-modal methodology 2009
Author: JMP Consultants
Published by: TRICS
Date: 2009

TRICS has been undertaking multi-modal person trip data collection since 2000. They have developed a tried and tested methodology for multi-modal trip data collection since then and in 2009 commissioned 270 transport surveys, 170 of which were multi-modal.

TRICS collects data for inclusion in its database, but has produced guidance notes on their multi-modal data collection methodology so that any data collected by others will be compatible with the data standards and definitions adopted by TRICS. TRICS has a three-stage process:

1 site visit/inventory

2 survey design/specification

3 data collection.

There are three levels of multi-modal survey collection methods adopted in TRICS:

1 fully observational

2 part observational

3 full interview.

A fully observed survey is one where all modes to a site can be recorded by observation alone (rare). A partially observed survey is one where some trips can be recorded through observations but where others need to be collected face to face. A full interview survey is exactly that, where all arrivals and departures are recorded. A partially observed survey might be one where, for example, vehicle trips to/from the site can be observed but face-to-face questionnaire surveys of pedestrians are necessary in order to ascertain if they walked, used public transport or parked off-site.

The site visits/inventory provide basic information about the site to be surveyed which will assist in determining the type of multi-modal survey data collection method to be adopted. Factors to be considered in determining the survey methodology include:

- site boundary integrity – if a site is 'fenced-in' it might be possible to survey at the site access points but a large open frontage site is likely to require full interview surveys at all building entrances/doorways
- on-site parking – the number of parking spaces and parking demand is one of the trip rate parameters that can be used in TRICS. It is therefore important to note if on-site parking is being used by people not specifically using the site as this could distort calculated trip rates

- off-site parking – a site with fully occupied parking may have users parking off-site. As such, this could under-represent actual parking demand if off-site parking is ignored. People visiting the site only as drivers (ie providing site users with a lift to/from work, or taxi drivers) should be excluded from the surveys in order not to distort site generation trip rates
- bus stop/public transport availability – if none is available then this mode can be excluded from the survey. Readily observed usage may reduce the need for interview surveys
- number of access points – this provides an indication of the likely number of surveyors
- potential for through-trips – these need to be identified in order to ensure they are not attributed to the activity and hence distort activity-related trip rates, ie a residential development may have a route used as a short-cut by others, including by foot or cycle
- 'cross-over' trips – these occur where two distinct land uses adjoin, as in a mixed retail centre. Cross-over trips may be associated with a trip chain, whereby a site user from an adjacent activity visits the site under observation to use that activity as well. In this case, there needs to be a record of the mode used to arrive at the centre, not simply the mode from the adjacent activity
- exceptions for town centres – a town centre trip is much more likely to have many cross-over trips with these being part of a much larger 'greater trip'. These sites need identifying as the wording used in interviews will necessarily vary in order to correctly capture the mode used
- double-counting – this could occur when two buildings on a site are being surveyed. It would be necessary to identify trips between the buildings to ensure these are not double counted
- head counts – how busy a site is can determine the survey methodology as it might be acceptable to have a reduced sample size, or if not, then more surveyors are required or a shorter face-to-face questionnaire survey time required
- surveyor locations – this identifies the number of surveyors required which can also affect the survey type/duration. There should always be enough surveyors to obtain 100% of all trips associated with the site
- surveyor requirements at each location – clearly every surveyor needs to be told exactly what they are collecting, and this may differ depending on their location
- site photographs – these are not only helpful for survey specification but an overall site photograph capturing the most relevant elements of the site will be used as part of the TRICS database for end users to see.

All the above go towards the survey specification.

The methodology within the TRICS guidelines provides a form for multi-modal site visit notes and examples of fully observational survey specification, partial observation survey specification and full interview survey specification.

Title: Review of trip generation studies
Author(s): M Dasgupta, N Raha and K Sharmana
Published by: TRL
Date: 1996

This document reviews methodological practices and factors determining trip attraction rates, modal split, travel times and trip lengths to specific developments.

It describes 'trip generation' as meaning something quite explicit in terms of traffic models, but suggests this is not strictly correct when considering land uses as these are usually 'trip attractors'. 'Trip attraction' is therefore more applicable when describing trip rates to different land uses.

It suggests that trip attraction rates reduce the further from a city centre the site is located. This is because a city centre location is usually a more efficient site as space is at a premium and is therefore better utilised than an edge of town site where space is cheaper and more available. In other words, a centrally located office is likely to have more staff per unit floor area than one on the edge of the city centre, which will affect trip rates. This was demonstrated within the research by comparing offices in central, inner and outer London. The number of employee trips per employee, as well as the number of visitor trips per employee, remained remarkably similar, whereas the number of trips per 100sqm was greatest for central locations, including the number of employees per 100sqm.

For multi-modal trip data, the research found that different types of activity exhibited different levels of dependence for various modes of transport. The greatest level of walk trips was found for educational activity; both work and education exhibiting the highest level of public transport trips. The highest level of car use was for trips 'in the course of work' and for trips to/from work.

The research used the TRICS database to assess variations of modal split for different activity classes. This was an arduous task as TRICS was not fully multi-modal interactive at the time, pre-1996, so sites with multi-modal data had to be surveyed on a site-by-site basis.

Not surprisingly, the non-car mode split for retail decreases the further from the city centre the site is located, which is predominantly due to poorer public transport provision. Food retail mode share is variable, whereas non-food retail, such as DIY is less variable with trips predominantly being made by car (99%). In the research, the non-food shopper group size was 1.98 people per group and the food shopper group size was 1.70 people per group, which would indicate the potential for more family involvement in non-food retail trips, which would also influence the use of the car because the larger the group size, the more likely car would be used as the transport mode.

The research considers the methodology for estimating different aspects of trip attraction. It discusses trip definitions (eg redistributed primary, pass-by and diverted link trips), traffic impacts, trip chaining, estimating modal split and parking provision. It suggests estimating the future traffic impact is not an easy task. However, although various methodologies are available, they may not determine if these trips are genuinely newly generated trips or if they already exist and are passing the site, have been diverted from elsewhere or are part of a trip chain.

Although this is an extensive research report, there is only a short section on estimating modal split. Reference is made to 'Traffic generation: user's guide and review of studies', 2nd ed, *Review and studies series no.25* (Greater London Council 1985) which recognises that modal split is reliant upon a number of factors, such as accessibility by public transport, location, car availability, parking availability or road capacity. Other similar land uses should be surveyed although a large amount of judgement is still necessary. It concludes that 'there is a need, therefore, to develop a robust set of rules which could take

into account site-specific attributes and locational effects. The ad hoc nature of existing surveys appears not to offer possibility of providing an adequate database for this purpose'.

In conclusion, trip generation studies on their own do not yield sufficient information for modal split modelling because the prime determinants of mode choice are household characteristics, eg car ownership, although destinational characteristics (such as the availability of parking) have an additional effect.

A5 Literature review – other sources

As well the specific reports reviewed in sections A2, A3 and A4 covering New Zealand, Australia and the UK respectively, other sources of information were also searched by either contacting organisations directly, or by internet searches or through contacts made during the research process.

It is clear that other organisations, which have traditionally focused only on developing car trip rates for developments, are now beginning to recognise the need to include the effects and magnitudes of non-car trips. However, this does not necessarily mean they all have commenced collecting data in order to derive trip rates for non-car modes.

RTA current research

The Roads and Traffic Authority in New South Wales, Australia has commenced a series of trip generation and parking demand studies, to update the background research in the widely recognised and adopted *Guide to traffic generating developments* (RTA 2002a).

The RTA surveyed seniors' housing, bulky goods and hardware stores during the first half of 2009. Sites were specifically selected that had poor public transport and likely low non-car usage, although they included a provision to count bicycle use as well as car traffic and pedestrians. As would be expected, the results showed very few visits by pedestrians or cyclists. The purpose of selecting such sites was to derive a base level of trip generation for sites with few other mode opportunities.

The RTA specifically investigated sites with low public transport accessibility as they are trialling a new two-step methodology for taking account of public transport in their vehicle trip and parking requirement calculations. Essentially, the method involves determining rates for an unconstrained site (ie no recognition of public transport accessibility – the 'historical' rate) then applying a discount factor to reflect both the proximity and frequency of public transport. Therefore, it seems that the method, rather than providing information specifically on non-car modes, is essentially a way of reducing car-related trip rates where other modes are available. The proposed method provides car trip rates (as already exists within the RTA database) but then reduction factors will be applied to these trip rates to account for the availability of alternative modes.

The RTA completed surveys of office blocks and low-density detached residential areas during 2009/10. The reports are in the RTA library. During 2010, the RTA took on the bigger task of surveying shopping centres and will use the entire trip generation survey budget for 2010/11. A draft of the updated *Guide to traffic generating developments* is expected in the second quarter of 2011. This will ultimately be placed on the RTA website, and updated as new surveys are completed

For the office block surveys, the RTA specified the sites were to reflect a range of public transport accessibilities, in order to determine any relationship between the calculated accessibility score and the percentage of people arriving at the site by public transport. The RTA expect these factors would rise generally in unison, although other issues such as the availability of plentiful on-site parking and/or nearby all-day street parking may distort the results.

The revised *Guide to traffic generating developments* is expected to be released in 2011. One of the features of this revision will be a greater recognition of non-car trip behaviour. The summarised results of the surveys will be released periodically.

The RTA recognises that it may be some time before empirical work can be undertaken that underpins and renders mandatory any demand-based requirements for pedestrian and cyclist facilities in NSW, eg when urban development applications are approved. In the meantime, such provisions tend to be recommended rather than compulsory, with the type and/or rate of provision guided by policy considerations. Bike access is something to be encouraged by providing capacity in excess of initial demand, unlike car access, which NSW planning policies are generally moving towards discouraging, within reason, by imposing supply limitations.

The main NSW Government resource that guides developers, local councils and others with recommendations on the provision of pedestrian and cyclist facilities is the *Planning guidelines for walking and cycling* (New South Wales Government 2004)

Other resources, like the RTA guidelines on preparing a local bike plan (RTA 2002b) or a pedestrian access and mobility plan (RTA 2002c), lay out a qualitative or consultative approach to establishing the demand for active transport.

ITE current research

ITE is currently involved in a project called 'The National Bicycle & Pedestrian Documentation Program' or NBPD. This project is co-sponsored by Alta Planning + Design and the ITE Pedestrian and Bicycle Council. NBPD is a nationwide effort to provide a consistent model of data collection and ongoing data for use by planners, governments, and bicycle and pedestrian professionals.

In developing traffic and transportation impact analyses, professionals often rely on the Institute of Transportation Engineers' (ITE) published trip-generation rates for various types of land uses (ITE 2008); however, it may not be accurate to use currently available trip-generation rates to analyse traffic impacts associated with proposed infill land-use projects. Such data typically does not take into account variations in type and location of proposed land uses, the availability and proximity of public transport services, and the existence of pedestrian and bicycle facilities. Applying available trip-generation rates to proposed urban or suburban infill development projects that have public transport or good pedestrian access can over-predict vehicular traffic impacts.

The consequences of over-estimating vehicle trips can lead to recommendations for excessive traffic mitigation fees and infrastructure improvements, leading to possible neighbourhood opposition (including sometimes costly and time-consuming litigation). This process can also result in demand for more parking spaces than may be needed to support the proposed development. Over-estimating trips can, in turn, result in higher development costs as well as delay and even cancellation of otherwise beneficial infill projects—impacts that can stall economic development and the provision of needed housing and job growth within existing urban and suburban redevelopment areas. As a result, the ITE is currently engaged in research to help better understand trip-generation characteristics of infill development.

The objective of this NBPD research is to develop an easily applied methodology to prepare and review site-specific transportation impact analyses of infill development projects located within existing higher-density urban and suburban areas. For the purposes of this study, 'methodology' refers to trip-generation, modal split and parking generation. The methodology will address both daily and peak-hour demand for all travel modes.

The ITE Pedestrian & Bicycle Sub-Committee formed a Trip Generation Task Force to study how the NBPD could be used to establish a consistent count and survey methodology, and specifically, how trip generation rates could be developed and used. However, the ITA and its partner on the research, Alta Planning & Design, are still reviewing, discussing and working on drafts of the memorandum of understanding for the research. It is hoped progress will be made in the second quarter of 2011.

A6 Conclusions

Countries around the world are recognising the need to take into account non-car modes when calculating trips to and from land-use activities. However, the way in which they undertake this, or intend to do so, differs.

New Zealand's guidance on assessing the transport impacts of developments is becoming more multi-modal in nature and compares reasonably well with the UK and USA.

Survey methods need to be simple and of a short duration in order to ensure information is obtained from people. There also need to be sufficient individuals to provide quality results. Face-to-face questionnaire surveys are better at capturing data, rather than self-completed pre-paid paper or online questionnaires. Generally, a limited amount of good quality data for a given budget is better than a large amount of poor quality data. However, the quality of the data depends on the survey type and method adopted. Survey design should be governed by qualitative, not quantitative outcomes.

The type of mode chosen by an individual is clearly affected by many external factors to the trip relating to site location and local demographics, such as: availability of parking spaces at the destination; accessibility by public transport; or car ownership. Current trip rate calculations do not provide direct correlation between the trip rates and these factors.

The RTA in Australia is updating its widely adopted and recognised 'Guide to traffic generating developments' (RTA 2002a), a document widely used throughout Australia as well as in New Zealand. The RTA has chosen to take a different approach from the UK. Rather than survey all modes to a site and calculate trip rates for these modes, they propose to adopt a two-stage process. The first stage is to calculate an appropriate car trip rate. The second stage is to reduce this using derived factors that take into account availability of non-car modes. The RTA approach does not, however, have the ability to calculate the number of non-car trips directly.

The ITE in the USA is currently researching how to better understand trip-generation characteristics of infill development. They propose to derive a method of applying these to existing trip rates that do not take into account non-car modes. However, this methodology has not yet been determined. Further consideration will be made when the information becomes available.

The UK has adopted what appears to be a simplistic approach whereby all trips to a land use are recorded and trip rates for each mode are subsequently calculated. TRICS currently has the largest database of trip related data, including multi-modal trip information. There also appears to be a correlation between TRICS data in the UK and TDB data in New Zealand (and also RTA data in Australia to some extent). This would indicate that there are possibilities that such data can be used collectively in the future.

Given the strong links with TRICS, it would make sense, for the purposes of progressing this current research, to adopt the TRICS survey methods as a first step in assessing pilot surveys during milestone 2 of this NZTA research project. Ongoing monitoring of the ITE methodology will be maintained, and consideration will be made when the ITE methodologies are available. This will not however restrict the progress of this NZTA research work.

A7 References

Abley, S, M Douglass and A Milne (2009) Comparisons of NZ and UK trips and parking rates. *NZ Transport Agency research report no.374.*

Alta Planning + Design (n.d.) National bicycle and pedestrian documentation project. Accessed 25 September 2009. *www.altaplanning.com/national+bicycle+and+pedestrian+documentation+project.aspx*

Ampt, S, A Meyburg and A Richardson (1995) *Survey methods for transport planning.* Eucalyptus Press.

Bunker, J, L Ferreira and D Muley (2008) Conducting visitor travel survey for a TOD – case study from South East Queensland'. *Proceedings 31st Australian Transport Research Forum.*

Collins, Z, N Fuller and P Weller (2007a) Transport impact guidelines for site development. *Land Transport NZ research report no.327*. Part 1. 37pp.

Collins, Z, N Fuller and P Weller (2007b) Transport impact guidelines for site development: literature review. *Land Transport NZ research report no.327*. Part 2

Dasgupta, M, N Raha and K Sharman (1996) *Review of trip generation studies*. TRL.

Douglass M and D McKenzie (2001a) Trips and parking related to land use. Volume 1: Report. *Transfund NZ research report no.209.*

Douglass M and D McKenzie (2001b) Trips and parking related to land use. Volume 2: Trip and parking surveys database. *Transfund NZ research report no.210.*

Greater London Council (1985) Traffic generation: user's guide and review of studies. 2nd ed, *Review and studies series no.25*, Greater London Council.

JMP Consultants (2009) *TRICS multi-modal methodology 2009*. TRICS Consortium.

Institute of Transportation Engineers (ITE) (2008) *Trip generation*. 8th edition.

New South Wales Government (2004) *Planning guidelines for walking and cycling*. New South Wales Government.

Roads and Traffic Authority (RTA) (2002a) *Guide to traffic generating developments*. Version 2.2. RTA.

Roads and Traffic Authority (RTA) (2002b) *How to prepare a bike plan*. RTA.

Roads and Traffic Authority (RTA) (2002c) *How to prepare a pedestrian access and mobility plan*. RTA.

Trips Database Bureau (TDB) (2009) *TDB database user guide*. Christchurch: TDB.

Appendix B: TDB site survey form

SITE SURVEY SUMMARY SHEET

Office Ref Only

Survey Period Date & Time	Day	Date	Time Start	Time Finish
☐ Extended Data Collection (Several Days)		Date Start		Date End

A. SITE DATA

Activity Name		Results & Comments			
Land Use Description					
Territorial Local Authority					
Street Address & Suburb					
Survey Site General Location	OuterRur ☐	InnerRur ☐	OuterSub ☐	Inner Sub ☐	Town Ctr ☐
Pedestrian Activity	Nil ☐	Low ☐	Moderate ☐	High ☐	V High ☐
Public Transport Opportunities	Nil ☐	Low ☐	Moderate ☐	High ☐	V High ☐
Highest Classification of Frontage Road/s		Major Arterial ☐	Minor Arterial ☐	Collector ☐	Local ☐
		Traffic aadt =		SH/TLA/Other Rd (state)	
Occupied Site Area (Ha or m^2)					
Gross Floor Area (GFA m^2)					
Employees (during survey)					
Other Size (please specify value and units eg seats, rooms, beds, pupils)					

B. PARKING

Parking Spaces Provided On-site (inc Staff)	Total			
Other Parking Spaces Available On-street Off-site	Total			
Staff Parking Spaces Provided On-site	Total			☐ Not Relevant ☐ Not Surveyed ☐ Estimated
Staff Parking Spaces On-street and Off-site	Total			
Peak Parking Demand	Time	Total (inc Staff)		Staff (number)
Peak Parking Demand During Survey	total / 100m^2 GFA	total / other unit (state unit)		staff / 100m^2 GFA

C. TRIP GENERATION

SITE SURVEYED ARRIVAL/DEPARTURE FLOW					
AM Peak (veh/hr)	TIME	start	end	Comments	
	IN	trips	IN + OUT		
	OUT	trips			
PM Peak (veh/hr)	TIME	start	end		
	IN	trips	IN + OUT		
	OUT	trips			
Daily (veh/day)	TIME	start	end		
	TOTAL IN+OUT	trips			
Peak Trip Rate per 100m^2 or other unit (state)	AM Hr	/ 100m^2 GFA / hr		/ other unit (state) / hr	
	PM Hr	/ 100m^2 GFA / hr		/ other unit (state) / hr	
	DAILY	/ 100m2 GFA / day		/ other unit (state) / day	

GENERAL COMMENTS AND NOTES

eg. Site location characteristics, parking durations, weather and other special aspects (school holidays, public holidays)

Modal Split	Number	%
Car Drivers		
Car Passengers		
Goods Drivers		
Goods Passengers		
Pedestrians		
Cyclists		
Bus Passengers		
Total		100%

Survey undertaken by (org): **Surveyor Contact (ph):**

Survey undertaken by (surveyor): **email:**

Inclusion in the TDB database fax to 03 377 4702, email to admin@tdbonline.org or post to PO Box 28105, Christchurch 8

03/2009

Appendix C: Research site selection form

Site information

Activity name									
Activity type/classification									
Street address									
Suburb name									
Rural		Outer suburb		Inner suburb		Town centre		Other	
PT opportunities		Nil		Low		Moderate		High	
Pedestrian activity		Nil		Low		Moderate		High	
Frontage road		Major arterial		Minor arterial		Collector		Local	
Occupied site area (ha or sqm)			Gross floor area (GFA sq m)						
Employees									
Other size (GPs, seats, rooms)									
Parking on-site		Staff			Other				
Is off-site parking observable?									
Bus trips observable?		Yes		No		N/A			
Train trips observable?		Yes		No		N/A			
Total number of access points?		Vehicular only		Shared veh and ped		Pedestrian only			

Site photos

Google Earth aerial context photo	Site visit photo/Google streetview (last resort)

Count specification

Number of surveyors counting vehicles only	
Number of surveyors counting pedestrians only	
Number of surveyors counting PT users	
Number of surveyors interviewing	
Other	

Contact details

Permission obtained in principle?	
Site contact name	
Site contact telephone number	
Site contact email address	

Form nztapsds1.doc

Appendix D: First tranche surveys

D1 Site 1 – office

D1.1 Location and surrounding features

The office of Hayes Knight (NZ) Ltd was chosen as it is a self-contained office-type building and is located in an inner suburb area on a minor arterial at 470 Parnell Road, Auckland.

Public transport (PT) opportunities were moderate with a bus stop located directly outside the entrance and another across the road. This meant bus trips would be observable at this location. As the nearest train station is Newmarket about 1km from the site, any people using train to reach the office would not be observable.

Pedestrian activity was moderate as it is close to residential areas.

There is one driveway for cars, which can also be used by pedestrians, and one pedestrian-only entrance directly in front of the building entrance.

D1.2 Duration of survey

The busiest periods for arriving at and departing from offices are the morning and evening peaks. The survey period was therefore selected as 7.30am to 9.30am.

D1.3 Site usage on day of survey

Unfortunately, there were very few people using this office, with only 34 people observed entering the site and six people observed leaving the site during the two-hour survey period.

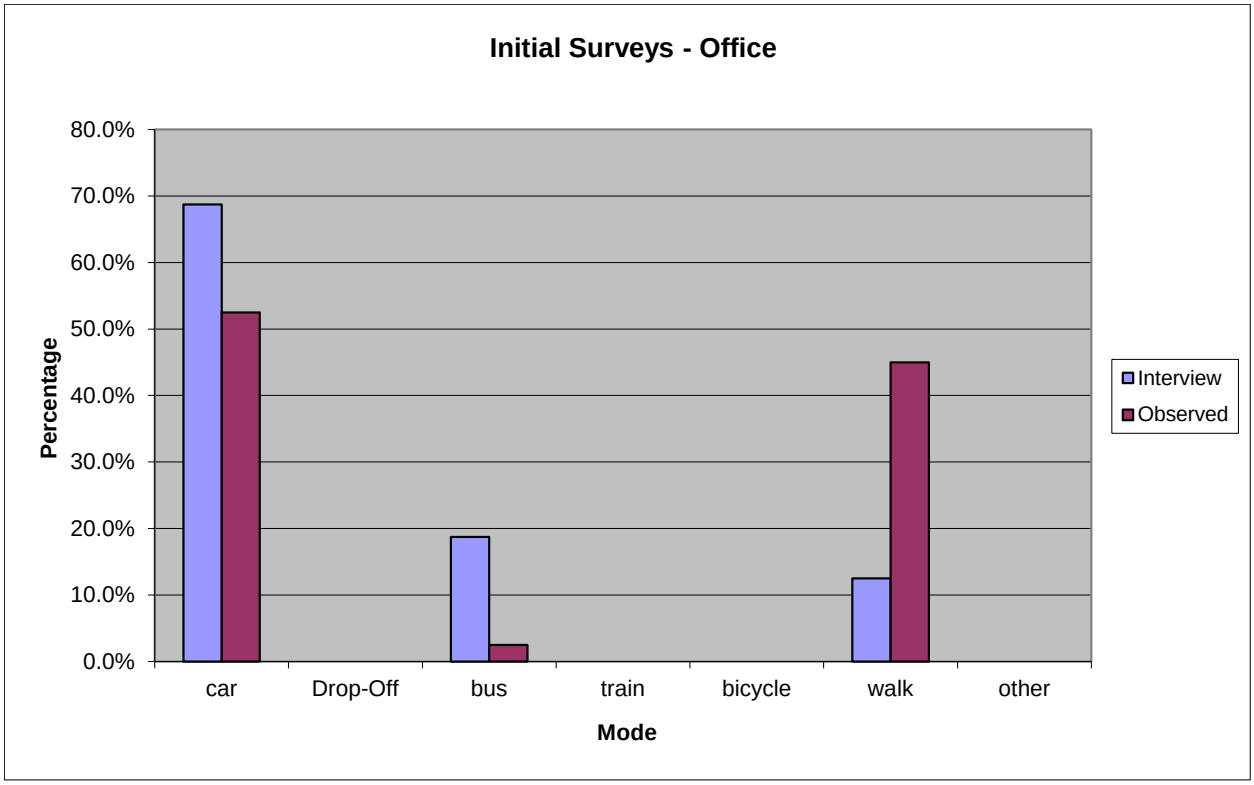
Two surveyors were used for the survey. The site also had one independent person who did a tally count as well as the observer survey. Given the low count of people using the site, it would be expected that the surveyors captured all interviewees.

The peak hour was 8.15am to 9.15am.

D1.4 Results

The modal split summary is provided in figure D.1.

Figure D.1 Results of the office survey, 7.30am to 9.30am



D1.5 Post-survey assessment

The observer noted that it was relatively easy to see if people used the bus for their journey as the bus stops are close to the site entrance. However, figure D.1 shows the proportion of people observed using the bus was much lower than the number of people interviewed, and vice versa for the number of people walking. It is therefore likely that the observer could not accurately differentiate between bus users and those walking.

The survey organiser originally had difficulties knowing how many surveyors to use for the face-to-face questionnaire surveys. Given the short interview duration, it was considered that two surveyors would be sufficient.

The surveyors felt the survey went well.

Given the small sample size, data entry was not an issue.

The analysis did not take long given the small data size and limited scope for analysis.

D2 Site 2 – retail

D2.1 Location and surrounding features

The Newmarket branch of Dick Smith Electronics was chosen as it is a self-contained retail unit. It is located in an inner suburb retail area on a minor arterial, at 50 Remuera Road, Newmarket, Auckland.

PT opportunities at the Remuera Road site were high with bus stops located nearby and the entrance to Newmarket train station only 40m away. However, observing the use of buses and train modes was difficult given the distance from the store.

Pedestrian activity was high as it is close to residential areas as well as being part of the Newmarket retail district.

There are several parking spaces in the front of the store on Remuera Road and additional customer parking available at the rear of the store accessed from Middleton Road. There is one pedestrian entrance to the store, on the Remuera Road frontage.

D2.2 Duration of survey

Given the location within the Newmarket retail district, it was considered that lunchtime would afford sufficient trips, particularly with workers in the area using this period to visit the store. The survey period selected was 11am to 2pm.

D2.3 Site usage on day of survey

A total of 137 people were observed entering the store and 130 people observed leaving the store during the three-hour survey period.

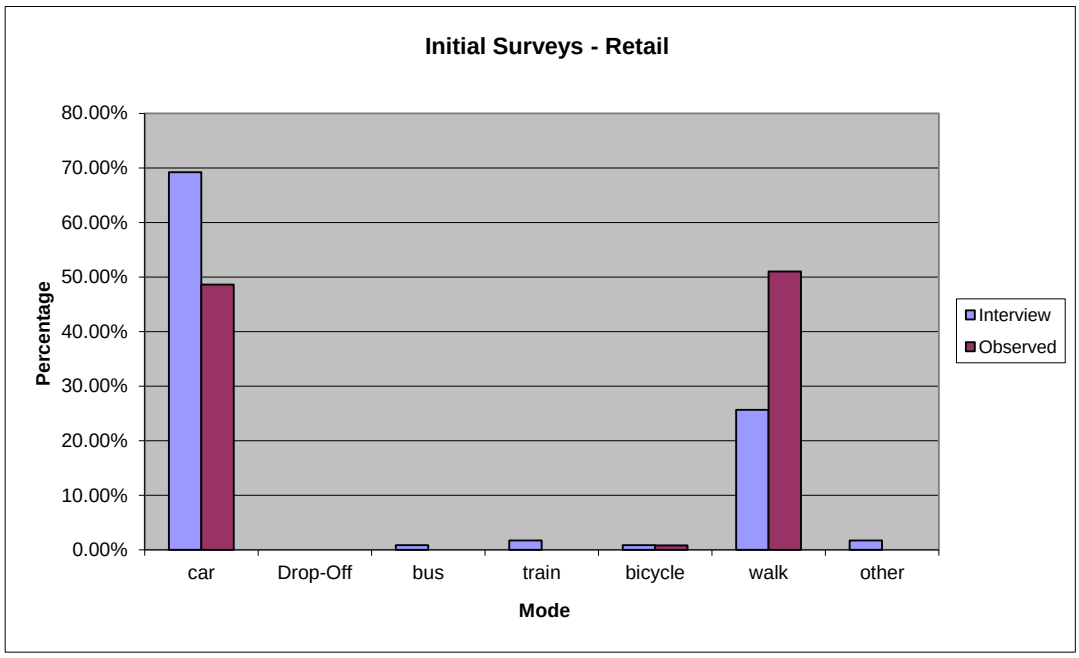
Two surveyors were used for the survey. The site also had one additional person who did a tally count as well as the observer survey. Given the relatively low count of people using the site, it would be expected that the surveyors captured all interviewees.

The peak hour was 12.30pm to 1.30pm.

D2.4 Results

The modal split summary is provided in figure D.2.

Figure D.2 Results of the retail site survey, 11am to 2pm



D2.5 Post-survey assessment

The survey worked well for the interviewers but the observer noted it was difficult to see if people arriving /departing on foot were using the train station or bus stops nearby.

The survey organiser originally had difficulties knowing how many surveyors to use for the face-to-face questionnaire surveys. Given the short interview duration, it was considered that two surveyors would be sufficient.

The surveyors felt the survey went well apart from people leaving the store who refused to answer the survey again having been captured on their way in.

Given the small sample size, data entry was not an issue.

The analysis did not take long given the small data size and limited scope for analysis.

D3 Site 3 – medical centre

D3.1 Location and surrounding features

The One Health Medical Centre was chosen as it is a self-contained medical unit. It is located in an inner suburban retail area on a minor arterial road, at 122 Remuera Road, Newmarket, Auckland.

PT opportunities were moderate with bus stops located nearby approximately 80m from the site entrance in both directions.

Pedestrian activity was high as it is close to residential areas.

There is one driveway for cars in the front of the centre leading to an underground car park. Access to the building is gained directly from the car park via lift/stairs. There is also one pedestrian access, although pedestrians can also use the car driveway. There is one ground floor entrance to the building.

D3.2 Duration of survey

The building owner suggested late afternoons were typically quite busy as parents tended to arrive with children straight after school. Consequently, the survey period selected was 3pm to 6pm. The peak hour was 3pm to 4pm, which coincided with the end of the school day.

D3.3 Usage on day of survey

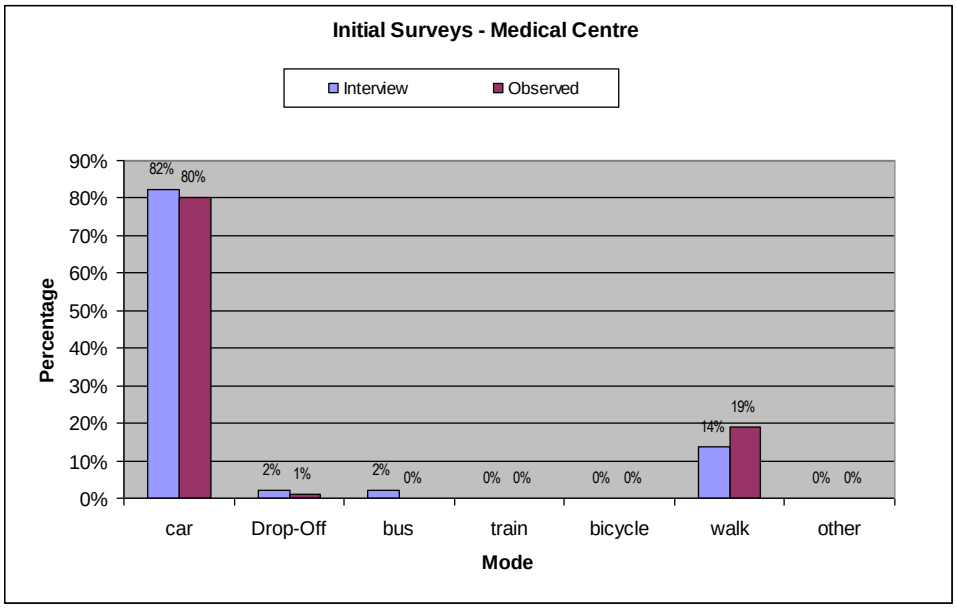
A total of 102 people were observed entering the medical centre and 114 people observed leaving the centre during the three-hour survey period.

Two surveyors were used for the survey. The site also had one additional person who did a tally count as well as the observer survey. Given the relatively low count of people using the site, it would be expected that the surveyors captured all interviewees.

D3.4 Results

The modal split summary is provided in figure D.3.

Figure D.3 Results of the medical centre survey, 3pm to 6pm



D3.5 Post-survey assessment

The survey worked well for the interviewers but the observer noted it was difficult to see if people arriving/departing on foot were using the bus stops as they are 80m away in either direction from the entrance.

The survey organiser originally had difficulties knowing how many surveyors to use for the face-to-face questionnaire surveys. Given the short interview duration, it was considered two surveyors would be sufficient.

The surveyors felt the survey went well with most people willing to answer questions.

Given the small sample size, data entry was not an issue.

The analysis did not take long given the small data size and limited scope for analysis.

Appendix E: Second tranche surveys

E1 Site 4 – video rental store

E1.1 Location and surrounding features

Alice n Videoland is a self-contained video rental store with no dedicated on-site parking. It is in a town centre location on the corner of Tuam Street and High Street, Christchurch.

PT opportunities were high with bus stops located along Tuam Street and the Christchurch Bus Exchange located within moderate walking distance of the site.

Pedestrian accessibility was high given its town centre location.

E1.2 Duration of survey

The building owner suggested Friday evenings or Saturday mornings were typically their busiest periods. Consequently, the survey period selected was 10.30am to 2.30pm.

E1.3 Site usage on day of survey

A total of 349 people were observed entering the video store and 360 people observed leaving the video store during the four-hour survey period.

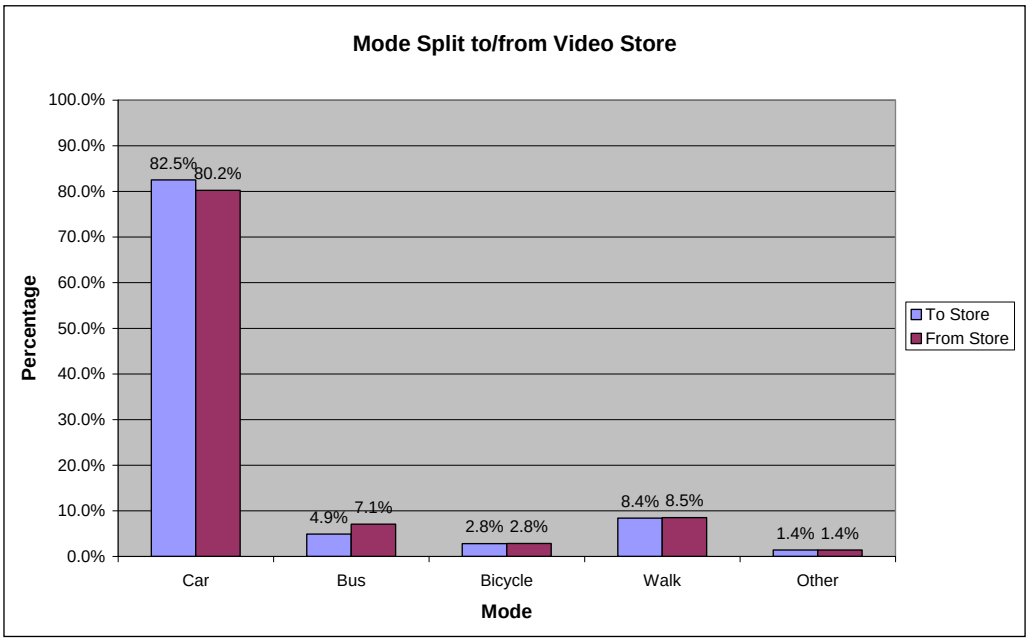
Two surveyors were used for the survey. The site also had one additional person who did a tally count as well as the observer survey. This was found to be an appropriate level of survey staffing to provide sufficient results for analysis.

The peak hour was between 1.15pm and 2.15pm.

E1.4 Results

The modal split summary is provided in figure E.1.

Figure E.1 Results of video store survey, 10.30am to 2.30pm



E1.5 Post-survey assessment

The survey worked well for the interviewers.

The surveyors concluded that the survey went well with most people willing to answer questions. There were two surveyors. From their survey sheets, it was clear one surveyor had more refusals than the other. It was not known if this was because one was not recording refusals or if it was due to the interview styles. Subsequent discussion with the survey organiser indicated one of the surveyors was a very task-focused person and hence probably attempted and recorded more surveys than the other and consequently had more refusals. There also appeared to be personality differences between the two which could have accounted for some of the differences in response and refusal rates.

Given the small sample size, data entry was not an issue.

The analysis did not take long given the small data size and limited scope for analysis.

E2 Site 5 – Commonsense Organics

E2.1 Location and surrounding features

Commonsense Organics is a self-contained organics store with limited on-site parking. It is in a city centre location on a major arterial at 270 Wakefield Street, Wellington.

PT opportunities were high and pedestrian accessibility moderate given the combination of the central city location and the proximity alongside the major arterial route.

E2.2 Duration of survey

The store closes at 7pm weekdays and a four-hour period of 3pm to 7pm was chosen.

E2.3 Site usage on day of survey

A total of 186 people were counted leaving the store in the four-hour survey period.

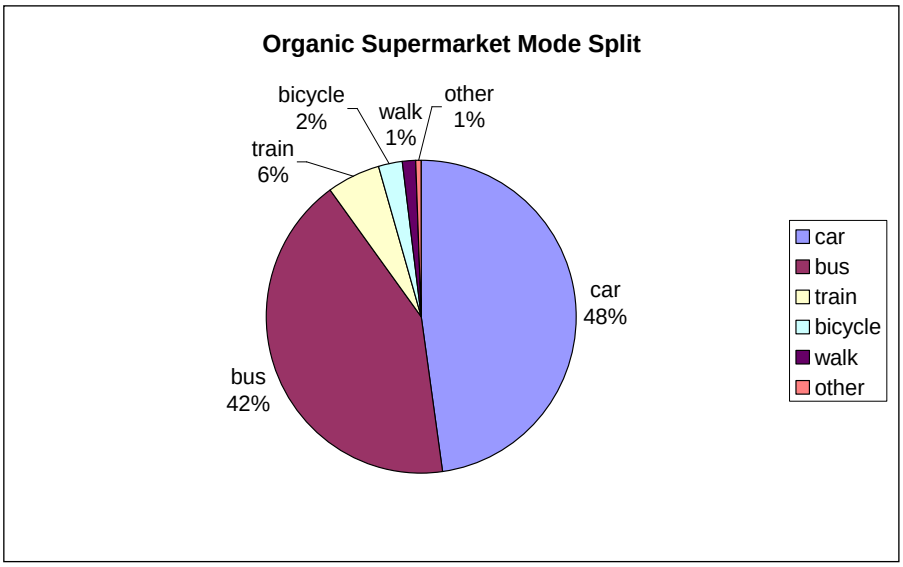
Two surveyors used for the survey. The site also had one additional person who did a tally count. There was a reasonable amount of people to provide sufficient results for analysis.

The peak hour was 1.15pm to 2.15pm.

E2.4 Results

The modal split summary is provided in figure E.2 below.

Figure E.2 Results of the organics store survey, 3pm to 7pm



E2.5 Post-survey assessment

The survey worked well for the interviewers. The survey itself was undertaken quickly; the introduction and asking people if they wanted to participate seemed to take longer than the actual survey. The survey organiser thought it could easily be extended by a few questions without inconveniencing people.

Given the small sample size, data entry was not an issue.

The analysis did not take long given the small data size and limited scope for analysis.

Post-survey, the survey organiser raised some valid points.

The notes and documentation were generally untidy and the instructions were not clear. Proper templates and clear instruction sheets were recommended. For example, the organiser had to rewrite the surveyor instructions and rearrange the recording table before the survey.

The question 'How did you travel to the food store today?' contained some ambiguity. As expected for this survey, many people said that they visited the food store as part of a multi-destination trip, and were unsure which travel mode they should note. Maybe this question should be modified to include details of all stages of a trip and the different activities it involved. The high percentage of pedestrians found in this survey was probably due in part to this ambiguity, with a high number of people having walked straight from work on their way home, a trip which might be predominantly by bus. Several times the interviewers were unsure which mode to put down and ended up writing them all in the comments box, eg walk-

bicycle-walk, or they ticked the ‘car’ box and wrote ‘walk’ beside it. However, on reflection, it was considered that trip chains were difficult to define for the layperson and hence the information gleaned would be questionable. Also, current trip rate information for car modes does not account for trip chains and therefore data gathered may be inconsistent with historic data.

In response to the issue, changes were made to ensure the question was about the **main** mode of travel.

The table for surveyors to record the results in did not handle some people's responses very well. People who were shopping in one group but used different travel modes to arrive or leave could only be recorded through the comments column. Likewise people who were using different travel modes to and from the store could not be fully captured.

The table columns were not well aligned on the question sheet. For example, the numbers above the columns did not always match the number of relevant question.

Interviewers recorded those who arrived by taxi as arriving by car. Whether or not it should be recorded as a ‘car’ or ‘other’ should be decided and clarified with interviewers before the survey.

The store owners were initially apprehensive about letting the surveys take place, as interviewers had been overbearing in previous surveys and customers had complained. They eventually consented but only after the store manager had checked with a supervisor, and after reassurance that customers would not be treated in this way.

The face-to-face questionnaires recorded several staff. The organiser was not sure if these should be identified separately.

Appendix F: Third tranche survey

F1 Site 6 – Countdown supermarket

F1.1 Location and surrounding features

The supermarket is self-contained with on-site parking. It is located in an outer suburb adjacent to a major arterial, at 5–7 Pakuranga Road, Highland Park, Auckland.

PT opportunities were considered to be low as was likely pedestrian activity. Although the supermarket is a self-contained unit, it is adjacent to other retail stores.

F1.2 Duration of survey

The store is normally open from 7am to 12am. It was considered that the period from 9am to 6.30pm would be long enough for testing the survey, which was done on a Thursday.

F1.3 Site usage on day of survey

A total of 2600 people were counted entering the store during the survey period and 2618 people were counted leaving the store.

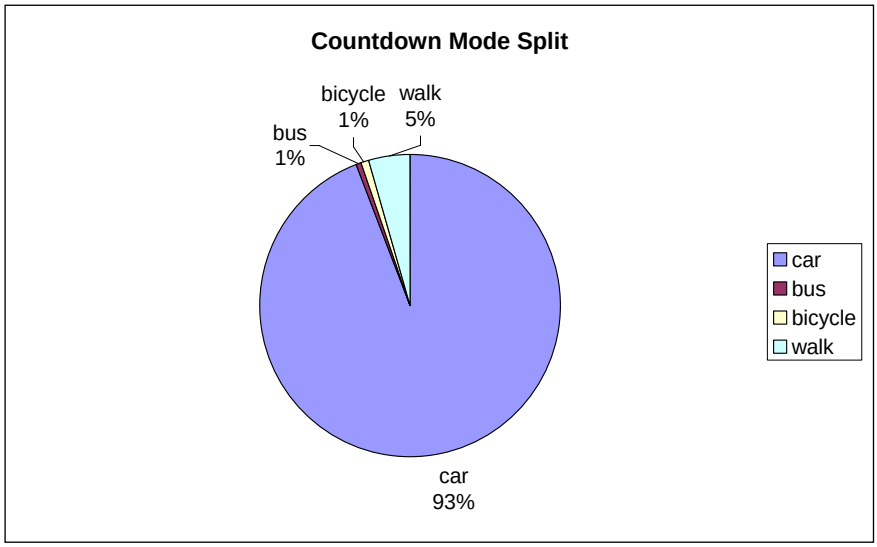
Two surveyors were used for most of the day but this was increased to three during the busiest period which was late afternoon to early evening. The site also had an additional person at the store entrance who did a tally of all people entering and leaving the store and a separate surveyor who counted cars entering and leaving the carpark. The result was a significant sample.

The peak hour occurred between 3.15pm and 4.15pm.

F1.4 Results

The modal split summary is provided in figure F.1. It can be seen that car was the dominant mode of transport at 93%.

Figure F.1 Results of the Countdown supermarket survey, 9am to 6.30pm



F1.5 Post-survey assessment

As the previous survey face-to-face questionnaires were relatively short, it was decided to add additional questions to increase the usefulness of the survey. As part of the survey development, there were suggestions that information related to trip chains might be useful. This had been discounted previously because it was considered too difficult to explain these in simple terms and within a short time frame to the general public. Another piece of information considered relevant, particularly for a supermarket, was whether the trip was a passby trip or a diverted trip (ie whether the trip to the supermarket was part of an already established trip past the site).

Trip chains, as defined by the FHWA, are those that link journeys where each activity takes less than 30 minutes. It would not be feasible to ask such a question of the public and still keep the face-to-face questionnaires relatively short with a high sample size. Consideration was given to having a diagram to show the public when asking about these aspects to their journey. However, even a simple diagram showing three places A, B and C with two versions: arrows between A and C or arrows linking A, B and C to illustrate a trip chain would need to be explained to the general public. There could also be confusion using the same diagrams to illustrate passby or diverted trips.

In the end, it was decided to have one simple question for each subject. The trip chain question would relate to the trip purpose and the passby issue would relate to trip type.

The first additional question was:

> *Was the purpose of your trip out today solely to visit this supermarket?*

If the answer was yes, then this trip was deemed not to be part of a chain. It would be assumed the trip was made directly to the store, and asking if the trip was a passby then became irrelevant. Consequently, only if the answer was 'no' would a subsequent question be asked:

> *To visit this supermarket, did you have to change your route to get here, or would you have been travelling directly past the supermarket anyway?*

Many different ways of phrasing this question were considered and there were still some reservations about the final wording. If someone had planned to visit their doctor and then decided to go to the supermarket en route, which took them out of their way, this would be a diverted trip. Would the person who had made the decision, probably without thinking much about it, have answered yes to the above question?

The survey worked well for the interviewers and still remained relatively short.

This survey resulted in a considerable amount of data. Data entry was an issue with some records that were not coded accurately. In addition, some data was missing from the questionnaire record sheets – some of the interviewers did not include all the information required for short periods of time, such as the time the interview was done, which is a crucial piece of information.

There was some misunderstanding about the new questions relating to trip purpose and trip type, in that the trip type question was always asked, regardless of the answer given to the trip purpose. This resulted in a few records where the trip purpose was solely to visit the supermarket yet the trip type was diverted, which could not be the case. This may illustrate that some members of the public did not understand the question. There were also some occasions where the trip purpose was other (ie a chain) yet the subsequent question was not asked.

The analysis took somewhat longer to complete compared with earlier site analyses due to the added complexity of the questions and the amount of data. However, the results and analysis that could subsequently be undertaken was significantly greater.

As with the other sites, a tally count was undertaken of people entering and leaving the store with the tally counter making a note of group size. This is typically a relatively simple exercise for a supermarket as people in groups tend to stay together, particularly when exiting the store as they usually surround one trolley.

A check on accuracy was to compare the observed group size against the response group size.

Figure F.2 Comparison of observed group size against answered group size

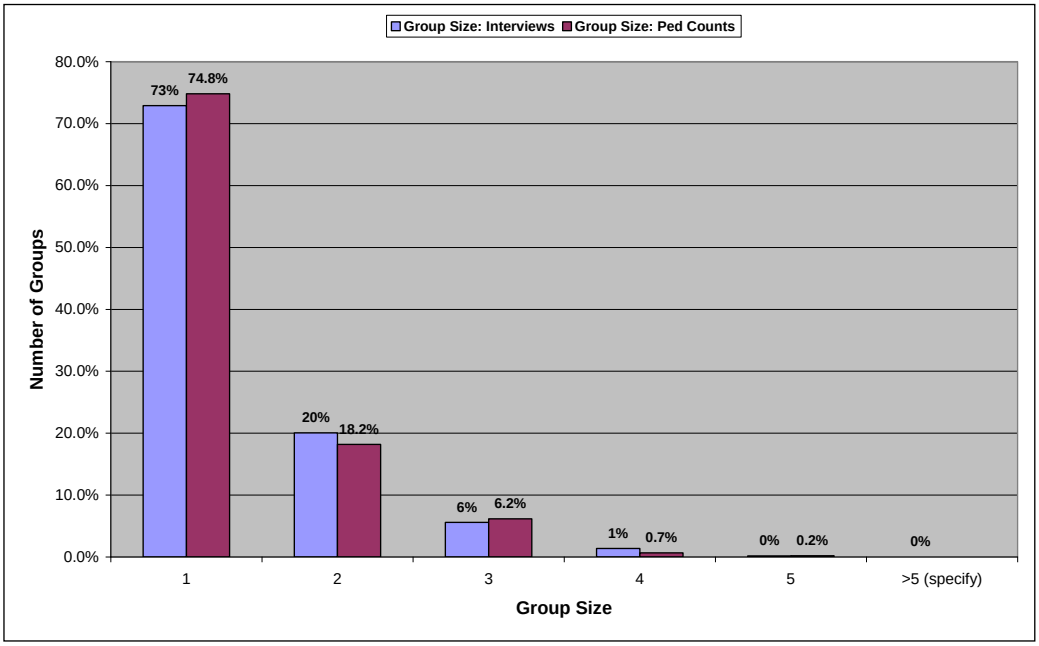


Figure F.2 demonstrates a particularly close fit between observed group size and answered group size. While the face-to-face questionnaires only captured a sample of the full population recorded by the tally counter, the accuracy of the records was greater as people gave the actual group size, whereas the tally counter could only observe and make their best estimate of who was in a group. Overall, given the close correlation between total pedestrians as well, it is considered that the survey provided an appropriate representation of site usage.

Another check on accuracy was undertaken similar to pedestrian counts, but this time using car data.

Figure F.3 People observed using cars against people asked using cars

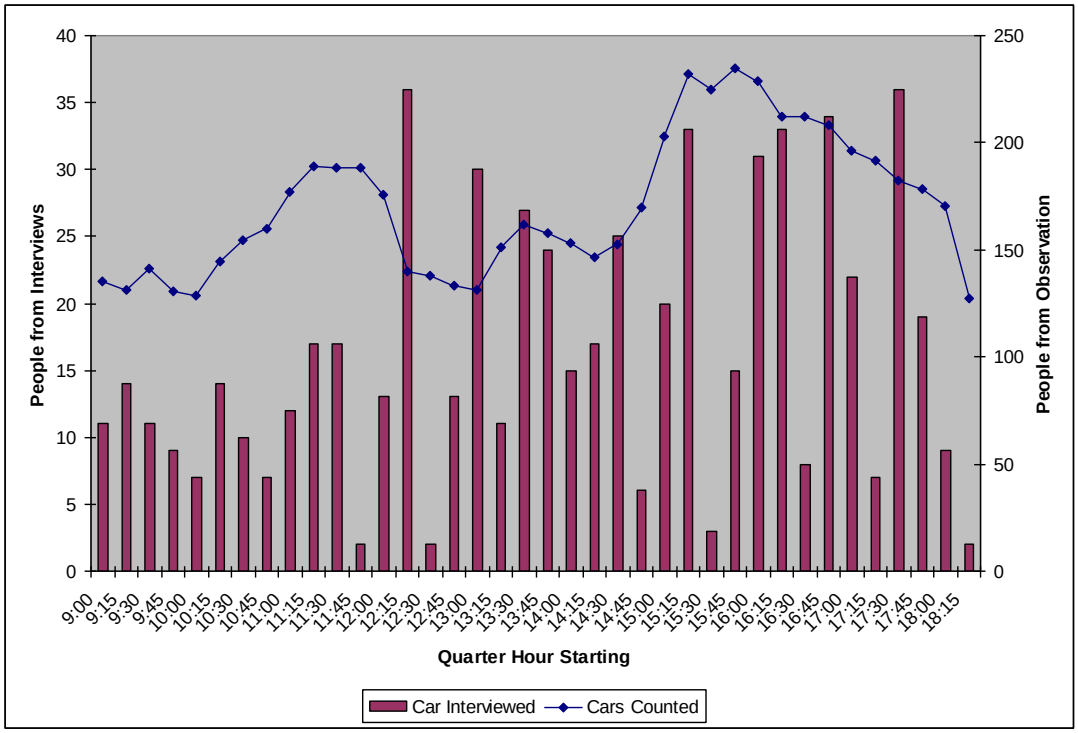
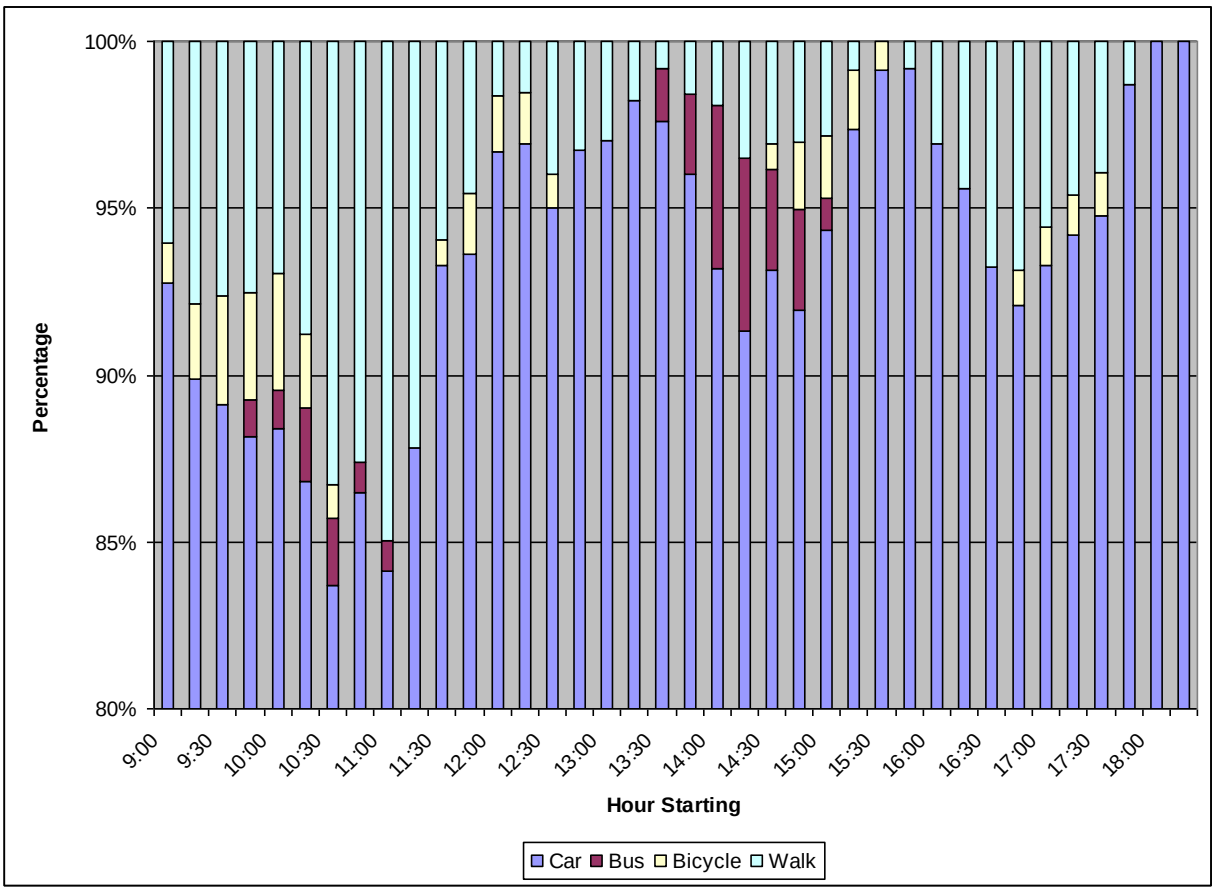


Figure F.3 shows the pattern between those observed using cars (taking into account occupancy) and those answering their mode as car (taking into account group size). There was a similarity of pattern between observed and interviewed through the first 2.5 hours of the survey; however, from about 11.45am onwards there was a greater variability between the two methods. The observed car users clearly had a steadier pattern through the period and it could be expected that due to the variability of the face-to-face questionnaire technique and individual nature there was a greater variability in the number of car respondents using the face-to-face questionnaire method.

The face-to-face questionnaire method with its arrival and departure time capture could also be adopted to derive an estimate of car-based traffic generation if desired to complement the data derived for non-car travel mode statistics.

Figure F.4 Hourly mode split throughout the day



The Y-axis on figure F.4 has been stretched between 80%–100% to see the smaller percentage values, given that car mode was the predominant mode, typically around 93% on average during the whole day. Interestingly, though, the mode split for car was less during the morning, bottoming at around 84%, than during the afternoon period. The next dominant mode after car was walking. The average mode share for the whole day was around 5% walking, but figure F.4 illustrates how the pedestrian mode share had a maximum value of 15% at about 11am. There were some pedestrian modes throughout the whole day. Bus and cycle modes were more sporadic.

Given the amount of data available, it can also be used to obtain information not specifically relevant to trip rates or mode share. The survey of cars entering the site also includes the number of people in each car. It is then possible to calculate the average occupancy of cars throughout the day. This is shown in figure F.5.

Figure F.5 Average car occupancy throughout the day

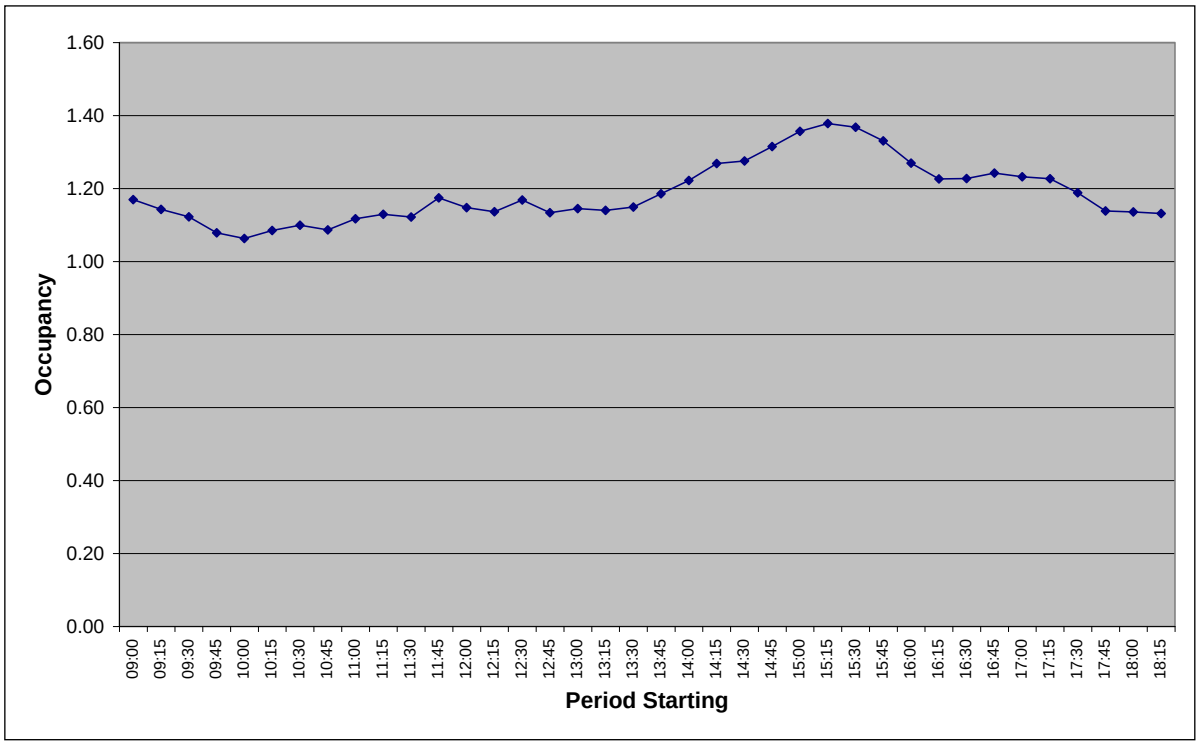


Figure F.5 illustrates that the morning period had a lower car occupancy than the afternoon period. The afternoon peaked at around 3.30pm, which coincides with school finishing times. This shows that parents most likely shopped on their way home after picking up the children from school.

Further analysis of the data helps to understand the patterns of duration of stay:

Figure F.6 Duration of stay

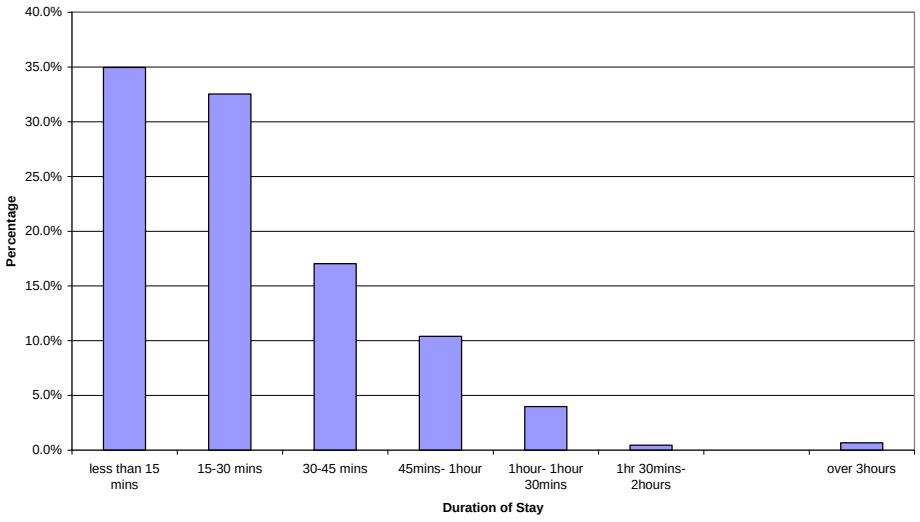


Figure F.6 shows that the vast majority of people stayed in the supermarket for up to 30 minutes (around 68%). The spread of time spent is negative exponential. The small peak for three hours or more relates to staff who were interviewed.

This survey also included questions about trip purpose and trip type. The results are shown below in figures F.7 and F.8.

Figure F.7 Trip purpose

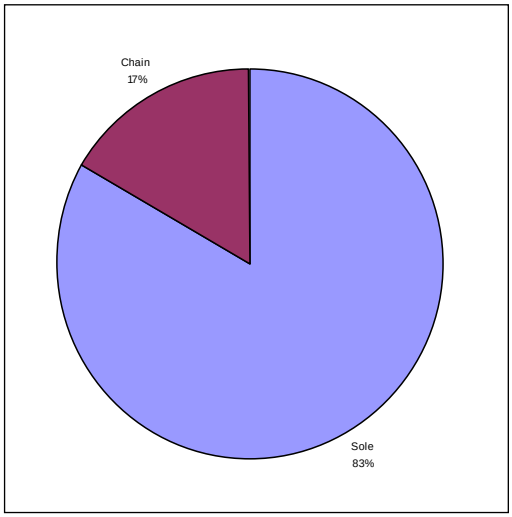


Figure F.8 Trip type

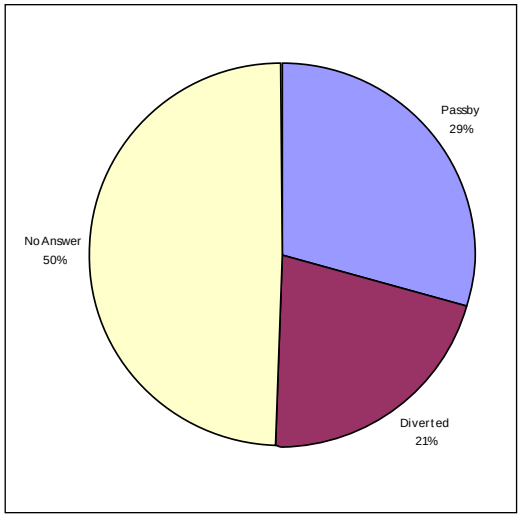


Figure F.7 shows whether the trip to the supermarket was a single-purpose trip or if it was part of a chain. The vast majority of trips were recorded as sole purpose at 83%. This is a high incidence of sole purpose trips for this activity, which may signify some misinterpretation of the question. To clarify the question, it would be useful if surveyors asked where the interviewee came from and where they were going next (eg home, work, shops, recreation, education, other). Of the 17% whose trip was part of a chain, 29% would have been passing the site anyway, 21% diverted to the store but 50% had no answer as illustrated in figure F.8. This is likely to be due to surveyor error in either not asking the subsequent question about trip type or the interviewee not understanding the question. It is noted that pass-by and diverted trip types had a high link to the site location, therefore it would not be useful to compare pass-by and diverted trip proportions between sites, and this data need not necessarily be included in the database.

The preceding figures clearly demonstrate the depth of data that can be gathered by a relatively simple survey.

Table F.1 Sample rates

	Group counted	Interviews attempted	%	Successful interviews	%	Refused	%	Missed	%
Countdown supermarket	1964	765	39.0%	665	86.9%	78	11.7%	1299	66.1%

Table F.1 shows that the sample rate for the supermarket was lower than the less busy sites with interviews with 39% of all groups attempted and a success rate of 89% for those attempted. Overall, 66% of groups were missed. However, it is worth putting these into perspective in terms of statistical significance. Assuming a confidence level of 95%, the following are the confidence levels, as calculated using the technique contained within section 8.3.1 of the main report.

Table F.2 Confidence limits

Mode	Number	P	Interval	Confidence limits	
				Lower	Upper
Car	818	93.4%	1.340%	92.04%	94.72%
Bus	7	0.8%	1.380%	-0.58%	2.18%
Bicycle	7	0.8%	1.380%	-0.58%	2.18%
Walk	43	4.9%	1.170%	3.74%	6.08%
Other	1	0.1%	0.170%	-0.06%	0.28%
Total	**876**	-	-	-	-

The previous surveys resulted in a maximum confidence interval of ±2.1% or ±2.5%. This survey resulted in a maximum confidence interval of ±1.4%, a much more accurate level as shown in table F.2. Many of the answers for mode of travel were low in terms of percentage of response, such as bus and bicycle mode, and as a result the lower confidence level became negative, which in reality would mean zero.

The survey therefore resulted in high levels of confidence and a good sample rate. However, there still seemed to be issues with the data. These mainly related to the surveyors not making a note of both the time of the interview (the person's departure time) or when the person arrived. These two pieces of information are critical when deriving trip rates as trip rates are time dependent, ie trip rates are typically quoted not just for the whole survey period but also for the peak periods within a survey period. It seemed that some interviewers had several refusals while others did not. An anonymous questionnaire about the survey method was sent to the surveyors to obtain some feedback. All the interviewers thought the survey went well. Clearly, with the variations found in the quality of data with some data missing, this was not the case.

There needed to be some refinement to the survey technique to make sure that all the basic information was being gathered.

Appendix G: Fourth tranche survey

G1 Site 7 – Countdown supermarket

G1.1 Location and surrounding features

The Countdown supermarket at 5–7 Pakuranga Road, Highland Park, Auckland is a self-contained supermarket with on-site parking. It has a town centre location on a major arterial.

PT opportunities were considered to be high and pedestrian activity moderate given the town centre location.

G1.2 Duration of survey

The store is normally open from 7am to 12am. It was considered that the period 9am to 7pm would be long enough to test the survey, which took place on a Thursday.

G1.3 Survey

A total of 2573 people were counted entering the store over during survey period and 2592 people were counted leaving the store. These numbers are similar to the previous survey.

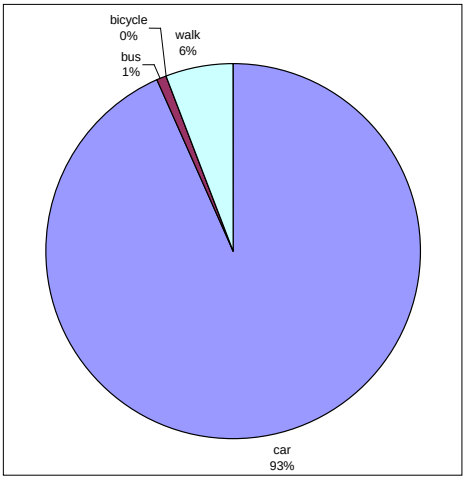
Two surveyors were used for most of the day but this was increased to three at the busiest times which were late afternoon to early evening. The site also had an additional person at the store entrance who did a tally of all people entering and leaving the store and a separate surveyor who counted cars entering and leaving the carpark. The result was a significant sample.

The peak hour was found to be 3.30pm to 4.30pm.

G1.4 Results

Figure G.1 summarises the mode of arrival for people arriving at the store. These values are similar to the previous survey.

Figure G.1 Results of the Countdown supermarket survey, 9am to 7pm



G1.5 Post-survey assessment

The aim of this survey was to test the refined instructions provided to the surveyors and the resulting data in terms of making sure data was entered.

The instructions are included as appendix E. For this new survey, surveyors were instructed that should they have a refusal, this needed to be noted along with the time the interview was attempted. All other data fields were mandatory, including the estimated time the person arrived as well as the time the interview took place.

Table G.1 is a comparison of tally counts, interviews and refusals between the previous survey and the new survey.

Table G.1 Sample rates

	Groups counted	Interviews attempted	%	Successful interviews	%	Refused	%	Missed	%
Previous survey	1964	765	39.0%	665	86.9%	78	10.2%	1299	66.1%
New survey	1954	1147	58.7%	839	73.1%	306	26.7%	1115	57.1%

The total number of groups was similar between the two surveys. However, the number of interviews attempted was considerably higher the second time around. As a result, although the sample rate was lower, the number of successful interviews was higher. The number of refusals was higher but this may be due to (a) more interviews being attempted and (b) surveyors noting a refusal which may not have been done in the first survey. The level of refusals at 27% is still considered to be generally acceptable although it would be advisable to aim for no more than 10%–15% refusals.

An analysis of the survey accuracy is shown in table G.2.

Table G.2 Confidence limits

Mode	Number	P	Interval	Confidence limits	
				Lower	Higher
Car	1063	92.52%	1.13%	91.39%	93.65%
Bus	7	0.61%	0.34%	0.27%	0.95%
Walk	78	6.79%	1.09%	5.70%	7.88%
Other	1	0.09%	0.13%	-0.04%	0.22%
Total	**1149**	-	-	-	-

The previous survey resulted in a maximum confidence interval of ±1.4%, which was considered extremely good for a travel mode survey. Although the new methodology noted more refusals, it also had more successful interviews. This resulted in the confidence limits reducing further to only ±1.1%.

Given that the eventual mode splits identified in both surveys were very similar for the same site, it likely that the results were accurate enough for the purposes of calculating the mode split for this site.

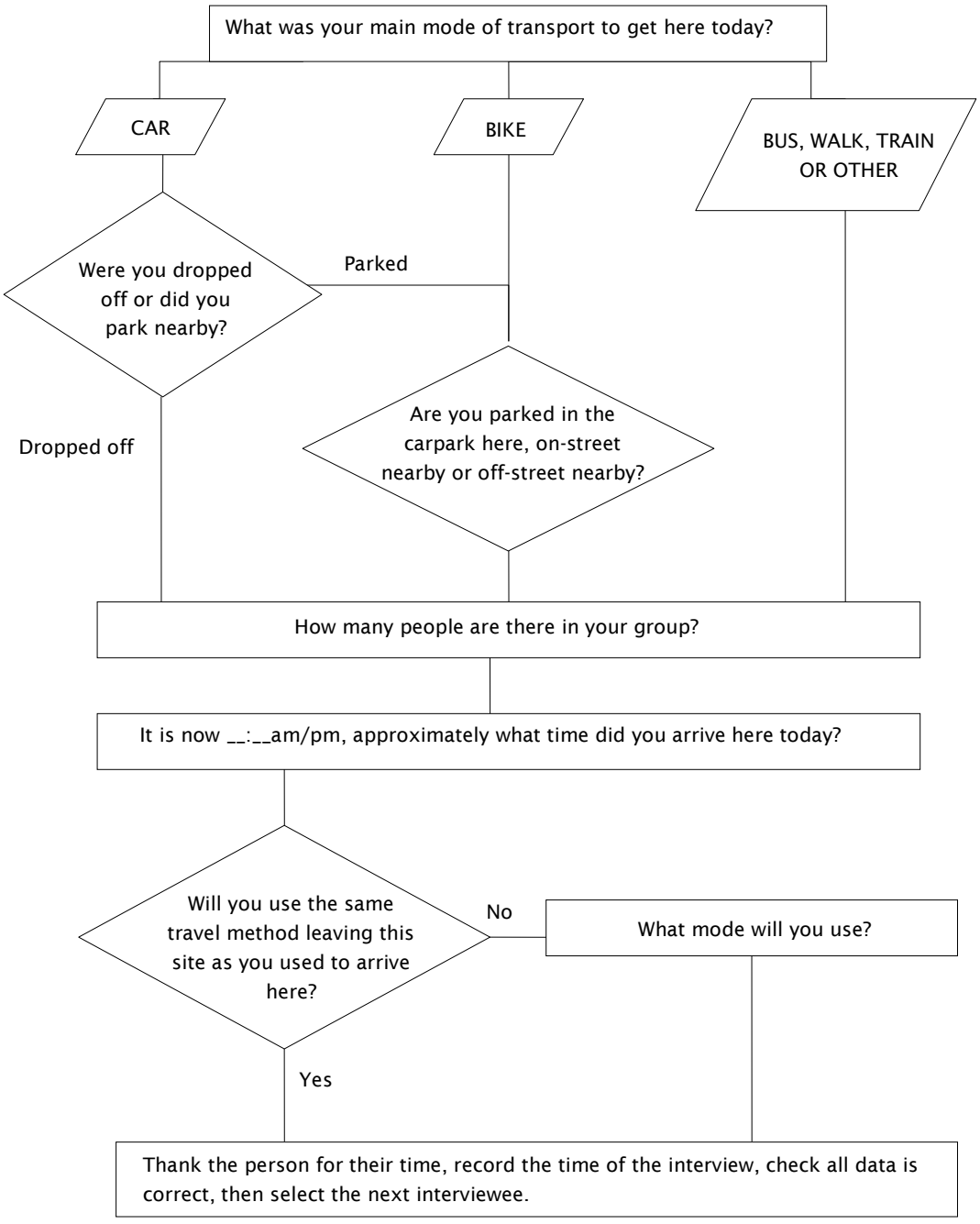
It is considered that the updated survey methodology and surveyor instructions resulted in a greater level of accuracy not only in terms of the eventual mode splits, but also in noting non-responses.

Appendix H: Research survey method

Can I have a few moments of your time to ask you about your transport choice today?

We are collecting information on behalf of the NZ Transport Agency for the purposes of research.

Your assistance in answering the following questions would therefore be appreciated.



Interview Surveys
Site: _____
Date: _____
Weather: _____
Interviewer: _____
Answer Sheets

Denotes mandatory field - MUST BE COMPLETED

Traffic Design Group

Level 1 103 Carlton Gore Road ph 531 5006

Question	Q 1					Q 1B					Q 2					Q 3	Q 4		NOTE	
	Main Arrival Travel Mode					If you arrived by car….					Group Size					Arrival Time	Main Departure Travel Mode		Interview (Departure) Time	Any comments / observations
Answer	a car	b bus	c bicycle	d walk	other (note)	Dropped Off	Parked Nearby On-Site parking	 On-street	 Off-street	Other	1	2	3	4	5 or more (specify)	HH:MM	Same	Other (a, b, c, d or note)	HH:MM	
1																				
2																				
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Appendix I: Fifth tranche survey

I1 Site 8 – residential development

I1.1 Location and surrounding features

A cul-de-sac residential development with on-site parking was selected for the fifth tranche survey. It is located in a high-density residential suburb at Morning Star Place, Sandringham, Auckland and has only one vehicular point of access, directly off a major arterial, although it also provides a pedestrian through route. It is a high-density residential development with on-site parking.

PT opportunities and pedestrian accessibility were assessed as being moderate given it is opposite a large retail centre with good footpath connections, plus signalised intersections across the adjoining arterial route.

I1.2 Duration of survey

A shorter time period was chosen to do a simple test of the survey method. The survey period was 4pm to 7pm to capture an evening peak period. The survey day was a Friday.

I1.3 Site usage on day of survey

A total of 396 people were counted entering the residential cul-de-sac during the survey period and 288 people were counted leaving the site. Of these, 114 people walked in and 65 people walked out, a total two-way flow of 179 pedestrians.

The total number of pedestrians captured by the face-to-face questionnaire surveys was 167, a very high capture rate of 93%. No refusals were noted.

Two surveyors were used for the survey, one on each footpath either side of the main entrance into the site. The site also had one independent person who did a tally of all people entering and leaving by vehicles.

The peak hour was 4pm to 5pm.

I1.4 Results

Of the face-to-face questionnaire surveys, 100% responded that their mode was walking. None responded that their mode was public transport.

Of everyone passing the survey point, the mode split was 73.8% by car and 26.2% walking. No other modes were recorded.

Many of the face-to-face questionnaire respondents mentioned they were residents who did not own a car. A few were using the route as a short cut to another residential development.

I1.5 Post-survey assessment

The location is across the road from Westfield St Lukes Retail centre and it is likely that many of the pedestrian trips were to and from this centre.