



## **ROADS AND MARITIME SERVICES**

### **TRIP GENERATION SURVEYS**

#### **SERVICE STATIONS**

#### **ANALYSIS REPORT**





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# 1 INTRODUCTION

## 1.1 Study Brief / Outcomes

The former Roads and Traffic Authority (RTA) published its Guide to Traffic Generating Developments (“*Guide*”) in the mid-1990s. This document drew on the results of a number of trip generation and parking demand surveys covering a range of land uses. These surveys had been progressively conducted since 1978. The trip generation and parking requirement data in the Guide is becoming increasingly out-of-date. Several new business types are not adequately represented (eg factory outlet centres) and there is evidence of ongoing industry rationalisation (eg larger service stations, hardware supercentres, etc).

The Guide contains trip generation and parking demand information derived from a 1979 survey of ten Service Stations across greater Sydney. Half of the sites were self-service, and half offered the then-traditional driveway service. Since that survey was undertaken:

- self-service has displaced driveway service
- service stations are now much larger
- it is now rare for a service station to also contain a vehicle service workshop or bay
- service stations now also offer convenience items and groceries
- service stations are often attached to fast food outlets
- much petrol retailing is now allied to large supermarket chains and loyalty schemes
- petrol pricing is highly variable day-to-day, with consequent wide variations in customer patronage.

Given these changes, there is now a need to validate (or otherwise) the 1979 trip generation and parking demand data for Service Stations, to assist with traffic impact assessment and planning.

TEF Consulting (the Consultant) was appointed to undertake a validation study of trip generation and parking demand of service stations. The study includes surveys of traffic characteristics relating to vehicle trips and parking demand.

## 1.2 Service stations

Five service stations out of 10 selected for this Study did not contain any ancillary services. Three stations had a fast food restaurant on site, four had a car wash drive-through and one of the latter stations also had a car service garage.

## 1.3 Approach

The approach to this trip generation study is described below:

- The Consultant has initially compiled a list of 14 prospective survey sites. A list of required attributes and other criteria for the area selection is provided in the Brief. These attributes and criteria are hereby acknowledged.
- The Consultant has assessed the suitability of the sites for the Study in consultation with the RMS Project Manager and have found that four of the provided sites were less suitable than the others, conforming to a lesser extent with the selection criteria than the other 10 sites, eventually adopted as subjects for the study.
- The Consultant then undertook site inspections and collection of site characteristics.
- The Consultant then arranged traffic counts on a weekday at all sites between 6:00 am and 7:00 pm (except Site 1 which was chosen for a special 24/hour 7-day survey). The surveys were undertaken on either a Tuesday, Wednesday or Thursday. The survey data included vehicle

classification counts entering and exiting each site as well as classification counts of traffic flows on the main road adjacent to the site.

- A count of vehicles parked on site in marked parking spaces as well as outside formal parking areas was also carried out, at 15 minute intervals. The observers also collected petrol pricing information (price of E10 petrol) at 15 minute intervals.
- The Consultant studied the data using linear and non-linear regression analysis and considered the generated data as a function of a number of the key variables.
- The Consultant prepared a report to summarise the findings of the survey and data analysis.
- The reporting is presented in two documents. The first, this report, contains the analysis covering all of the calculations and comparisons. The second report contains the raw data from the surveys and other data such as survey site plans and tabulated vehicle-trip and person-trip data.

## 1.4 Report Structure

This analysis report has the following structure:

- **Chapter 1: Introduction** – This contains the background to the study, approach and report structure;
- **Chapter 2: Survey methodology** – This contains a description of the survey and survey area selection process;
- **Chapter 3: Survey analysis** – This section analyses the survey results using linear and non-linear regression;
- **Chapter 4: Summary**

## 2 SURVEY METHODOLOGY

### 2.1 Selection of survey sites

The survey areas were selected according to the specifications set out in the RMS Brief.

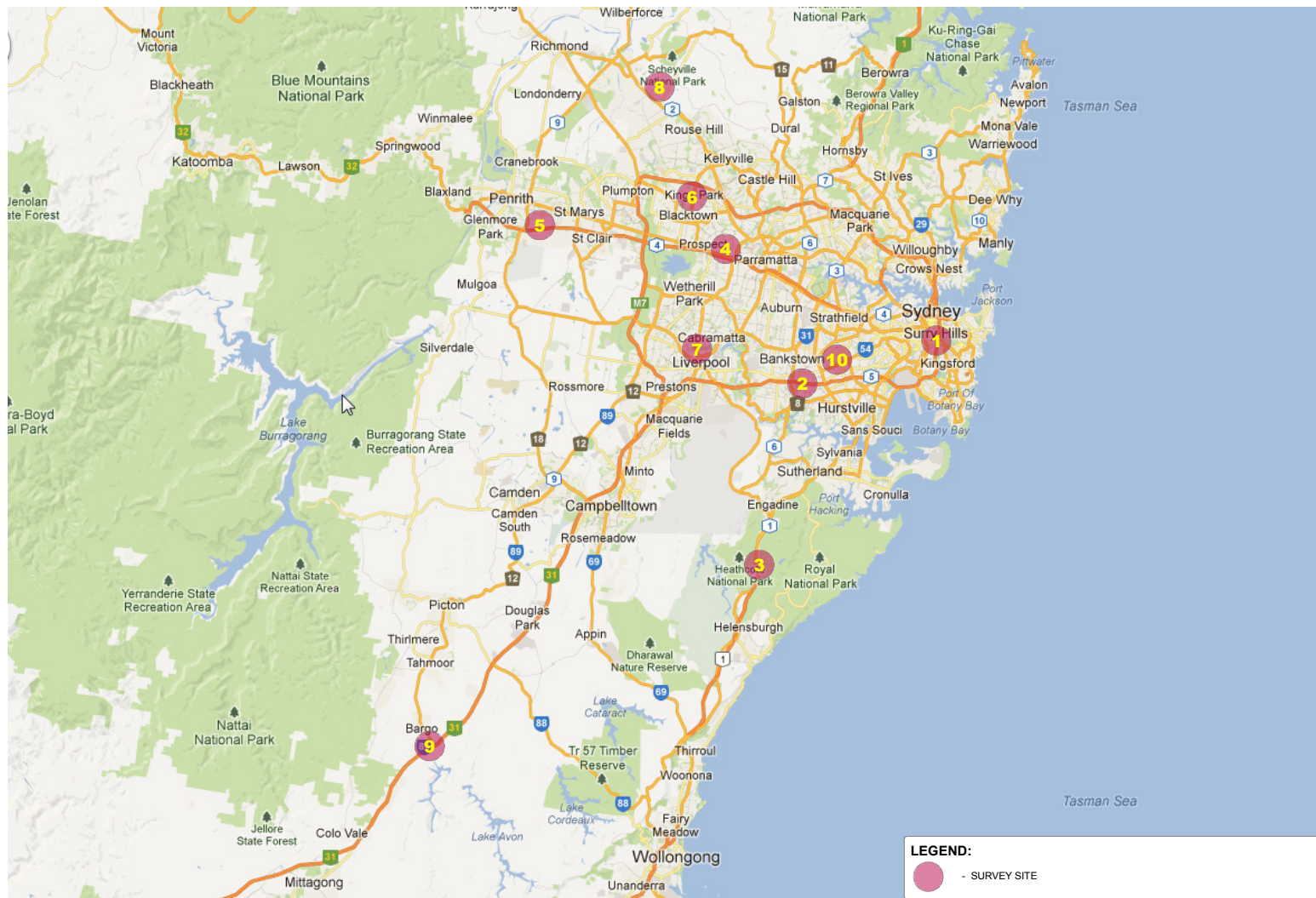
### 2.2 Survey site Selection Methodology

- Consultation with the RMS
- Detailed examination of cadastral maps and aerial photographs
- Identification of survey site characteristics
  - Survey site location
  - Identification of access points
  - Identification of additional services
- Initial survey planning to check suitability in terms of ease of observations
- Confirmation of 10 survey sites including one site for a special 7-day survey.
  - Survey area visits and collection of specific details
  - Questionnaire survey of all establishments within each site (to gauge the information about the number of employees, floor areas, opening hours, specifics of operations, etc.)
  - Photographic and video records of access locations

The details of the selected survey areas are summarised in **Table 2.1** (a full summary table, including trip and parking statistics is contained in the **Appendix**). The locations of the survey areas are shown on **Figure 2.1**.

**Table 2.1 Details of the selected survey sites.**

Site ID	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10
Site operator	Shell - Coles Express	BP	Caltex	APW	7-Eleven	BP	Caltex - Woolworths	Caltex - Woolworths	7-Eleven	BP
Site address	867 South Dowling St, Waterloo	9 Davies Road, Padstow	1403 Princes Highway, Heathcote	449 Great Western Hwy, Greystanes	15-19 Aspen St, South Penrith	162 Sunnyholt Rd, Kings Park	59 Orange Grove Rd, Liverpool	1 Woodland St, Riverstone	Hume Hwy, Bargo	146-152 Moorefields Rd, Kingsgrove
Day/date of survey(s)	Fri 17/05/13 to Thu 23/05/13	Tue, 21/05/13	Tue, 26/03/13	Wed, 27/03/13	Thu, 28/03/13	Thu, 28/03/13	Wed, 27/03/13	Tue, 26/03/13	Wed, 27/03/13	Mon, 27/05/13
Duration of survey - site and frontage road	6:00-19:00	6:00-19:00	6:00-19:00	6:00-19:00	6:00-19:00	6:00-19:00	6:00-19:00	6:00-19:00	6:00-19:00	6:00-19:00
Duration of survey - site trip generation	24 hrs 7 days									
Surrounding area characteristics:										
Surrounding landuse	commercial / retail / residential	industrial / residential / open space	residential / park	industrial / residential / commercial	commercial / residential	industrial / residential / commercial	commercial / retail / residential	commercial / retail / residential	open space	residential
Frontage road - AM peak period (weekday)	07:00-08:00	07:15-08:15	06:15-07:15	11:00-12:00	07:45-08:45	11:45-12:45	07:15-08:15	07:45-08:45	07:30-08:30	08:00-09:00
Frontage road - PM peak period (weekday)	17:15-18:15	15:45-16:45	16:30-17:30	17:15-18:15	15:00-16:00	17:15-18:15	17:00-18:00	17:00-18:00	17:00-18:00	17:00-18:00
Frontage road - daily peak period (Saturday & Sunday) [NB: for 7-day surveys only]										
<b>Development details:</b>										
Year opened	1995	pre-2005	2006	pre-2002	pre-2005	pre-2005	pre-2002	pre-2002	pre-2003	pre-2005
Other services / businesses on site	fast food & car wash	fast food & car wash	none	car wash	none	car wash & car service	none	none	fast food	none
Total site area (m <sup>2</sup> )	3540	3957	1860	1652	4392	1031	3798	3187	11030	988
Gross Floor Area (m <sup>2</sup> ):										
o Convenience store	140	261	193.5	144.5	265	90	443	197	200	245
o Fast food area	150	220							138	
o Car wash & car service				38		173			53	
<b>TOTAL GFA (m<sup>2</sup>)</b>	<b>290</b>	<b>481</b>	<b>193.5</b>	<b>182.5</b>	<b>265</b>	<b>263</b>	<b>443</b>	<b>197</b>	<b>391</b>	<b>245</b>
No. of pumps	12	12	12	8	6	4	20	16	16	8
No. of service channels	6	6	6	4	6	4	10	8	12	4
No. of seats in fast food area	38	26	N/A	N/A	N/A	N/A	N/A	N/A	28	N/A



**Figure 2.1** Survey site locations - Sydney

### 2.2.1 Survey site selection and survey conduct issues

- There were no technical issues with the manual counts and video surveys, except obtaining permissions from the service station operators.
- Most operators could not provide information about the year when the station was opened; available information was only approximate.

## 2.3 Survey Process

### Conduct of surveys

Survey period	March – May 2013
	Outside school holidays and public holidays
Day of the week	Monday, Tuesday, Wednesday or Thursday
	One survey day for each of the survey sites
	Special survey (Site 1) – 7 consecutive days
Survey times	6.00 am to 7.00 pm
	Special survey (Site 1) – 24 hours per day for all vehicles entering the development

### Data Recorded by traffic surveyors

- A count of vehicles parked on-site in marked parking spaces [ie excluding vehicles parked for refuelling] at the commencement of the survey
- A count of vehicles (broken down into customer cars / customer heavy vehicles / service & delivery vehicles) entering and leaving the site, in 15-minute bands
- A count of the number of vehicles parked on-site in marked parking spaces taken at 15-minute intervals
- Recording of the advertised price per litre of E10 fuel at 15-minute intervals
- An hourly light/heavy vehicle classification count on the frontage road, to establish the impact of the development on underlying hourly traffic patterns.
- For Site 1 (special survey over 7 days): a 15-minute video camera count of all vehicles entering the development for each 24 hours over the full 7-day period, to establish daily and hourly visitation patterns.
- Questionnaire surveys of businesses to obtain information about the mode of operation (opening times, number of staff, etc.)
- Information about the site design parameters – site area, building area, number of seats in the fast food area, number of service channels and the number of pumps (note that for the purpose of this survey the number of pumps was defined as the number of vehicles able to be served at once).

## 3 SURVEY ANALYSIS

### 3.1 Survey Output Requirements

The data was analysed with the key parameters needing to be established being

- Daily Vehicle Trips (ie inward trips + outgoing trips)
- Peak Vehicle Trips (ie the maximum number of vehicle trips to/from the site in any one-hour period)
- Peak Vehicle Trips in the AM and PM peak (ie the number of vehicle trips to/from the site during the morning and afternoon peak hours on the frontage road)

### 3.2 Average Trip Rates for Service Stations

The trip generation calculation that was to be performed would depend upon the variable that was interrogated. Several variables were interrogated, as listed below.

- number of pumps
- number of service channels
- total Gross Floor Area (GFA) of buildings on site
- convenience store GFA
- fast food GFA (where applicable)

The summary of the survey data for each of the surveyed areas is shown in **Table 3.1**. Average trip generation rates are summarised in **Table 3.2**. Site 9 (Bargo) was considered to be substantially different from all other sites (due to its remote location from the metropolitan area, large site area and its function as a rest/refresh stopping point on a major highway) to justify a separate analysis of the average trip rates for all site but Site 9.

The detailed results are contained in a separate “Data Report”.

A review of the data reveals a number of observations

- The surveys were undertaken at service stations with the floor space varying from 182.5 m<sup>2</sup> to 481 m<sup>2</sup> and with the total site area varying from 988 m<sup>2</sup> to 11,030 m<sup>2</sup>.
- The results of the analyses for both peak hour and daily trips rates indicate high values of standard deviation in all cases, with somewhat lower standard deviation for the number of trips per service channel and per 100 m<sup>2</sup> of total GFA. The base data is therefore regarded as wide-spread and average rates are not recommended to be used for predicting the trip generation because of wide prediction intervals around the mean estimated values.

**Table 3.1 Traffic survey results summary.**

Site ID	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10
Site operator	Shell - Coles Express	BP	Caltex	APW	7-Eleven	BP	Caltex - Woolworths	Caltex - Woolworths	7-Eleven	BP
Site address	867 South Dowling St, Waterloo	9 Davies Road, Padstow	1403 Princes Highway, Heathcote	449 Great Western Hwy, Greystanes	15-19 Aspen St, South Penrith	162 Sunnyholt Rd, Kings Park	59 Orange Grove Rd, Liverpool	1 Woodland St, Riverstone	Hume Hwy, Bargo	146-152 Moorefields Rd, Kingsgrove
Day/date of survey(s)	Fri 17/05/13 to Thu 23/05/13	Tue, 21/05/13	Tue, 26/03/13	Wed, 27/03/13	Thu, 28/03/13	Thu, 28/03/13	Wed, 27/03/13	Tue, 26/03/13	Wed, 27/03/13	Mon, 27/05/13
Duration of survey - site and frontage road	6:00-19:00	6:00-19:00	6:00-19:00	6:00-19:00	6:00-19:00	6:00-19:00	6:00-19:00	6:00-19:00	6:00-19:00	6:00-19:00
Duration of survey - site trip generation	24 hrs 7 days									
<b>Vehicle Trips:</b>										
o Peak 1-hour vehicle-trips (in+out) *	143	160	159	183	203	178	216	161	318	95
o Time of peak 1-hour vehicle-trips	17:00-18:00	16:45-17:45	16:30-17:30	17:45-18:45	15:15-16:15	13:30-14:30	07:30-08:30	16:15-17:15	17:00-18:00	17:15-18:15
o Peak vehicle-trips per pump	11.9	13.3	13.3	22.9	33.8	44.5	10.8	10.1	19.9	11.9
o Peak vehicle-trips per service channel	23.8	26.7	26.5	45.8	33.8	44.5	21.6	20.1	26.5	23.8
o Peak vehicle-trips per 100m <sup>2</sup> of total GFA	49.3	33.3	82.2	100.3	76.6	67.7	48.8	81.7	81.3	38.8
o Peak vehicle-trips per 100m <sup>2</sup> of convenience store GFA	102.1	61.3	82.2	126.6	76.6	197.8	48.8	81.7	159.0	38.8
o Peak vehicle-trips per 100m <sup>2</sup> of fast food GFA	95.3	72.7	N/A	N/A	N/A	N/A	N/A	N/A	230.4	N/A
o Total daily vehicle-trips	1543	1276	1449	1463	1629	1399	2329	1472	3234	720
o Total daily vehicle-trips per pump	128.6	106.3	120.8	182.9	271.5	349.8	116.5	92.0	202.1	90.0
o Total daily vehicle-trips per service channel	257.2	212.7	241.5	365.8	271.5	349.8	232.9	184.0	269.5	180.0
o Total daily vehicle-trips per 100m <sup>2</sup> of total GFA	532.1	265.3	748.8	801.6	614.7	531.9	525.7	747.2	827.1	293.9
o Total daily vehicle-trips per 100m <sup>2</sup> of convenience store GF	1102.1	488.9	748.8	1012.5	614.7	1554.4	525.7	747.2	1617.0	293.9
o Total daily vehicle-trips per 100m <sup>2</sup> of fast food GFA	1028.7	580.0	N/A	N/A	N/A	N/A	N/A	N/A	2343.5	N/A
o Vehicle-trips during adjacent road's AM peak **	101	81	152	86	126	85	214	114	217	59
o Vehicle-trips during adjacent road's PM peak **	130	136	159	154	202	112	178	143	318	78
<b>Parking:</b>										
o No of reserved car spaces	0	0	0	2	0	0	0	0	0	0
o No of public car spaces	31	16	14	7	12	3	22	17	18	8
o No of staff car spaces	1	2	0	0	0	0	0	0	0	0
o No of Disabled car spaces	1	0	1	0	0	0	1	0	0	0
o No of Loading / unloading bays	1	2	0	1	0	1	1	0	1	1
TOTAL parking spaces	34	20	15	10	12	4	24	20	19	9
o Peak Parking Accumulation	12	12	8	10	7	11	7	5	52	4
o Time of Peak Parking Accumulation	12:00-12:15	12:00-12:15	08:15	18:45-19:00	06:45, 16:15 & 16:45	12:45	14:45; 18:45	17:30	17:00	18:30
o Parking Accumulation per 100m <sup>2</sup> total GFA	4.1	2.5	4.1	5.5	2.6	4.2	1.6	2.5	13.3	1.6

Note: \* - the number of trips for Site 1 is average over five week days

\*\* - number of vehicle trips in adjacent road is for one direction only, on the petrol station side of the road.



**Table 3.2 Trips rate summary.**

	Sites 1 to 10				Sites 1 to 10 except Site 9			
	Min	Max	Avg	St Dev	Min	Max	Avg	St Dev
<b>Vehicle Trips:</b>								
o Peak 1-hour vehicle-trips (in+out) *	95.0	318.0	181.6	58.4	95.0	216.0	166.4	35.3
o Time of peak 1-hour vehicle-trips								
o Peak vehicle-trips per pump	10.1	44.5	19.2	11.5	10.1	44.5	19.2	12.2
o Peak vehicle-trips per service channel	20.1	45.8	29.3	9.1	20.1	45.8	29.6	9.6
o Peak vehicle-trips per 100m <sup>2</sup> of total GFA	33.3	100.3	66.0	22.2	33.3	100.3	64.3	22.8
o Peak vehicle-trips per 100m <sup>2</sup> of convenience store GFA	38.8	197.8	97.5	50.3	38.8	197.8	90.7	48.2
o Peak vehicle-trips per 100m <sup>2</sup> of fast food GFA	72.7	230.4	132.8	85.3	72.7	95.3	84.0	16.0
o Total daily vehicle-trips	720.0	3,234.0	1,651.4	679.6	720.0	2,329.0	1,475.6	414.4
o Total daily vehicle-trips per pump	90.0	349.8	166.0	86.4	90.0	349.8	162.0	90.7
o Total daily vehicle-trips per service channel	180.0	365.8	256.5	62.2	180.0	365.8	255.0	65.8
o Total daily vehicle-trips per 100m <sup>2</sup> of total GFA	265.3	827.1	588.8	198.8	265.3	801.6	562.4	191.2
o Total daily vehicle-trips per 100m <sup>2</sup> of convenience store GFA	293.9	1,617.0	870.5	446.1	293.9	1,554.4	787.6	382.8
o Total daily vehicle-trips per 100m <sup>2</sup> of fast food GFA	580.0	2,343.5	1,317.4	916.5	580.0	1,028.7	804.3	317.3
o Vehicle-trips during adjacent road's AM peak **	59.0	217.0	123.5	55.0	59.0	214.0	113.1	46.8
o Vehicle-trips during adjacent road's PM peak **	78.0	318.0	161.0	64.9	78.0	202.0	143.6	36.2
<b>Parking:</b>								
o Peak Parking Accumulation	4.0	52.0	12.8	14.1	4.0	12.0	8.4	3.0
o Parking Accumulation per 100m <sup>2</sup> total GFA	1.6	13.3	4.2	3.4	1.6	5.5	3.2	1.3

Note: \* - the number of trips for Site 1 is average over five week days

\*\* - number of vehicle trips in adjacent road is for one direction only, on the petrol station side of the road.

### 3.3 Regression analysis

As agreed in the project brief, the data has been analysed to determine the most consistent measure of trip generation, using a simple linear regression approach.

The coefficient of determination ( $R^2$ ) has been used to provide a measure of the usefulness of the regression equation. It measures the proportion of variation in Y (trip behaviour) that is explained by the independent variable X (such as gross floor area or the number of pumps) in the regression model. The values vary from 0 to 1 with higher values representing a higher degree of correlation. In this study,  $R^2$  above 0.8 are considered to provide the desired level of correlation. In other words, at least 80% of the variation in trip behaviour can be explained by the variability in the independent variable in the acceptable level.

A number of simple linear regression models did not fit the data at an acceptable level, returning low  $R^2$ . For this reason, non-linear regression models were trialled as well.

#### 3.3.1 Relationship between the number of trips and principal independent variables

The following key independent variables were used for this regression analysis.

- total building GFA
- convenience store GFA
- total site area
- number of pumps
- number of service channels
- number of seats in the fast food area (where applicable)
- petrol price

The analysis was carried out for the following trip characteristics

- Daily Vehicle Trips (ie inward trips + outgoing trips)
- Peak Vehicle Trips (ie the maximum number of vehicle trips to/from the site in any one-hour period)
- Peak Vehicle Trips in the AM and PM peak (ie the number of vehicle trips to/from the site during the morning and afternoon peak hours on the frontage road).

### 3.3.1.1 Total building GFA

- $R^2$  for all trip characteristics for all service stations is low and indicates little correlation between the number of trips and the overall gross floor area.

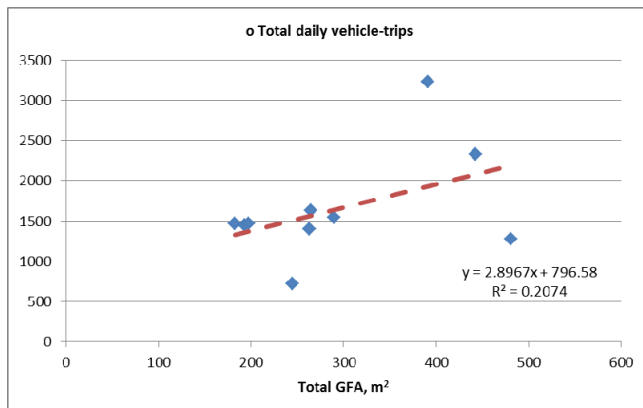


Figure 3-2 Total daily vehicle trips vs total building GFA – Linear type

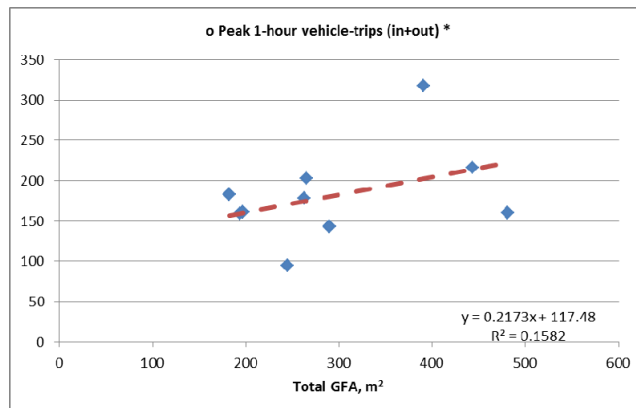


Figure 3-3 Peak hour vehicle trips vs total building GFA – Linear type

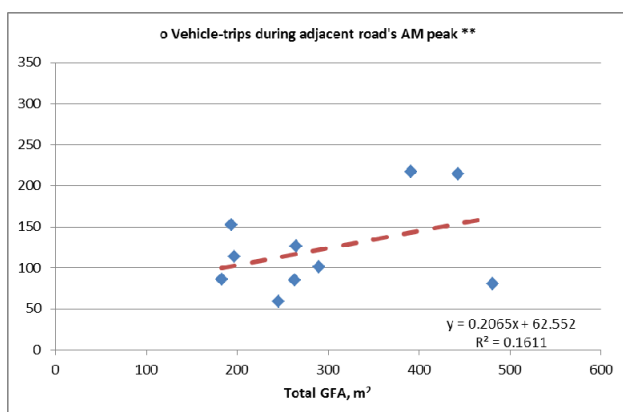


Figure 3-4 Vehicle trips vs total building GFA – Linear type - during AM Peak Hour on adjacent road

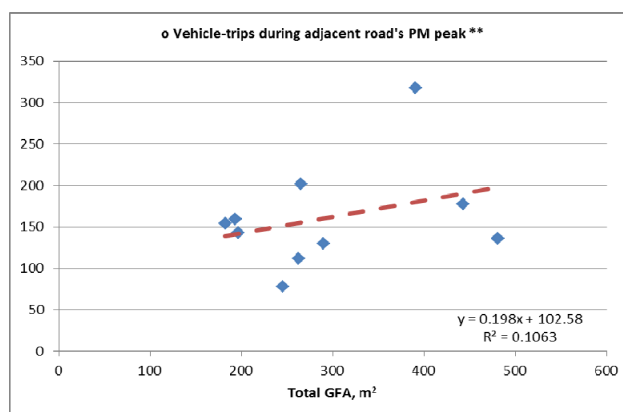
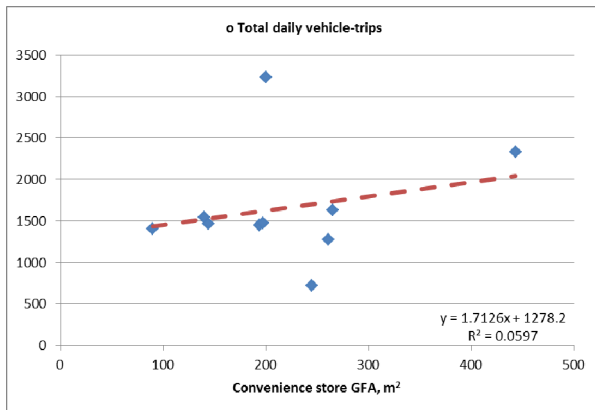


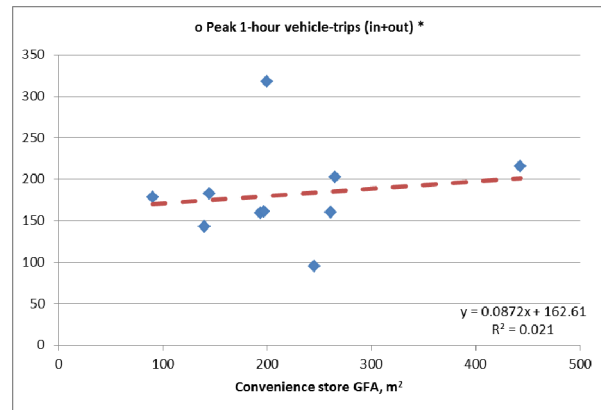
Figure 3-5 Vehicle trips vs total building GFA – Linear type - during PM Peak Hour on adjacent road

### 3.3.1.2 Convenience store GFA

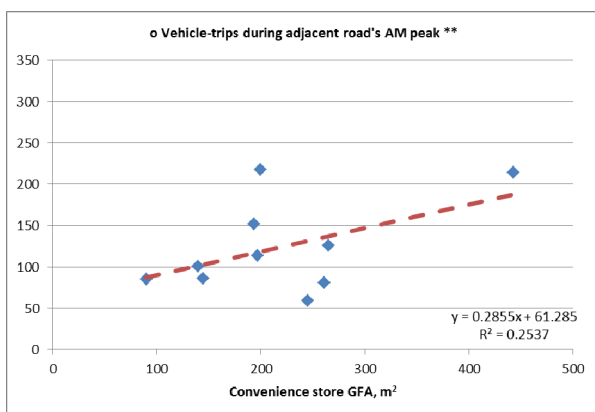
- $R^2$  for all trip characteristics for all service stations is low and indicates little correlation between the number of trips and the convenience store gross floor area.
  - Note that the convenience store area equals to the total building area if there are no ancillary services like fast food or car wash.



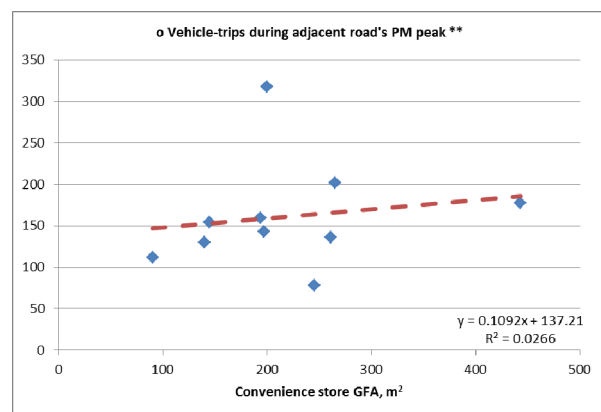
**Figure 3-6** Total daily vehicle trips vs convenience store GFA – Linear type



**Figure 3-7** Peak hour vehicle trips vs convenience store GFA – Linear type



**Figure 3-8** Vehicle trips vs convenience store GFA – Linear type - during AM Peak Hour on adjacent road



**Figure 3-9** Vehicle trips vs convenience store GFA – Linear type - during PM Peak Hour on adjacent road

### 3.3.1.3 Total site area

- $R^2$  for the number of trips during the AM peak hour on adjacent road for all service stations is low and indicates little correlation between the number of trips and the total site floor area.
- However,  $R^2$  for the total daily trips (0.77), peak hour trips (0.74) and in particular for the number of trips during the PM peak hour on adjacent road (0.84) for all service stations is near or above 0.8 and indicates good correlation between the number of trips and the total site floor area.

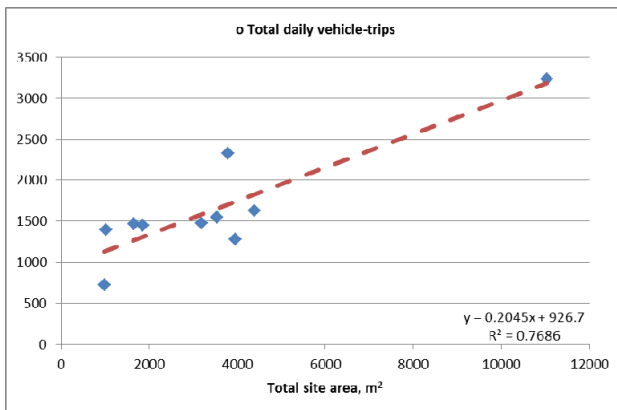


Figure 3-10 Total daily vehicle trips vs total site area – Linear type

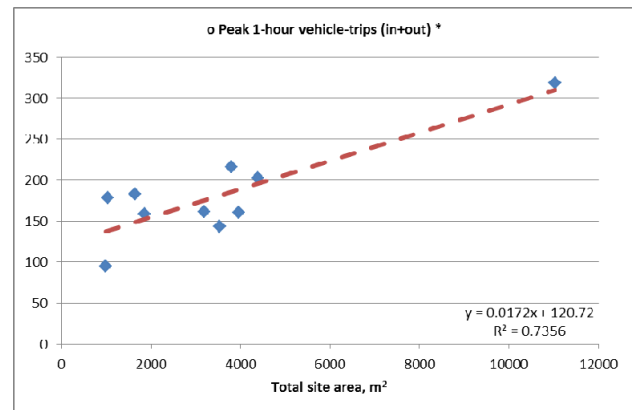


Figure 3-11 Peak hour vehicle trips vs total site area – Linear type

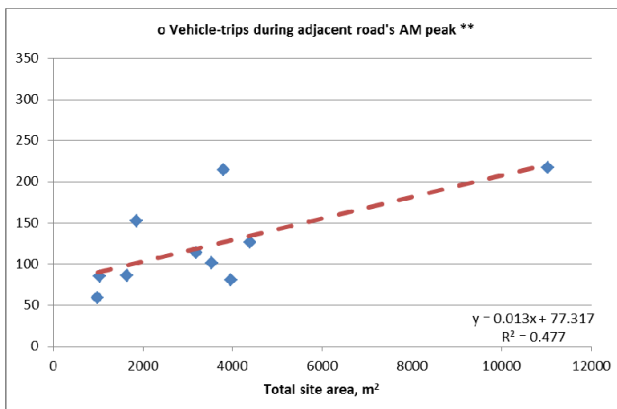


Figure 3-12 Vehicle trips vs total site area – Linear type - during AM Peak Hour on adjacent road

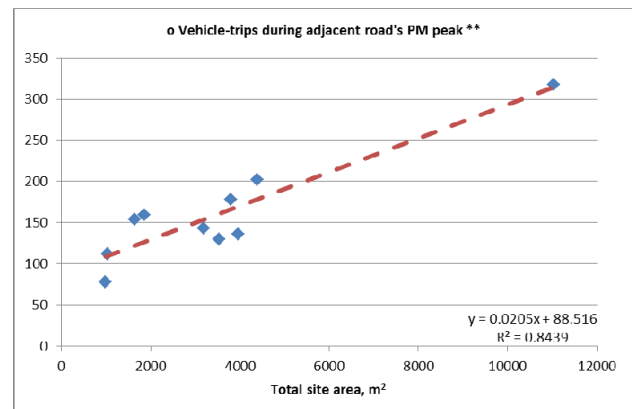


Figure 3-13 Vehicle trips vs total site area – Linear type - during PM Peak Hour on adjacent road

### 3.3.1.4 Number of pumps

- $R^2$  for all trip characteristics for all service stations is low and indicates little correlation between the number of trips and the number of pumps.
  - note that for the purpose of this survey the number of pumps was defined as the number of vehicles able to be served at once.

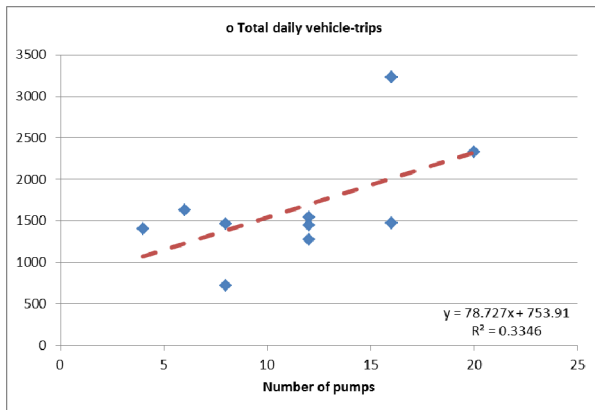


Figure 3-14 Total daily vehicle trips vs number of pumps – Linear type

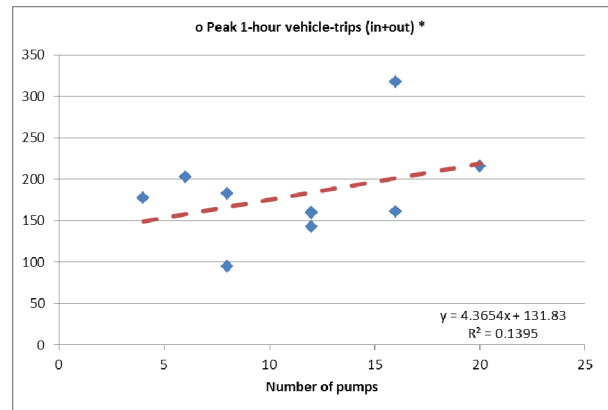


Figure 3-15 Peak hour vehicle trips vs number of pumps – Linear type

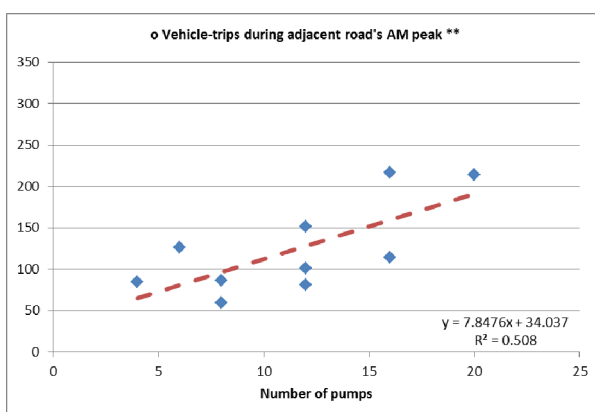


Figure 3-16 Vehicle trips vs number of pumps – Linear type - during AM Peak Hour on adjacent road

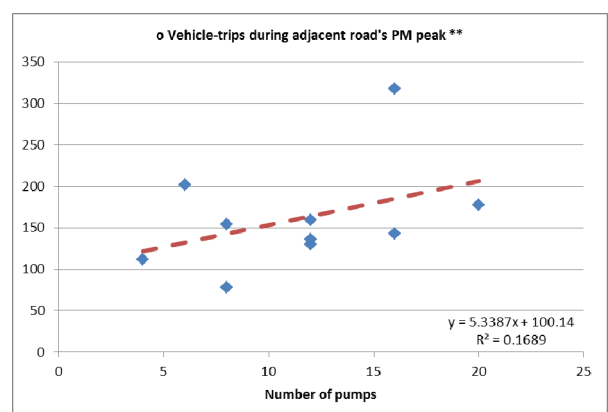


Figure 3-17 Vehicle trips vs number of pumps – Linear type - during PM Peak Hour on adjacent road

### 3.3.1.5 Number of service channels

#### 3.3.1.5.1 Linear regression analysis

- $R^2$  for peak hour trips (0.61) and the number of trips during the PM peak hour on adjacent road (0.60) for all service stations is low and although it indicates some correlation between the number of trips and the number of service channels, it is not high enough to be utilised for trip prediction for new developments.
- However,  $R^2$  for the total daily trips (0.80) and for the number of trips during the AM peak hour on adjacent road (0.80) indicates good correlation between the number of trips and the number of service channels.

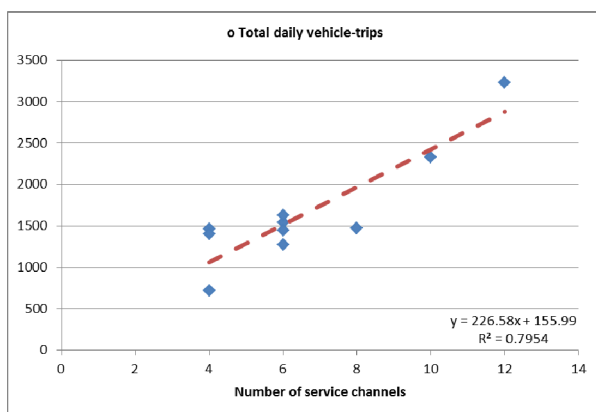


Figure 3-18 Total daily vehicle trips vs number of service channels – Linear type

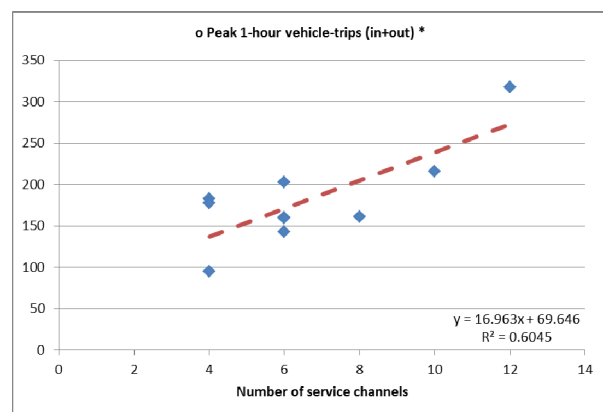


Figure 3-19 Peak hour vehicle trips vs number of service channels – Linear type

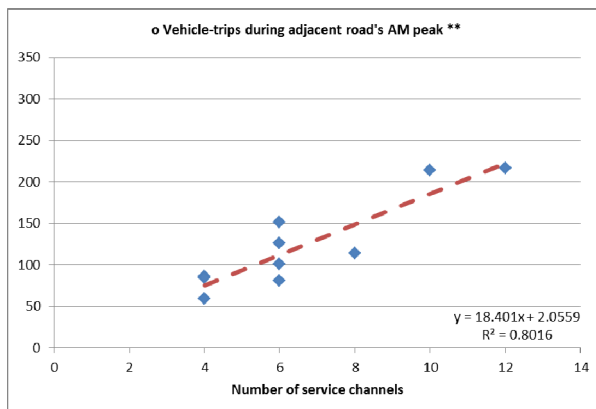


Figure 3-20 Vehicle trips vs number of service channels – Linear type - during AM Peak Hour on adjacent road

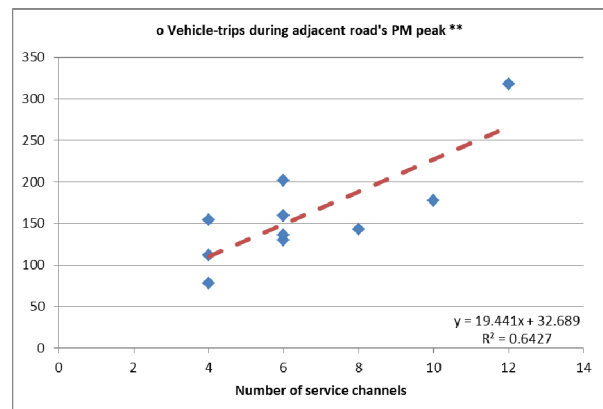


Figure 3-21 Vehicle trips vs number of service channels – Linear type - during PM Peak Hour on adjacent road

- Based on the observation of the above scatter diagrams it was considered worthwhile analysing whether application of a non-linear relationship would improve the correlation between the number of service channels and the trip characteristics. The results of this analysis are presented in the next subsection.

### 3.3.1.5.2 Non-linear regression analysis

- $R^2$  for peak hour trips (0.74) and the number of trips during the PM peak hour on adjacent road (0.71) have improved, however in both cases they remained at a level which is not high enough to be utilised for trip prediction for new developments.
- $R^2$  for the total daily trips (0.87) improved significantly, whilst  $R^2$  for the number of trips during the AM peak hour on adjacent road (0.80) remained the same as that for the linear relationship. Both continued to indicate good correlation between the number of trips and the number of service channels.

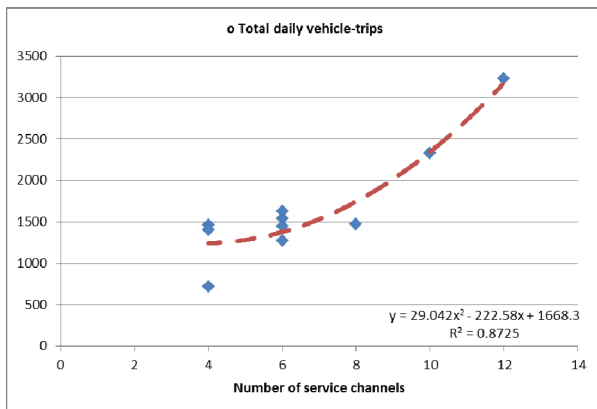


Figure 3-22 Total daily vehicle trips vs number of service channels – Non-linear type

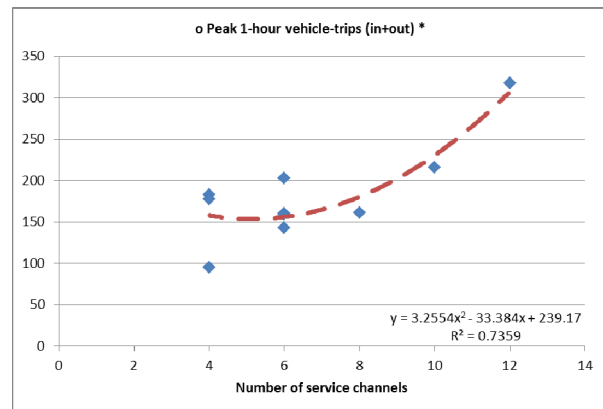


Figure 3-23 Peak hour vehicle trips vs number of service channels – Non-linear type

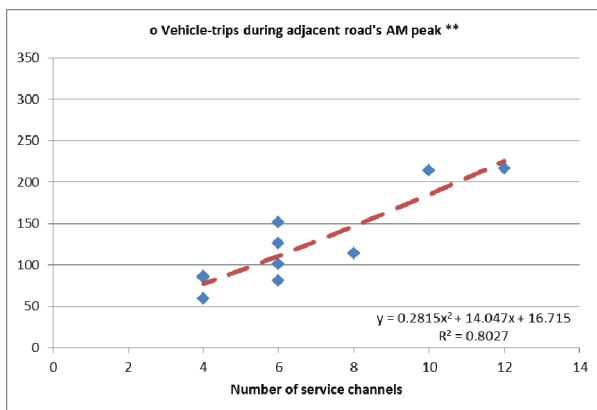


Figure 3-24 Vehicle trips vs number of service channels – Non-linear type - during AM Peak Hour on adjacent road

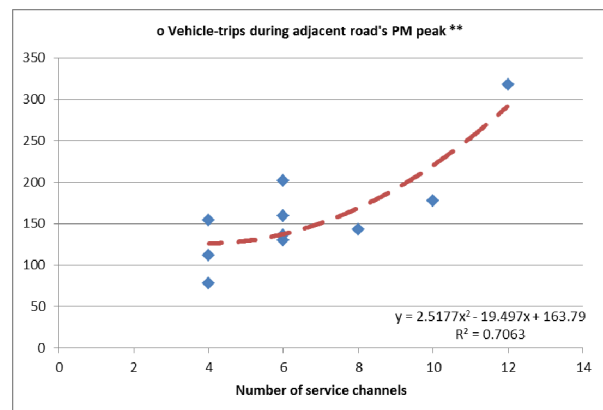


Figure 3-25 Vehicle trips vs number of service channels – Non-linear type - during PM Peak Hour on adjacent road



### 3.3.1.6 Number of seats in the fast food area

- $R^2$  for all trip characteristics for all service stations is low and indicates little correlation between the number of trips and the number of seats in the fast food area.
  - note that only three of the surveyed stations had fast food facilities on site; the sample was thus very small and further research is required for better understanding of possible dependency between the two variables.

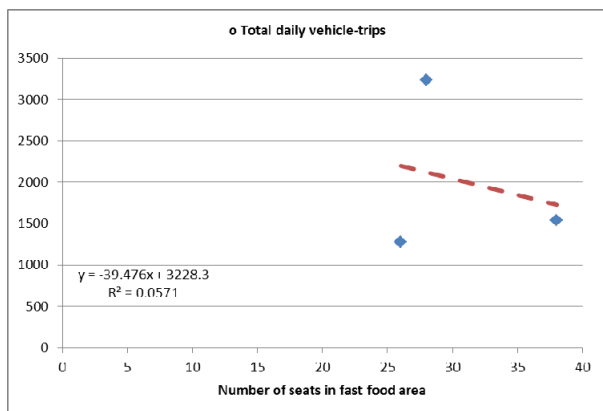


Figure 3-26 Total daily vehicle trips vs number of fast food seats – Linear type

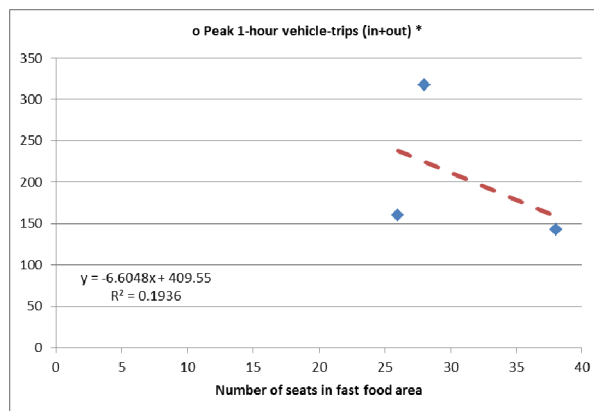


Figure 3-27 Peak hour vehicle trips vs number of fast food seats – Linear type

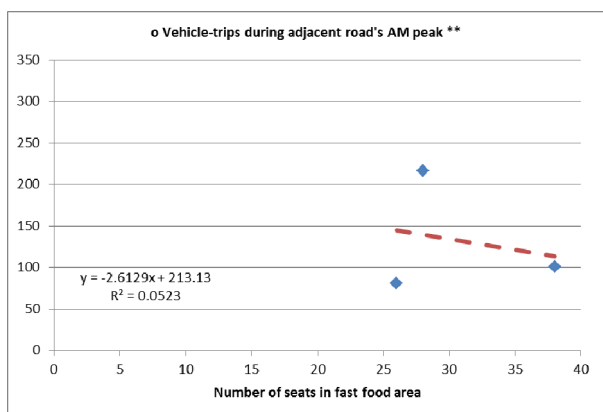


Figure 3-28 Vehicle trips vs number of fast food seats – Linear type - during AM Peak Hour on adjacent road

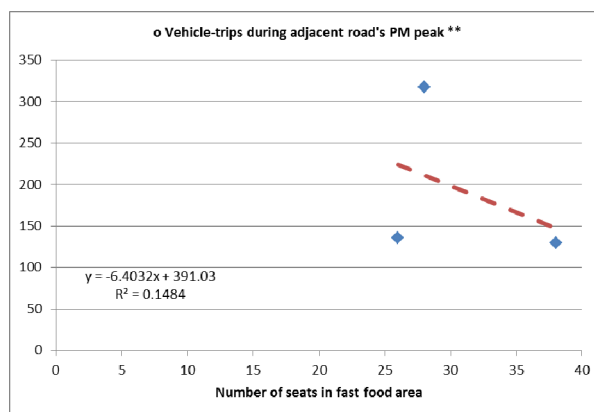
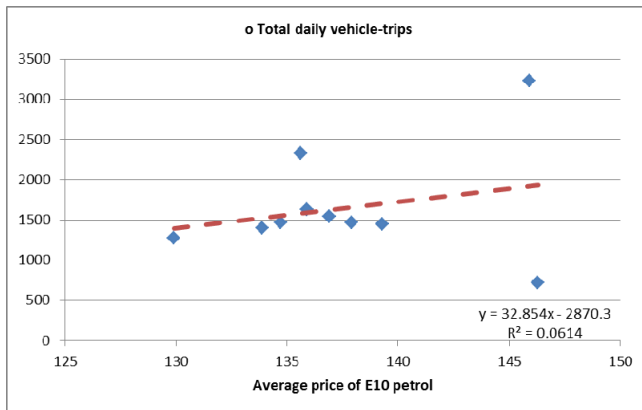


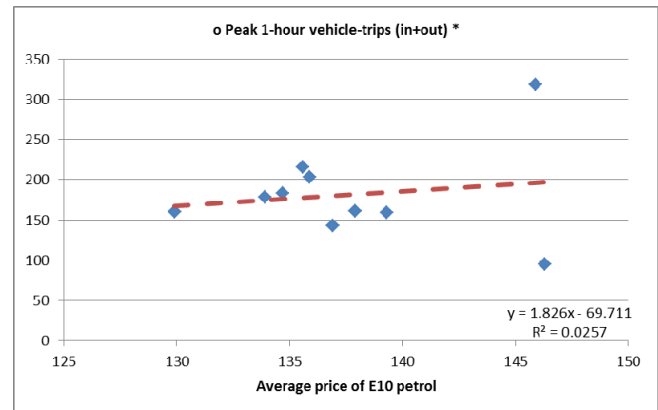
Figure 3-29 Vehicle trips vs number of fast food seats – Linear type - during PM Peak Hour on adjacent road

### 3.3.1.7 Petrol price

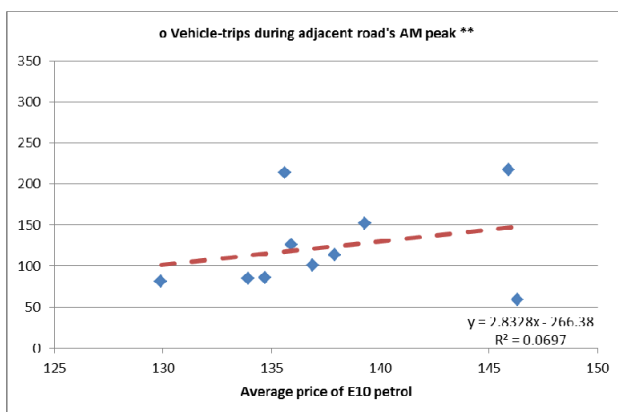
- $R^2$  for all trip characteristics for all service stations is very low and indicates no correlation between the number of trips and the average or maximum petrol price on the survey day.
  - Charts below show the results of the analysis for the average petrol price. Analysis of the correlation with the maximum prices showed very similar results.



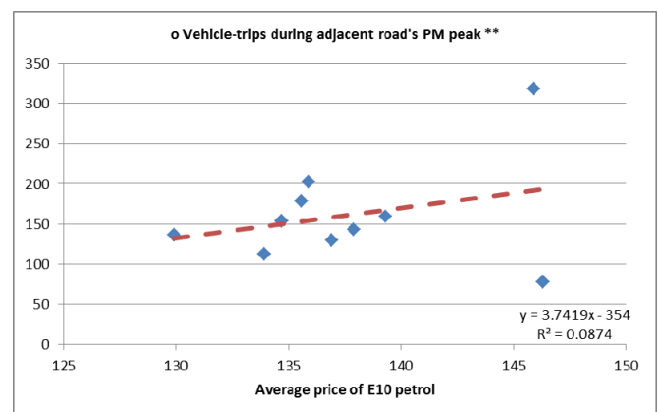
**Figure 3-30 Total daily vehicle trips vs average price of E10 petrol – Linear type**



**Figure 3-31 Peak hour vehicle trips vs average price of E10 petrol – Linear type**



**Figure 3-32 Vehicle trips vs average price of E10 petrol – Linear type - during AM Peak Hour on adjacent road**



**Figure 3-33 Vehicle trips vs average price of E10 petrol – Linear type - during PM Peak Hour on adjacent road**

- Analysis for daily variations of petrol prices at Site 1 for a 7- day period revealed similar results to those described above.  $R^2$  for all trip characteristics for all survey days is very low and indicates no correlation between the number of trips and the average or maximum petrol price.
  - Refer to Figures 3-34 and 3-35 overleaf.

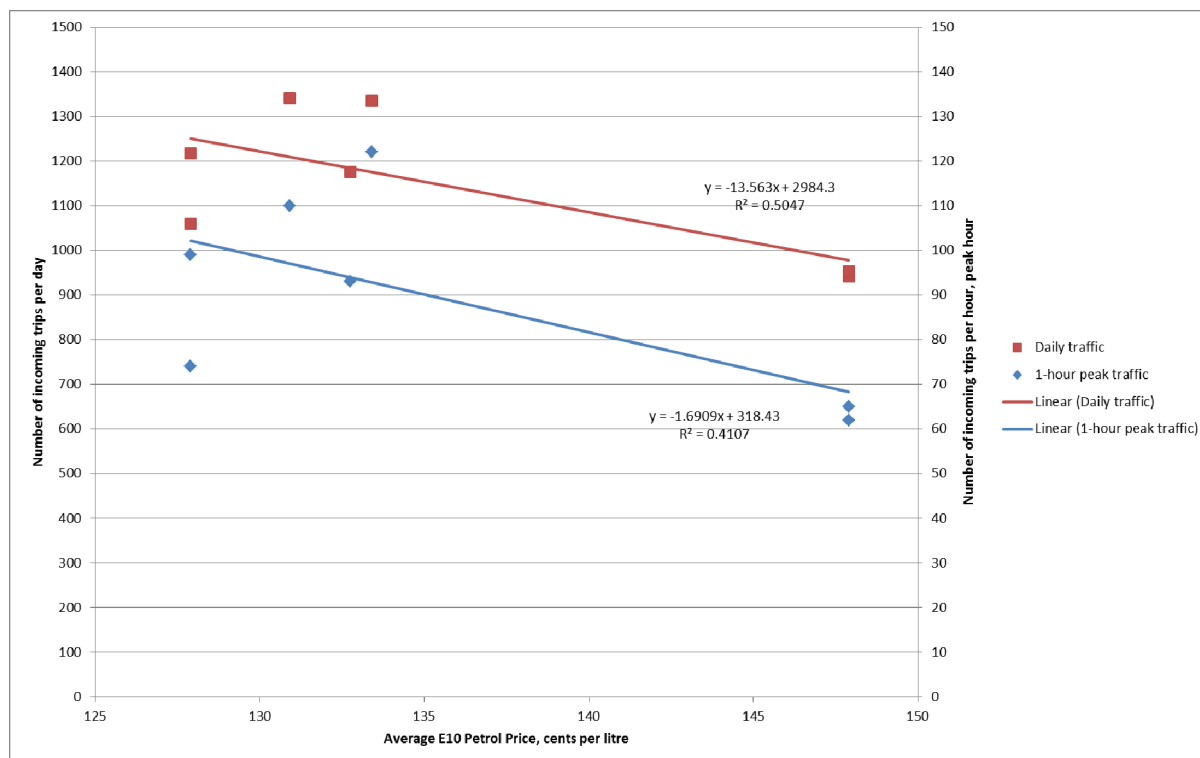


Figure 3-34 Total daily and peak hour vehicle trips vs average price of E10 petrol – 7 days at Site 1 - Linear type

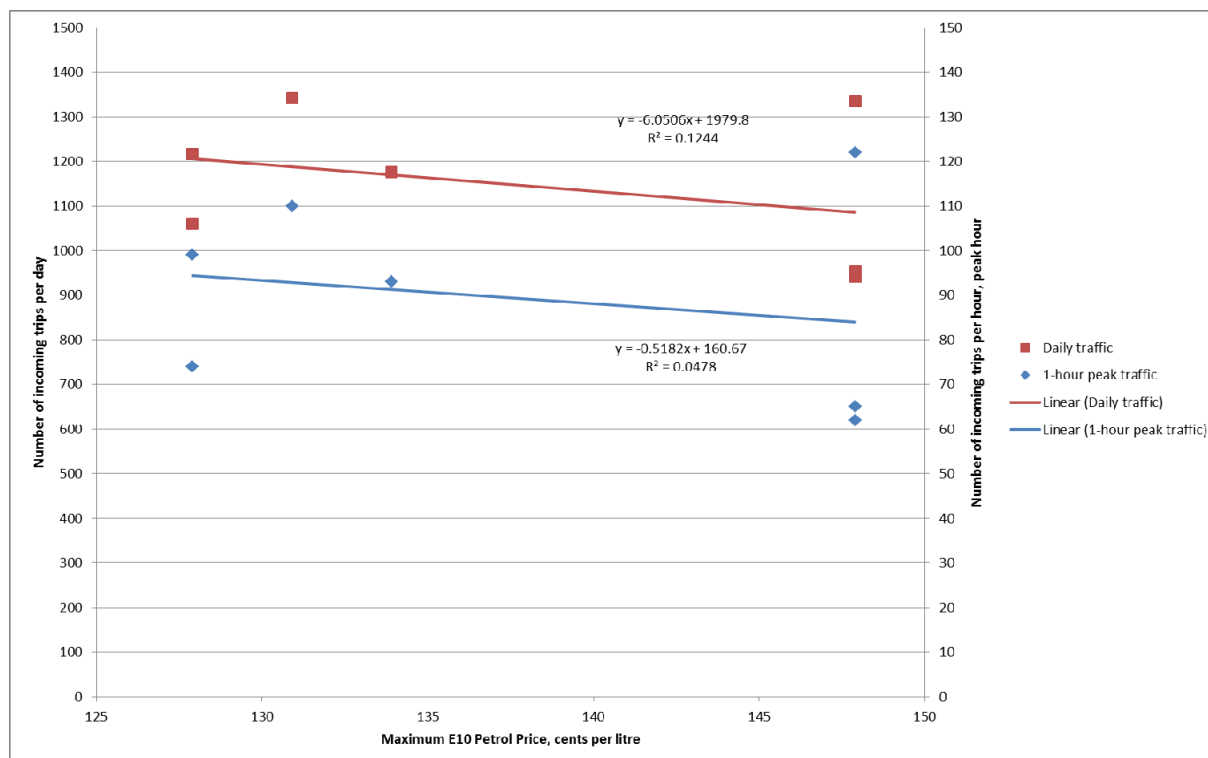


Figure 3-35 Total daily and peak hour vehicle trips vs maximum price of E10 petrol – 7 days at Site 1 - Linear type

### 3.3.1.8 Multiple regression analysis

- Further analysis has been undertaken to determine whether multiple regression based on two or more independent variables yields a more reliable estimate of peak and/or daily trip behaviour.
- Of all independent variables under examination only two were considered suitable for multiple regression analysis – the total site area and the number of service channels.
- A check for inter-correlation between the above two independent variables has been carried out in the form of linear regression analysis and revealed correlation level under 0.80 ( $R^2 = 0.71$ ).

**Table 3.3 Total daily vehicle trips vs (total site area & number of service channels).**

<i>Regression Statistics</i>	
Multiple R	0.921
R Square	0.849
Adjusted R Square	0.806
Standard Error	299.293
Observations	10

ANOVA				
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>
Regression	2	3529764.659	1764882.330	19.703
Residual	7	627033.741	89576.249	
Total	9	4156798.400		

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	409.427	308.666	1.326	0.226
Total site area (m2)	0.101	0.064	1.580	0.158
No. of service channels	134.133	69.383	1.933	0.094

- Adjusted  $R^2$  of 0.81 is greater than the 0.80 benchmark. It is also better than that for the independent relationship for the total site area (0.77).
- It is, however, less than  $R^2$  of 0.87 for the independent relationship for the number of service channels. The latter non-linear regression equation thus provides a more reliable estimate.

**Table 3.4 Peak hour vehicle trips vs (total site area & number of service channels).**

<i>Regression Statistics</i>	
Multiple R	0.864
R Square	0.746
Adjusted R Square	0.673
Standard Error	33.364
Observations	10

ANOVA				
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>
Regression	2	22860.243	11430.121	10.268
Residual	7	7792.157	1113.165	
Total	9	30652.400		

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	104.912	34.409	3.049	0.019
Total site area (m2)	0.014	0.007	1.972	0.089
No. of service channels	4.099	7.735	0.530	0.613

- Adjusted  $R^2$  of 0.67 is less than 0.80 benchmark. It is also less than  $R^2$  for the independent relationships for both the total site area (0.74) and the number of service channels (0.74).
- All of the relationships are below the 0.80 benchmark and thus cannot be used for reliable estimates.

**Table 3.5 AM Peak Hour vehicle trips vs (total site area & number of service channels).**

<i>Regression Statistics</i>				
Multiple R	0.903			
R Square	0.816			
Adjusted R Square	0.763			
Standard Error	26.748			
Observations	10			
ANOVA				
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>
Regression	2	22194.280	11097.140	15.510
Residual	7	5008.220	715.460	
Total	9	27202.500		
	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	-8.522	27.586	-0.309	0.766
Total site area (m2)	-0.004	0.006	-0.738	0.485
No. of service channels	22.259	6.201	3.590	0.009

- Adjusted  $R^2$  of 0.76 is less than 0.80 benchmark. It is, however, substantially better than that for the independent relationship for the total site area (0.48).
- Nevertheless,  $R^2$  of 0.80 for the independent relationship for the number of service channels provides a more reliable estimate.

**Table 3.6 Multiple regression analysis – PM Peak Hour vehicle trips vs (total site area & number of service channels).**

<i>Regression Statistics</i>				
Multiple R	0.920			
R Square	0.846			
Adjusted R Square	0.803			
Standard Error	28.820			
Observations	10			
ANOVA				
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>
Regression	2	32057.679	16028.840	19.298
Residual	7	5814.321	830.617	
Total	9	37872.000		
	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	79.770	29.723	2.684	0.031
Total site area (m2)	0.019	0.006	3.048	0.019
No. of service channels	2.268	6.681	0.339	0.744

- Adjusted  $R^2$  of 0.80 is at the 0.80 benchmark. It is also substantially better than that for the independent relationship for the number of service channels (0.71).
- Nevertheless,  $R^2$  of 0.84 for the independent relationship for the total site area provides a more reliable estimate.

### 3.3.1.9 Relationship among trip-making statistics

- A separate analysis was carried out to determine relationships between peak hour vehicle trips and the total daily trips (the latter as an independent variable).
- In all cases  $R^2$  was equal to or greater than 0.80, indicating that peak hour traffic generation could be reliably predicted based on the total daily trip data.

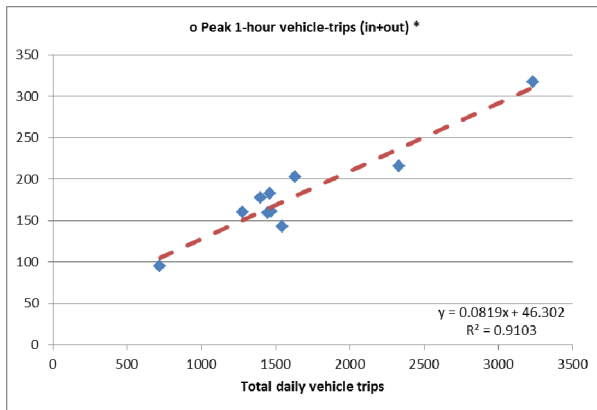


Figure 3-36 Peak hour vehicle trips vs total daily trips

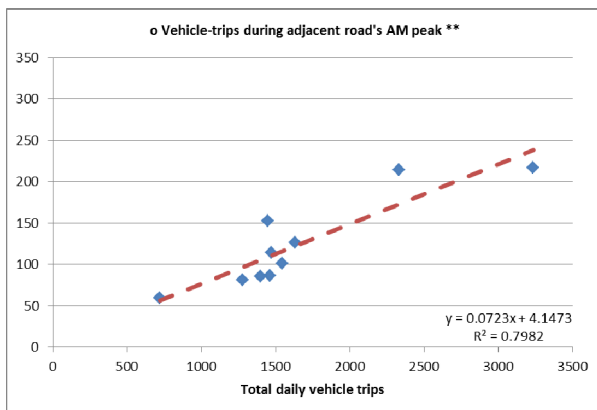


Figure 3-37 AM Peak Hour vehicle trips vs total daily trips

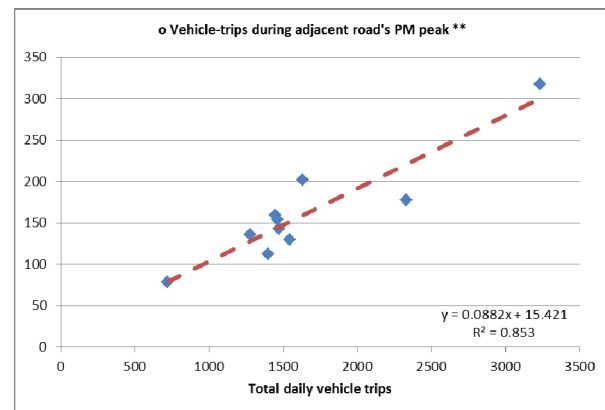
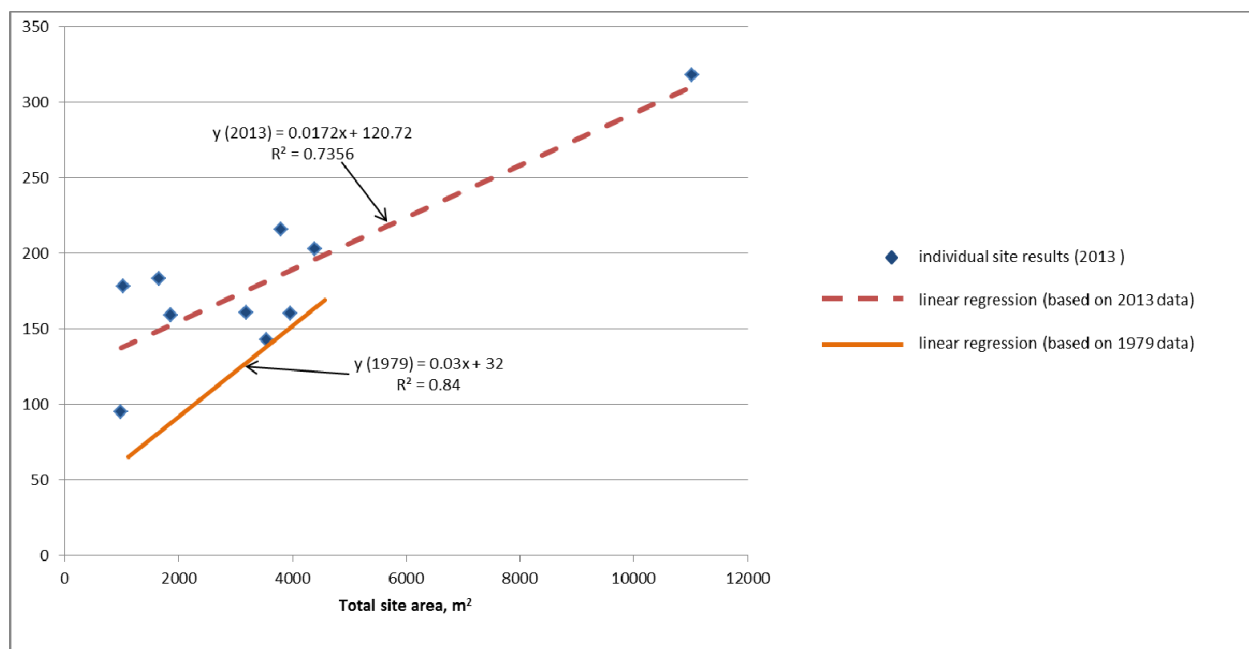


Figure 3-38 PM Peak Hour vehicle trips vs total daily trips

### 3.3.1.10 Comparison of findings with the 1979 data

- The total site area was the most reliable independent variable determined in the 1979 Study. Of the dependent variables, the number of peak hour vehicle movements is the only one which was studied both in the previous and the present Studies.
- A graph below illustrates the difference in the relationships between the peak hour trips and the site area from the two studies. It may be seen from the graph that the 1979 data indicates a steeper increase of the peak hour trips with the increase of the site area. However, overall the 2013 peak hour trip generation rates were found to be much greater than those in 1979 for the comparable range of the independent variable (1,110 – 4,570 m<sup>2</sup>).



**Figure 3-39 Peak hour vehicle trips versus total site area – comparison of 1979 and 2013 data**

- It is noted that in the 1979 Study no reliable dependency was found between the trip generation statistics and the number of service channels, whereas the present Study has found this independent variable to provide reliable estimates.

### 3.4 Special survey

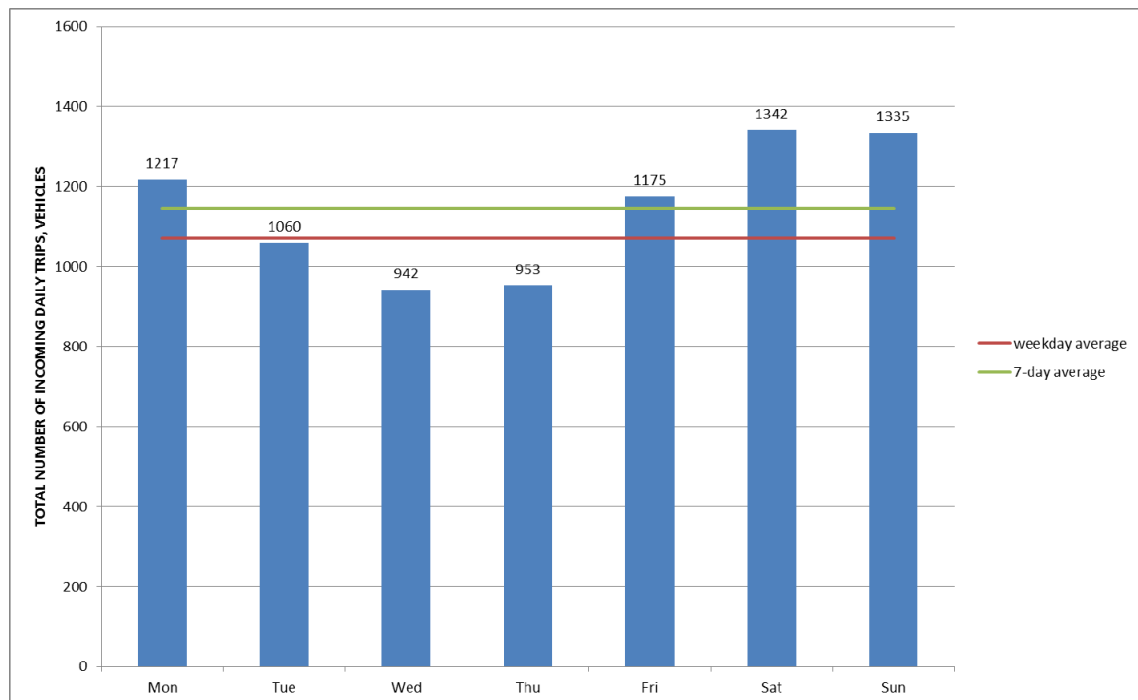
A special 7-day survey was carried out at Site 1. In addition to the same survey format as for the one-day surveys at all other sites, classification vehicle movement counts were carried out for 24-hour periods for each day of the survey.

The aim of the special survey was to establish daily and hourly visitation patterns.

Graphs in **Figure 3-40** and **3-41** and **Table 3.7** show the daily and hourly incoming trips for the whole survey period.

The following observations have been made.

- The trip generation on Saturday and on Sunday between 9 am and 4 pm was generally greater than that on the weekdays.
- Of the weekdays, Monday and Friday were the busiest days, whilst daily trip generation values on Tuesdays, Wednesdays and Thursdays were generally lower than those on Monday and Friday by 10% to 23% for the day totals.
- Generally, peak trip generation occurred in the late morning and early afternoon on all days except Monday when the peak was closer to the evening.
- One-hour peak trip generation levels on Tuesday and Wednesday were the closest to both the weekday average and the 7-day average.



**Figure 3-40** Daily trip data for Site 1 over a 7-day period.



Table 3.7 Hourly trip data for Site 1 over a 7-day period.

17/05/13-23/05/13 1-hour Data	Coles Express, South Dowling St, Waterloo																		Average	
WEATHER Fine	All vehicles																		1-hour Data	
	IN									OUT									IN + OUT	
								Average									Average			
TIME	Mon	Tue	Wed	Thu	Fri	Sat	Sun	5 days	7 days	Mon	Tue	Wed	Thu	Fri	Sat	Sun	5 days	7 days	5 days	7 days
0:00 to 1:00	28	19	21	15	20	32	49	21	26	27	22	26	18	24	45	47	23	30	44	56
1:00 to 2:00	14	21	19	16	14	24	26	17	19	14	26	20	16	21	29	29	19	22	36	41
2:00 to 3:00	10	11	15	9	20	17	28	13	16	13	10	17	18	18	20	35	15	19	28	35
3:00 to 4:00	13	8	15	10	13	9	24	12	13	13	10	16	15	20	10	33	15	17	27	30
4:00 to 5:00	12	11	13	16	20	15	22	14	16	13	9	14	13	15	18	20	13	15	27	31
5:00 to 6:00	36	31	30	31	26	20	25	31	28	30	28	23	30	30	20	21	28	26	59	54
6:00 to 7:00	65	59	58	60	59	53	37	60	56	63	59	60	60	59	45	34	60	54	120	110
7:00 to 8:00	50	58	46	50	57	49	31	52	49	53	59	54	51	52	53	33	54	51	106	100
8:00 to 9:00	50	64	60	54	57	55	48	57	55	45	60	59	54	74	56	48	58	57	115	112
9:00 to 10:00	62	69	60	62	63	73	71	63	66	63	68	61	59	60	72	68	62	64	125	130
10:00 to 11:00	66	73	65	62	57	77	73	65	68	63	66	66	70	52	76	72	63	66	128	134
11:00 to 12:00	86	72	48	61	78	84	80	69	73	92	81	50	56	75	80	78	71	73	140	146
12:00 to 13:00	79	74	48	60	93	100	86	71	77	81	70	59	64	85	95	76	72	76	143	153
13:00 to 14:00	82	48	37	44	84	104	122	59	74	74	64	36	43	86	111	116	61	76	120	150
14:00 to 15:00	74	45	40	45	74	89	102	56	67	78	45	40	52	68	84	117	57	69	113	136
15:00 to 16:00	81	50	50	49	81	110	108	62	76	88	48	49	45	72	95	112	60	73	122	149
16:00 to 17:00	88	64	53	42	76	82	69	65	68	86	68	39	47	86	92	77	65	71	130	139
17:00 to 18:00	99	57	41	40	77	84	67	63	66	101	56	46	42	72	83	68	63	67	126	133
18:00 to 19:00	88	43	39	43	51	68	91	53	60	88	50	36	45	52	72	92	54	62	107	122
19:00 to 20:00	26	42	40	47	11	41	51	33	37	29	47	52	52	14	52	52	39	43	72	80
20:00 to 21:00	26	37	43	40	29	36	36	35	35	44	44	47	41	41	41	45	43	43	78	78
21:00 to 22:00	30	41	42	37	43	36	30	39	37	39	38	45	42	57	47	43	44	44	83	81
22:00 to 23:00	29	34	30	31	36	35	36	32	33	39	40	31	46	42	53	47	40	43	72	76
23:00 to 0:00	23	29	29	29	36	49	23	29	31	24	24	42	47	37	51	27	35	36	64	67
Total	1217	1060	942	953	1175	1342	1335	1071	1146	1260	1092	988	1026	1212	1400	1390	1114	1197	2185	2343
1-hour peak as % of																				
weekday average	139%	104%	92%	87%	131%	155%	172%													
7-day average	129%	96%	84%	81%	121%	143%	158%													

Legend: 99 - peak hour of station trip generation

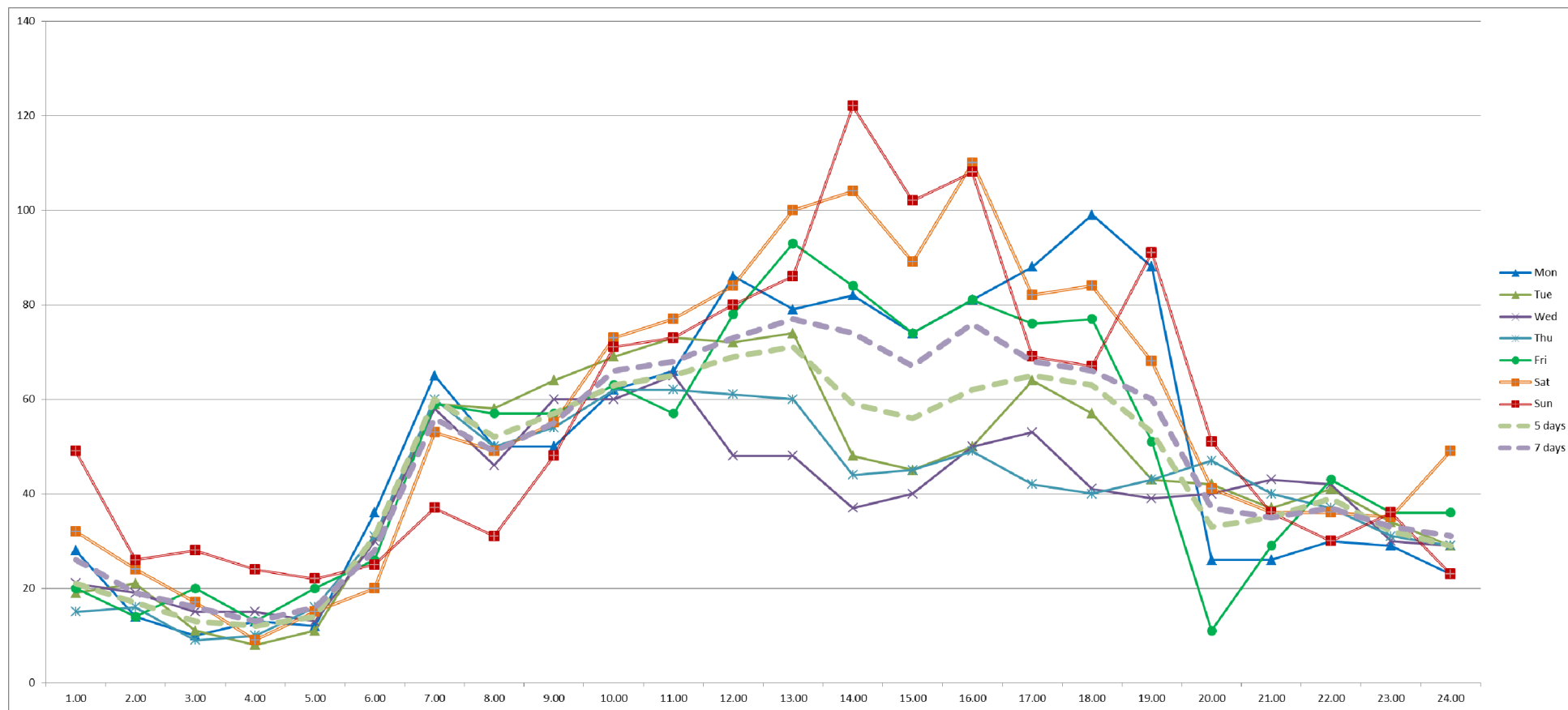


Figure 3-41 Hourly trip data for Site 1 over a 7-day period.

## 4 SUMMARY

The former Roads and Traffic Authority (RTA, now Roads and Maritime Services) published its Guide to Traffic Generating Developments (“Guide”) in the mid-1990s. The trip generation and parking requirement data in the Guide is becoming increasingly out-of-date. The Guide contains trip generation and parking demand information derived from a 1979 survey of ten Service Stations across greater Sydney. Half of the sites were self-service, and half offered the then-traditional driveway service. A number of changes have occurred since then in terms of service stations’ mode of operation, services offered and size. Given these changes, there is now a need to validate (or otherwise) the 1979 trip generation and parking demand data for Service Stations, to assist with traffic impact assessment and planning.

Nine (9) sites within the Sydney Metropolitan Area (SMA) and one (1) site outside SMA on a major highway were selected in consultation with RMS Project Manager.

There were no technical issues with the conduct of the surveys, except obtaining permissions from the service station operators and collecting information about the year when the station was opened.

Surveys of trips generation were carried out in March-May 2013, outside school holidays. Classification counts of vehicles entering and leaving the sites were undertaken at each site generally between 6 am and 7 pm on Monday, Tuesday, Wednesday or Thursday. Site 1 was chosen for a special survey where the entering and leaving traffic was counted for each 24 hours over a full 7-day period, to establish daily and hourly visitation patterns.

### 4.1 Average rates

A review of the data revealed a number of observations

- The surveys were undertaken at service stations with the floor space varying from 182.5 m<sup>2</sup> to 481 m<sup>2</sup> and with the total site area varying from 988 m<sup>2</sup> to 11,030 m<sup>2</sup>.
- Slightly higher station trip rates were observed during the PM peak on the adjacent road than during AM peak.

The results of the analyses for both peak hour and daily trips rates indicated high values of standard deviation in all cases for vehicle trips. The base data was therefore regarded as wide-spread. The average rates are thus not recommended to be used for predicting the trip generation because of wide prediction intervals around the mean estimated values.

### 4.2 Regression analysis

The trip generation rates were then analysed in terms of their dependency on a number of variables, using linear and non-linear regression analysis. The interrogated variables are listed below.

- total building GFA
- convenience store GFA
- total site area
- number of pumps
- number of service channels
- number of seats in the fast food area (where applicable)
- petrol price

The regression analysis showed that the number of trips generated by the service stations showed good level of correlation with some variables, as summarised in **Table 4.1**.

Table 4.1 Trip generation relationships

	Variable	
	$X_1$ = Total site area, m <sup>2</sup>	$X_2$ = Number of service channels
<b>Variable range</b>	988 m <sup>2</sup> to 11,030 m <sup>2</sup>	4 to 12
<b>Y = Total daily vehicle trips</b>		$Y = 29.042X_1^2 + 222.58X_2 + 1668.3$ <b>R<sup>2</sup>=0.87</b>
<b>Y = Peak 1-hour vehicle trips (in+out)</b>	No reliable relationship has been found	
<b>Y = Vehicle trips (in+out) during AM peak hour on adjacent road</b>		$Y = 0.2815X_1^2 + 14.047X_2 + 16.715$ <b>R<sup>2</sup>=0.80</b>
<b>Y = Vehicle trips (in+out) during PM peak hour on adjacent road</b>	$Y = 0.0205 X_1 + 88.52$ <b>R<sup>2</sup>=0.84</b>	

Although no reliable relationships has been found between the site parameters and the peak 1-hour vehicle trips, the latter have been found to be closely related to the total daily vehicle trips ( $R^2=0.91$ ). The following equation may be used to estimate the peak 1-hour trips from the total daily trips.

$Y = 0.0819 X + 46.302$ , where

$Y$  = Peak 1-hour vehicle trips (in+out)

$X$  = Total daily vehicle trips

In summary, the analysis of data highlighted the following facts:

- Average trip rates should not be utilised for planning purposes.
- Good linear and non-linear relationships were established between the number of total daily and AM and PM peak trips and two independent variables: the total site area and the number of service channels.
- Peak 1-hour vehicle trips can be reliably estimated from the total daily trips.

### 4.3 Special survey

A special 7-day / 24-hour survey designed to establish daily and hourly visitation patterns revealed the following.

- The trip generation on Saturday and on Sunday between 9 am and 4 pm was generally greater than that on the weekdays.
- Of the weekdays, Monday and Friday were the busiest days, whilst daily trip generation values on Tuesdays, Wednesdays and Thursdays were generally lower than those on Monday and Friday by 10% to 23% for the day totals.
- Generally, peak trip generation occurred in the late morning and early afternoon on all days except Monday when the peak was closer to the evening.

- One-hour peak trip generation levels on Tuesday and Wednesday were the closest to both the weekday average and the 7-day average.

#### **4.4 Comparison with 1979 data**

- Of the dependent variables, the number of peak hour vehicle movements is the only one which was studied both in the previous and the present Studies.
- The 1979 data indicates a steeper increase of the peak hour trips with the increase of the site area. However, overall the 2013 peak hour trip generation rates were found to be much greater than those in 1979 for the comparable range of the independent variable (1,110 – 4,570 m<sup>2</sup>).
- It is noted that in the 1979 Study no reliable dependency was found between the trip generation statistics and the number of service channels, whereas the present Study has found this independent variable to provide reliable estimates.
- The trip generation relationships based on the 1979 data are considered to be out-dated and are not recommended for further use.



## **Appendix**

### **A summary of collected site data**

**Table A.1 Details of the selected survey sites and traffic survey results summary**

Site ID	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10
Site operator	Shell - Coles Express 867 South Dowling St, Waterloo	BP 9 Davies Road, Padstow	Caltex 1403 Princes Highway, Heathcote	APW 449 Great Western Hwy, Greystanes	7-Eleven 15-19 Aspen St, South Penrith	BP 162 Sunnyholt Rd, Kings Park	Caltex - Woolworths 59 Orange Grove Rd, Liverpool	Caltex - Woolworths 1 Woodland St, Riverstone	7-Eleven Hume Hwy, Bargo	BP 146-152 Moorefields Rd, Kingsgrove
Site address										
Day/date of survey(s)	Fri 17/05/13 to Thu 23/05/13	Tue, 21/05/13	Tue, 26/03/13	Wed, 27/03/13	Thu, 28/03/13	Thu, 28/03/13	Wed, 27/03/13	Tue, 26/03/13	Wed, 27/03/13	Mon, 27/05/13
Duration of survey - site and frontage road	6:00-19:00	6:00-19:00	6:00-19:00	6:00-19:00	6:00-19:00	6:00-19:00	6:00-19:00	6:00-19:00	6:00-19:00	6:00-19:00
Duration of survey - site trip generation	24 hrs 7 days									
Surrounding area characteristics:										
Surrounding landuse	commercial / retail / residential	industrial / residential / open space	residential / park	industrial / residential / commercial	commercial / residential	industrial / residential / commercial	commercial / retail / residential	commercial / retail / residential	open space	residential
Frontage road - AM peak period (weekday)	07:00-08:00	07:15-08:15	06:15-07:15	11:00-12:00	07:45-08:45	11:45-12:45	07:15-08:15	07:45-08:45	07:30-08:30	08:00-09:00
Frontage road - PM peak period (weekday)	17:15-18:15	15:45-16:45	16:30-17:30	17:15-18:15	15:00-16:00	17:15-18:15	17:00-18:00	17:00-18:00	17:00-18:00	17:00-18:00
Frontage road - daily peak period (Saturday & Sunday) [NB: for 7-day surveys only]										
<b>Development details:</b>										
Year opened	1995	pre-2005	2006	pre-2002	pre-2005	pre-2005	pre-2002	pre-2002	pre-2003	pre-2005
Other services / businesses on site	fast food & car wash	fast food & car wash	none	car wash	none	car wash & car service	none	none	fast food	none
Total site area (m <sup>2</sup> )	3540	3957	1860	1652	4392	1031	3798	3187	11030	988
Gross Floor Area (m <sup>2</sup> ):										
o Convenience store	140	261	193.5	144.5	265	90	443	197	200	245
o Fast food area	150	220							138	
o Car wash & car service				38		173			53	
<b>TOTAL GFA (m<sup>2</sup>)</b>	290	481	193.5	182.5	265	263	443	197	391	245
No. of pumps	12	12	12	8	6	4	20	16	16	8
No. of service channels	6	6	6	4	6	4	10	8	12	4
No. of seats in fast food area	38	26	N/A	N/A	N/A	N/A	N/A	N/A	28	N/A
<b>Vehicle Trips:</b>										
o Peak 1-hour vehicle-trips (in+out) *	143	160	159	183	203	178	216	161	318	95
o Time of peak 1-hour vehicle-trips	17:00-18:00	16:45-17:45	16:30-17:30	17:45-18:45	15:15-16:15	13:30-14:30	07:30-08:30	16:15-17:15	17:00-18:00	17:15-18:15
o Peak vehicle-trips per pump	11.9	13.3	13.3	22.9	33.8	44.5	10.8	10.1	19.9	11.9
o Peak vehicle-trips per service channel	23.8	26.7	26.5	45.8	33.8	44.5	21.6	20.1	26.5	23.8
o Peak vehicle-trips per 100m <sup>2</sup> of total GFA	49.3	33.3	82.2	100.3	76.6	67.7	48.8	81.7	81.3	38.8
o Peak vehicle-trips per 100m <sup>2</sup> of convenience store GFA	102.1	61.3	82.2	126.6	76.6	197.8	48.8	81.7	159.0	38.8
o Peak vehicle-trips per 100m <sup>2</sup> of fast food GFA	95.3	72.7	N/A	N/A	N/A	N/A	N/A	N/A	230.4	N/A
o Total daily vehicle-trips	1543	1276	1449	1463	1629	1399	2329	1472	3234	720
o Total daily vehicle-trips per pump	128.6	106.3	120.8	182.9	271.5	349.8	116.5	92.0	202.1	90.0
o Total daily vehicle-trips per service channel	257.2	212.7	241.5	365.8	271.5	349.8	232.9	184.0	269.5	180.0
o Total daily vehicle-trips per 100m <sup>2</sup> of total GFA	532.1	265.3	748.8	801.6	614.7	531.9	525.7	747.2	827.1	293.9
o Total daily vehicle-trips per 100m <sup>2</sup> of convenience store GF	1102.1	488.9	748.8	1012.5	614.7	1554.4	525.7	747.2	1617.0	293.9
o Total daily vehicle-trips per 100m <sup>2</sup> of fast food GFA	1028.7	580.0	N/A	N/A	N/A	N/A	N/A	N/A	2343.5	N/A
o Vehicle-trips during adjacent road's AM peak **	101	81	152	86	126	85	214	114	217	59
o Vehicle-trips during adjacent road's PM peak **	130	136	159	154	202	112	178	143	318	78
<b>Parking:</b>										
o No of reserved car spaces	0	0	0	2	0	0	0	0	0	0
o No of public car spaces	31	16	14	7	12	3	22	20	18	8
o No of staff car spaces	1	2	0	0	0	0	0	0	0	0
o No of Disabled car spaces	1	0	1	0	0	0	1	0	0	0
o No of Loading / unloading bays	1	2	0	1	0	1	1	0	1	1
<b>TOTAL parking spaces</b>	34	20	15	10	12	4	24	20	19	9
o Peak Parking Accumulation	12	12	8	4	7	11	7	5	52	4
o Time of Peak Parking Accumulation	12:00-12:15	12:00-12:15	08:15	18:45-19:00	06:45, 16:15 & 16:45	12:45	14:45, 18:45	17:30	17:00	18:30
o Parking Accumulation per 100m <sup>2</sup> total GFA	4.1	2.5	4.1	2.2	2.6	4.2	1.6	2.5	13.3	1.6