Trip Generation, Parking Demand and Vessel Movement Surveys of Marinas

Analysis Report

Prepared for:

Transport for NSW

23 November 2020

The Transport Planning Partnership

E: info@ttpp.net.au

Trip Generation, Parking Demand and Vessel Movement Surveys of Marinas

Analysis Report

Client: Transport for NSW

Version: V03

Date: 23 November 2020

TTPP Reference: 19431

Quality Record

Version	Date	Prepared by	Reviewed by	Approved by	Signature
V01	07/07/20	Lalaine Malaluan	Kelly Yoon	Ken Hollyoak	DRAFT
V02	17/09/20	Lalaine Malaluan	Kelly Yoon	Ken Hollyoak	DRAFT
V03	23/11/20	Lalaine Malaluan	Kelly Yoon	Ken Hollyoak	

Table of Contents

Tables

Figures

APPENDICES

1 Introduction

1.1 Study Brief/Outcomes

The former Roads and Traffic Authority (RTA) published its *Guide to Traffic Generating Developments* in the mid-1990s. This document, which is still used extensively by Councils, consultants and developers, drew on the results of a number of trip generation and parking demand surveys covering a wide range of business and land use types. These surveys had been conducted since 1978.

The latest edition of the Guide (2002) stipulates rates for marinas which have been in place since the 1992 edition of the Guide. These rates are based on surveys undertaken in Pittwater in 1978 and Middle Harbour in 1990.

In April 2001, Christopher Hallam & Associates (CHA) prepared the report "*The Car Parking Implications of Marina Developments*" for the Boating Industry Association of NSW. In November 2008, CHA issued a follow-up report titled "*The Traffic and Parking Implications of Marina Developments*", which updated the 2001 report by including more recent survey data collected between September 2006 and January 2008. Among the report's key findings were a higher parking demand per mooring than per berth, and a small trend for larger group size and parking demands with increasing boat lengths. Australian Standard AS 3962:2020 (Marina Design) was updated on March 2020 with lower parking rates stipulated in the latest version, in comparison to the 2001 version.

Nonetheless, with a growth in the number and variety of marinas throughout Australia, it is necessary to undertake a new study for marinas featuring a much greater range of characteristics, including:

- Range of mooring and vessel storage types,
- Range of marina sizes,
- Range of geographic locations,
- Public access and private membership facilities, and
- Other on-site facilities.

Consequently, The Transport Planning Partnership (TTPP) has been appointed to undertake a detailed analysis of marinas. The study includes new surveys to collect traffic characteristics relating to vehicle, person and vessels trips as well as site observations to determine travel behaviour of visitors and staff.

The results from these surveys are then compared with similar data available from the other Australian road / planning agencies and various overseas organisations to assess the relevance and applicability of that data for use in the local context.

1.2 Approach

The approach to this generation study and the tasks involved are described below:

- Undertake detailed site assessments of marinas, contacting the development managers and occupiers to obtain comprehensive information including site area, car parking and vessel spaces, number of employees, and opening hours.
- Arrange traffic surveys on Friday, Saturday and Sunday at all sites. The surveys were undertaken during summer months when marinas are known to be busiest.
- Where no existing/suitable Roads and Maritime Services volume count data was available, automatic traffic counters were placed on adjacent major roads to determine the surrounding network peak hour periods.
- Undertake multiple linear regression analysis of a number of key variables as functions of various sub-categories of vessel berthing / storage. Undertake linear regression analysis of the various visitation statistics as functions of single key variables.
- Compare these relationships with similar trip generation and parking demand information for this land use currently available from other sources, as a means of assessing the relevance of this data for use in the NSW context.
- Prepare an analysis report, which contains the analysis covering all of the calculations and comparisons.
- Prepare a data report, which contains the raw data from the surveys and other data such as site plans.

1.3 Report Structure

The remainder of this analysis report is set out as follows:

- Chapter 2 contains a description of the survey and the selected sites,
- Chapter 3 presents the survey results,
- Chapter 4 presents the regression analysis,
- Chapter 5 compares the NSW survey results with other country's databases such as TRICS (United Kingdom), NZTDB (New Zealand) and ITE (United States), and
- Chapter 6 presents the summary of this investigation.

2 Survey Methodology

2.1 Selected Sites

A total of 12 marinas have been nominated to undertake the surveys. The list of selected sites is shown in Table 2.1. The details of the site are described in this Chapter.

Table 2.1: Survey Site List

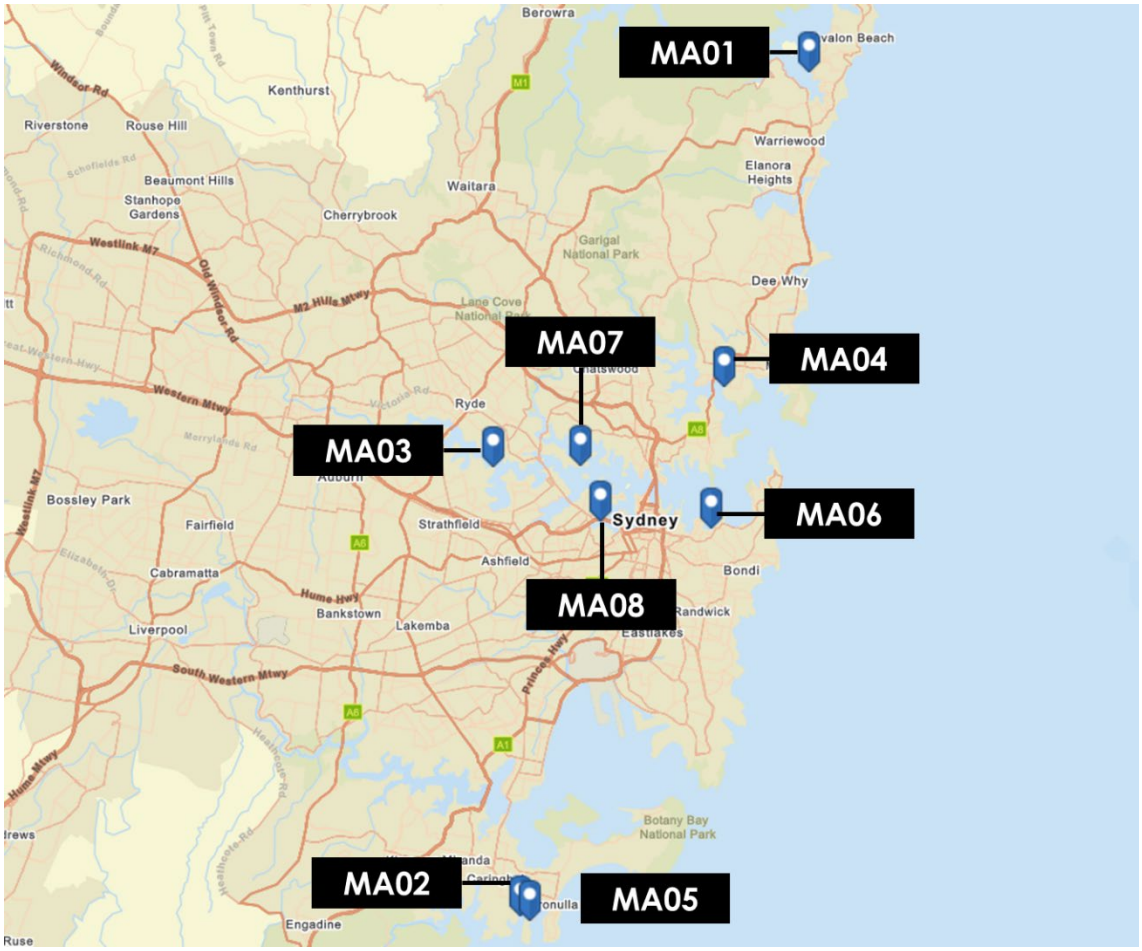
Site ID	Marinas	Metropolitan (M) or Regional (R)
MA01	Royal Motor Yacht Club, Broken Bay	M
MA02	Burraneer Bay Marina	M
MA03	D'Albora Marina Cabarita Point	M
MA04	Clontarf Marina	M
MA05	Royal Motor Yacht Club, Port Hacking	M
MA06	Double Bay Marina	M
MA07	Woolwich Marina	M
MA08	Sydney Superyacht Marina	M
MA09	Coffs Harbour Marina	R
MA10	Port Macquarie Marina	R
MA11	Soldiers Point Marina	R
MA12	Koolewong Marina	R

The selected sites include eight marinas in metropolitan Sydney and four regional sites. The identified sites conform with TfNSW's requirements by providing a reasonable cross-section of marina sites, including the following variables:

- geographic location,
- mooring/berth types,
- size of marina,
- public access or membership,
- on-site parking provision, and
- provision of other facilities e.g. restaurant/café, vessel brokers, boat maintenance etc.

Site locations are also graphically presented in Figure 2.1 and Figure 2.2, for Sydney and Regional sites, respectively.

Figure 2.1: Site Locations (Sydney Sites)



Source: OpenStreetMap

Figure 2.2: Site Locations (Regional Sites)

Source: OpenStreetMap

2.2 Survey Process

The surveys counted the vehicles and pedestrians at marinas' access points to record the number of vehicles and pedestrians entering and exiting the site. The number of vessels in swing moorings, wet berths and hard stand / dry storage within the perimeter of the site was also recorded.

Site surveys were undertaken from Friday to Sunday during summer months (i.e. January to February) when marinas are typically busiest.

Unfortunately, TTPP did not receive responses from the majority of marina operators prior to the scheduled surveys requesting surveyors to be on-site and conduct face-to-face interviews.

As such, surveyors were assigned within the site vicinity to observe the travel behaviour of the marina's staff and visitors. The following were observed on site:

- Is the person entering the site a marina employee, visitor accessing/transporting a vessel or a visitor to a business at the marina?
- What is the primary mode of travel?
- If arrived by car, where did they park?
- If arrived by car, how many people are travelling including driver?
- If the person is accessing/transporting a vessel, is the vessel located in wet berth, swing mooring or hard stand/dry storage?

2.3 Data Recorded

The following information was recorded by the traffic surveyors on site:

- Number of vehicles parked on site at the commencement of the survey,
- Number of vehicles and the number of occupants in each vehicle entering and leaving the site,
- Number of pedestrians entering and leaving the site,
- Number of vessels berthed/stored at the commencement of the survey,
- Number of vessels entering and leaving the site,
- Trip purpose of visitors/staff (interview survey),
- Travel mode of visitors/staff (interview survey),
- Parking location of visitors/staff who travelled by car (interview survey),
- Number of car occupants of visitors/staff who travelled by car (interview survey), and
- Berthing/storage location of visitors' vessels (interview survey).

The collected information would help establish person trips, vehicle trips, vessel movements and parking accumulation at each site.

Hourly traffic volumes on the principal frontage access road were also collected to determine background peak hours using either automatic traffic counters or existing Roads and Maritime Services count station data.

The survey data and key statistics and ratios for all survey sites are also presented in Appendix A.

3 Survey Analysis

3.1 Key Statistics

The survey data was analysed to determine the following key statistics:

Vehicle-based:

- adjacent road network peak hour
- site peak hour
- site peak vehicle trip generation (i.e. during site peak hour and during external road network peak hour)
- daily site vehicle trip generation
- average vehicle occupancy of cars which entered the site
- peak parking accumulation
- parking location (based on on-site observations)

Person-based:

- peak person trips (i.e. during site peak hour and during external road network peak hour)
- daily person trips
- purpose of travel (based on on-site observations)
- travel mode split (based on on-site observations)

Vessel-based:

- peak vessel movements
- daily vessel movements
- vessel storage/berthing location

3.2 Key Variables

The trip and parking generation rates could be derived from the following key variables:

- site area,
- vessel storage/berthing capacity, and
- number of parking spaces.

The site area of each site includes land area plus the on-water footprint of moorings and berths which are based off property boundary lines and aerial imagery.

The vessel storage/berthing capacity has been based on the information obtained from marinas' websites and maximum counts observed from site survey, whichever is higher.

However, it is noted that some vessel counts observed on site exceeds the marinas' capacities indicated on the websites. It is acknowledged that there are no visual indicators on water to show the extent of site boundary for marinas. As such, there could be cases wherein vessels berthed/moored outside the boundary were counted.

3.3 Trip Rates

The summary of survey data across all marinas is presented in Table 3.1 to Table 3.3.

It is noted that the external road network peak hours are based on 24-hour automatic vehicle counts. Therefore, there are cases wherein the external road network peak hours are outside the site survey hours. As such, the following tables show some of the sites having no network peak hour vehicle/pedestrian/vessel counts.

In addition, no vehicle counts are recorded at MA04 and MA06 since these two sites have no on-site parking facilities.

The following trip generation rates have been summarised using the surveyed trips and the following parameters:

- site area,
- on-site car parking capacity, and
- vessel spaces (no. of swing moorings plus wet berths).

Table 3.1: Survey Results Summary (Friday)

Site ID:	Sydney Metropolitan Area								Regional Area			
	MA01	MA02	MA03	MA04	MA05	MA06	MA07	MA08	MA09	MA10	MA11	MA12
Name	Royal Motor Yacht Club, Broken Bay	Burraneer Bay Marina	D'Albora Marina Cabarita Point	Clontarf Marina	Royal Motor Yacht Club, Port Hacking	Double Bay Marina	Woolwich Marina	Sydney Superyacht Marina	Coffs Harbour Marina	Port Macquarie Marina	Soldiers Point Marina	Koolewong Marina
Person-based Trips												
Daily Person Trips												
- Car-based (parked on-site)	667	58	56	0	350	0	23	106	572	249	350	141
- Other	34	0	26	64	2	138	8	3	19	48	482	0
- TOTAL	701	58	82	64	352	138	31	109	591	297	832	141
Average Person Trips	74	7	10	7	44	15	4	12	70	30	88	18
Peak Person Trips												
- AM Peak	86	10	19	17	20	31	11	24	93	83	137	22
- PM Peak	91	10	18	9	128	27	6	18	81	27	139	27
Peak Network Hour Person Trips												
- AM Peak	77	5	-	5	-	-	6	12	93	64	97	-
- PM Peak	70	0	-	6	18	6	2	-	49	24	78	20
Mode Split (%)												
- Car	97%	100%	70%	86%	100%	34%	73%	84%	98%	89%	87%	100%
- Public Transport	3%	0%	30%	14%	0%	52%	27%	5%	2%	11%	13%	0%
- Walk/Cycle	0%	0%	0%	0%	0%	9%	0%	5%	0%	0%	0%	0%
- Taxi/Ride Share	0%	0%	0%	0%	0%	5%	0%	5%	0%	0%	0%	0%
Vehicle-based Trips (on-site)												
Daily Vehicle Trips	527	66	43	-	164	-	24	70	391	169	131	88
Peak Vehicle Trips												
- AM Peak	62	10	7	-	15	-	9	17	63	43	25	12
- PM Peak	66	13	10	-	51	-	4	10	53	17	24	15
Peak Network Hour Vehicle Trips												
- AM Peak	58	5	-	-	-	-	7	7	63	34	18	-
- PM Peak	41	0	-	-	12	-	2	-	33	17	14	12
Peak Parking Accumulation (%)	67%	37%	51%	-	83%	-	20%	16%	26%	57%	59%	60%
Average Vehicle Occupancy	1.20	1.16	1.12	-	1.91	-	1.00	1.26	1.57	1.44	2.91	1.64
Vessel Movements												
Daily Vessel Movements	46	8	6	14	9	57	10	125	7	16	44	9
Peak Vessel Movements												
- AM Peak	8	2	0	3	0	10	4	33	2	2	9	2
- PM Peak	8	2	3	3	3	11	2	14	2	4	7	2

Note: No vehicle trips were recorded at MA04 and MA06 as there are no on-site parking facilities at these marinas. It is noted that there could be visitors and staff who travelled to site by car and parked on-street which were not included in the survey

Table 3.2: Survey Results Summary (Saturday)

Site ID:	Sydney Metropolitan Area								Regional Area			
	MA01	MA02	MA03	MA04	MA05	MA06	MA07	MA08	MA09	MA10	MA11	MA12
Name	Royal Motor Yacht Club, Broken Bay	Burraneer Bay Marina	D'Albora Marina Cabarita Point	Clontarf Marina	Royal Motor Yacht Club, Port Hacking	Double Bay Marina	Woolwich Marina	Sydney Superyacht Marina	Coffs Harbour Marina	Port Macquarie Marina	Soldiers Point Marina	Koolewong Marina
Person-based Trips												
Daily Person Trips												
- Car-based (parked on-site)	328	36	108	0	309	0	32	81	640	283	312	144
- Other	18	0	36	71	0	264	20	31	15	34	369	0
- TOTAL	346	36	144	71	309	264	52	112	655	317	681	144
Average Person Trips	36	5	17	8	39	29	6	12	77	32	72	18
Peak Person Trips	62	7	35	17	90	67	14	33	109	59	108	27
Peak Network Hour Person Trips	41	-	11	9	25	32	6	15	103	37	88	18
Mode Split (%)												
- Car	93%	100%	80%	89%	100%	35%	76%	88%	99%	93%	88%	100%
- Public Transport	7%	0%	20%	7%	0%	57%	24%	0%	1%	7%	11%	0%
- Walk/Cycle	0%	0%	0%	0%	0%	0%	0%	3%	0%	0%	1%	0%
- Taxi/Ride Share	0%	0%	0%	4%	0%	7%	0%	9%	0%	0%	0%	0%
Vehicle-based Trips (on-site)												
Daily Vehicle Trips	202	36	80	-	119	-	23	58	419	190	145	87
Peak Vehicle Trips	37	7	19	-	31	-	5	15	71	32	26	15
Peak Network Hour Vehicle Trips	12	-	7	-	11	-	4	7	71	24	22	11
Peak Parking Accumulation (%)	38%	19%	103%	-	84%	-	17%	18%	33%	53%	73%	64%
Average Vehicle Occupancy	1.60	1.00	1.20	-	2.52	-	1.77	1.50	1.72	1.45	2.37	1.53
Vessel Movements												
Daily Vessel Movements	30	4	7	20	5	69	16	108	11	13	60	13
Peak Vessel Movements	6	3	2	4	2	13	4	20	3	4	11	4

Note: No vehicle trips were recorded at MA04 and MA06 as there are no on-site parking facilities at these marinas. It is noted that there could be visitors and staff who travelled to site by car and parked on-street which were not included in the survey.

Table 3.3: Survey Results Summary (Sunday)

Site ID:	Sydney Metropolitan Area								Regional Area			
	MA01	MA02	MA03	MA04	MA05	MA06	MA07	MA08	MA09	MA10	MA11	MA12
Name	Royal Motor Yacht Club, Broken Bay	Burraneer Bay Marina	D'Albora Marina Cabarita Point	Clontarf Marina	Royal Motor Yacht Club, Port Hacking	Double Bay Marina	Woolwich Marina	Sydney Superyacht Marina	Coffs Harbour Marina	Port Macquarie Marina	Soldiers Point Marina	Koolewong Marina
Person-based Trips												
Daily Person Trips												
- Car-based (parked on-site)	291	60	129	0	311	0	18	83	1,595	186	228	161
- Other	38	0	41	314	0	25	16	59	34	30	239	0
- TOTAL	329	60	170	314	311	25	34	142	1,629	216	467	161
Average Person Trips	35	8	20	35	39	3	4	16	192	22	49	20
Peak Person Trips	56	15	27	63	69	8	10	37	229	59	91	28
Peak Network Hour Person Trips	25	7	18	36	23	3	1	24	218	24	56	26
Mode Split (%)												
- Car	93%	100%	80%	89%	100%	35%	76%	88%	99%	93%	88%	100%
- Public Transport	7%	0%	20%	7%	0%	57%	24%	0%	1%	7%	11%	0%
- Walk/Cycle	0%	0%	0%	0%	0%	0%	0%	3%	0%	0%	1%	0%
- Taxi/Ride Share	0%	0%	0%	4%	0%	7%	0%	9%	0%	0%	0%	0%
Vehicle-based Trips (on-site)												
Daily Vehicle Trips	173	38	91	-	120	-	16	53	1,139	126	100	86
Peak Vehicle Trips	28	9	14	-	24	-	4	15	159	33	18	15
Peak Network Hour Vehicle Trips	14	7	12	-	11	-	1	8	150	13	9	12
Peak Parking Accumulation (%)	41%	19%	92%	-	72%	-	13%	16%	74%	78%	57%	64%
Average Vehicle Occupancy	1.60	1.00	1.20	-	2.52	-	1.77	1.50	1.72	1.45	2.37	1.53
Vessel Movements												
Daily Vessel Movements	48	2	14	28	4	17	13	50	14	18	28	13
Peak Vessel Movements	9	2	5	6	2	5	3	13	3	5	6	4

Note: No vehicle trips were recorded at MA04 and MA06 as there are no on-site parking facilities at these marinas. It is noted that there could be visitors and staff who travelled to site by car and parked on-street which were not included in the survey.

Table 3.4: Person Trip Rates per 10,000m² Site Area

Site ID:	Sydney Metropolitan Area								Regional Area			
	MA01	MA02	MA03	MA04	MA05	MA06	MA07	MA08	MA09	MA10	MA11	MA12
Name	Royal Motor Yacht Club, Broken Bay	Burraneer Bay Marina	D'Albora Marina Cabarita Point	Clontarf Marina	Royal Motor Yacht Club, Port Hacking	Double Bay Marina	Woolwich Marina	Sydney Superyacht Marina	Coffs Harbour Marina	Port Macquarie Marina	Soldiers Point Marina	Koolewong Marina
Site area (m²)	67,500	14,260	30,530	7,958	22,590	4,216	5,765	29,410	125,600	23,890	16,470	15,750
Friday												
Daily Person Trips												
- Car-based (parked on-site)	98.81	40.67	18.34	0.00	154.94	0.00	39.90	36.04	45.54	104.23	212.51	89.52
- Other	5.04	0.00	8.52	80.42	0.89	327.32	13.88	1.02	1.51	20.09	292.65	0.00
- TOTAL	103.85	40.67	26.86	80.42	155.82	327.32	53.77	37.06	47.05	124.32	505.16	89.52
Average Person Trips	10.93	5.08	7.64	8.94	19.48	36.37	6.33	4.12	5.54	12.43	53.17	11.19
Peak Person Trips												
- AM Peak	12.74	7.01	6.22	21.36	8.85	73.53	19.08	8.16	7.40	34.74	83.18	13.97
- PM Peak	13.48	7.01	5.90	11.31	56.66	64.04	10.41	6.12	6.45	11.30	84.40	17.14
Peak Network Hour Person Trips												
- AM Peak	11.41	3.51	-	6.28	-	-	10.41	4.08	7.40	26.79	58.89	-
- PM Peak	10.37	-	-	7.54	7.97	14.23	3.47	-	3.90	10.05	47.36	12.70
Saturday												
Daily Person Trips												
- Car-based (parked on-site)	48.59	25.25	35.38	0.00	136.79	0.00	55.51	27.54	50.96	118.46	189.44	91.43
- Other	2.67	0.00	11.79	89.22	0.00	626.19	34.69	10.54	1.19	14.23	224.04	0.00
- TOTAL	51.26	25.25	47.17	89.22	136.79	626.19	90.20	38.08	52.15	132.69	413.48	91.43
Average Person Trips	5.40	3.16	5.55	9.91	17.10	69.58	10.61	4.23	6.14	13.27	43.52	11.43
Peak Person Trips	9.19	4.91	11.46	21.36	39.84	158.92	24.28	11.22	8.68	24.70	65.57	17.14
Peak Network Hour Person Trips	6.07	-	3.60	11.31	11.07	75.90	10.41	5.10	8.20	15.49	53.43	11.43
Sunday												
Daily Person Trips												
- Car-based (parked on-site)	43.11	42.08	42.25	0.00	137.67	0.00	31.22	28.22	126.99	77.86	138.43	102.22
- Other	5.63	0.00	13.43	394.57	0.00	59.30	27.75	20.06	2.71	12.56	145.11	0.00
- TOTAL	48.74	42.08	55.68	394.57	137.67	59.30	58.98	48.28	129.70	90.41	283.55	102.22
Average Person Trips	5.13	5.26	6.55	43.84	17.21	6.59	6.94	5.36	15.26	9.04	29.85	12.78
Peak Person Trips	8.30	10.52	8.84	79.17	30.54	18.98	17.35	12.58	18.23	24.70	55.25	17.78
Peak Network Hour Person Trips	3.70	4.91	5.90	45.24	10.18	7.12	1.73	8.16	17.36	10.05	34.00	16.51

Table 3.5: Vehicle Trip Rates per 10,000m² Site Area

Site ID:	Sydney Metropolitan Area								Regional Area			
	MA01	MA02	MA03	MA04	MA05	MA06	MA07	MA08	MA09	MA10	MA11	MA12
Name	Royal Motor Yacht Club, Broken Bay	Burraneer Bay Marina	D'Albora Marina Cabarita Point	Clontarf Marina	Royal Motor Yacht Club, Port Hacking	Double Bay Marina	Woolwich Marina	Sydney Superyacht Marina	Coffs Harbour Marina	Port Macquarie Marina	Soldiers Point Marina	Koolewong Marina
Site area (m²)	67,500	14,260	30,530	7,958	22,590	4,216	5,765	29,410	125,600	23,890	16,470	15,750
Friday												
Daily Vehicle Trips	78.07	46.28	14.08	-	72.60	-	41.63	23.80	31.13	70.74	79.54	55.87
Peak Vehicle Trips												
- AM Peak	9.19	7.01	2.29	-	6.64	-	15.61	5.78	5.02	18.00	15.18	7.62
- PM Peak	9.78	9.12	3.28	-	22.58	-	6.94	3.40	4.22	7.12	14.57	9.52
Peak Network Hour Vehicle Trips												
- AM Peak	8.59	3.51	-	-	-	-	12.14	2.38	5.02	14.23	10.93	-
- PM Peak	6.07	-	-	-	5.31	-	3.47	-	2.63	7.12	8.50	7.62
Saturday												
Daily Vehicle Trips	29.93	25.25	26.20	-	52.68	-	39.90	19.72	33.36	79.53	88.04	55.24
Peak Vehicle Trips	5.48	4.91	6.22	-	13.72	-	8.67	5.10	5.65	13.39	15.79	9.52
Peak Network Hour Vehicle Trips	1.78	-	2.29	-	4.87	-	6.94	2.38	5.65	10.05	13.36	6.98
Sunday												
Daily Vehicle Trips	25.63	26.65	29.81	-	53.12	-	27.75	18.02	90.68	52.74	60.72	54.60
Peak Vehicle Trips	4.15	6.31	4.59	-	10.62	-	6.94	5.10	12.66	13.81	10.93	9.52
Peak Network Hour Vehicle Trips	2.07	4.91	3.93	-	4.87	-	1.73	2.72	11.94	5.44	5.46	7.62

Note: No vehicle trips were recorded at MA04 and MA06 as there are no on-site parking facilities at these marinas. It is noted that there could be visitors and staff who travelled to site by car and parked on-street which were not included in the survey.

Table 3.6: Vessel Movement Rates per 10,000m² Site Area

Site ID:	Sydney Metropolitan Area								Regional Area			
	MA01	MA02	MA03	MA04	MA05	MA06	MA07	MA08	MA09	MA10	MA11	MA12
Name	Royal Motor Yacht Club, Broken Bay	Burraneer Bay Marina	D'Albora Marina Cabarita Point	Clontarf Marina	Royal Motor Yacht Club, Port Hacking	Double Bay Marina	Woolwich Marina	Sydney Superyacht Marina	Coffs Harbour Marina	Port Macquarie Marina	Soldiers Point Marina	Koolewong Marina
Site area (m²)	67,500	14,260	30,530	7,958	22,590	4,216	5,765	29,410	125,600	23,890	16,470	15,750
Friday												
Daily Vessel Movements	6.81	5.61	1.97	17.59	3.98	135.20	17.35	42.50	0.56	6.70	26.72	5.71
Peak Vessel Movements												
- AM Peak	1.19	1.40	0.00	3.77	0.00	23.72	6.94	11.22	0.16	0.84	5.46	1.27
- PM Peak	1.19	1.40	0.98	3.77	1.33	26.09	3.47	4.76	0.16	1.67	4.25	1.27
Saturday												
Daily Vessel Movements	4.44	2.81	2.29	25.13	2.21	163.66	27.75	36.72	0.88	5.44	36.43	8.25
Peak Vessel Movements	0.89	2.10	0.66	5.03	0.89	30.83	6.94	6.80	0.24	1.67	6.68	2.54
Sunday												
Daily Vessel Movements	7.11	1.40	4.59	35.18	1.77	40.32	22.55	17.00	1.11	7.53	17.00	8.25
Peak Vessel Movements	1.33	1.40	1.64	7.54	0.89	11.86	5.20	4.42	0.24	2.09	3.64	2.54

Table 3.7: Trip Rates Summary (Trips per 10,000m² Site Area)

Site ID:	Sydney Metropolitan Area MA01 to MA08			Regional Area MA09 to MA12			All Surveyed Sites MA01 to MA12		
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Friday									
Person-based Trips									
Daily Person Trips									
- Car-based (parked on-site)	18.34	154.94	64.78	45.54	212.51	112.95	18.34	212.51	84.05
- Other	0.00	327.32	54.64	0.00	292.65	78.56	0.00	327.32	62.61
- TOTAL	26.86	327.32	103.22	47.05	505.16	191.51	26.86	505.16	132.65
Average Person Trips	3.16	36.37	11.80	5.54	53.17	20.58	3.16	53.17	14.73
Peak Person Trips									
- AM Peak	6.22	73.53	19.62	7.40	83.18	34.82	6.22	83.18	24.69
- PM Peak	5.90	64.04	21.87	6.45	84.40	29.82	5.90	84.40	24.52
Peak Network Hour Person Trips									
- AM Peak	3.51	11.41	7.14	7.40	58.89	31.03	3.51	58.89	16.10
- PM Peak	3.47	14.23	8.72	3.90	47.36	18.50	3.47	47.36	13.06
Vehicle-based Trips									
Daily Vehicle Trips	14.08	78.07	46.08	31.13	79.54	59.32	14.08	79.54	51.38
Peak Vehicle Trips									
- AM Peak	2.29	15.61	7.75	5.02	18.00	11.45	2.29	18.00	9.23
- PM Peak	3.28	22.58	9.18	4.22	14.57	8.86	3.28	22.58	9.05
Peak Network Hour Vehicle Trips									
- AM Peak	2.38	12.14	6.66	5.02	14.23	10.06	2.38	14.23	8.11
- PM Peak	3.47	6.07	4.95	2.63	8.50	6.47	2.63	8.50	5.82
Vessel Movements									
Daily Vessel Movements	1.97	135.20	28.88	0.56	26.72	9.92	0.56	135.20	22.56
Peak Vessel Movements	1.19	26.09	8.04	0.16	5.46	1.93	0.16	26.09	5.60
Saturday									
Person-based Trips									
Daily Person Trips									
- Car-based (parked on-site)	25.25	136.79	54.84	50.96	189.44	112.57	25.25	189.44	77.93
- Other	0.00	626.19	96.89	0.00	224.04	59.87	0.00	626.19	84.55
- TOTAL	25.25	626.19	138.02	52.15	413.48	172.44	25.25	626.19	149.49
Average Person Trips	3.16	69.58	15.69	6.14	43.52	18.59	3.16	69.58	16.66
Peak Person Trips	4.91	158.92	35.15	8.68	65.57	29.02	4.91	158.92	33.11
Peak Network Hour Person Trips	3.60	75.90	17.64	8.20	53.43	22.14	3.60	75.90	19.27
Vehicle-based Trips									
Daily Vehicle Trips	19.72	52.68	32.28	33.36	88.04	64.04	19.72	88.04	44.98
Peak Vehicle Trips	4.91	13.72	7.35	5.65	15.79	11.09	4.91	15.79	8.85
Peak Network Hour Vehicle Trips	1.78	6.94	3.65	5.65	13.36	9.01	1.78	13.36	6.03
Vessel Movements									
Daily Vessel Movements	2.21	163.66	33.13	0.88	36.43	12.75	0.88	163.66	26.34
Peak Vessel Movements	0.66	30.83	6.77	0.24	6.68	2.78	0.24	30.83	5.44

Site ID:	Sydney Metropolitan Area MA01 to MA08			Regional Area MA09 to MA12			All Surveyed Sites MA01 to MA12		
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Sunday									
Person-based Trips									
Daily Person Trips									
- Car-based (parked on-site)	28.22	137.67	54.09	77.86	138.43	111.38	28.22	138.43	77.01
- Other	0.00	394.57	65.09	0.00	145.11	40.09	0.00	394.57	56.76
- TOTAL	42.08	394.57	105.66	90.41	283.55	151.47	42.08	394.57	120.93
Average Person Trips	5.13	43.84	12.11	9.04	29.85	16.73	5.13	43.84	13.65
Peak Person Trips	8.30	79.17	23.28	17.78	55.25	28.99	8.30	79.17	25.19
Peak Network Hour Person Trips	1.73	45.24	10.87	10.05	34.00	19.48	1.73	45.24	13.74
Vehicle-based Trips									
Daily Vehicle Trips	18.02	53.12	30.16	52.74	90.68	64.69	18.02	90.68	43.97
Peak Vehicle Trips	4.15	10.62	6.28	9.52	13.81	11.73	4.15	13.81	8.46
Peak Network Hour Vehicle Trips	1.73	4.91	3.37	5.44	11.94	7.62	1.73	11.94	5.07
Vessel Movements									
Daily Vessel Movements	1.40	40.32	16.24	1.11	17.00	8.48	1.11	40.32	13.65
Peak Vessel Movements	0.89	11.86	4.29	0.24	3.64	2.13	0.24	11.86	3.57

Note: Zero vehicle counts from MA04 and MA06 have been excluded in this assessment

Figure 3.1: Comparison of Daily Person Trips per 10,000m² Site Area

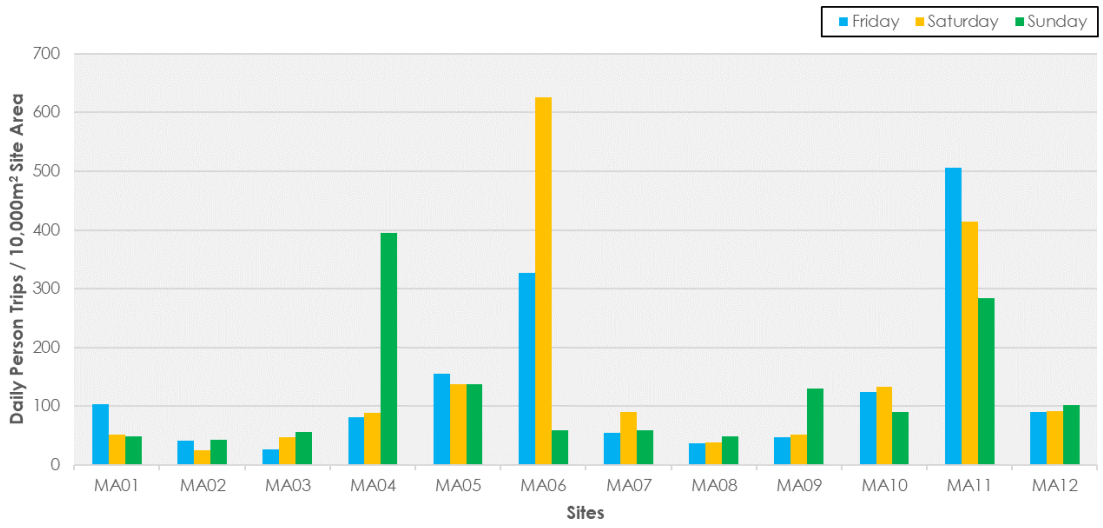


Figure 3.2: Comparison of Daily Vehicle Trips per 10,000m² Site Area

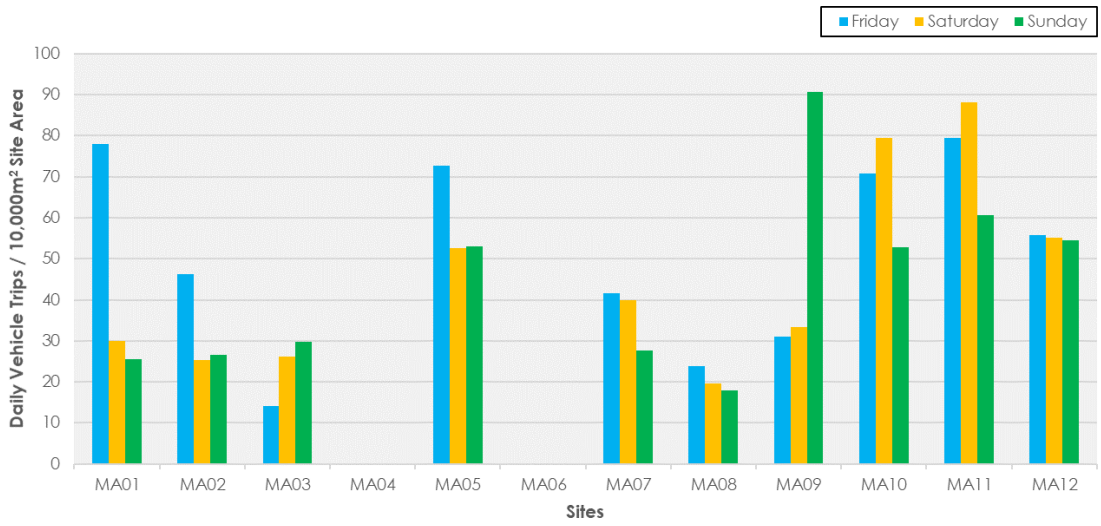


Figure 3.3: Comparison of Daily Vessel Movements per 10,000m² Site Area

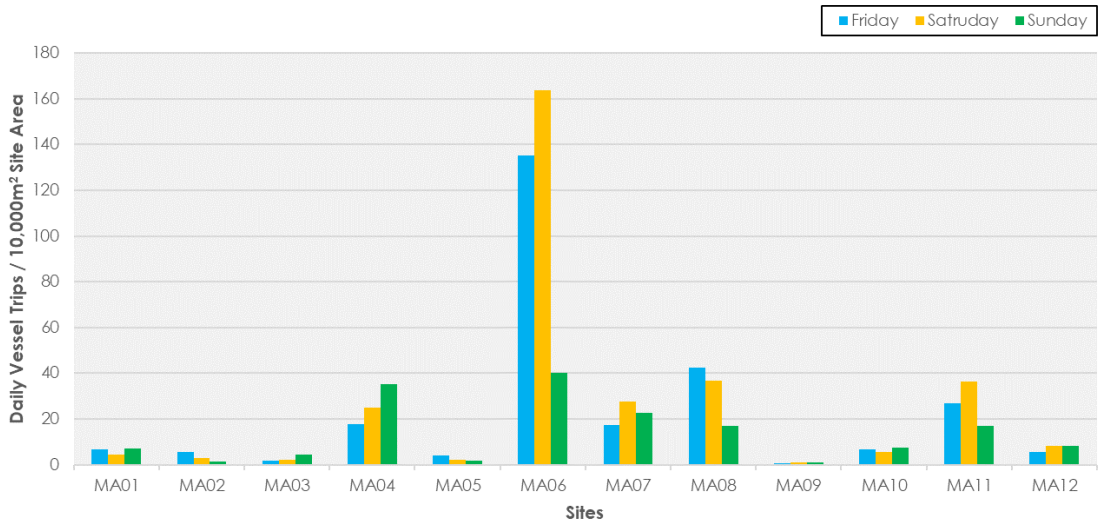


Figure 3.4: Comparison of Peak Hour Person Trips per 10,000m² Site Area

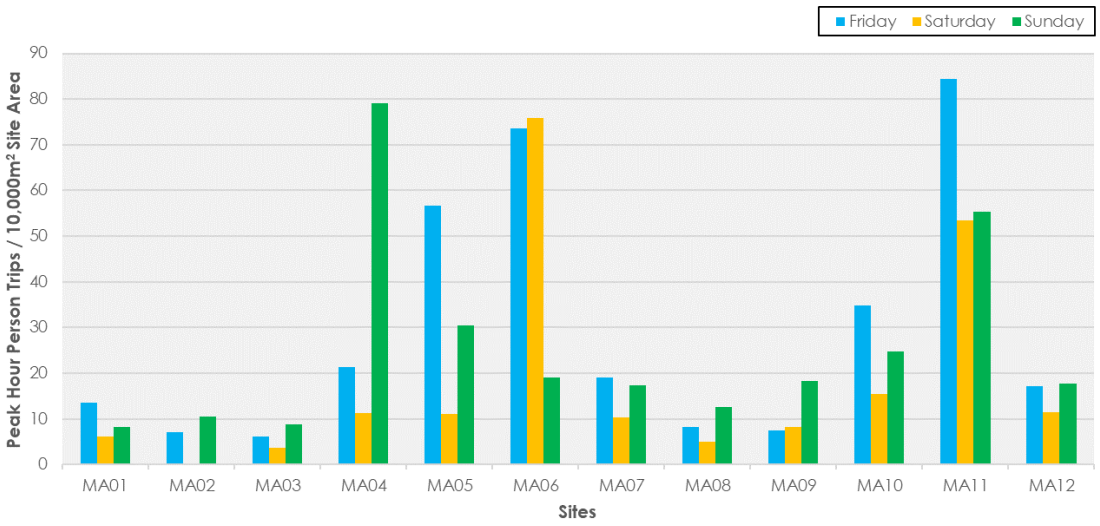


Figure 3.5: Comparison of Peak Hour Vehicle Trips per 10,000m² Site Area

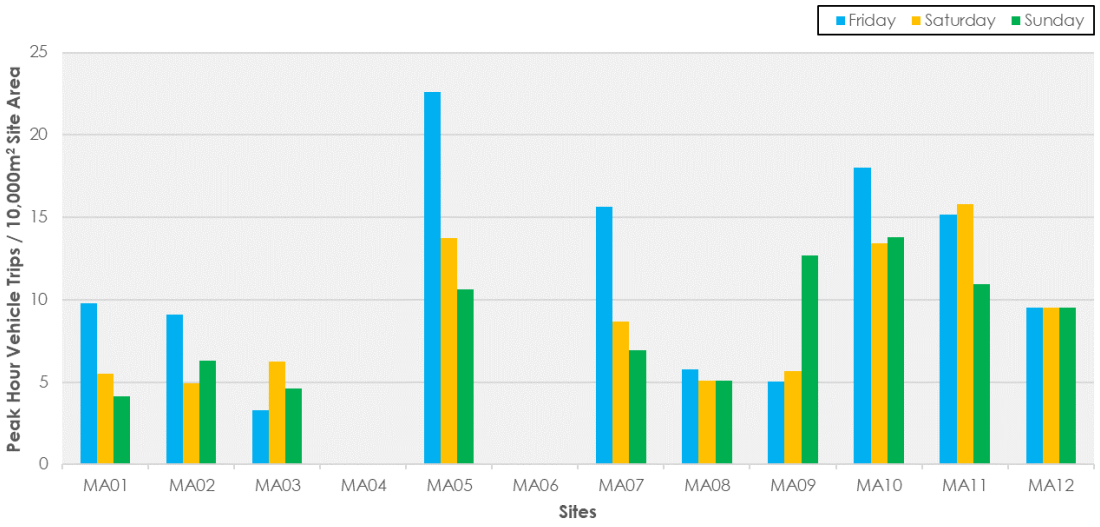


Figure 3.6: Comparison of Peak Hour Vessel Movements per 10,000m² Site Area

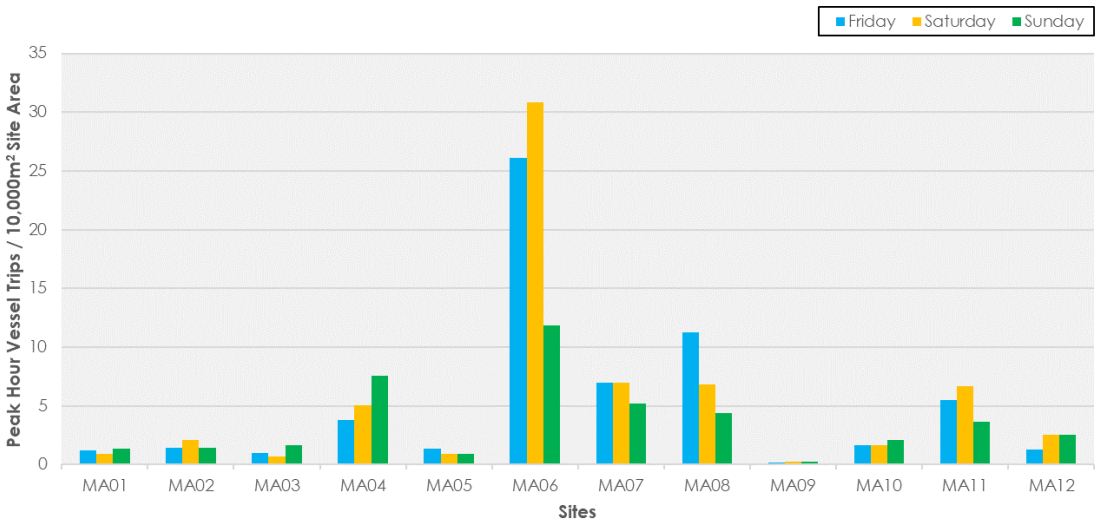


Table 3.8: Vehicle Trip Rates per Car Parking Space

Site ID:	Sydney Metropolitan Area								Regional Area			
	MA01	MA02	MA03	MA04	MA05	MA06	MA07	MA08	MA09	MA10	MA11	MA12
Name	Royal Motor Yacht Club, Broken Bay	Burraneer Bay Marina	D'Albora Marina Cabarita Point	Clontarf Marina	Royal Motor Yacht Club, Port Hacking	Double Bay Marina	Woolwich Marina	Sydney Superyacht Marina	Coffs Harbour Marina	Port Macquarie Marina	Soldiers Point Marina	Koolewong Marina
Total Parking Space	286	52	39	0	90	0	30	288	274	86	49	45
Friday												
Daily Vehicle Trips	1.84	1.27	1.10	-	1.82	-	0.80	0.24	1.43	1.97	2.67	1.96
Peak Vehicle Trips												
- AM Peak	0.22	0.19	0.18	-	0.17	-	0.30	0.06	0.23	0.50	0.51	0.27
- PM Peak	0.23	0.25	0.26	-	0.57	-	0.13	0.03	0.19	0.20	0.49	0.33
Peak Network Hour Vehicle Trips												
- AM Peak	0.20	0.10	-	-		-	0.23	0.02	0.23	0.40	0.37	-
- PM Peak	0.14	-	-	-	0.13	-	0.07	-	0.12	0.20	0.29	0.27
Saturday												
Daily Vehicle Trips	0.71	0.69	2.05	-	1.32	-	0.77	0.20	1.53	2.21	2.96	1.93
Peak Vehicle Trips	0.13	0.13	0.49	-	0.34	-	0.17	0.05	0.26	0.37	0.53	0.33
Peak Network Hour Vehicle Trips	0.04	-	0.18	-	0.12	-	0.13	0.02	0.26	0.28	0.45	0.24
Sunday												
Daily Vehicle Trips	0.60	0.73	2.33	-	1.33	-	0.53	0.18	4.16	1.47	2.04	1.91
Peak Vehicle Trips	0.10	0.17	0.36	-	0.27	-	0.13	0.05	0.58	0.38	0.37	0.33
Peak Network Hour Vehicle Trips	0.05	0.13	0.31	-	0.12	-	0.03	0.03	0.55	0.15	0.18	0.27

Note: No vehicle trips were recorded at MA04 and MA06 as there are no on-site parking facilities at these marinas. It is noted that there could be visitors and staff who travelled to site by car and parked on-street which were not included in the survey.

Table 3.9: Trip Rates Summary (Trips per Car Parking Space)

Site ID:	Sydney Metropolitan Area MA01 to MA08			Regional Area MA09 to MA12			All Surveyed Sites MA01 to MA12		
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Friday									
Daily Vehicle Trips	0.24	1.84	1.18	1.43	2.67	2.01	0.24	2.67	1.51
Peak Vehicle Trips									
- AM Peak	0.06	0.30	0.19	0.23	0.51	0.38	0.06	0.51	0.26
- PM Peak	0.03	0.57	0.25	0.19	0.49	0.30	0.03	0.57	0.27
Peak Network Hour Vehicle Trips									
- AM Peak	0.02	0.23	0.14	0.23	0.40	0.33	0.02	0.40	0.22
- PM Peak	0.07	0.14	0.11	0.12	0.29	0.22	0.07	0.29	0.17
Saturday									
Daily Vehicle Trips	0.20	2.05	0.96	1.53	2.96	2.16	0.20	2.96	1.44
Peak Vehicle Trips	0.05	0.49	0.22	0.26	0.53	0.37	0.05	0.53	0.28
Peak Network Hour Vehicle Trips	0.02	0.18	0.10	0.24	0.45	0.31	0.02	0.45	0.19
Sunday									
Daily Vehicle Trips	0.18	2.33	0.95	1.47	4.16	2.39	0.18	4.16	1.53
Peak Vehicle Trips	0.05	0.36	0.18	0.33	0.58	0.42	0.05	0.58	0.27
Peak Network Hour Vehicle Trips	0.03	0.31	0.11	0.15	0.55	0.29	0.03	0.55	0.18

Note: Zero vehicle counts from MA04 and MA06 have been excluded in this assessment

Figure 3.7: Comparison of Daily Vehicle Trips per Car Parking Space

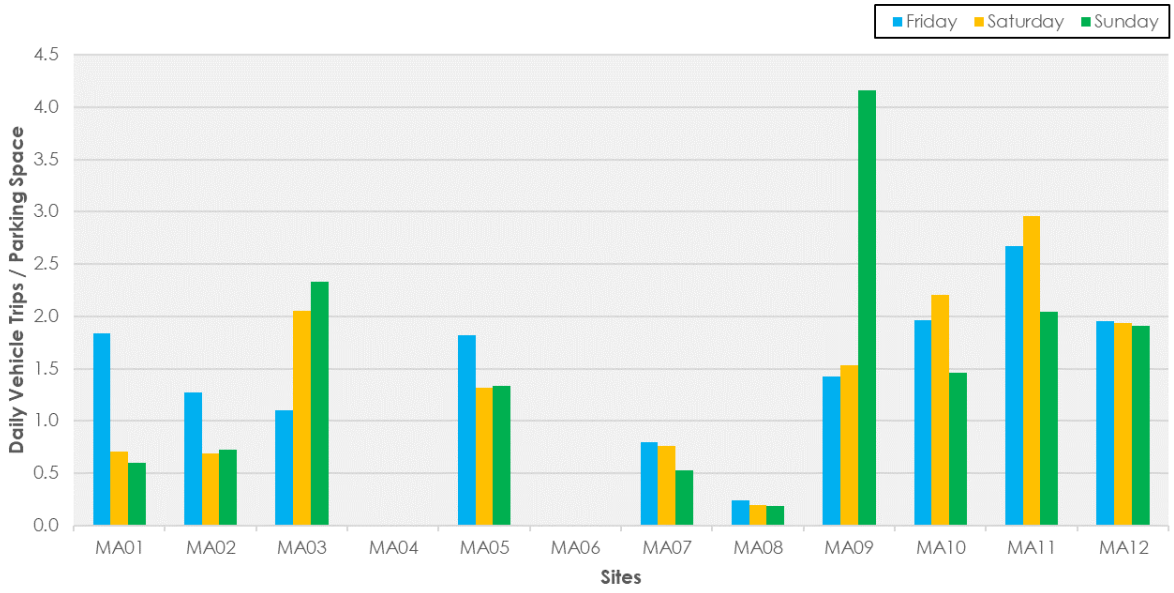


Figure 3.8: Comparison of Peak Hour Vehicle Trips per Car Parking Space

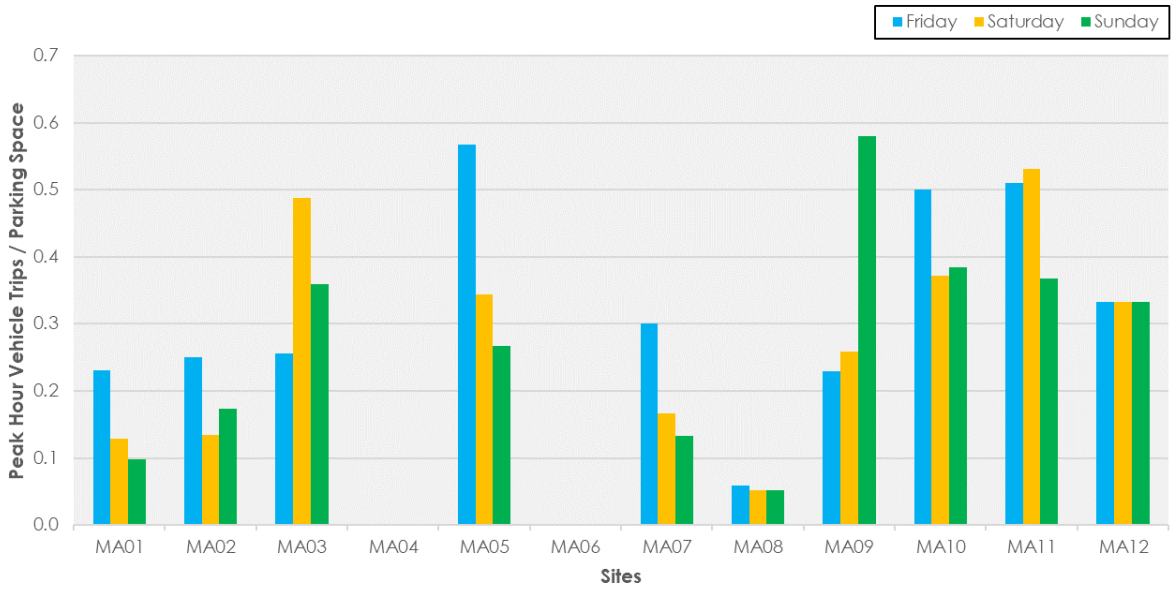


Table 3.10: Vehicle Trip Rates per Vessel Space (Swing Moorings + Wet Berths)

Site ID:	Sydney Metropolitan Area								Regional Area			
	MA01	MA02	MA03	MA04	MA05	MA06	MA07	MA08	MA09	MA10	MA11	MA12
Name	Royal Motor Yacht Club, Broken Bay	Burraneer Bay Marina	D'Albora Marina Cabarita Point	Clontarf Marina	Royal Motor Yacht Club, Port Hacking	Double Bay Marina	Woolwich Marina	Sydney Superyacht Marina	Coffs Harbour Marina	Port Macquarie Marina	Soldiers Point Marina	Koolewong Marina
Total Vessel Capacity	369	255	136	84	209	143	57	94	175	148	150	50
Friday												
Daily Vehicle Trips	1.43	0.26	0.32	-	0.78	-	0.42	0.74	2.23	1.14	0.87	1.76
Peak Vehicle Trips												
- AM Peak	0.17	0.04	0.05	-	0.07	-	0.16	0.18	0.36	0.29	0.17	0.24
- PM Peak	0.18	0.05	0.07	-	0.24	-	0.07	0.11	0.30	0.11	0.16	0.30
Peak Network Hour Vehicle Trips												
- AM Peak	0.16	0.02	-	-		-	0.12	0.07	0.36	0.23	0.12	-
- PM Peak	0.11	-	-	-	0.06	-	0.04	-	0.19	0.11	0.09	0.24
Saturday												
Daily Vehicle Trips	0.55	0.14	0.59	-	0.57	-	0.40	0.62	2.39	1.28	0.97	1.74
Peak Vehicle Trips	0.10	0.03	0.14	-	0.15	-	0.09	0.16	0.41	0.22	0.17	0.30
Peak Network Hour Vehicle Trips	0.03	-	0.05	-	0.05	-	0.07	0.07	0.41	0.16	0.15	0.22
Sunday												
Daily Vehicle Trips	0.47	0.15	0.67	-	0.57	-	0.28	0.56	6.51	0.85	0.67	1.72
Peak Vehicle Trips	0.08	0.04	0.10	-	0.11	-	0.07	0.16	0.91	0.22	0.12	0.30
Peak Network Hour Vehicle Trips	0.04	0.03	0.09	-	0.05	-	0.02	0.09	0.86	0.09	0.06	0.24

Note: No vehicle trips were recorded at MA04 and MA06 as there are no on-site parking facilities at these marinas. It is noted that there could be visitors and staff who travelled to site by car and parked on-street which were not included in the survey

Table 3.11: Trip Rates Summary (Trips per Vessel Space)

Site ID:	Sydney Metropolitan Area MA01 to MA08			Regional Area MA09 to MA12			All Surveyed Sites MA01 to MA12		
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Friday									
Daily Vehicle Trips	0.26	1.43	0.66	0.87	2.23	1.50	0.26	2.23	1.00
Peak Vehicle Trips									
- AM Peak	0.04	0.18	0.11	0.17	0.36	0.26	0.04	0.36	0.17
- PM Peak	0.05	0.24	0.12	0.11	0.30	0.22	0.05	0.30	0.16
Peak Network Hour Vehicle Trips									
- AM Peak	0.02	0.16	0.09	0.12	0.36	0.24	0.02	0.36	0.15
- PM Peak	0.04	0.11	0.07	0.09	0.24	0.16	0.04	0.24	0.12
Saturday									
Daily Vehicle Trips	0.14	0.62	0.48	0.97	2.39	1.60	0.14	2.39	0.93
Peak Vehicle Trips	0.03	0.16	0.11	0.17	0.41	0.27	0.03	0.41	0.18
Peak Network Hour Vehicle Trips	0.03	0.07	0.06	0.15	0.41	0.23	0.03	0.41	0.14
Sunday									
Daily Vehicle Trips	0.15	0.67	0.45	0.67	6.51	2.44	0.15	6.51	1.25
Peak Vehicle Trips	0.04	0.16	0.09	0.12	0.91	0.39	0.04	0.91	0.21
Peak Network Hour Vehicle Trips	0.02	0.09	0.05	0.06	0.86	0.31	0.02	0.86	0.16

Note: Zero vehicle counts from MA04 and MA06 have been excluded in this assessment

Figure 3.9: Comparison of Daily Vehicle Trips per Vessel Space

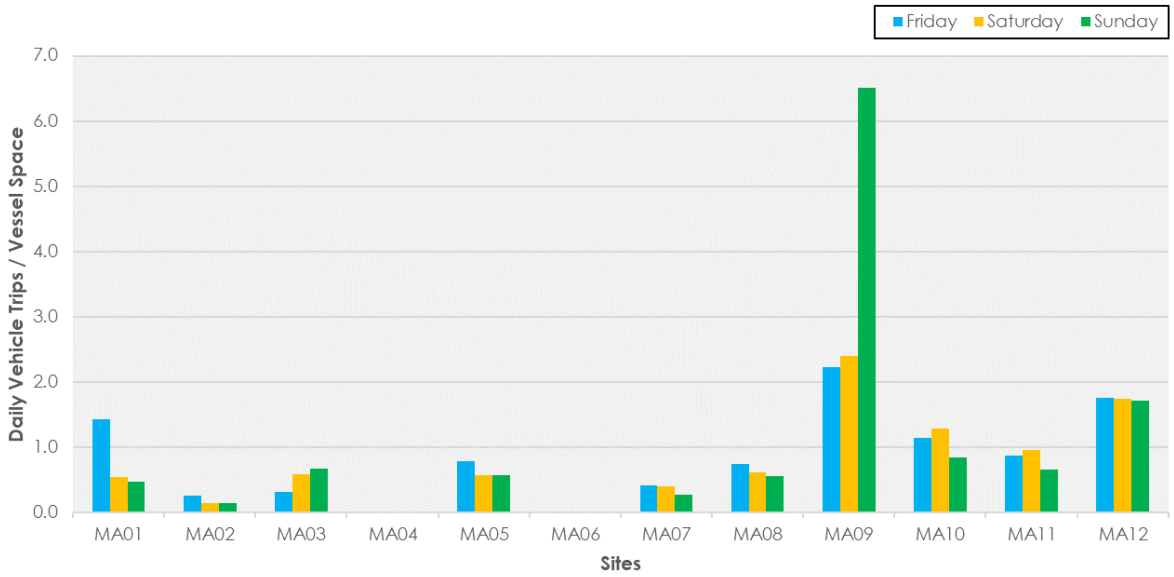
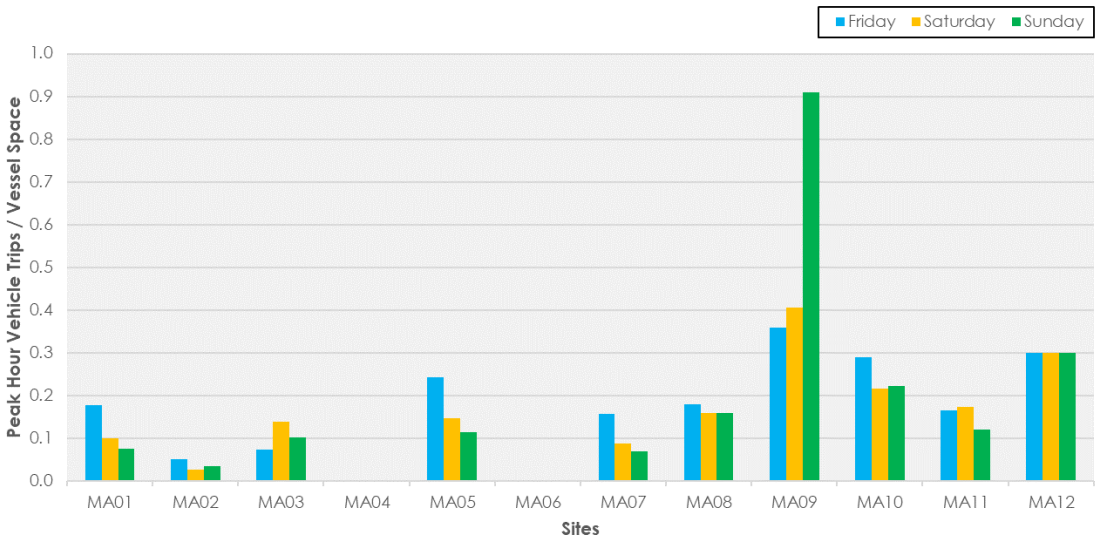


Figure 3.10: Comparison of Peak Hour Vehicle Trips per Vessel Space



The following have been observed from the survey data:

- The surveyed marina sites have site areas ranging from 4,216m^2 to 125,600m^2.
- The surveyed marina sites have vessel capacities (swing moorings plus wet berths) ranging from 50 to 369 vessels.
- Friday daily vehicle trip generation rate varied from 14.08 to 79.54 vehicle trips per 10,000m^2 site area, with an average of 51.38 vehicle trips per 10,000m^2 site area.
- Saturday daily vehicle trip generation rate varied from 19.72 to 88.04 vehicle trips per 10,000m^2 site area, with an average of 44.98 vehicle trips per 10,000m^2 site area.
- Sunday daily vehicle trip generation rate varied from 18.02 to 90.68 vehicle trips per 10,000m^2 site area, with an average of 43.97 vehicle trips per 10,000m^2 site area.
- Friday peak hour vehicle trip generation rate varied from 3.28 to 22.58 vehicle trips per 10,000m^2 site area, with an average of 9.23 vehicle trips per 10,000m^2 site area.
- Saturday peak hour vehicle trip generation rate varied from 4.91 to 15.79 vehicle trips per 10,000m^2 site area, with an average of 8.85 vehicle trips per 10,000m^2 site area.
- Sunday peak hour vehicle trip generation rate varied from 4.15 to 13.81 vehicle trips per 10,000m^2 site area, with an average of 8.46 vehicle trips per 10,000m^2 site area.
- Average peak hour vehicle trip generation per parking space is around 0.06, 0.05 and 0.05 vehicle trips per parking space for Friday, Saturday and Sunday, respectively.
- Average peak hour vehicle trip generation per vessel space is around 0.05, 0.03 and 0.04 vehicle trips per vessel space for Friday, Saturday and Sunday, respectively.
- The regional sites generally have higher trip generation rates than Sydney Metropolitan sites.

- Generally, higher trip rates are recorded on Friday morning peak period than the evening peak period.
- Trip variance over the survey period indicates that Saturday is the busiest day.

Figure 3.11: Daily Vehicle Trip Rates over Survey Period (per 10,000m² Site Area)

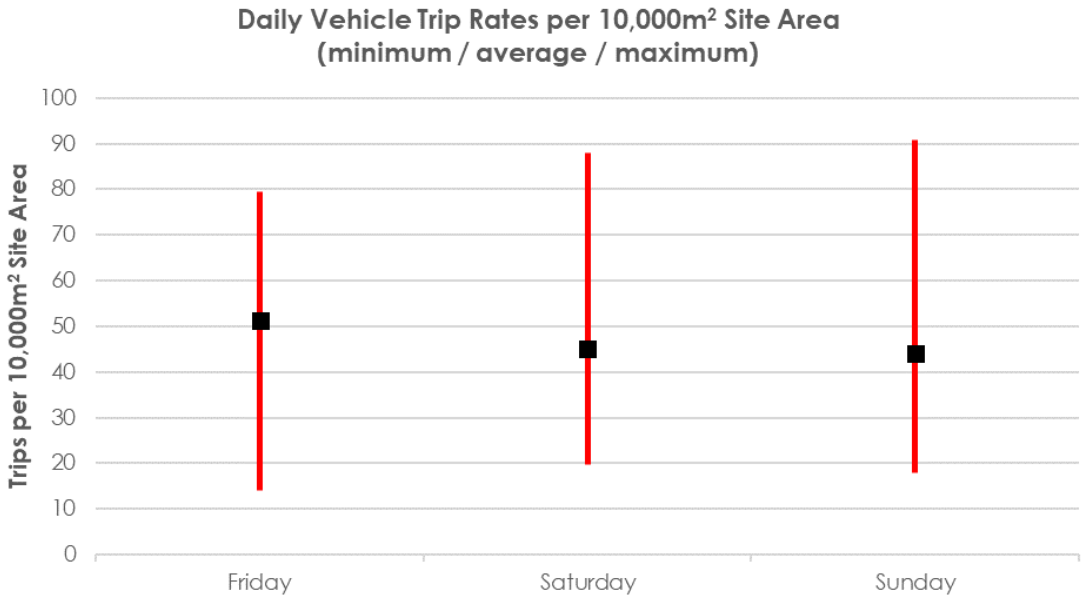


Figure 3.12: Peak Hour Vehicle Trip Rates over Survey Period (per 10,000m² Site Area)

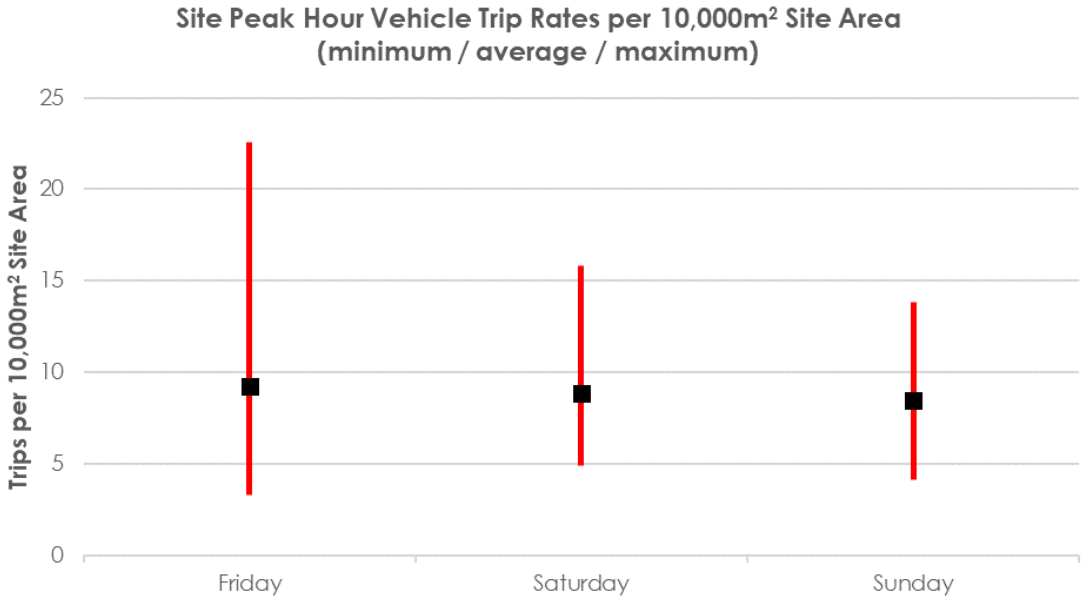


Figure 3.13: Daily Vehicle Trip Rates over Survey Period (per Parking Space)

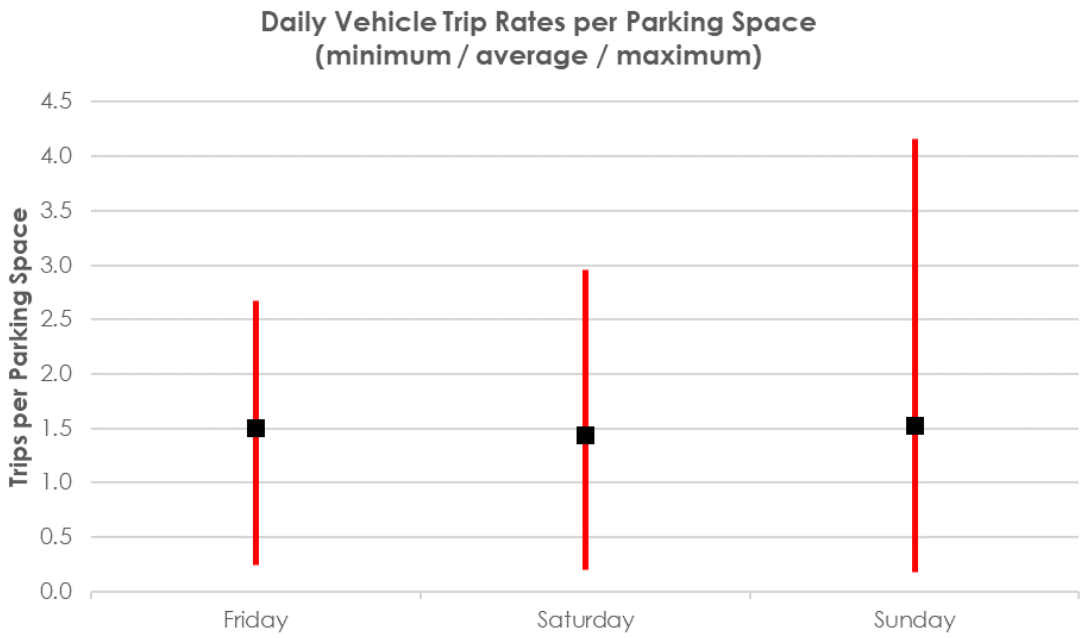


Figure 3.14: Peak Hour Vehicle Trip Rates over Survey Period (per Parking Space)

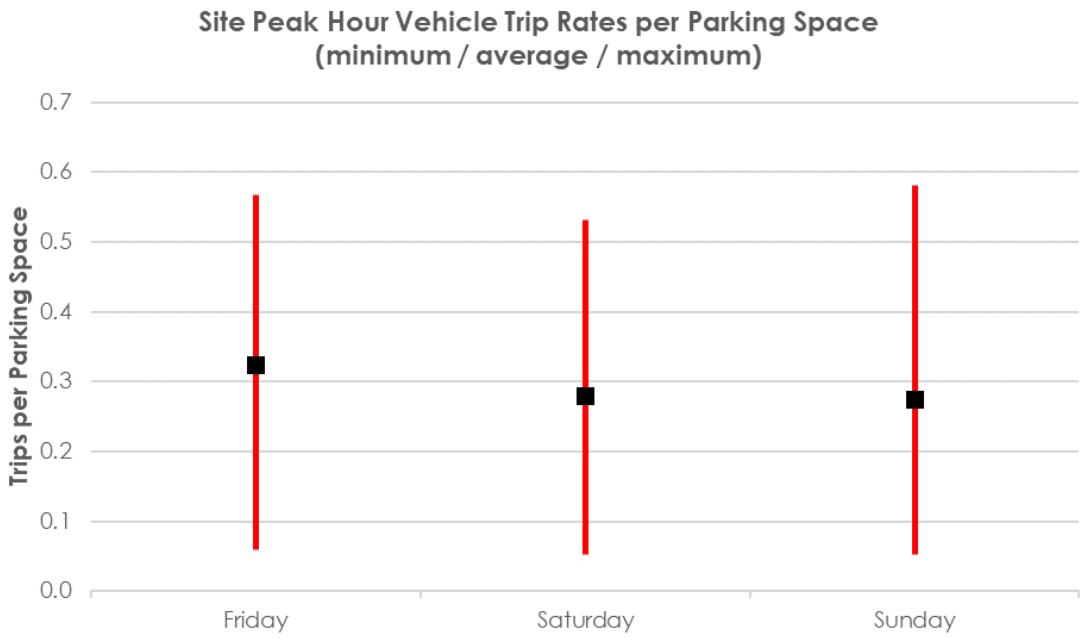


Figure 3.15: Daily Vehicle Trip Rates over Survey Period (per Vessel Space)

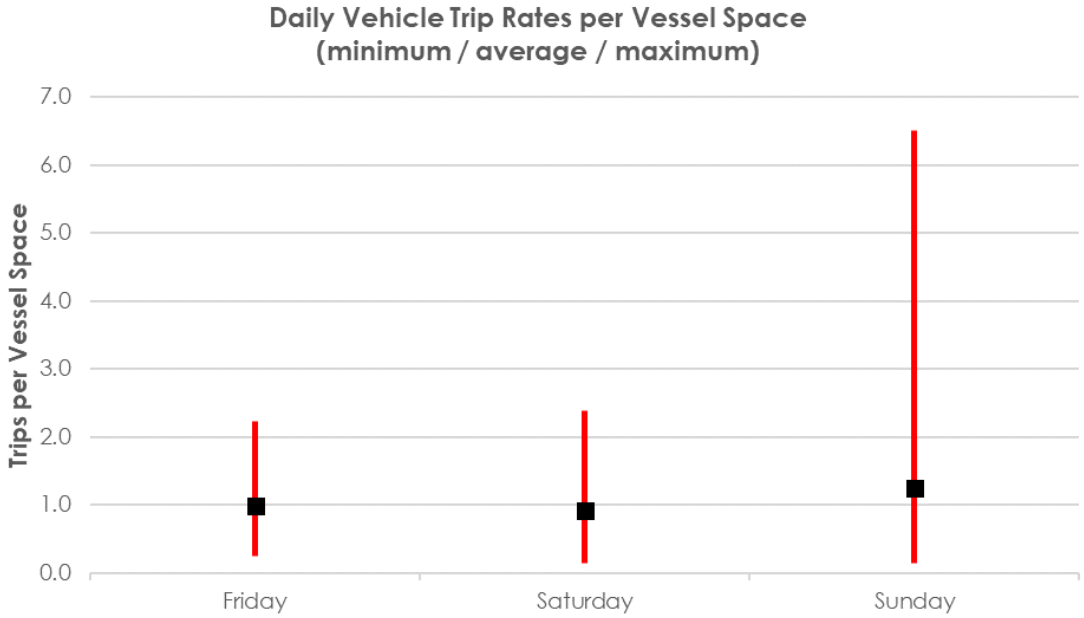
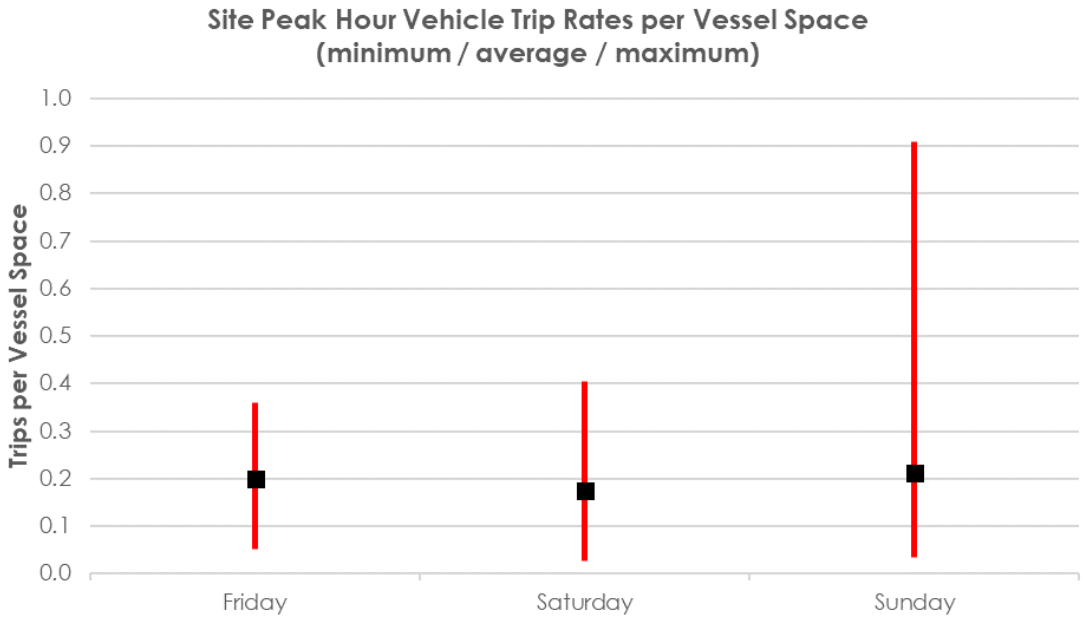


Figure 3.16: Peak Hour Vehicle Trip Rates over Survey Period (per Vessel Space)



3.4 Site Observation Results

Surveyors were assigned on site to observe the travel patterns of marinas' staff and visitors. The purpose of the site observations is to establish the following travel behaviours:

- purpose of travel (i.e. staff, visitor, others),
- mode of travel,
- parking location,
- car occupancy, and
- vessel location.

The number of observations at each site is summarised in Table 3.12.

Table 3.12: Number of Observations per Site

Site ID	Marinas	No. of Observations (sample size)			
		Friday	Saturday	Sunday	Total
MA01	Royal Motor Yacht Club, Broken Bay	218	102	99	**419**
MA02	Burraneer Bay Marina	25	18	18	**61**
MA03	D'Albora Marina Cabarita Point	24	44	56	**124**
MA04	Clontarf Marina	24	27	57	**108**
MA05	Royal Motor Yacht Club, Port Hacking	89	75	82	**246**
MA06	Double Bay Marina	44	54	12	**110**
MA07	Woolwich Marina	15	17	12	**44**
MA08	Sydney Superyacht Marina	35	33	32	**100**
MA09	Coffs Harbour Marina	116	147	199	**462**
MA10	Port Macquarie Marina	72	83	59	**214**
MA11	Soldiers Point Marina	100	85	52	**237**
MA12	Koolewong Marina	47	51	50	**148**
Total		**809**	**736**	**728**	**2,273**

Details of the site observation results are presented in the Data Report.

3.5 Parking Demand and Provision

The parking demand and parking supply rates have been calculated in relation to the site area and vessel space.

Table 3.13 provides a summary of the parking accumulation and parking provision rates of each marina site.

Table 3.13: Parking Demand and Provision Summary

Site ID:	Sydney Metropolitan Area								Regional Area			
	MA01	MA02	MA03	MA04	MA05	MA06	MA07	MA08	MA09	MA10	MA11	MA12
Name	Royal Motor Yacht Club, Broken Bay	Burraneer Bay Marina	D'Albora Marina Cabarita Point	Clontarf Marina	Royal Motor Yacht Club, Port Hacking	Double Bay Marina	Woolwich Marina	Sydney Superyacht Marina	Coffs Harbour Marina	Port Macquarie Marina	Soldiers Point Marina	Koolewong Marina
Site area (m²)	67,500	14,260	30,530	7,958	22,590	4,216	5,765	29,410	125,600	23,890	16,470	15,750
Vessel capacity												
- Swing moorings	77	149	21	20	135	95	17	68	10	43	50	0
- Wet berths	292	106	115	64	74	48	40	26	165	105	100	50
- Hard stand / rack storage	0	28	0	2	16	1	0	14	2	15	13	0
- TOTAL	369	283	136	86	225	144	57	108	177	163	163	50
On-site Parking	286	52	39	0	90	0	30	288	274	86	49	45
Peak Parking Accumulation												
- Friday (no. of spaces)	201	21	24	-	75	-	6	47	72	49	31	27
- Friday (% occupied)	70%	40%	62%	-	83%	-	20%	16%	26%	57%	63%	60%
- Saturday (no. of spaces)	109	11	40	-	82	-	5	53	111	50	39	35
- Saturday (% occupied)	38%	21%	103%	-	91%	-	17%	18%	41%	58%	80%	78%
- Sunday (no. of spaces)	128	10	36	-	78	-	5	45	248	67	29	32
- Sunday (% occupied)	45%	19%	92%	-	87%	-	17%	16%	91%	78%	59%	71%
Parking Rate												
- per 10,000m² site area	42.37	7.70	5.78	-	13.33	-	4.44	42.67	40.59	12.74	7.26	6.67
- per swing moorings	3.71	0.35	1.86	-	0.67	-	1.76	4.24	27.40	2.00	0.98	-
- per wet berths	0.98	0.49	0.34	-	1.22	-	0.75	11.08	1.66	0.82	0.49	0.90
- per hard stand / rack storage	-	1.86	-	-	5.63	-	-	20.57	137.00	5.73	3.77	-
- per swing moorings + wet berths	0.78	0.20	0.29	-	0.43	-	0.53	3.06	1.57	0.58	0.33	0.90

Note: No vehicle trips were recorded at MA04 and MA06 as there are no on-site parking facilities at these marinas. It is noted that there could be visitors and staff who travelled to site by car and parked on-street which were not included in the survey

Table 3.1: Parking Rates Summary

Site ID:	Sydney Metropolitan Area MA01 to MA08			Regional Area MA09 to MA12			All Surveyed Sites MA01 to MA12		
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Parking rate									
- per 10,000m2 site area	4.44	42.67	19.38	6.67	40.59	16.81	4.44	42.67	18.36
- per swing moorings	0.35	4.24	2.10	0.98	27.40	10.13	0.35	27.40	4.77
- per wet berths	0.34	11.08	2.48	0.49	1.66	0.97	0.34	11.08	1.87
- per hard stand / rack storage	1.86	20.57	9.35	3.77	137.00	48.83	1.86	137.00	29.09
- per swing moorings + wet berths	0.20	3.06	0.88	0.33	1.57	0.84	0.20	3.06	0.87

The parking analysis results presented in Table 3.13 and Table 3.1 indicate the following:

- The parking provision rate ranges from 4.44 to 42.67 spaces per 10,000m^2 site area.
- The parking provision rate ranges from 0.20 to 3.06 spaces per vessel space (i.e. swing moorings + wet berths).
- Peak parking accumulation generally had been accommodated by the on-site parking supply, with the exemption of D'Albora Marina Cabarita Point which had 103% peak parking accumulation on Saturday.

4 Regression Analysis

4.1 Linear Regression Analysis

The data has been analysed to determine the most consistent measure of trip generation and parking demand, using a simple linear regression approach that is the highest R^2 value.

As stated in Section 3.2.1, the following parameters have been used as key independent variables for this regression analysis:

- site area,
- vessel storage/berthing capacity, and
- number of parking spaces.

The trip behaviour is plotted against the following unit:

- daily total trips,
- site peak hour trips,
- network peak hour trips,
- parking supply, and
- parking accumulation.

4.1.1 Daily Total Trips per Site Area

Table 4.1 presents the summary of correlation coefficients of daily trips in relation to the site area.

Table 4.1: Summary of Correlation Coefficient (R^2) for Daily Trips per Site Area

	Person Trips	Vehicle Trips	Vessel Movements
Friday	0.30	0.61	0.00
Saturday	0.35	0.83	0.02
Sunday	0.79	0.86	0.03

Results presented in Table 4.1 indicate the following:

- For person trips, R^2 is generally low with maximum of 0.79 on Sunday.
- For vehicle trips, R^2 is generally above 0.6, with highest R^2 obtained from Sunday trips.
- Very low R^2 values are observed between daily vessel movements and site area.

Figure 4.1: Daily Person Trips per Site Area (Friday)

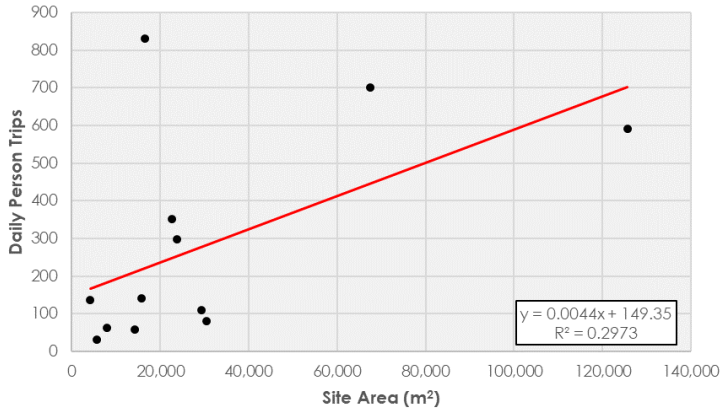


Figure 4.2: Daily Person Trips per Site Area (Saturday)

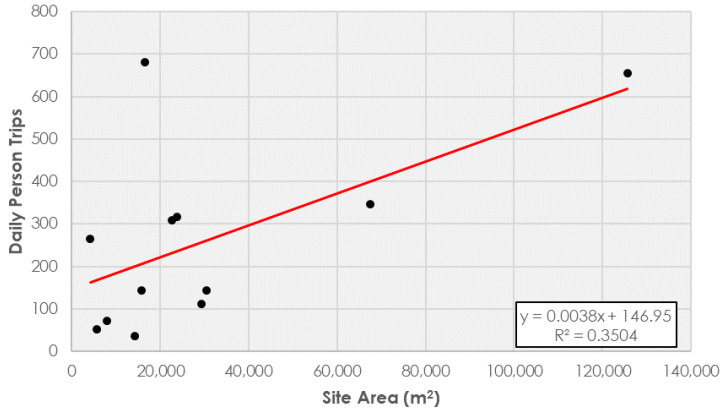


Figure 4.3: Daily Person Trips per Site Area (Sunday)

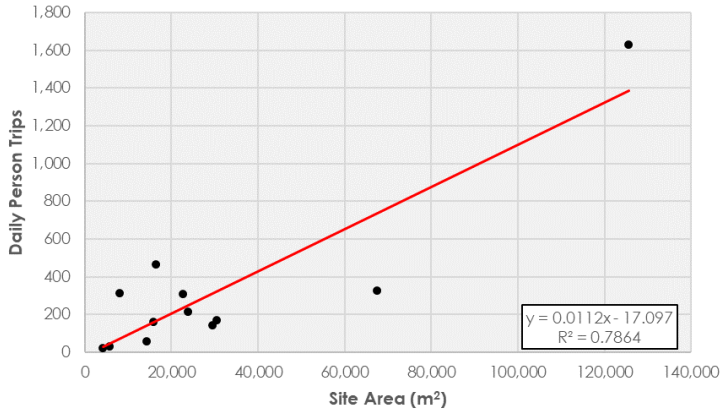


Figure 4.4: Daily Vehicle Trips per Site Area (Friday)

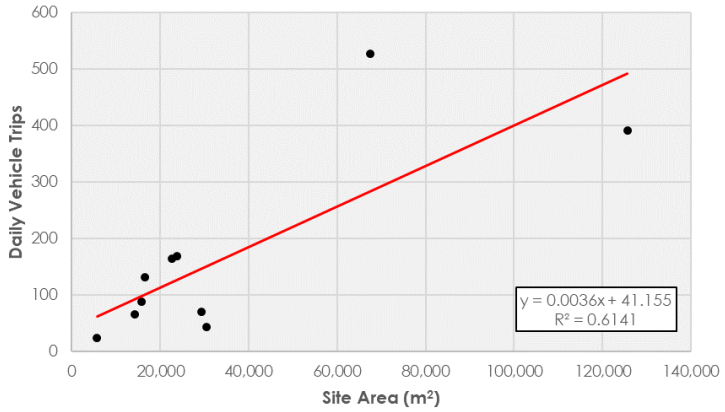


Figure 4.5: Daily Vehicle Trips per Site Area (Saturday)

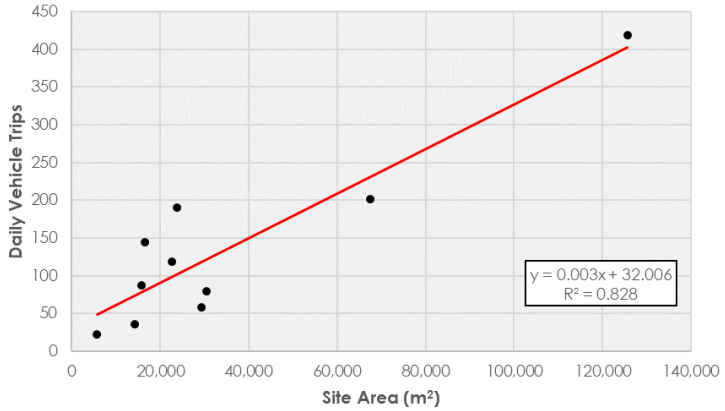


Figure 4.6: Daily Vehicle Trips per Site Area (Sunday)

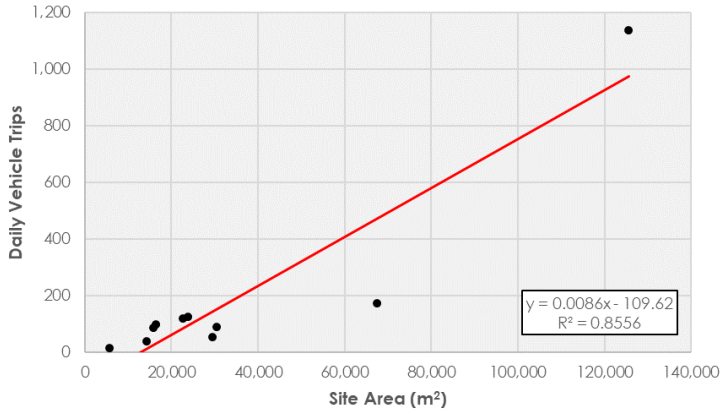


Figure 4.7: Daily Vessel Movements per Site Area (Friday)

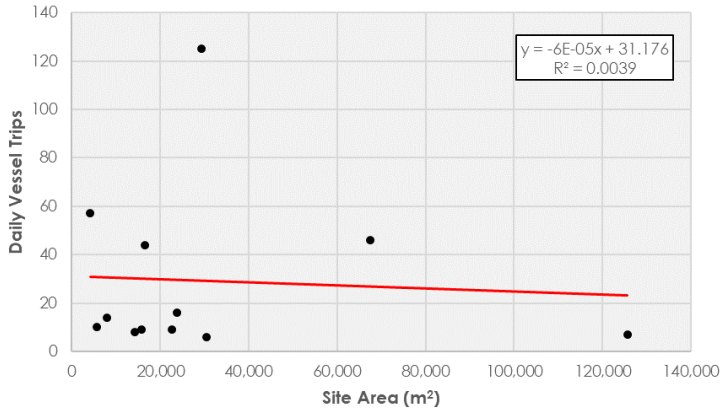


Figure 4.8: Daily Vessel Movements per Site Area (Saturday)

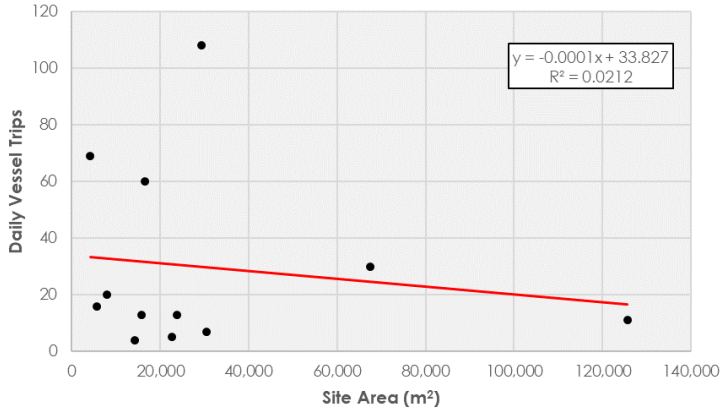
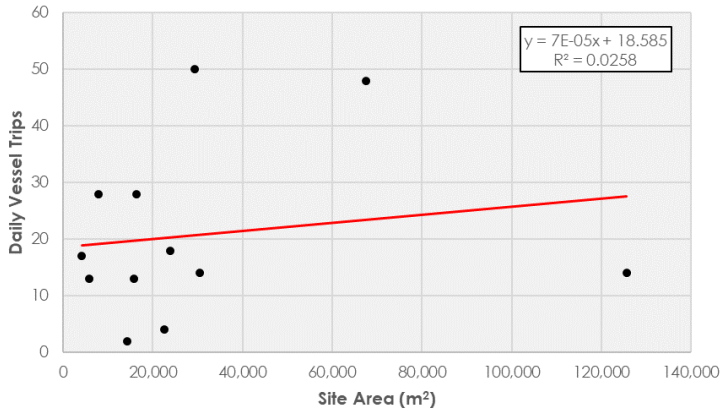


Figure 4.9: Daily Vessel Movements per Site Area (Sunday)



4.1.2 Site Peak Hour Trips per Site Area

Table 4.2 presents the summary of correlation coefficients of daily trips in relation to the site area.

Table 4.2: Summary of Correlation Coefficient (R^2) for Site Peak Hour Trips per Site Area

	Person Trips	Vehicle Trips	Vessel Movements
Friday	0.14	0.53	0.00
Saturday	0.27	0.83	0.03
Sunday	0.72	0.85	0.00

Results presented in Table 4.2 indicate the following:

- For person trips, R^2 is generally low on Friday and Saturday, but with significantly higher R^2 of 0.72 on Sunday.
- For vehicle trips, R^2 is generally above 0.5, with highest R^2 obtained from Sunday trips.
- Very low R^2 values are observed between daily vessel movements and site area.

Figure 4.10: Site Peak Hour Person Trips per Site Area (Friday)

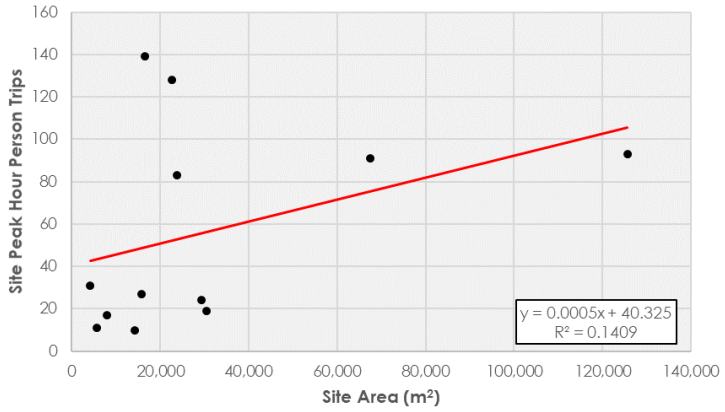


Figure 4.11: Site Peak Hour Person Trips per Site Area (Saturday)

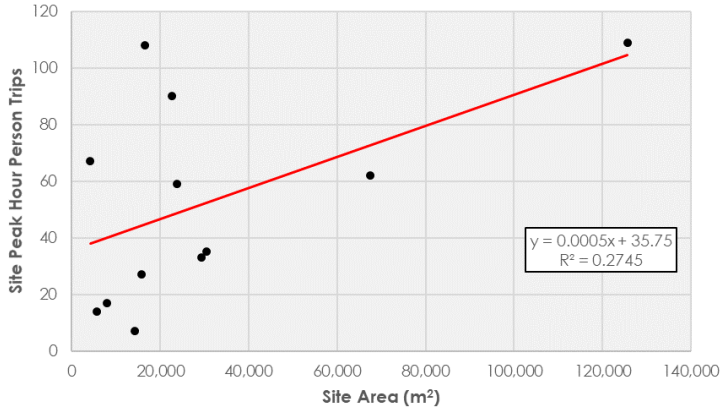


Figure 4.12: Site Peak Hour Person Trips per Site Area (Sunday)

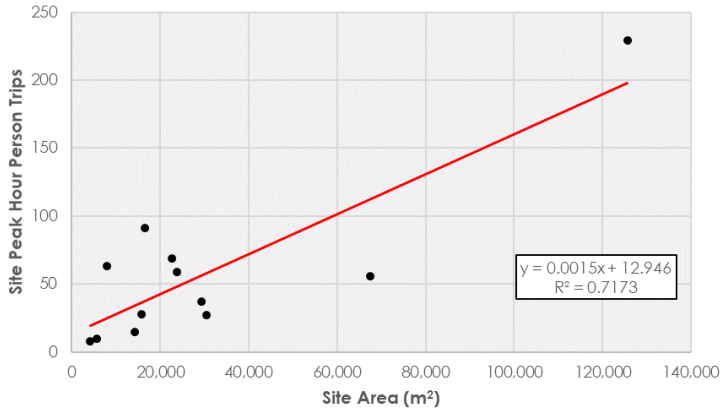


Figure 4.13: Site Peak Hour Vehicle Trips per Site Area (Friday)

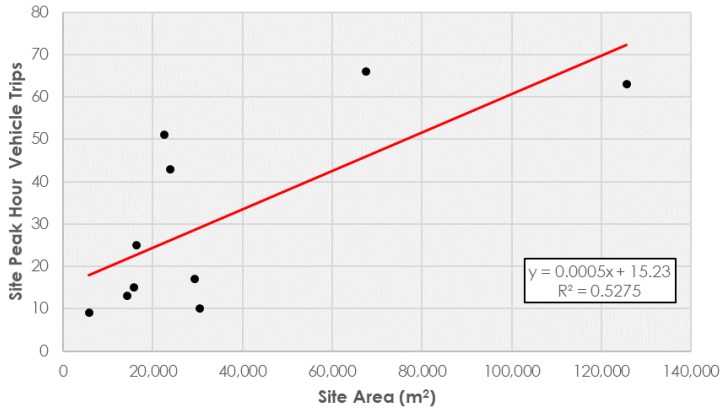


Figure 4.14: Site Peak Hour Vehicle Trips per Site Area (Saturday)

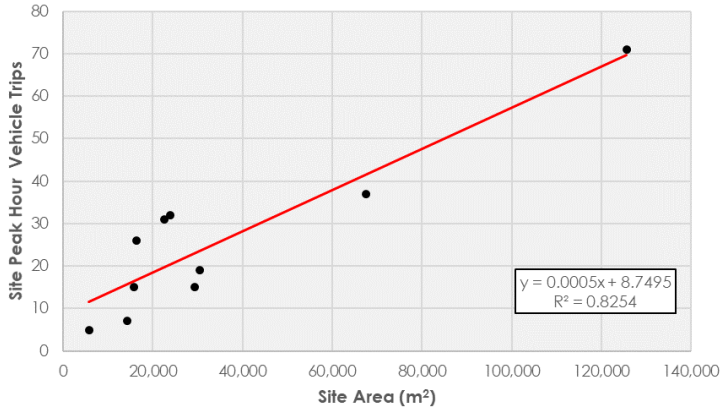


Figure 4.15: Site Peak Hour Vehicle Trips per Site Area (Sunday)

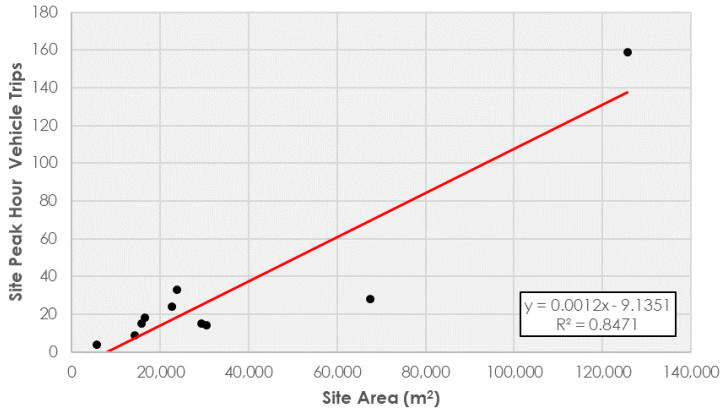


Figure 4.16: Site Peak Hour Vessel Movements per Site Area (Friday)

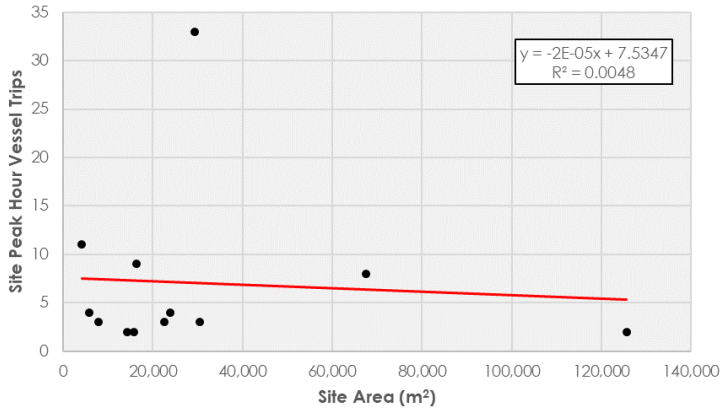


Figure 4.17: Site Peak Hour Vessel Movements per Site Area (Saturday)

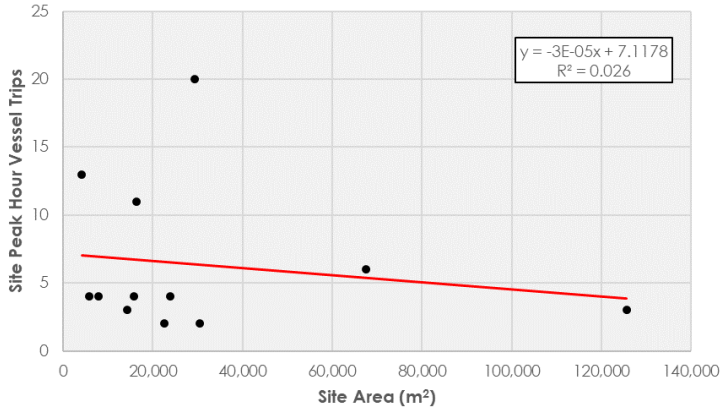
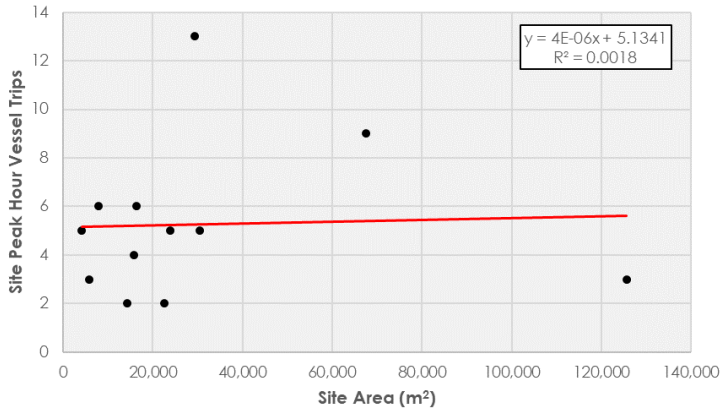


Figure 4.18: Site Peak Hour Vessel Movements per Site Area (Sunday)



4.1.3 Network Peak Hour Trips per Site Area

Table 4.3 presents the summary of correlation coefficients of daily trips in relation to the site area.

Table 4.3: Summary of Correlation Coefficient (R^2) for Network Peak Hours per Site Area

	Person Trips	Vehicle Trips
Friday	0.44	0.77
Saturday	0.45	0.71
Sunday	0.75	0.82

Results presented in Table 4.3 indicate the following:

- For person trips, R^2 is generally low with maximum of 0.75 on Sunday.
- For vehicle trips, R^2 is generally above 0.7, with highest R^2 obtained from Sunday trips.

Figure 4.19: Network Peak Hour Person Trips per Site Area (Friday)

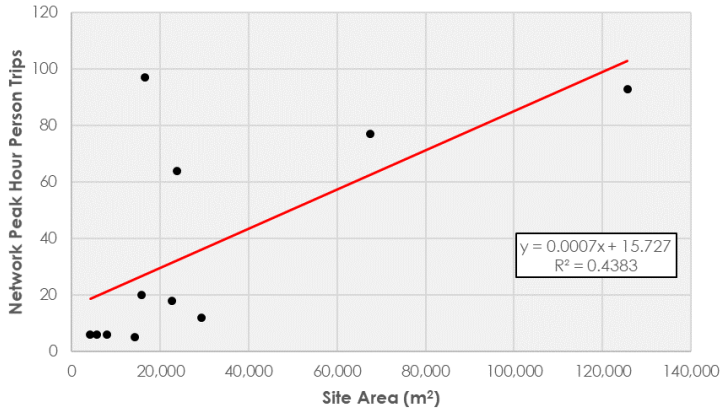


Figure 4.20: Network Peak Hour Person Trips per Site Area (Saturday)

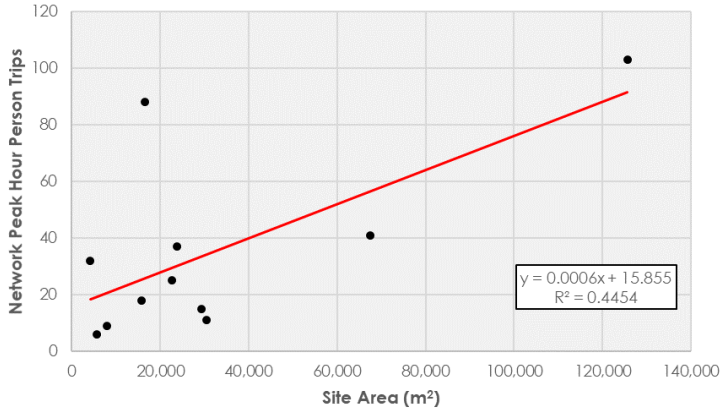


Figure 4.21: Network Peak Hour Person Trips per Site Area (Sunday)

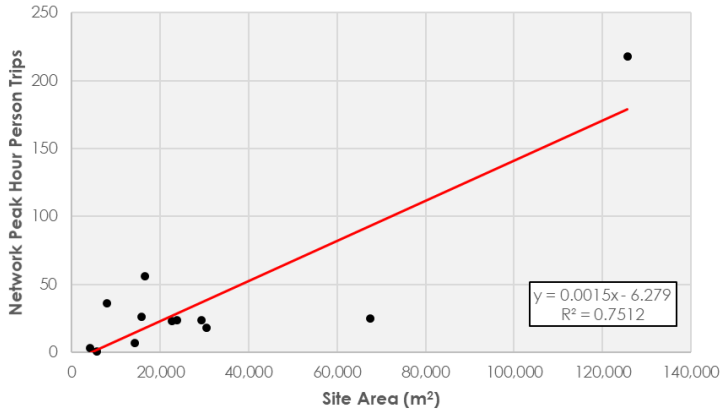


Figure 4.22: Network Peak Hour Vehicle Trips per Site Area (Friday)

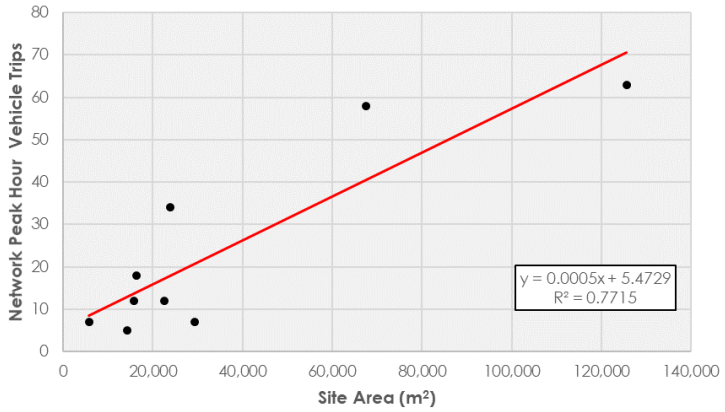


Figure 4.23: Network Peak Hour Vehicle Trips per Site Area (Saturday)

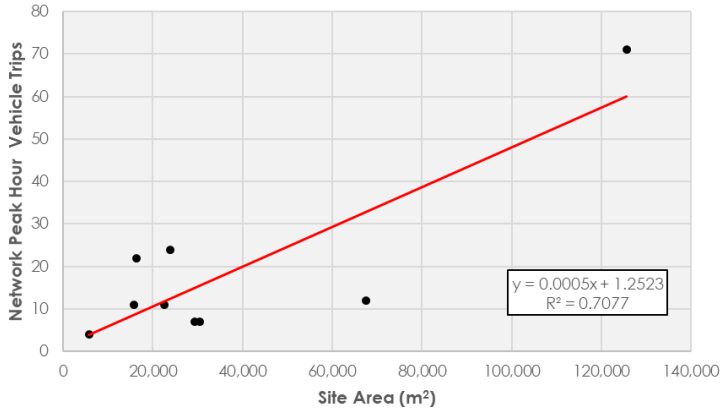
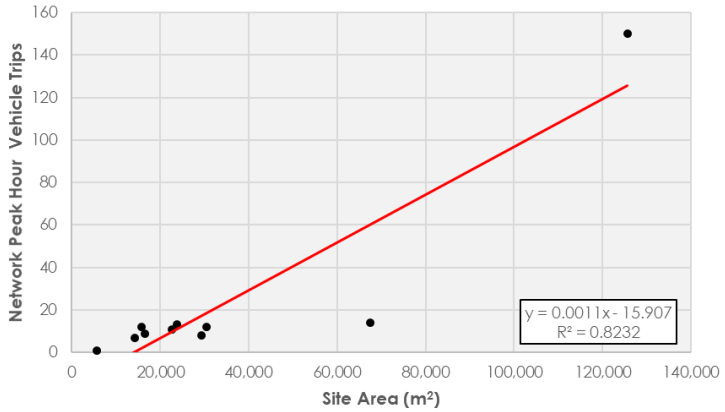


Figure 4.24: Network Peak Hour Vehicle Trips per Site Area (Sunday)



4.1.4 Vehicle Trips per Parking Space

A summary of coefficients obtained from the correlation of vehicle trips and number of on-site parking spaces is provided in Table 4.4.

Table 4.4: Summary of Correlation Coefficient (R^2) for Vehicle Trips per Parking Space

	Daily Trips	Site Peak Hour Trips	Network Peak Hour Trips
Friday	0.50	0.38	0.40
Saturday	0.31	0.34	0.16
Sunday	0.26	0.28	0.24

Results presented in Table 4.4 indicate that there is a low correlation between vehicle trips and on-site parking provision. The highest R^2 value obtained is 0.50 from the correlation of Friday daily trips and parking spaces.

Figure 4.25: Daily Vehicle Trips per Parking Space (Friday)

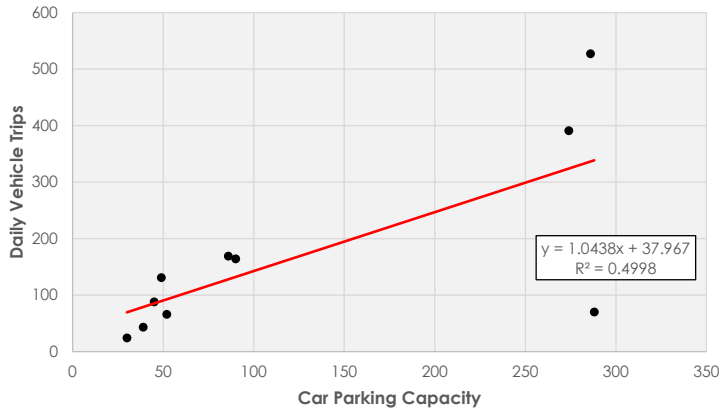


Figure 4.26: Daily Vehicle Trips per Parking Space (Saturday)

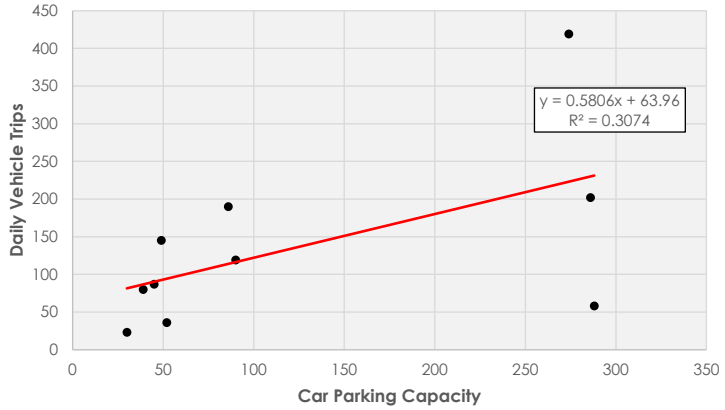


Figure 4.27: Daily Vehicle Trips per Parking Space (Sunday)

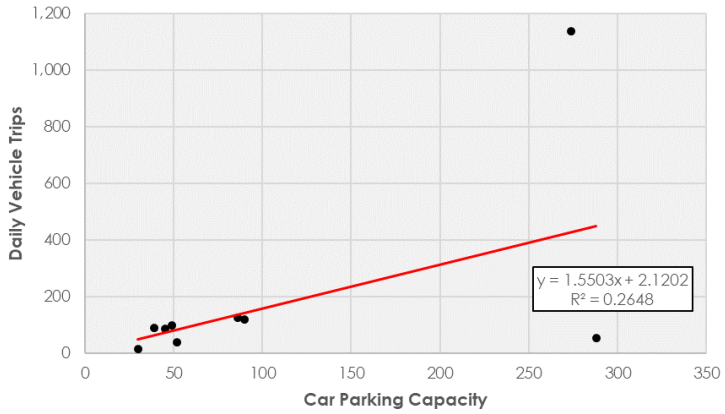


Figure 4.28: Site Peak Hour Vehicle Trips per Parking Space (Friday)

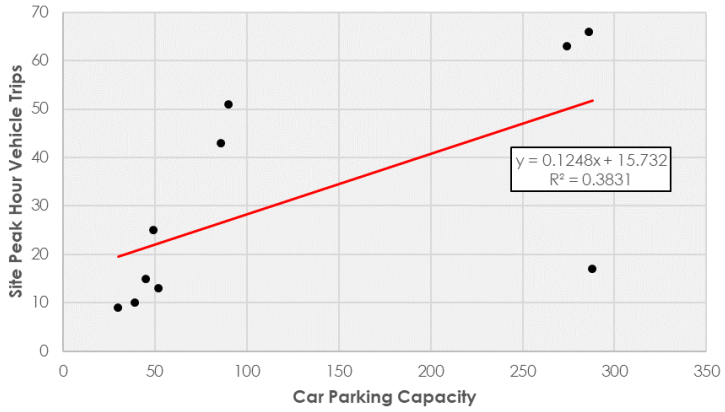


Figure 4.29: Site Peak Hour Vehicle Trips per Parking Space (Saturday)

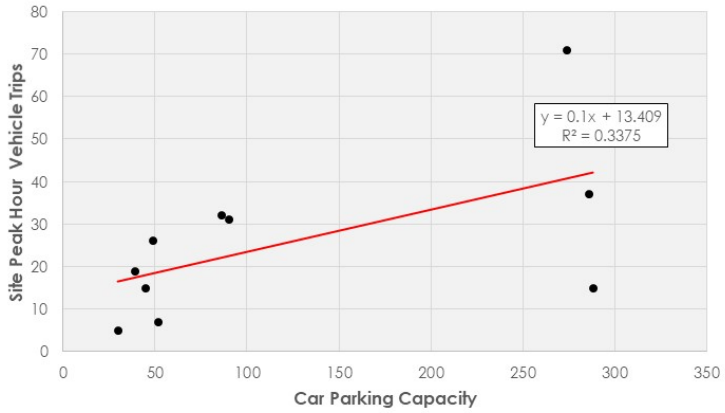


Figure 4.30: Site Peak Hour Vehicle Trips per Parking Space (Sunday)

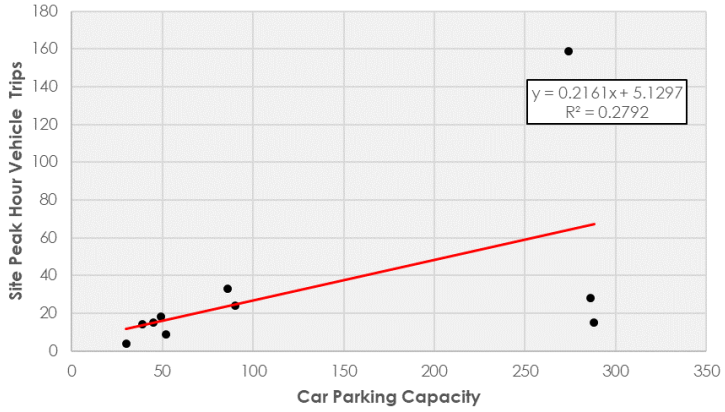


Figure 4.31: Network Peak Hour Vehicle Trips per Parking Space (Friday)

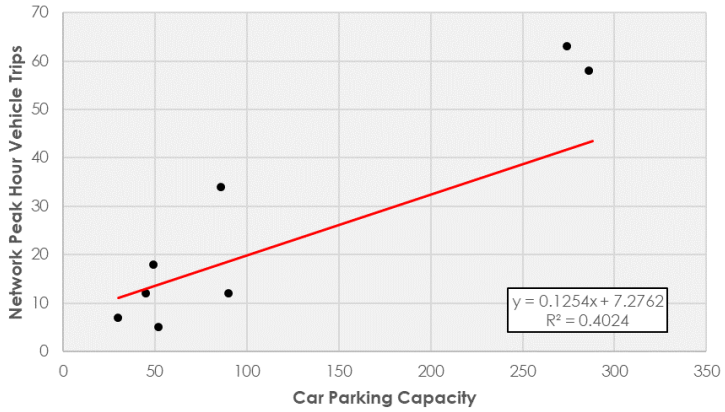


Figure 4.32: Network Peak Hour Vehicle Trips per Parking Space (Saturday)

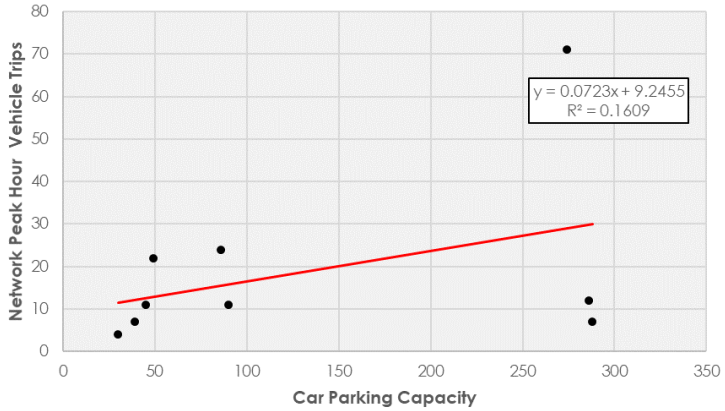
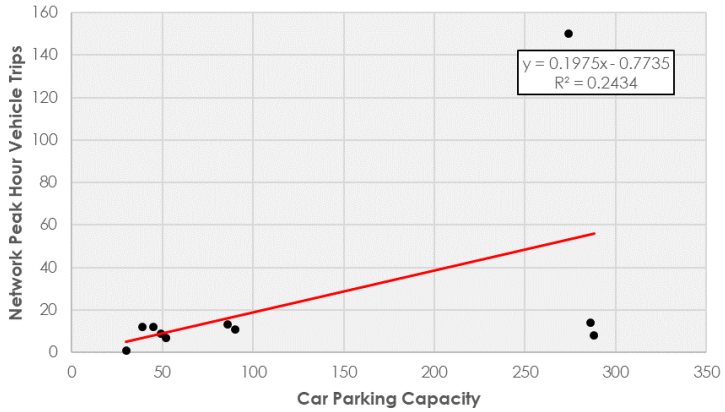


Figure 4.33: Network Peak Hour Vehicle Trips per Parking Space (Sunday)



4.1.5 Vehicle Trips per Vessel Space

Table 4.5 provides the summary of correlation coefficient between vehicle trips and vessel space (i.e. total number of swing moorings and wet berths).

As observed in Figure 4.34 to Figure 4.42, MA09 data (highlighted in a different colour) stands out as an outlier for Saturday and Sunday results. Thus, this data has been excluded in the linear regression analysis between vehicle trips and vessel capacity for these survey days.

Table 4.5: Summary of Correlation Coefficient (R^2) for Vehicle Trips per Vessel Space (Swing Mooring + Wet Berth)

	Daily Trips	Site Peak Hour Trips	Network Peak Hour Trips
Friday	0.52	0.41	0.27
Saturday	0.27	0.30	0.05
Sunday	0.37	0.21	0.18

Results presented in Table 4.5 indicate that there is a low correlation between vehicle trips and vessel space. The highest R^2 value obtained is 0.52 from the correlation of Friday daily trips and vessel space.

Figure 4.34: Daily Vehicle Trips per Vessel Space (Friday)

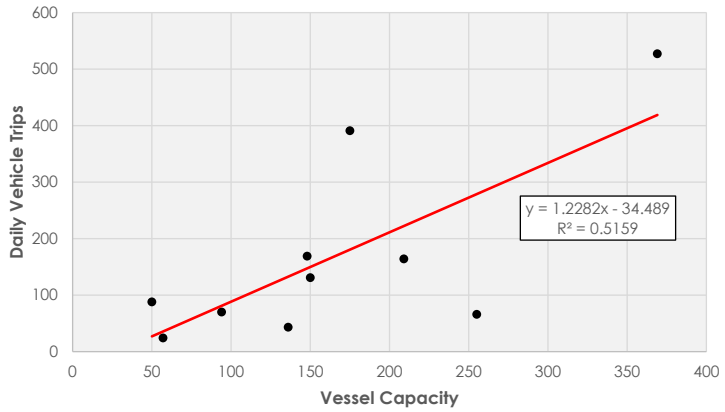


Figure 4.35: Daily Vehicle Trips per Vessel Space (Saturday)

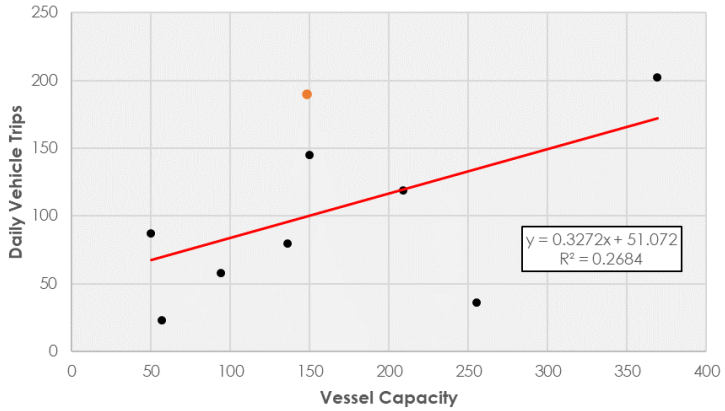


Figure 4.36: Daily Vehicle Trips per Vessel Space (Sunday)

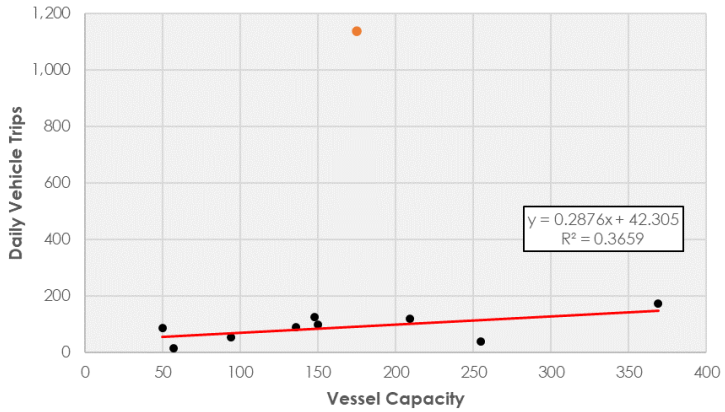


Figure 4.37: Site Peak Hour Vehicle Trips per Vessel Space (Friday)

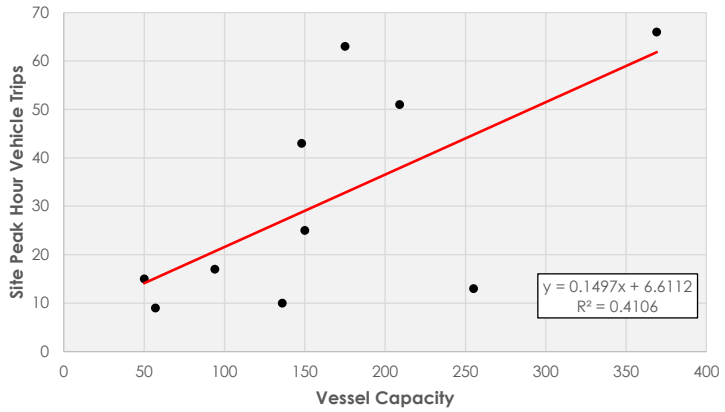


Figure 4.38: Site Peak Hour Vehicle Trips per Vessel Space (Saturday)

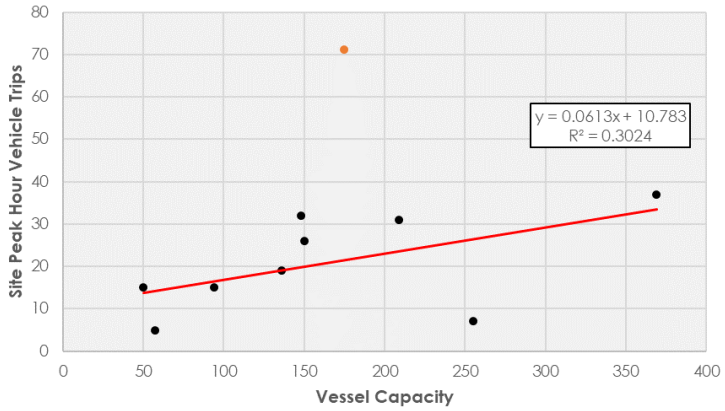


Figure 4.39: Site Peak Hour Vehicle Trips per Vessel Space (Sunday)

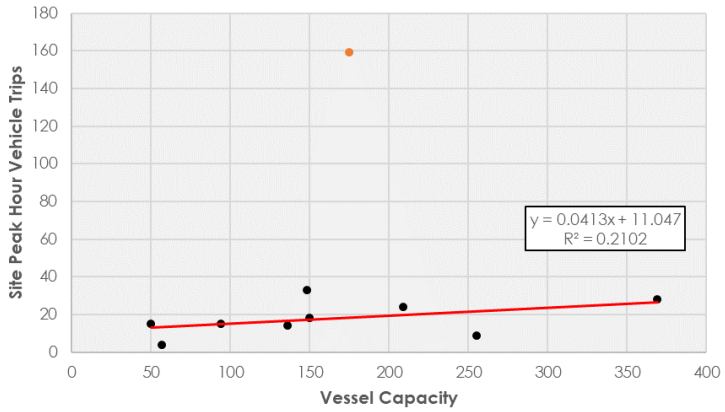


Figure 4.40: Network Peak Hour Vehicle Trips per Vessel Space (Friday)

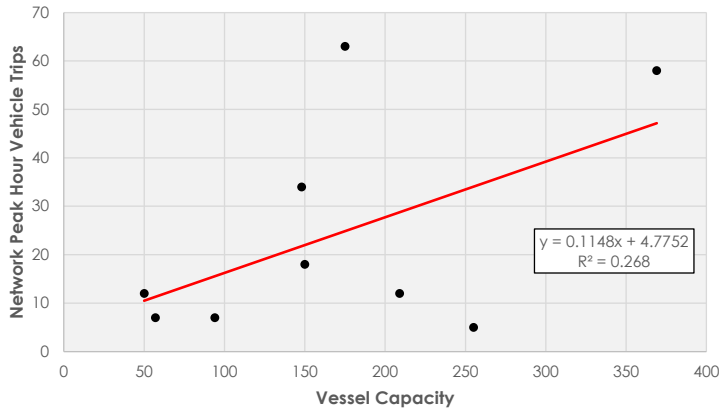


Figure 4.41: Network Peak Hour Vehicle Trips per Vessel Space (Saturday)

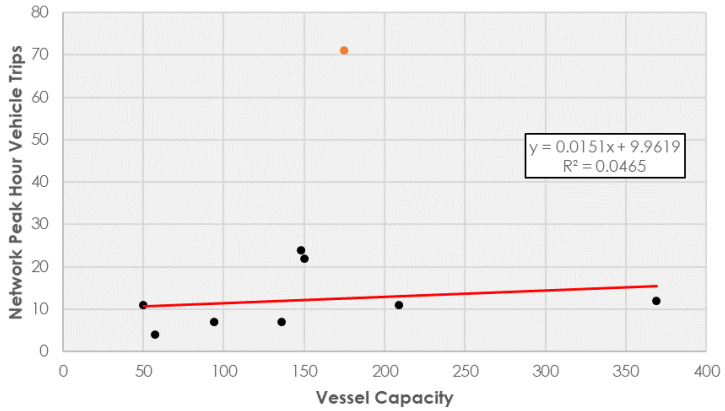
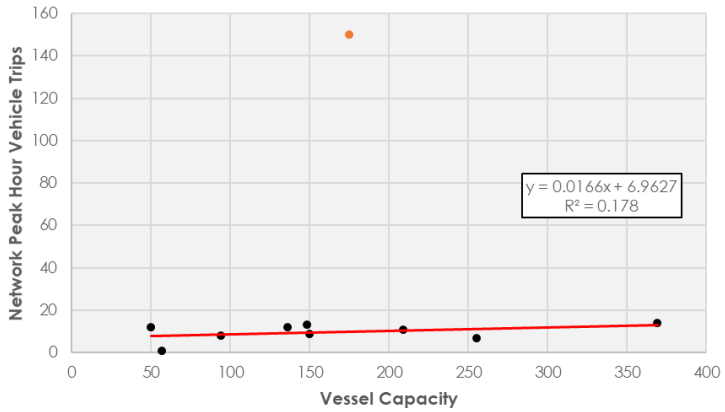


Figure 4.42: Network Peak Hour Vehicle Trips per Vessel Space (Sunday)



4.1.6 Parking Spaces per Site Area

Table 4.6 presents the summary of correlation coefficients of parking provision and demand in relation to the site area.

Table 4.6: Summary of Correlation Coefficient (R^2) for Parking Supply/Demand per Site Area

	Parking Supply	Parking Accumulation
Friday	0.59	0.27
Saturday		0.67
Sunday		0.94

Results presented in Table 4.3 indicate the following:

- R^2 of parking supply against site area is 0.59,
- The highest R^2 of parking accumulation per site area is obtained from Sunday data, with R^2 value of 0.94, and
- The lowest R^2 of parking accumulation per site area is obtained from Friday data, with R^2 value of 0.27.

Figure 4.43: Parking Supply per Site Area

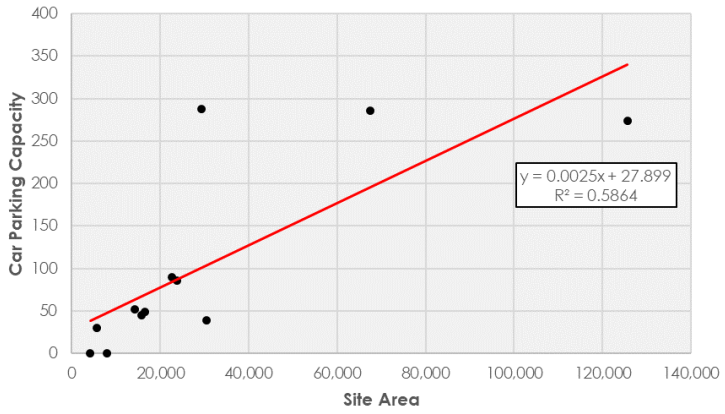


Figure 4.44: Parking Demand per Site Area (Friday)

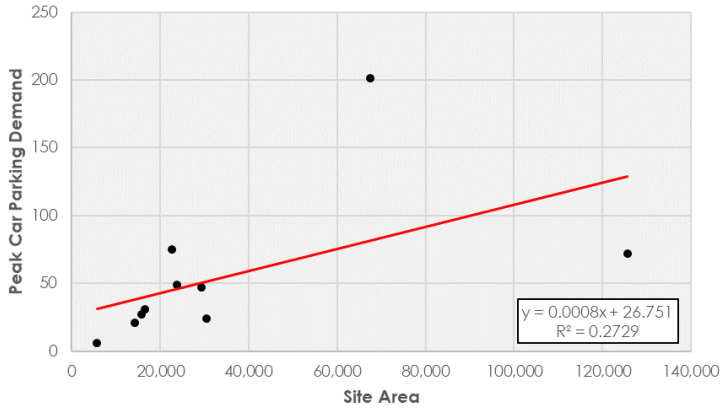


Figure 4.45: Parking Demand per Site Area (Saturday)

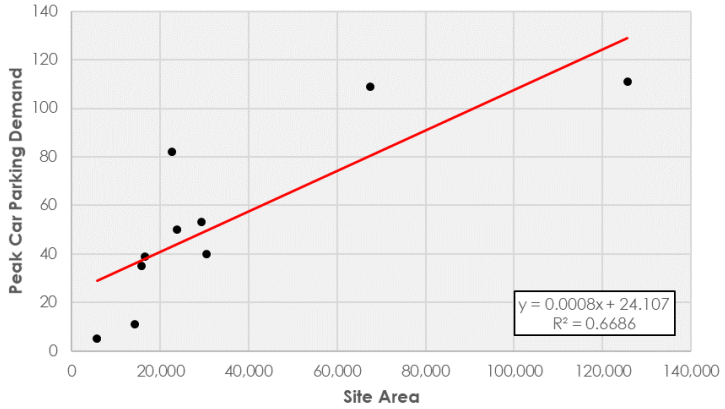
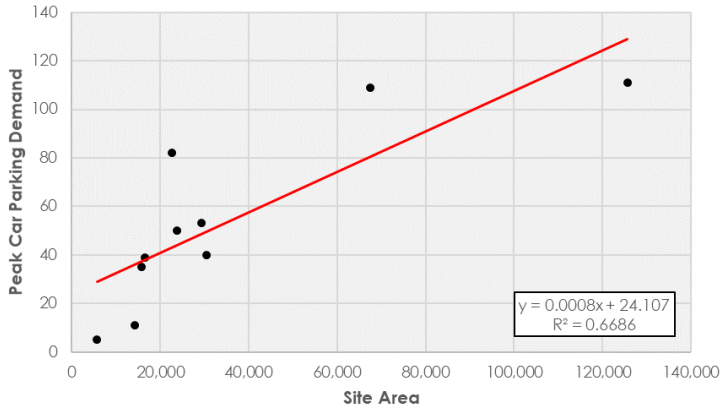


Figure 4.46: Parking Demand per Site Area (Sunday)



4.1.7 Parking Spaces per Vessel Space

Table 4.7 presents the summary of correlation coefficients of parking provision and demand in relation to vessel space (i.e. total number of swing moorings and wet berths).

Table 4.7: Summary of Correlation Coefficient (R^2) for Parking Supply/Demand per Vessel Space

	Parking Supply	Parking Accumulation
Friday	0.20	0.63
Saturday		0.30
Sunday		0.14

Results presented in Table 4.3 indicate the following:

- R^2 of parking supply against vessel space is 0.20,
- The highest R^2 of parking accumulation per site area is obtained from Friday data, with R^2 value of 0.64, and
- The lowest R^2 of parking accumulation per site area is obtained from Sunday data, with R^2 value of 0.14.

Figure 4.47: Parking Supply per Vessel Space

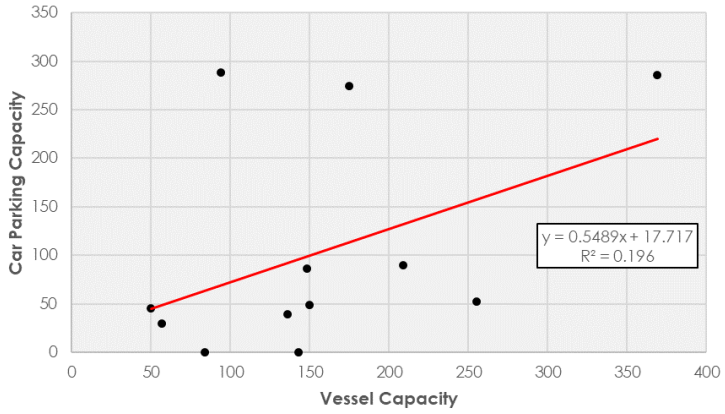


Figure 4.48: Parking Demand per Vessel Space (Friday)

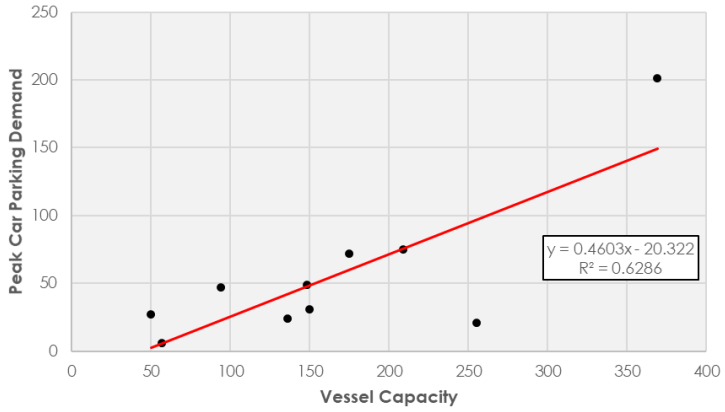


Figure 4.49: Parking Demand per Vessel Space (Saturday)

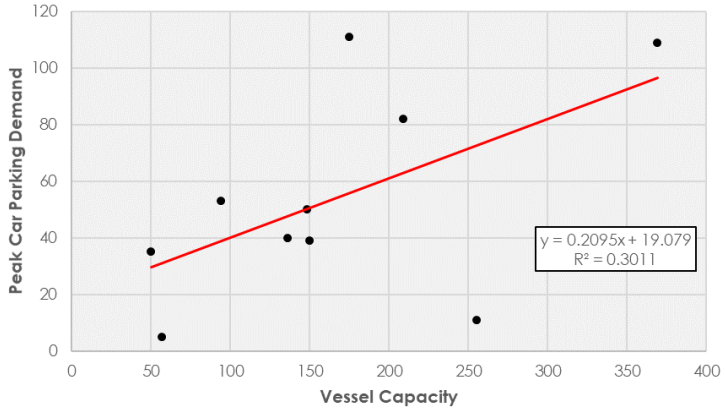
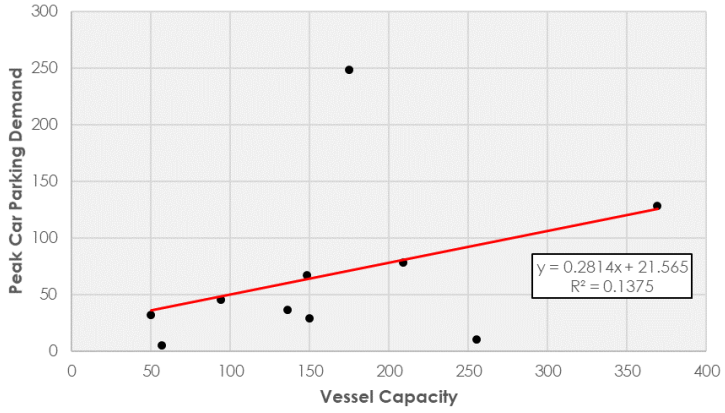


Figure 4.50: Parking Demand per Vessel Space (Sunday)



4.2 Multiple Regression Analysis

Multiple linear regression methods refer to measuring travel patterns as a function of several independent variables. These procedures have been used in a number of trip generation and parking studies and are considered to be more appropriate for particular land use types such as shopping centres, service stations, marinas and business parks according to Roads and Maritime Guide to Traffic Generating Developments 2002.

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 the dependent variable (trip behaviour) against independent variables (such as number of vessel space per type). The closer the value of R^2 to 1.0, the better the model. In this study, an R^2 value above 0.8 represents an acceptable level of correlation.

A number of equation models have been assessed to determine the correlation of the following variables against number of vessel space per type (i.e. swing mooring, wet berth, hard stand):

- daily total vehicle trips,
- site peak hour vehicle trips,
- network peak hour vehicle trips,
- parking supply, and
- peak parking accumulation.

The following independent variables are defined as follows:

- A: Swing moorings,
- B: Wet berths, and
- C: Hard stand.

Figure 4.51 presents the proportion of swing moorings, wet berths and hard stand at each marina site.

Figure 4.51: Proportion of Vessel Space per Type

As discussed in Section 4.1.5, MA09 has been excluded in the linear regression analysis of vehicle trips and vessel spaces for Saturday and Sunday data. For consistency, MA09 has also been excluded in the Saturday and Sunday multiple regression analysis of vehicle trips.

The multiple regression analysis has been undertaken using Microsoft Excel data analysis tool. The summary of the analysis outputs is presented below.

4.2.1 Daily Vehicle Trips

Friday: $DVT = -22.3 - 0.08A + 1.88B - 0.87C$ $R^2 = 0.80$

Saturday: $DVT = 43.26 - 0.76A + 0.74B + 3.55C$ $R^2 = 0.55$

Sunday: $DVT = 45.76 - 0.11A + 0.47B + 0.25C$ $R^2 = 0.55$

4.2.2 Site Peak Hour Vehicle Trips

Friday AM: $SPVT = 2.40 - 0.28A + 0.27B + 1.17C$ $R^2 = 0.72$

Friday PM: $SPVT = 3.61 + 0.22A + 017B - 0.93C$ $R^2 = 0.64$

Saturday: $SPVT = 10.80 - 0.03A + 0.10B + 0.18C$ $R^2 = 0.40$

Sunday: $SPVT = 9.58 - 0.07A + 0.08B + 0.48C$ $R^2 = 0.34$

4.2.3 Network Peak Hour Vehicle Trips

Friday AM: $NPVT = 6.70 - 0.44A + 0.30B + 1.097C$ $R^2 = 0.92$

Friday PM: $NPVT = 3.95 - 0.06A + 0.15B - 0.16C$ $R^2 = 0.87$

Saturday: $NPVT = 4.04 - 16A + 0.07B + 1.25C$ $R^2 = 0.82$

Sunday: $NPVT = 16.79 - 0.03A + 0.03B + 0.12C$ $R^2 = 0.33$

4.2.4 Parking Supply

$PS = 53.15 + 0.03A + 0.68B - 0.52C$ $R^2 = 0.23$

4.2.5 Peak Parking Demand

Friday: $PPD = -6.68 + 0.57A + 0.50B - 2.73C$ $R^2 = 0.80$

Saturday: $PPD = 24.51 + 0.12A + 0.28B - 0.93C$ $R^2 = 0.47$

Sunday: $PPD = 20.42 - 0.50A + 0.62B + 1.09C$ $R^2 = 0.40$

Based on the above analysis, the following relationships resulted to an acceptable level of correlation (i.e. R^2 value above 0.8):

- daily vehicle trips vs vessel space (Friday)
- network peak hour vehicle trips vs vessel space (Friday AM, Friday PM and Saturday)
- peak parking demand vs vessel space (Friday).

5 Comparison of Findings with Other Databases

Results obtained from the assessment presented in this report have been compared to the existing guidelines and standards. Findings of this examination are presented below.

5.1 Australian Documents

5.1.1 Australian Standard AS 3962

Australian Standard AS 3962:2001 (Marina Design) stipulates that a traffic and parking study should be undertaken to determine boat storage parking and provides car parking guidelines. The latest version of the standard (i.e. AS 3962:2020) replaced the 2001 version.

Table 5.1 presents a comparison of parking rates between the two documents. It is noted that the following parking requirements are recommendation only in the absence of any parking studies.

Table 5.1: AS 3962 Parking Rates

	AS 3962:2001	AS 3962:2020
Car Parking for Marina Activities	• 0.3-0.6 spaces per wet berth • 0.2-0.4 per dry berth • 0.3-0.6 per swing mooring • 0.5 per employee	• 0.25 spaces per wet berth • 0.25 spaces per dry berth • 0.25 spaces per swing mooring • 0.25 spaces per employee
Car Parking for Ancillary Facilities	Parking provision should comply with existing planning codes/standards If no codes/standards have been adopted, the following rates apply: • For activities directly related to boat berthing: 1 space per 50m^2 of NLA • For activities not directly related to boat berthing: 1 space per 30m^2 of NLA	Refer to relevant authorities
Accessible Parking	1% of parking spaces provided	Not specified

5.1.2 Roads and Maritime Services Guide to Traffic Generating Developments

Roads and Maritime Services *Guide to Traffic Generating Developments 2002 (Guide)* includes parking provision information for a wide range of land uses.

For marinas, the Guide recommends undertaking surveys of similar sites to establish the parking demand. If a survey is not conducted, the following parking rates are recommended:

- 0.6 spaces per wet berth
- 0.2 spaces per dry storage berth
- 0.2 spaces per swing mooring
- 0.5 spaces per marina employee

The Guide also stipulates the following rate to estimate the trip generation of marinas:

$$Daily\ vehicle\ trips\ =\ 2.7\ per\ fixed\ berth\ +\ 1.4\ per\ swing\ mooring$$

The above trip estimate is based on a summer weekend day and includes an allowance for shore-based facilities such as boat sales and repairs.

5.1.3 Guide to Traffic Impact Assessment (Department of Transport and Main Roads, Queensland)

The Department of Transport and Main Roads, Queensland *Guide to Traffic Impact Assessment 2017* supports the planning and development decisions across the state.

The document presents the following preferred hierarchy of data sources in estimating the traffic generation of a site:

- traffic generation survey of an existing development similar to the proposed development in terms of its land use, scale, location and so on
- traffic generation data – 2006–2017 (Queensland) Open Data
- Guide to Traffic Generating Developments Updated traffic surveys, Roads and Maritime Services (2013)
- Guide to Traffic Generating Developments, RTA (2002)
- NZ Trips Database Bureau, 2010 – contains survey data and characteristics of each site providing detailed trip information and characteristics for over 700 sites from 1983 to 2011
- first principles assessment preferably based on forecast usage data
- Trip Generation Manual, 9th edition, ITE 2012 – US database and may need to be modified to suit Australian conditions.

The 2006-2017 (Queensland) Open Data includes survey information of 407 sites of various land uses. However, the database does not include any marina sites.

5.1.4 Transport Impact Assessment Guidelines 2016 (Department of Planning, Lands and Heritage (DPLH), Western Australia)

The DPLH Western Australia *Transport Impact Assessment Guidelines 2016* refer to the following methods in assessing the traffic generation of a site:

- surveying a comparable development in a similar location
- using existing traffic data for a comparable development(s)
- using typical rates for similar developments

DPLH recognises the use of Roads and Maritime's Guide and ITE Trip Generation Manual as sources for trip generation rates however it is recommended to undertake sensitivity tests when using these guides since the data may not be particularly relevant to WA.

5.2 International Documents

5.2.1 New Zealand Trips and Parking Database Bureau (TDB)

New Zealand Trips and Parking Database Bureau (TDB) was formed in 2002 to maintain and share a database of parking and trip surveys for assistance in assessment and planning of transportation matters. The bureau includes councils, institutional organisations, consultancies and individual practitioners.

In 2001, Transfund New Zealand (now New Zealand Transport Agency) commissioned two research reports which formed the basis of the TDB database. The original reports included *Research Report No. 209: Trips and Parking Related to Land Use – Volume 1: Report* which is a review of surveyed information of various land uses.

The original report has been superseded to include updated surveys. The latest document is titled, NZ Transport Agency Research Report 453 (2011). The report presents trip generation and parking rates for various land uses. However, it does not include rates for marina developments.

5.2.2 Trip Rate Information Computer System (TRICS)

Trip Rate Information Computer System (TRICS) is the national standard system of trip generation and analysis in the UK and Ireland. TRICS contains over database from 7,150 transport surveys across 100 land use categories.

The database includes 45 marina sites of various site areas and vessel storage capacities.

Table 5.2 provides a summary of the marina survey data.

Table 5.2: TRICS Marina Database Summary

	Site Area*	Berths	Parking	Parking per Site Area	Parking per Berth
Minimum	0.7	10	15	3.4	0.2
Maximum	51	1,822	1,200	150	2.5
Average	8.7	307.5	211	40.96	0.87

Source: TRICS http://www.trics.org/marinas_results.aspx (accessed 15 June 2020)
** unit for measurement of site area is not specified*

5.2.3 US Institute of Transportation Engineers Trip Manual 8th Edition, 2008 (ITE)

The Institute of Transportation Engineers (ITE) published "Trip Generation" report which consists of trip generation rates, plots and equations of more than 4,800 sites and 162 land uses.

The report includes trip data from marina sites in California and Washington which were surveyed between the late 1960s and the late 1980s. Some of the marinas include limited retail and restaurant spaces.

The following summarises the site property of surveyed marinas:

- number of berths: 108 to 1,750
- area: 11 acres to 105 acres (about 4.45 hectare to 42 hectare)
- number of parking spaces: 65 to 493.

Table 5.3 provides a summary of ITE trip generation rates.

Table 5.3: US ITE Vehicle Trip Generation Rates of Marinas

Trip Rate	Weekday	Saturday	Sunday
Average Daily Trips per Berth	2.96	3.22	6.40
Site Peak Hour Trips per Berth	AM = 0.17	0.27	0.31
	PM = 0.21		
Network Peak Hour Trips per Berth	AM = 0.08	-	-
	PM = 0.19		
Average Trips per Acre	20.93	24.85	34.49

5.3 Comparison of Trip Generation and Parking Supply

Comparison of trip and parking rates presented in the previous sections are summarised in Table 5.4 and Table 5.5.

Since the vessel capacity is the consistent independent variable amongst all external databases, only vessel-dependent rates obtained from the survey result analysis are presented for comparison.

It is noted that the correlation coefficients obtained from regression analysis are considered low to draw a solid conclusion. Therefore, results obtained from the regression analysis are not included.

Table 5.4: Comparison of Trip Rates

Reference	Trip Rates (Daily)
RMS Guide (2002)	• 2.7 trips per fixed berth + 1.4 trips per swing mooring
US ITE*	• 2.96 trips per berth (weekday) • 3.22 trips per berth (Saturday) • 6.40 trips per berth (Sunday)
Average surveyed rate (current study)	• 0.93 to 1.25 trips per vessel space (swing moorings + wet berths)

*NOTE: * - US ITE provided peak hour trip rates. Please refer to Table 5.3*

Table 5.5: Comparison of Parking Rates

Reference	Parking Rates
AS 3962:2001 (superseded)	• 0.3-0.6 spaces per wet berth • 0.2-0.4 per dry berth • 0.3-0.6 per swing mooring • 0.5 per employee
AS 3962:2020	• 0.25 spaces per wet berth • 0.25 spaces per dry berth • 0.25 spaces per swing mooring • 0.25 spaces per employee
RMS Guide (2002)	• 0.6 spaces per wet berth • 0.2 spaces per dry storage berth • 0.2 spaces per swing mooring • 0.5 spaces per marina employee
TRICS	• 0.87 spaces per berth (min. 0.2 & max. 2.5 spaces per berth)
Average surveyed rate (current study)	• 0.87 spaces per vessel space (swing moorings + wet berths)

Based on Table 5.4, the average trip rates obtained from the surveys are lower than the rates presented in other databases.

However, the average parking rates obtained are generally higher than the rates stipulated in Australian databases. It is noted that parking requirements from AS 3962:2020 generally represent the minimum values when compared to other documents.

The following summaries are provided based on the data presented above:

- Daily trip generation estimate from other databases would generally yield to higher vehicle trips compared to the surveyed daily trips. Trip generation estimate using Roads and Maritime rates could be comparable with the surveyed data, depending on the distribution of wet berths and swing moorings.
- Parking provision of surveyed marinas are higher than the recommended parking rates from AS3962 and Roads and Maritime guide. However, information regarding the number of employees was unavailable, hence a direct comparison could not be made.

It is noted that most of the site information used in the analysis has been obtained from desktop research with limited information available. It is anticipated that further analysis could be undertaken if information such as GFA of ancillary facilities, number of vessels and staff numbers can be supplied by the marinas.

6 Summary

The latest edition of the Roads and Maritime *Guide to Traffic Generating Developments (2002)* stipulates rates for marinas which have been in place since the 1992 edition of the Guide. These rates are based on surveys undertaken in Pittwater in 1978 and Middle Harbour in 1990.

Since the Roads and Maritime surveys of marina sites, there have been some changes to the operation of marinas as well as societal and economic changes which could potentially impact the travel behaviour of marina's visitors and staff.

TTPP has been appointed to undertake a detailed analysis of marinas. A total of 12 marina sites have been surveyed to collect traffic characteristics relating to vehicle, person and vessels trips. The sites include eight marinas in metropolitan Sydney and four regional sites.

Site surveys were undertaken from Friday to Sunday during summer months (i.e. January to February) when marinas are typically busiest. Surveyors were also assigned on site to observe the travel behaviour of the marina's staff and visitors.

The trip and parking generation calculation used a number of key variables such as site area, number of parking spaces and vessel storage capacity. It is noted that the vessel storage/berthing capacity has been based on the information obtained from marina websites and maximum counts observed from site survey, whichever the higher.

A review of the data reveals a number of observations:

- The surveyed marina sites have site areas ranging from 4,216m^2 to 125,600m^2.
- The surveyed marina sites have vessel capacities (swing moorings + wet berths) ranging from 50 to 369 vessels.
- Friday Network Peak Hour vehicle trip generation rate varied from 14.08 to 79.54 vehicle trips per 10,000m^2 site area, with an average of 51.38 vehicle trips per 10,000m^2 site area.
- Saturday Network Peak Hour vehicle trip generation rate varied from 19.72 to 88.04 vehicle trips per 10,000m^2 site area, with an average of 44.98 vehicle trips per 10,000m^2 site area.
- Sunday Network Peak Hour vehicle trip generation rate varied from 18.02 to 90.68 vehicle trips per 10,000m^2 site area, with an average of 43.97 vehicle trips per 10,000m^2 site area.
- Friday peak hour vehicle trip generation rate varied from 3.28 to 22.58 vehicle trips per 10,000m^2 site area, with an average of 9.23 vehicle trips per 10,000m^2 site area.
- Saturday peak hour vehicle trip generation rate varied from 4.91 to 15.79 vehicle trips per 10,000m^2 site area, with an average of 8.85 vehicle trips per 10,000m^2 site area.
- Sunday peak hour vehicle trip generation rate varied from 4.15 to 13.81 vehicle trips per 10,000m^2 site area, with an average of 8.46 vehicle trips per 10,000m^2 site area.

- Average peak hour vehicle trip generation per parking space is around 0.06, 0.05 and 0.05 vehicle trips per parking space for Friday, Saturday and Sunday, respectively.
- Average peak hour vehicle trip generation per vessel space is around 0.05, 0.03 and 0.04 vehicle trips per vessel space for Friday, Saturday and Sunday, respectively.
- The regional sites generally have higher trip generation rates than Sydney Metropolitan sites.
- Generally, higher trip rates are recorded on Friday morning peak period than the evening peak period.
- Trip variance over the survey period indicates that Saturday is the busiest period.

Table 6.1 presents a summary of vehicle trip rates.

Table 6.1: Summary of Vehicle Trip Rates

	Friday	Saturday	Sunday
Trips/10,000m² Site Area			
Daily Vehicle Trips	51.38 (14.08 – 79.54)	44.98 (19.72 – 88.04)	43.97 (18.02 – 90.68)
Peak (Site) Vehicle Trips			
- AM Peak	9.23 (2.29 – 18.00)	8.85 (4.91 – 15.79)	8.46 (4.15 – 13.81)
- PM Peak	9.05 (3.28 – 22.58)		
Trips/Parking Space			
Daily Vehicle Trips	1.51 (0.24 – 2.67)	1.44 (0.20 – 2.96)	1.53 (0.18 – 4.16)
Peak (Site) Vehicle Trips			
- AM Peak	0.26 (0.06 – 0.51)	0.28 (0.05 – 0.53)	0.27 (0.05 – 0.58)
- PM Peak	0.27 (0.03 – 0.57)		
Trips/ Vessel Space			
Daily Vehicle Trips	1.00 (0.26 – 2.23)	0.93 (0.14 – 2.39)	1.25 (0.15 – 6.51)
Peak (Site) Vehicle Trips			
- AM Peak	0.17 (0.04 – 0.36)	0.18 (0.03 – 0.41)	0.21 (0.04 – 0.91)
- PM Peak	0.16 (0.05 – 0.30)		

NOTE: Average trip rates are provided; Figures in parentheses represent minimum and maximum rates.

The analysis results indicate the following results for parking:

- The parking provision rate ranges from 4.44 to 42.67 spaces per 10,000m^2 site area,
- The parking provision rate ranges from 0.20 to 3.06 spaces per vessel space (i.e. swing moorings + wet berths), and
- Peak parking accumulation generally had been accommodated by the on-site parking supply, with the exemption of D'Albora Marina Cabarita Point which had 103% peak parking accumulation on Saturday.

Table 6.2 presents a summary of parking rates.

Table 6.2: Summary of Parking Rates

	Parking Rates
-per 10,000m^2 site area	18.36 (4.44 – 42.67)
-per vessel space	0.87 (0.20 – 3.06)

NOTE: Average parking rates are provided; Figures in parentheses represent minimum and maximum rates.

Linear regression analysis was performed using site area, parking space and vessel space as the key independent variable. The trip behaviour was plotted against Network Peak Hour, site peak hour and network peak hour trips.

The regression analysis indicated that correlation (R^2) for the vehicle trips against site area ranges between 0.53 and 0.86. R^2 values obtained from the correlation of vessel movements with different parameters are generally low, with R^2 less than 0.11.

Multiple regression analysis was undertaken for vehicle trips and parking supply and demand, against each type of vessel storage. The coefficient of determination (R^2) for the multiple regression analysis was considered low to draw a solid conclusion.

A review of other reference documents suggests that:

- Limited trip and parking rate data is available on marinas within Australia and overseas.
- Limited information is available on trip rates, in particular on hourly trip rates.
- Parking requirements from AS 3962:2020 generally represent the minimum values when compared to documents.

It is noted that most of the site information used in analysis has been obtained from desktop research with limited information available. It is anticipated that more accurate results would be obtained if marina operators are to confirm the site data presented in this report and to provide further information such as GFA of ancillary facilities, number of vessels and staff numbers.

Appendix A

Summary Table of Key Statistics and Ratios

Appendix B

Detailed Multiple Regression Analysis Results

The Transport Planning Partnership
Suite 402 Level 4, 22 Atchison Street
St Leonards NSW 2065

P.O. Box 237
St Leonards NSW 1590

02 8437 7800

info@ttpp.net.au

www.ttpp.net.au