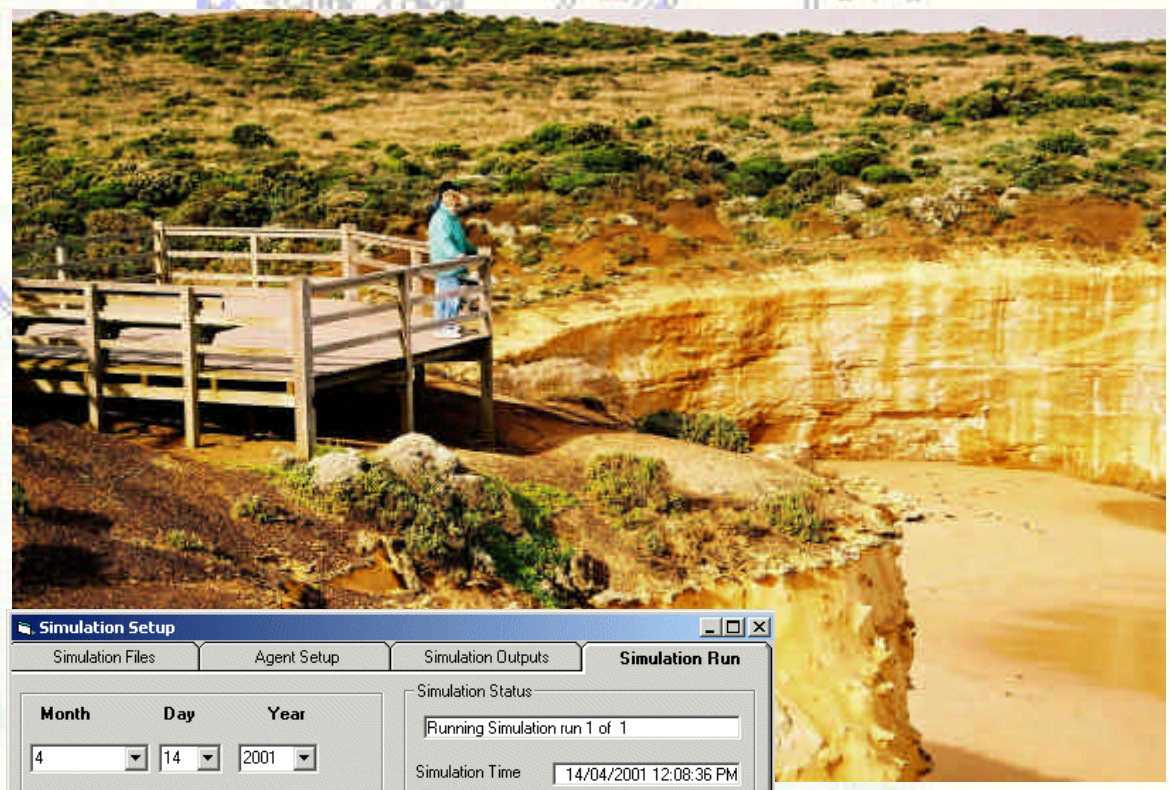
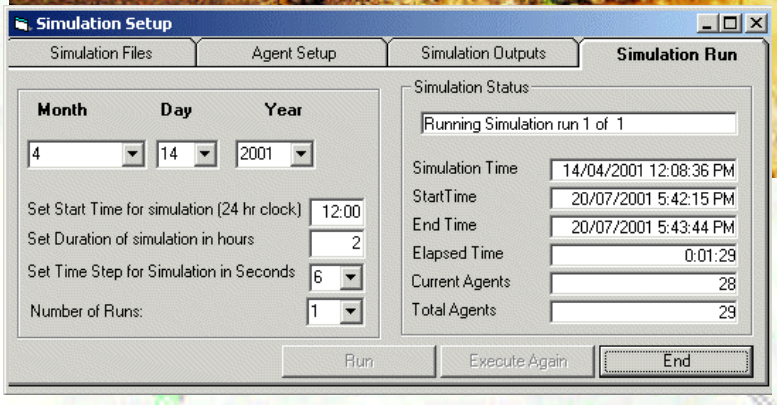
Visitor Management Model for Port Campbell National Park and Bay of Islands Coastal Reserve Phase 2 Simulation

Final Report

May 2003





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By

Robert M. Itami

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1 Port Campbell National Park and Bay of Islands Coastal Park

Parks Victoria has the responsibility for management of over 3.8 million hectares of parks and reserves in Victoria, or 16% of the total area of Victoria. One of the major natural resource initiatives in Parks Victoria's 1997-1998 corporate plan is to gain a clear understanding of the natural resources under Parks Victoria management and in the development of systems to guide future resource allocation, including the abilities to support management decision making and reporting.

Underlying the use of Victoria's parks are two key assumptions: firstly that the visitor use and tourism in parks contributes to individual and collective well being, inspiration, education and economic prosperity, and secondly that visitor use and tourism must be environmentally sustainable in order to maintain or improve the first assumption.

Because the management of visitor services requires a significant proportion of available resources, there is a real need for improvements in understanding relationships between visitor use, customer satisfaction and the condition of the natural environment. These better understandings will allow the improvement in management of resources and in making effective use of limited financial resources, whilst maintaining or improving the condition of the environment.

Port Campbell National Park and the Bay of Islands Coastal Park are located on the Great Ocean Road, approximately 250 Km west of Melbourne. Comprising 65 Km of rugged and spectacular coastal scenery, the two parks are protected in a strip ranging in width from a few metres in the Bay of Islands park to 2 km within the Port Campbell National Park.

The parks have World Conservation Union (IUCN) ratings of Category II (National Parks) and Category III (National Monuments) and are designated for ecosystem conservation and appropriate recreation and protection of outstanding natural features, education, research and recreation respectively.

In addition to the main park attractions of coastal views, walks and water-based recreation, there are a range of other significant regional attractions from the Otways National Park to State Parks and the historic towns of Warrnambool and Port Fairy.

Figure 1. View of Loch Ard Gorge, Port Campbell National Park, Victoria, Australia (photo by Itami)

The Port Campbell National Park and the Bay of Islands Coastal Park attract large and steadily increasing numbers of visitors (2.1 million visits per year in 1996/97 combined between both parks). Annual growth rate of the visitors is estimated at 3.55%, although it may be higher at some key sites.

This increase in visitation suggests that by 2001/2 there will be approximately 2.7 million visits per year to Port Campbell and Bay of Islands combined, causing considerable load on facilities and pressure on the coastal ecosystem. *By 2006/7 this is expected to rise to 3.2 million combined visits per year for the parks.*

Like high use recreation areas worldwide, this study is typified by the high value the public places on the landscape that leads to the consequential heavy visitor use, and the inevitable crowding and decline of visitor satisfaction and environmental quality. In this study, RBSim, a recreation behaviour simulator, is used to examine the impact of changes in park infrastructure and increasing visitor rates over a 10 year period on 9 sites in Port Campbell National Park and Bay of Islands Coastal Park. These sites were selected as those most likely to encounter future problems from crowding at the parks. They were selected from a preliminary assessment of parking at all 23 (excluding the 12 Apostles site) visitor sites at both parks. This study is an expansion of a similar study conducted by Parks Victoria in 2001 (see report by Itami, Zanon and Chladek, 2001) for the 12 Apostles site in particular.

This report describes the construction of the simulation model for 9 sites for visitor use levels for 2002, 2007 and 2012. Simulation results are examined to answer a set of

five management questions of key interest to the rangers of Port Campbell National Park.

These include:

1. How well will existing facilities at each of the nine sites cope with growing visitor loads?
2. How crowded will the sites get in the future?
3. How will visitor satisfaction be affected growing visitor numbers?
4. How does length of stay affect the pattern of use at each of the site?

These management questions are answered via a set of more specific, operational questions using measures generated by the simulator in section 3.1.

2 RBSim Multi-Agent simulation of outdoor recreation.

Outdoor recreation is on the increase world wide as people have more leisure time, greater mobility, and more disposable income. In addition there is a proliferation of new types of recreation such as mountain bike riding, snow boarding, canyoning and other emerging activities that have different environmental requirements and are often in conflict with more traditional outdoor activities. As visitor numbers increase, there is a simultaneous increase in environmental impacts, crowding, and conflicts between different recreational types and users. These circumstances make recreation management a complex problem. Managers of natural areas must accommodate increasing visitor use while at the same time, maintaining environmental quality and assuring visitors have the high quality experience they anticipate.

Conventional methods used in the design and planning of park management facilities have depended on user surveys and traffic counts to estimate the requirements. However these methods fall far short of the real needs of managers who need to comprehensively evaluate the cascading effects of the flow of visitors through a sequence of sites and estimating the effects of increasing visitor flows through time. In addition, managers need to know if designed capacities for parking, visitor centres, roads, camping areas, and day use facilities can accommodate projected visitor numbers. Crowding, conflicts between different recreation modes, impacts on environments and seasonal effects such as day length and weather are all factors park planners must consider in the design and location of new facilities.

There are many options available to park managers to deal with heavy visitor use. New sites can be opened up, a system of reservations can be implemented; areas can be closed so sites can recover from over use; facilities can be expanded or sites can be hardened to accommodate larger numbers of visitors. Each of these strategies will have different impacts on the overall system. The complex inter-relationships between these decisions are almost impossible for a manager to predict. It is in this context where simulation of recreation behaviour is of real value. This report describes a computer simulation methodology that uses intelligent agents to simulate recreation behaviour, coupled with Geographic Information Systems to represent the environment.

Even though simulations are built on assumptions to represent reality, they provide an excellent and rich source of data to answer management questions relating to facility capacities and visitor flows. Simulations are particularly valuable where “real world” data is difficult or expensive to collect or because of inherent constraints in traditional survey research methods.

RBSim 2 (Recreation Behaviour Simulation) (Gimblett & Itami, 1997; Gimblett, 1998; 1998a; Gimblett et al. 1999; Itami et al., 1999; Itami et al., 2000, Itami and Gimblett, 2000; Itami, in Press) is a computer simulation tool, integrated with a Geographic Information System (GIS) that is designed to be used as a general management evaluation tool for any park. This capability is achieved by providing a user interface that will import park information required for the simulation from a geographic information system. Once the geographic data is imported into RBSim 2, the park manager can change a number of variables including the number and kind of vehicles, the number of visitors, and facilities such as the number of parking spaces, road and trail widths and the total capacity of facilities

RBSim 2 allows park management to explore the consequences of change to one or more variables so that the quality of visitor experience is maintained or improved. The simulation model generates statistical measures of visitor experience to document the performance of any given management scenario. Management scenarios are saved in a database so they can be reviewed and revised. In addition, the results of a simulation are stored in a database for further statistical analysis. The software provides tables from the simulation data so park managers can identify points of over crowding, bottle necks in circulation systems, and conflicts between different user groups.

Figure 2. View of Mutton Bird Island. Photo by Itami

3 The Port Campbell National Park and Bay of Islands Coastal Park RBSim Model

3.1 Introduction

Following the successful trial of RBSim to simulate alternative visitor scenarios for the 12 Apostles site in 2001, continued interest in improving visitor experience at Port Campbell National Park and Bay of Islands Coastal Park has prompted further use of simulation technology to examine a more complete range of visitor sites in the two parks to identify potential bottle necks and to begin to understand the interaction of visitor use between sites. Traffic count data was collected and analysed for 23 locations within the two parks over a 28 day period during Winter, extending from May 29th to June 28th. Data captured per site at the base level related to the site of entry, the type of vehicle, and the time of arrival and exit. To complement this data, an additional annual survey was carried out at the Twelve Apostles, providing total vehicle counts for the yearly period from September 2001 to August 2002. Total daily vehicle counts per site from the Winter survey data was then combined with this annual Twelve Apostles data, with time series regression then providing yearly vehicle estimates for each PCNP and BICP site. In turn, this figure then enabled an approximation of total numbers of visitors for this annual September to August period, incorporating estimates for the number of passengers per vehicle (2.7 for cars and 20 for buses), and the proportion of pedestrian entries into sites (1%). These annual daily vehicle estimates then determined the 95th percentile "criterion day", effectively translating to the 18th busiest visitation day of the year. Using expected tourism growth rates of 3.55% for cars and 5.0% for buses annually, this figure was then extrapolated to produce expected vehicle numbers per site for this criterion day in the year 2012. These vehicle estimations per site for this 2012 criterion day were then used as the basis for identifying the likelihood of future failed trips at particular sites, with those exhibiting potential problems to be investigated further through the use of RBSim (see report by Dino Zanon and David Downer for complete discussion of the analysis and results of the traffic survey.)

Nine sites that showed potential problems from the analysis of the original 23 sites are:

- ?? Bay of Islands
- ?? Bay of Martyrs
- ?? Discovery Walk
- ?? Gibson Steps 2002
- ?? Loch Ard Gorge
- ?? London Bridge
- ?? Massacre Bay
- ?? The Arch
- ?? The Grotto

The simulation model and analysis was then designed to address the following management questions:

1. How long will existing bus and car parks accommodate the projected increase in visitor use before the capacity of the parking areas are exceeded on peak visitor days?
2. How many visual contacts will visitors experience as visitor numbers increase?
3. What are the queuing times for visitors for parking lots?
4. What is the satisfaction of visitors measured by queuing times and success rates of trips.
5. How is length of stay affected by the new configuration of the 12 Apostles site?

Three separate scenarios have been run for each of the 9 sites:

?? Scenario 1 – Existing traffic conditions based on traffic counts for 2002.

?? Scenario 2 – Projected traffic conditions for 2007.

?? Scenario 3 – Projected traffic conditions for 2012

Hourly vehicle arrivals for each site was estimated for 2002 for a hypothetical 95th percentile criterion day based on a traffic survey using the methodology described in section 3.1.

A simulation model of Port Campbell National Park and Bay of Islands Coastal Park has been created using RBSim. The model includes a road and trail network that has been attributed with the locations and capacities of facilities for each site. Details of the simulation parameters used in this study are provided in Section 8 (Appendix 1) of this report.

4 Simulation Results

4.1 Introduction

Simulation results are reported for the three time periods (2002, 2007 and 2012) for each of the nine sites.

Each section uses the following key output criteria:

?? Car park and bus park capacity. This is a measure of the site's ability to handle average and peak vehicle visitation across the day. The total capacity of all car and bus parking (if present) is reported for each site. RBSim then tracks the number of parking spaces occupied for each time step of the simulation. Capacity is then reported as the average percentage of spaces available for each hour of the criterion day and the minimum percentage of spaces for each hour of the criterion day.

?? Queuing time. This is a measure of the average and peak waiting time for a visitor to obtain a vehicle park at the locale. Queuing times are reported in minutes. In sites with more than one parking area, agents may queue at a parking area if it is full even if there are available spaces in another parking area.

?? Trip completion rates. When an agent enters a site, it processes its rules, if any rule is imperative, then the agent must successfully execute the rule or the trip will fail and the agent will abandon its trip to the locale. In the simulation for each site, agents entering by car are assigned an imperative rule to find a car park. If all car parking spaces are occupied, the rule fails to execute and the trip fails and is recorded by RBSim as an incomplete trip. Likewise, agents arriving by bus are assigned an imperative rule to find a bus park. If all bus parking spaces are occupied the trip fails. Because of this logic, trip completion rates should be analysed in relationship to queuing times. If these vehicles had entered the site, queuing times would increase. Trip completion rates are recorded for each hour of the day as a percentage of arrivals for that hour.

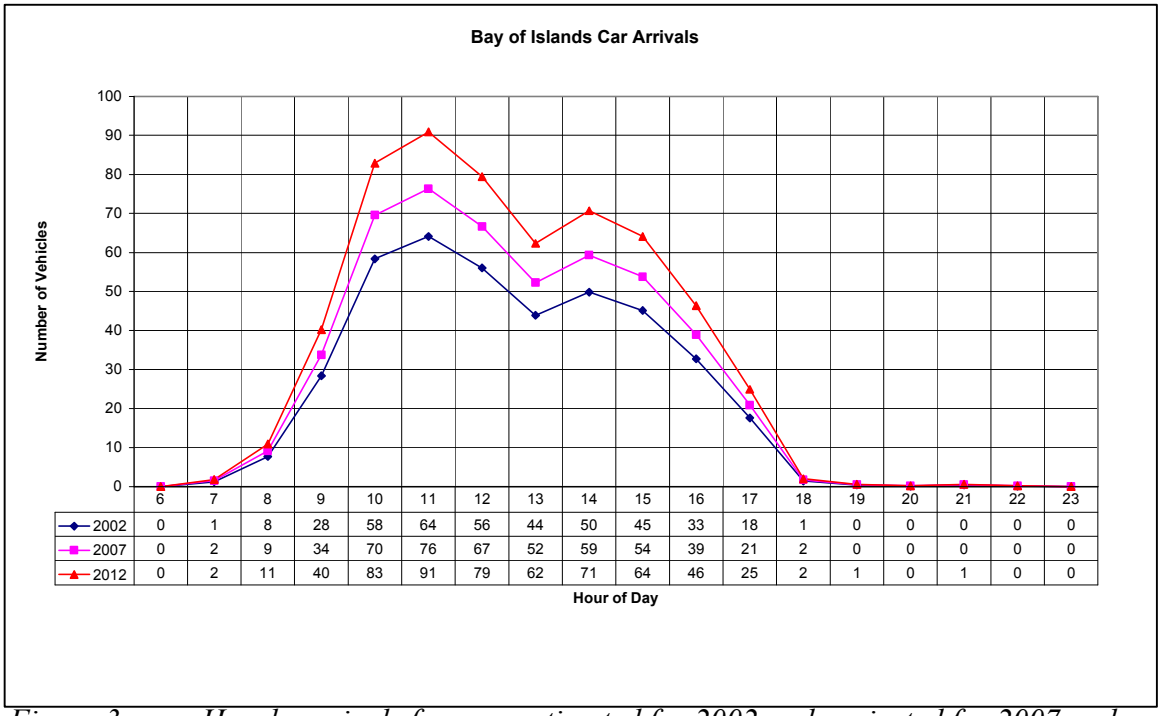
?? Length of stay. This is a reality check more than a performance measure, as simulated length of stay can be compared to actual length of stay. If the simulation is greater than the estimated length of stay from the traffic survey, then the output statistics should be viewed as conservative in that simulated length of stay exceeds estimated stay so that queuing times, and visual encounters will be overestimated.

?? Visitor Encounters. This is a measure of crowding at a site. A visual encounter is defined when one agent has a line of sight view of another agent within a radius of 100 metres. Visual encounters are reported for the site and for all viewing platforms.

4.2 Bay of Islands

4.2.1 Car arrivals

Figure 3 shows hourly arrivals for cars peaking at 11:00 am declining until 1:00pm with a secondary peak at 2:00pm. Arrivals continue to drop off until 7:00pm.



	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
2002	0	1	8	28	58	64	56	44	50	45	33	18	1	0	0	0	0	0
2007	0	2	9	34	70	76	67	52	59	54	39	21	2	0	0	0	0	0
2012	0	2	11	40	83	91	79	62	71	64	46	25	2	1	0	1	0	0

Figure 3. Hourly arrivals for cars estimated for 2002 and projected for 2007 and 2012.

4.2.2 Parking Capacity and Loading

The Bay of Islands Locale has parking for 19 cars, 3 buses and 1 parking bay for the disabled.

4.2.2.1 Parking Capacity for Cars

A fairly uniform increase in average capacity can be seen over the projected years in Figure 4, with the lowest average capacity between 11am and 12pm for all years. At this time a low of 33% was recorded in 2002 and capacities of 22% in 2007 and 14% in 2012. A secondary peak can be observed during the hours of 2pm to 4pm, where capacity is decreasing more rapidly. However, when the available capacity is averaged over the hour, the worse case is in 2012 when only two spaces are available at 11:00am.

Figure 5 shows the minimum available car parking available during each hour of the day. By 2007 between 10am and 12pm the car park will be full, and the next 3 hours following will have lows of less than 3 spaces. This trend worsens slightly to 2012. This will result in increased queuing times and trip failures.

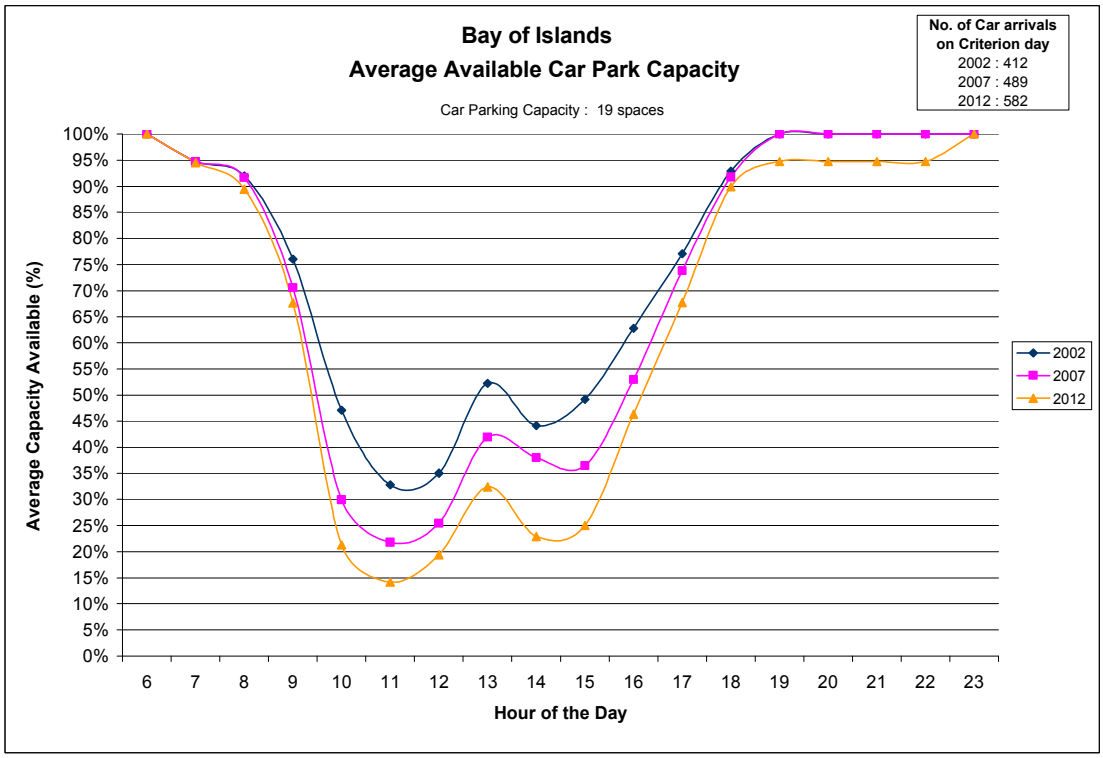


Figure 4. - Bay of Islands Average Available Car Park Capacity

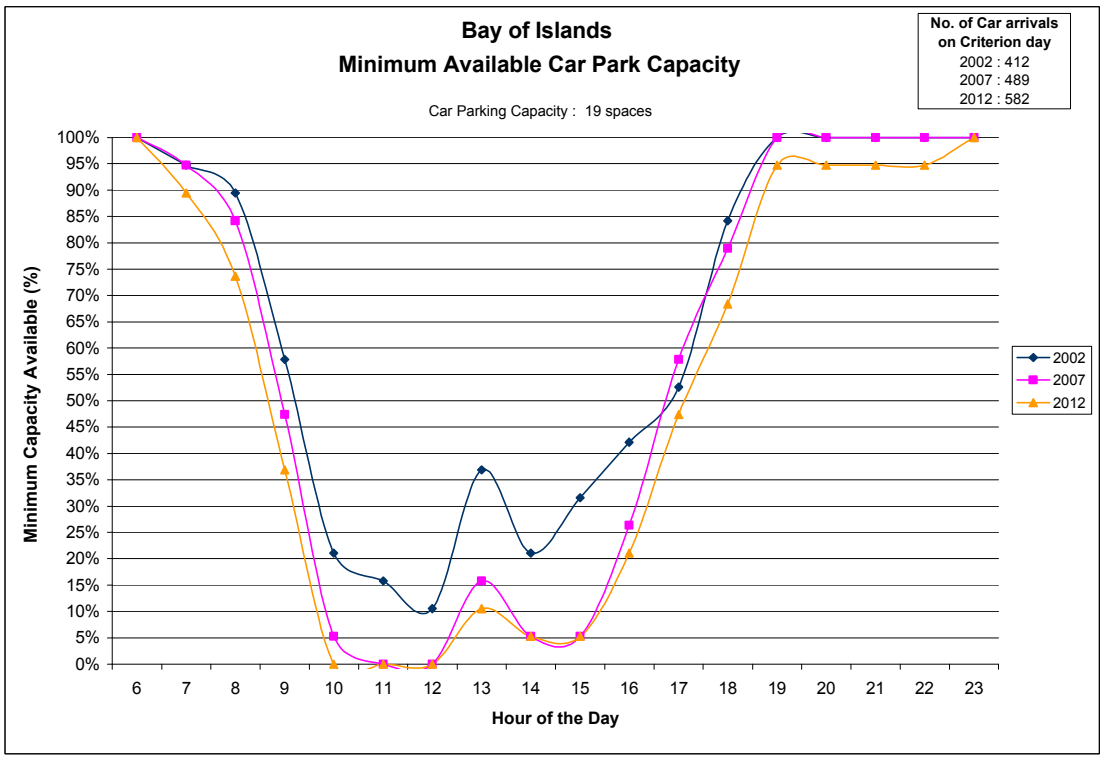


Figure 5. Bay of Islands Minimum Available Car Park Capacity

4.2.2.2 Capacity at Viewing Platforms

The Bay of islands has two small viewing platforms each with a capacity of 5 people.

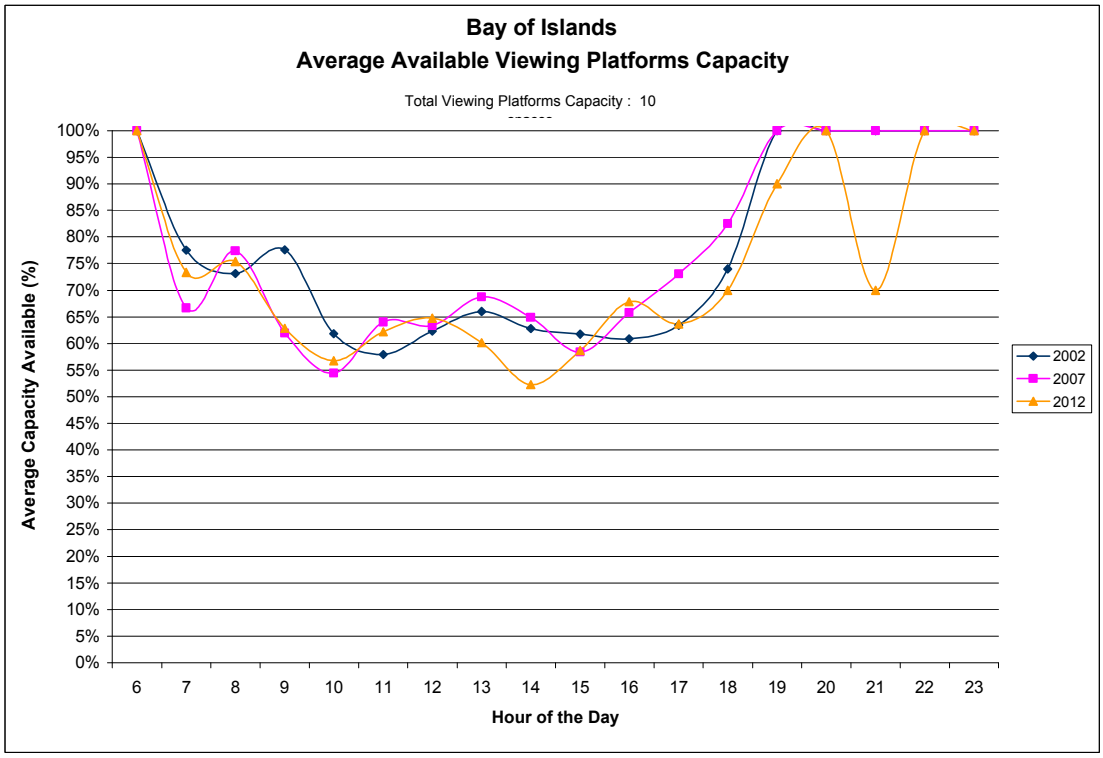


Figure 6. Bay of Islands Average Available Viewing Platform Capacity

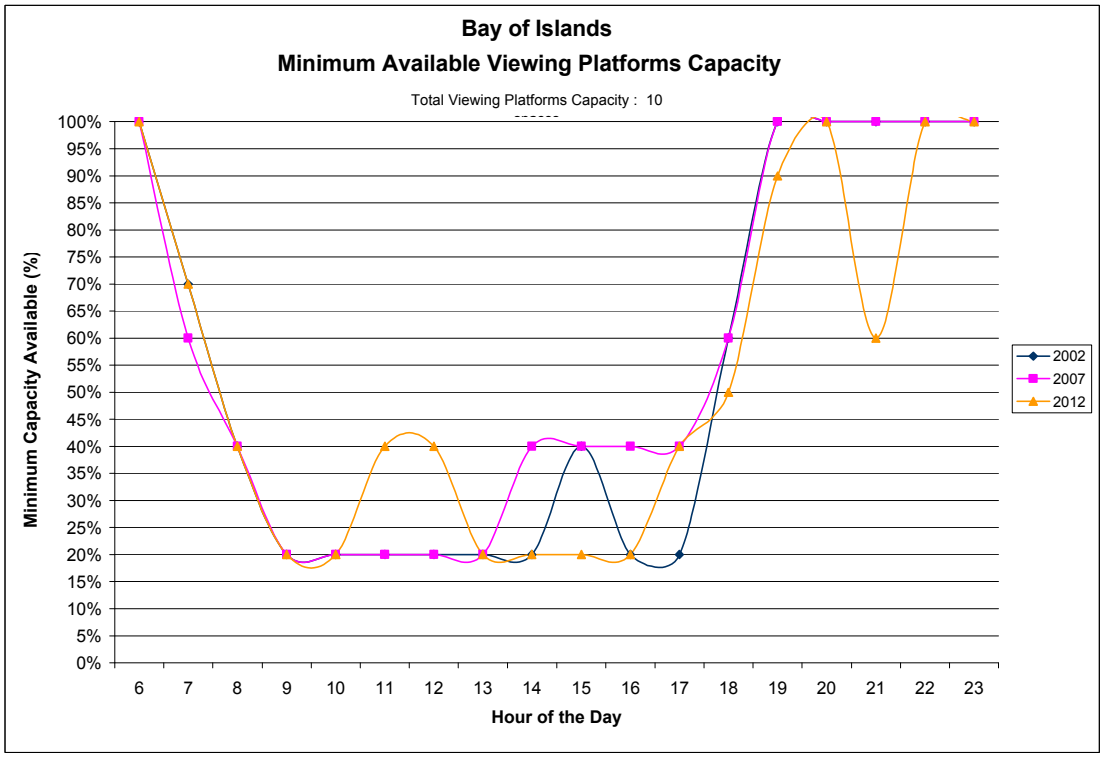


Figure 7. Bay of Islands Minimum Available Viewing Platform Capacity

The average viewing platform capacity shown in Figure 6 doesn't show any major change over the next 10 years, never dropping below 50%.

The projection (Figure 7) for minimum available capacity for the viewing platform to 2012 shows that at peak periods the platform is only 80% full, which fluctuates to 60% full at other busy times.

4.2.2.3 Queuing Times

4.2.2.4 Queuing Times for Cars

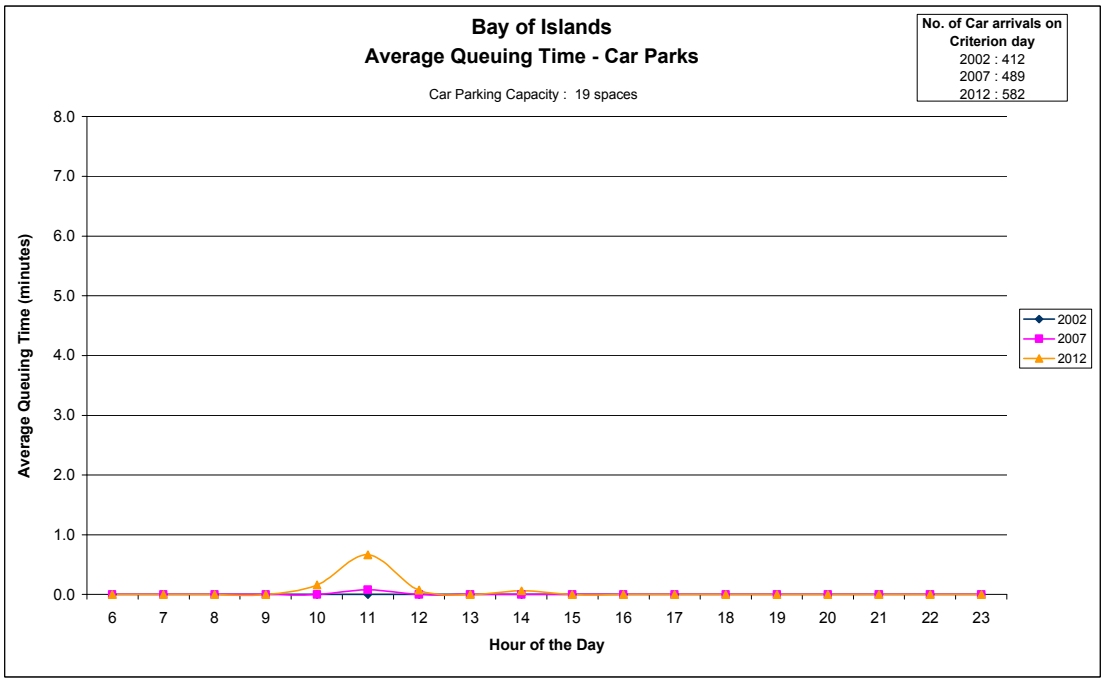


Figure 8. Bay of Islands Average Queuing Time – Car Parks

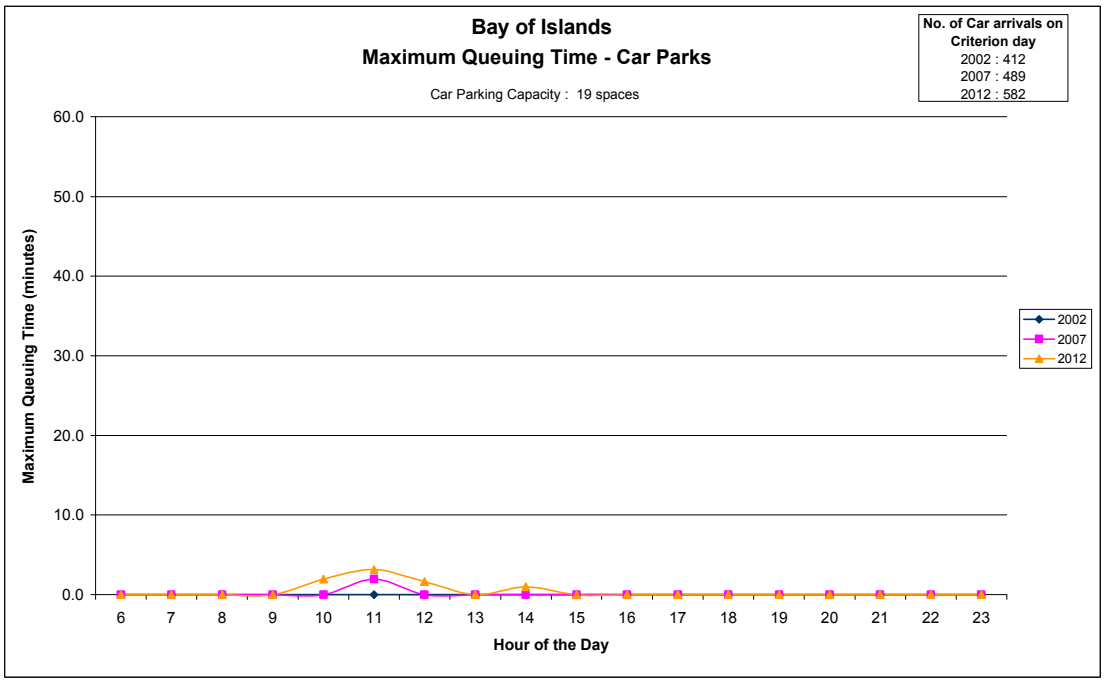


Figure 9. Bay of Islands Maximum Queuing Time – Car Parks

The average queuing time (Figure 8) for the Bay of Islands car park is projected to be less than 1 minute to 2012, with no queuing for a majority of the day. This is consistent with the available car parking capacity data.

Maximum queuing time (Figure 9) for the car park is currently zero and are predicted to be fairly negligible in the future with a peak at 11am of 2mins in 2007, and 3mins in 2012.

4.2.3 Trip Completion Rates

4.2.3.1 Cars

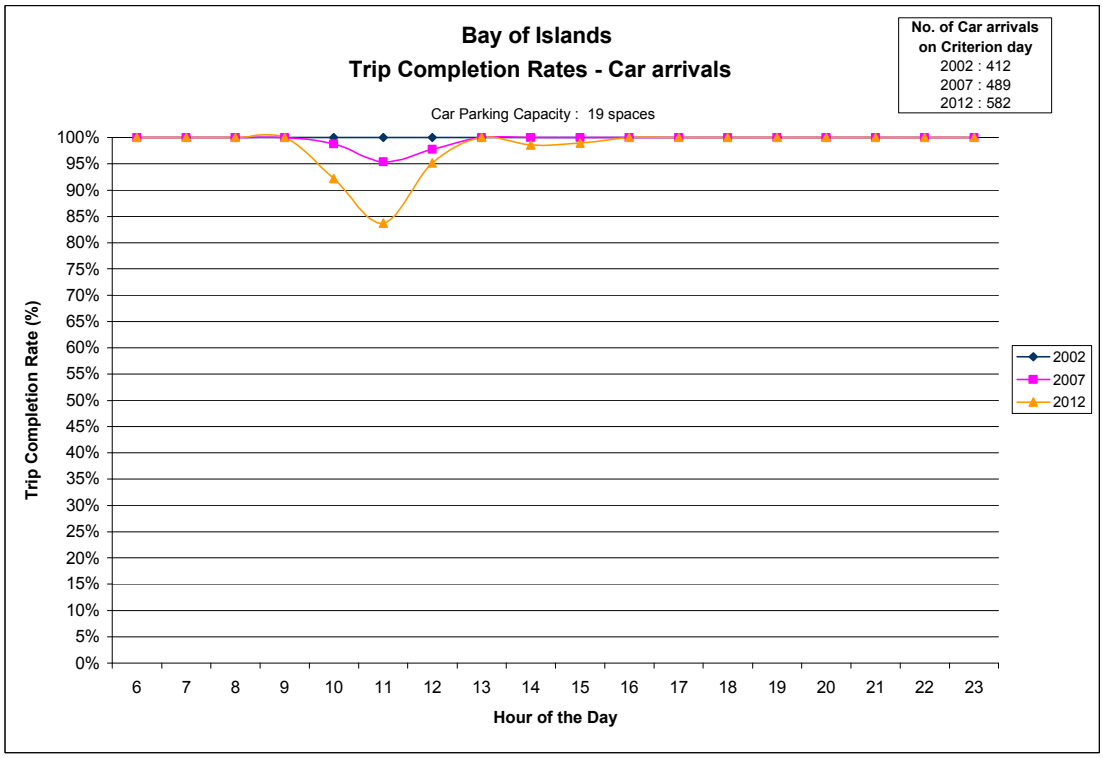


Figure 10. Bay of Islands Trip Completion Rates - Car Arrivals

There are currently no trip failures for the Bay of Islands facility, however this is predicted to rise at the peak time of 11am in 2007 to approximately 5% (4 cars), and continuing in 2012 to rise to approximately 16% (15 (see table) cars). Again this is consistent with the available car parking capacity and queuing data.

4.2.4 Length of Stay

4.2.4.1 Cars

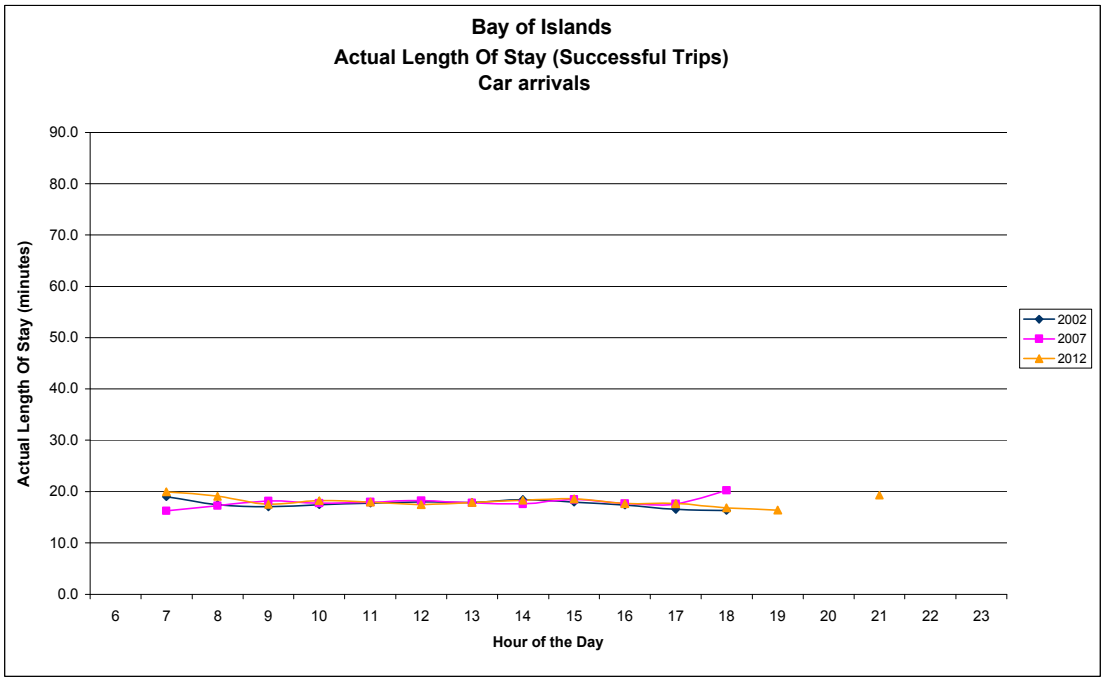


Figure 11. Bay of Islands Actual Length of Stay Car Arrivals

Length of stay in the future is projected to be similar to current lengths of stay all ranging between 15 and 20 minutes. This is consistent with the average length of stay calculated from accumulated arrivals and departures from actual traffic counts, which is 15 minutes for cars.

4.2.5 Encounters

4.2.5.1 Overall

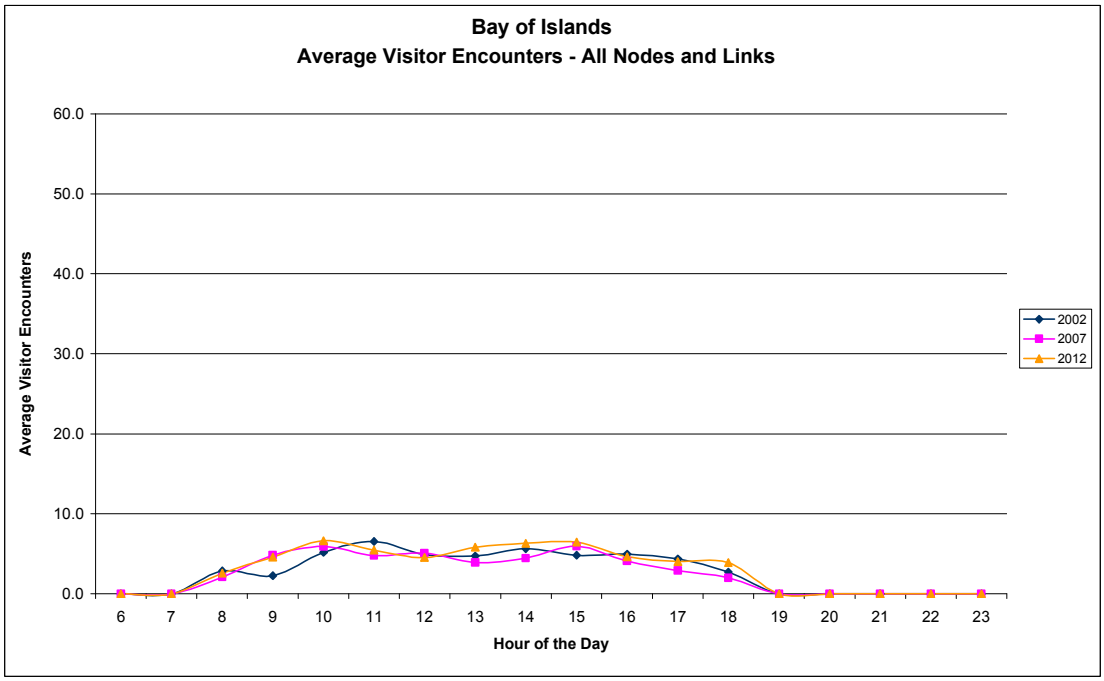


Figure 12. Bay of Islands Average Visitor Encounters – All Nodes and Links

Visitor encounters at the site are set to remain relatively consistent with 2002 figures, only showing a slight fluctuation at times.

4.2.5.2 Viewing Platforms

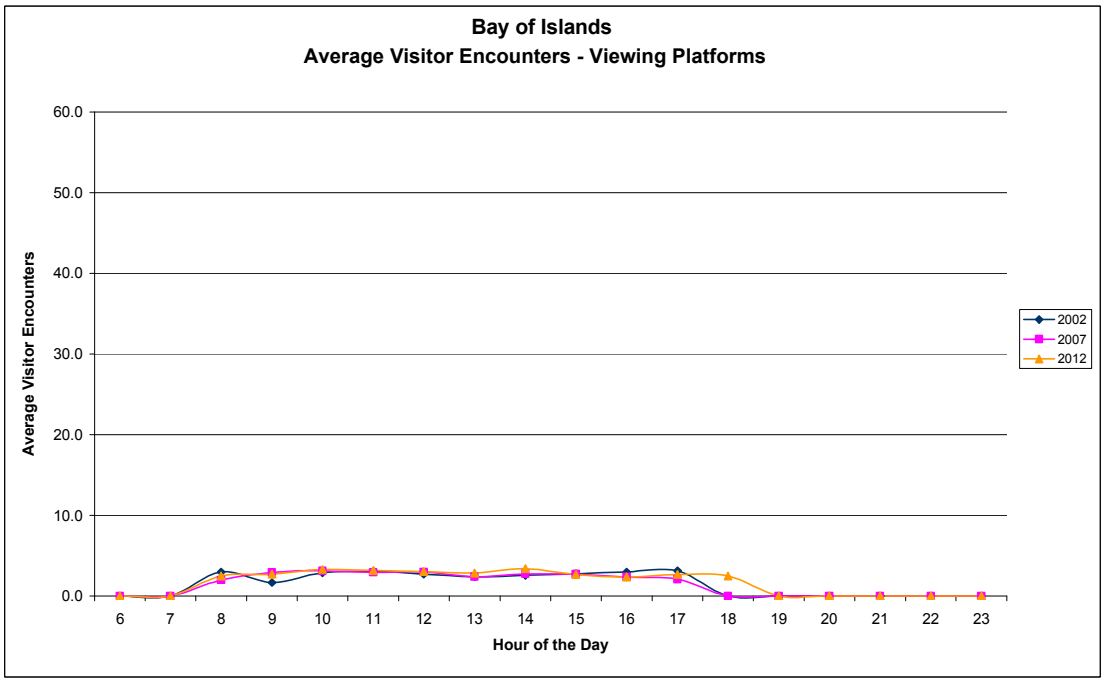


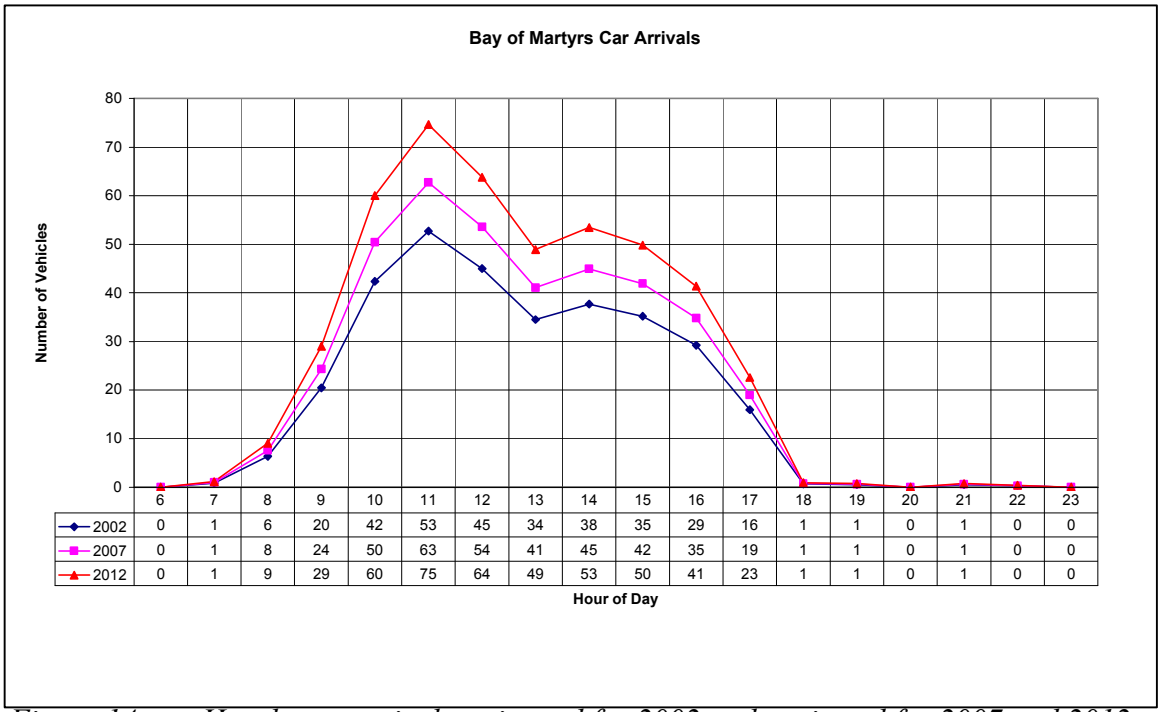
Figure 13. Bay of Islands Average Visitor Encounters – Viewing Platforms

Visitor encounters at viewing platforms are predicted to remain almost identical to 2002 figures for both 2006 and 2012.

4.3 Bay of Martyrs

4.3.1 Car Arrivals

Figure 14 shows arrivals for cars peaking at 11:00 am declining until 1:00pm with a secondary peak at 2:00pm. Arrivals continue to drop off until 6:00pm.



	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
2002	0	1	6	20	42	53	45	34	38	35	29	16	1	1	0	1	0	0
2007	0	1	8	24	50	63	54	41	45	42	35	19	1	1	0	1	0	0
2012	0	1	9	29	60	75	64	49	53	50	41	23	1	1	0	1	0	0

Figure 14. Hourly car arrivals estimated for 2002 and projected for 2007 and 2012.

4.3.2 Parking Capacity and Loading

The Bay of Martyrs has 4 car parking areas with 18, 12, 20 and 8 spaces respectively for a total of 58 spaces. There is one bus parking area for 4 buses however buses were not simulated for this locale.

4.3.2.1 Parking Capacity for Cars

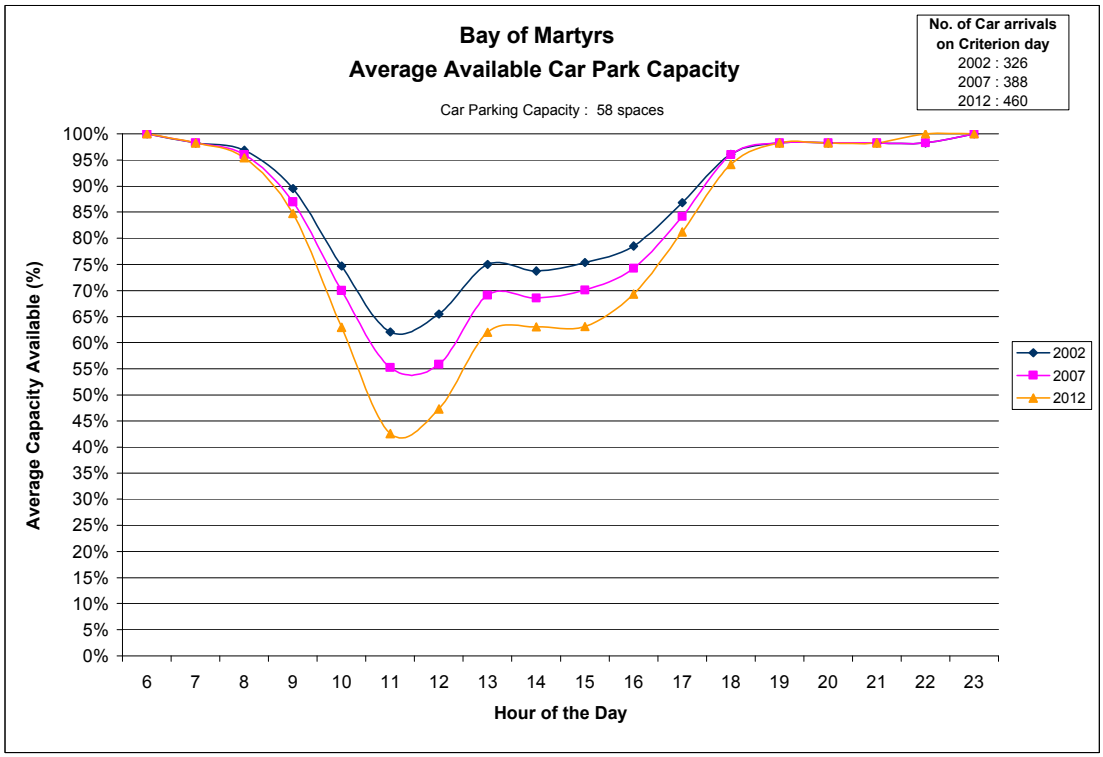


Figure 15. Bay of Martyrs Average Available Car Park Capacity

Figure 15 shows the average car park capacity available at the Bay of Martyrs. Car park capacity is lowest between 11:00 am and 12pm. Over the 10 year period available capacity is projected in 2007 to be at a minimum of 55% and in 2012 decreasing to 43%.

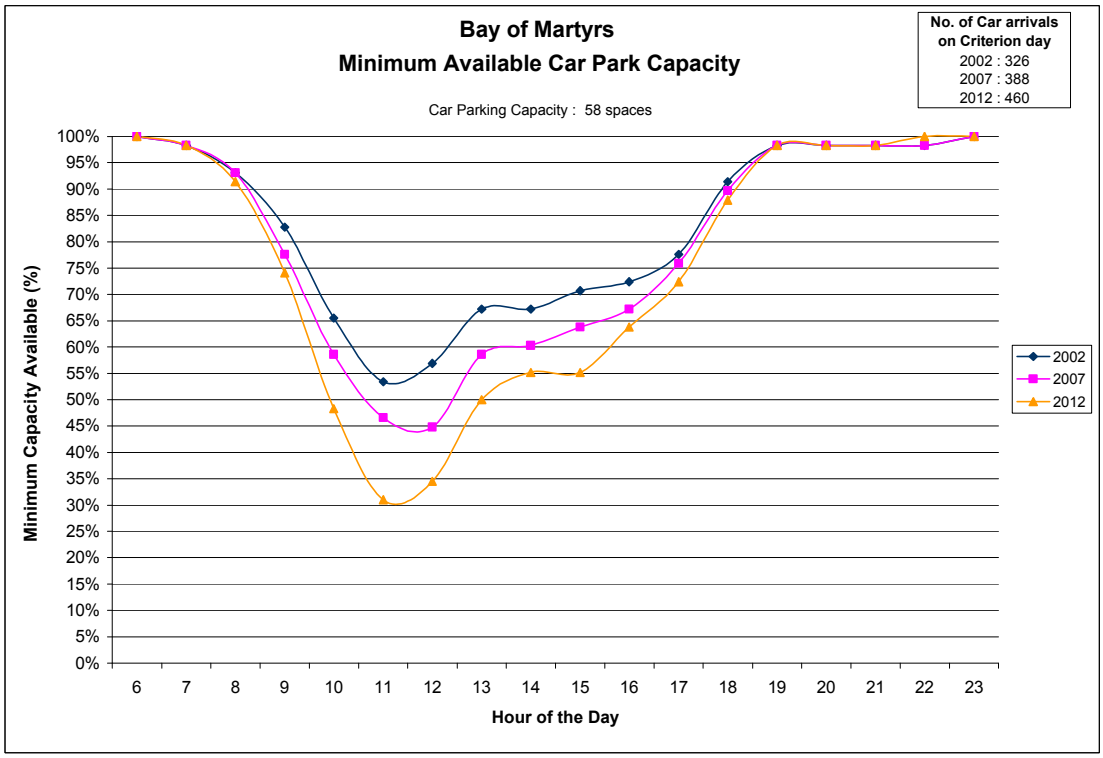


Figure 16. Bay of Martyrs Minimum Available Car Park Capacity

The minimum available capacity of the Bay of Martyrs car park (Figure 14) at the peak period (11am to 12pm) is approximately 31 spaces, this figure is only expected to drop to 26 spaces in 2007 and 18 spaces in 2012. This projection shows that until 2012 that the car park will only be up to 70% full.

4.3.2.2 Capacity at Viewing Platforms

The Bay of Martys has 3 viewing platform each holding 5 people for a total capacity of 15 people.

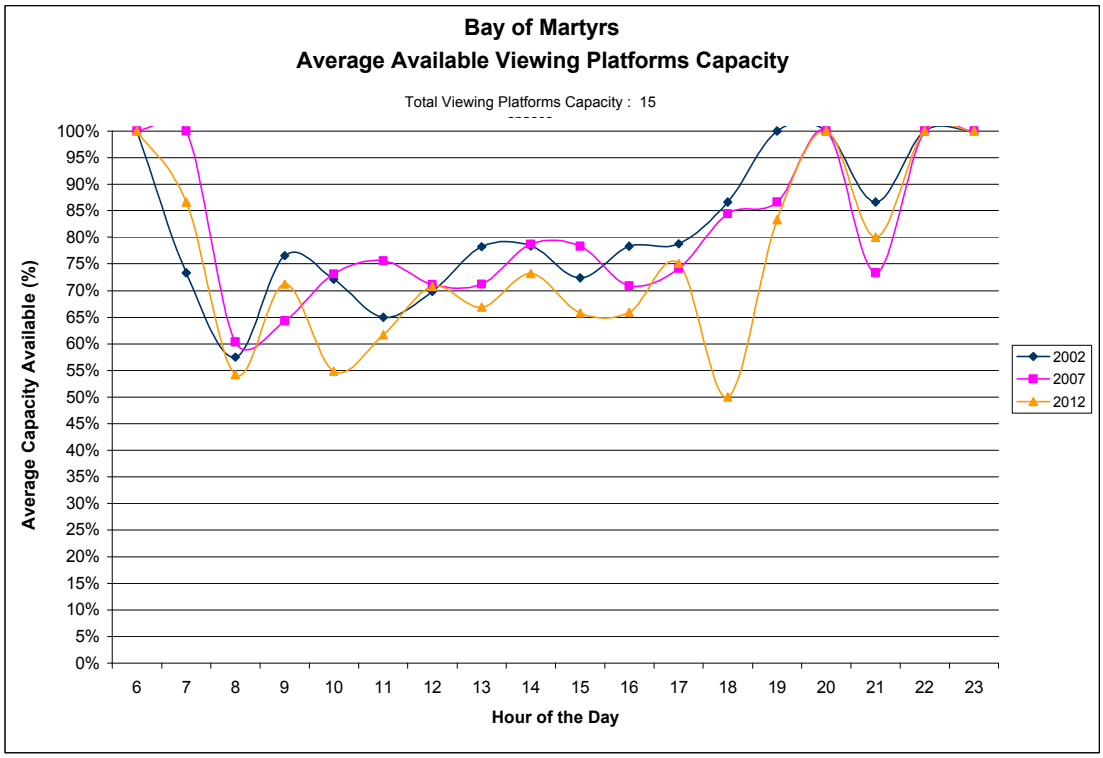


Figure 17. Bay of Martyrs Average Available Viewing Platform Capacity

Average capacity at viewing platforms is not set to change greatly over the time period, with only a slight increase in 2012.

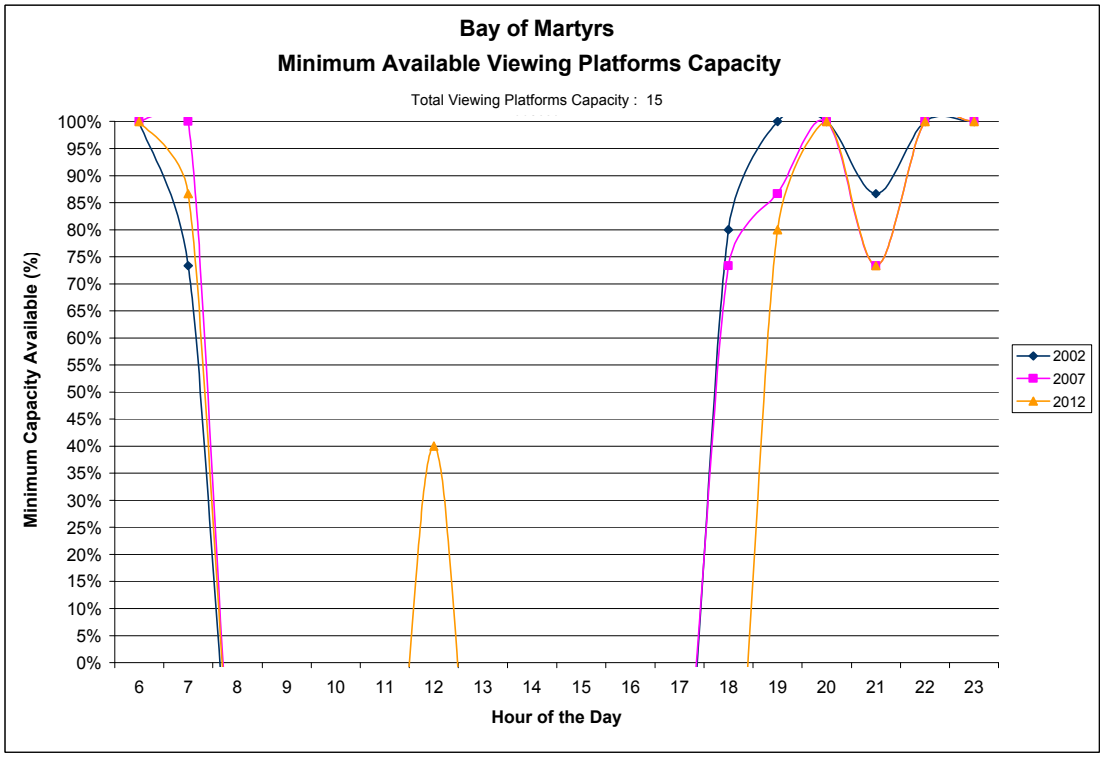


Figure 18. Bay of Martyrs Minimum Available Viewing Platform Capacity

Viewing platforms will periodically exceed their capacity at peak times for most hours of the day, and this periodic overload will continue into the future.

4.3.3 Queuing Times

4.3.3.1 Queuing Times for Cars

There is no queuing in either the average and maximum queuing times over the 10 year period; hence the figure is not shown.

4.3.4 Trip Completion Rates

4.3.4.1 Cars

There are no trip failures expected at the site, as the car park is not expected to be full over the 10 year period studied; hence the figure is not shown.

4.3.5 Length of Stay

4.3.5.1 Cars

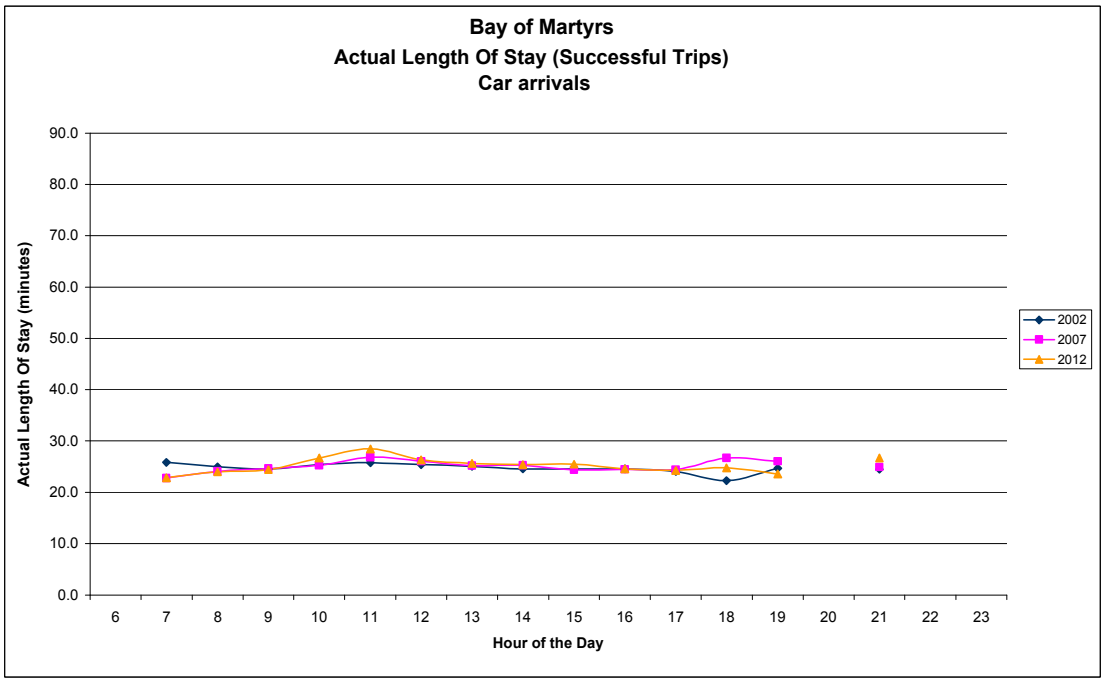


Figure 19. Bay of Martyrs Actual Length of Stay Successful Trips Car Arrivals

The average length of stay calculated from actual accumulated arrivals and departures from traffic counts is 20 minutes for cars. The simulator generated slightly higher trip durations fluctuating between 22 and 28 minutes with little variation over the periods from 2002 to 2012.

4.3.6 Encounters

4.3.6.1 Overall

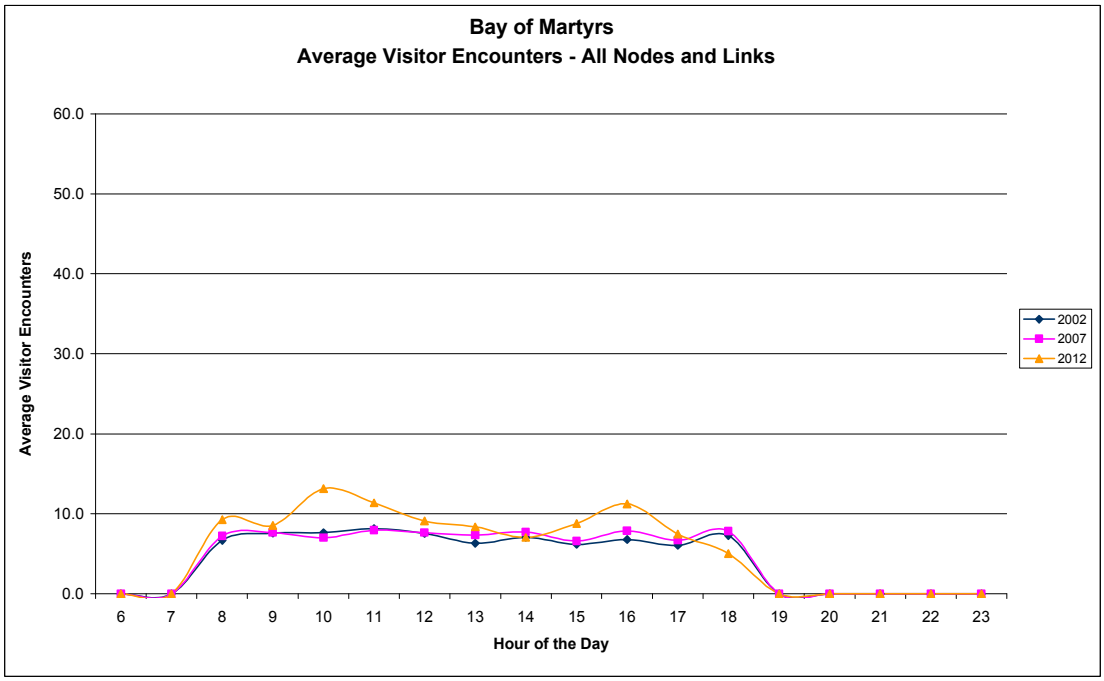


Figure 20. Bay of Martyrs Average Visitor Encounters – All Nodes and Links

Visitor encounters are predicted to stay consistent with 2002 figures during 2007, and increase in 2012 to between 4 and 6 people during peak times.

4.3.6.2 Viewing Platforms

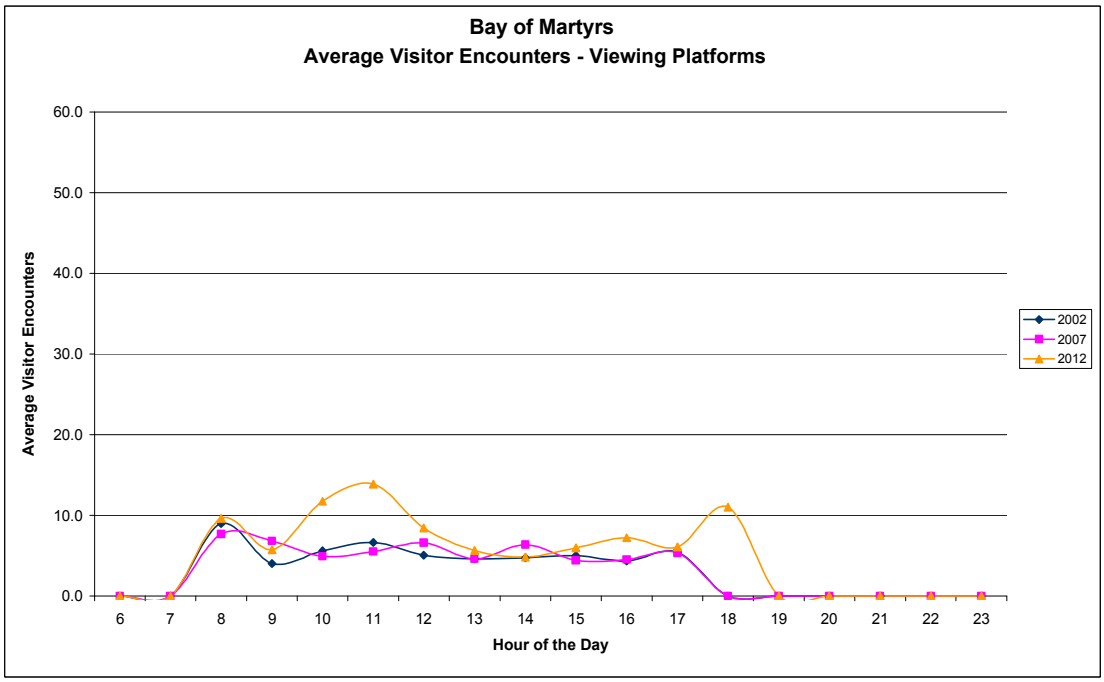


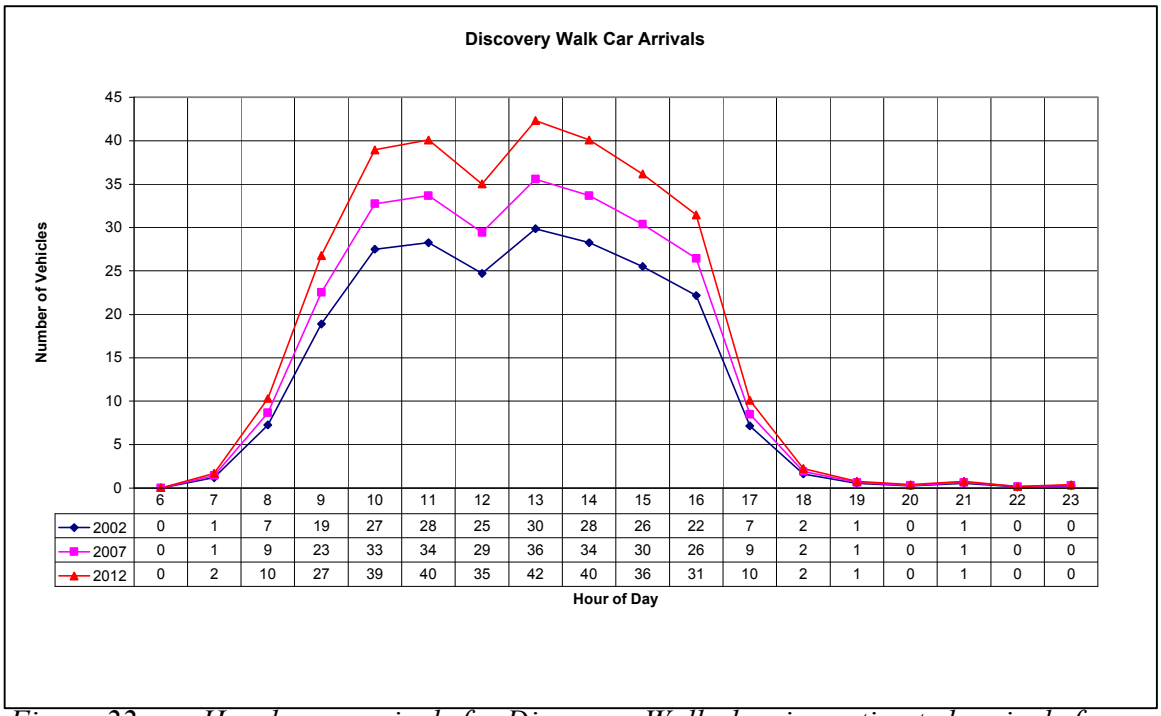
Figure 21. Bay of Martyrs Average Visitor Encounters – Viewing Platforms

Visitor encounters at viewing platforms (Figure 22) are forecast to stay similar in 2007 to 2002 statistics, and rise slightly during busy periods.

4.4 Discovery Walk

4.4.1 Car Arrivals

Figure 22 shows arrivals for cars peaking at 11:00 am declining until 12:00pm with a secondary peak at 1:00pm. Arrivals drop off slowly until 4:00 pm and then off rapidly until 9:00pm.



	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
2002	0	1	7	19	27	28	25	30	28	26	22	7	2	1	0	1	0	0
2007	0	1	9	23	33	34	29	36	34	30	26	9	2	1	0	1	0	0
2012	0	2	10	27	39	40	35	42	40	36	31	10	2	1	0	1	0	0

Figure 22. Hourly car arrivals for Discovery Walk showing estimated arrivals for 2002 and projected arrivals for 2007 and 2012

4.4.2 Parking Capacity and Loading

Discovery Walk has a single car park for 6 cars.

4.4.2.1 Parking Capacity for Cars

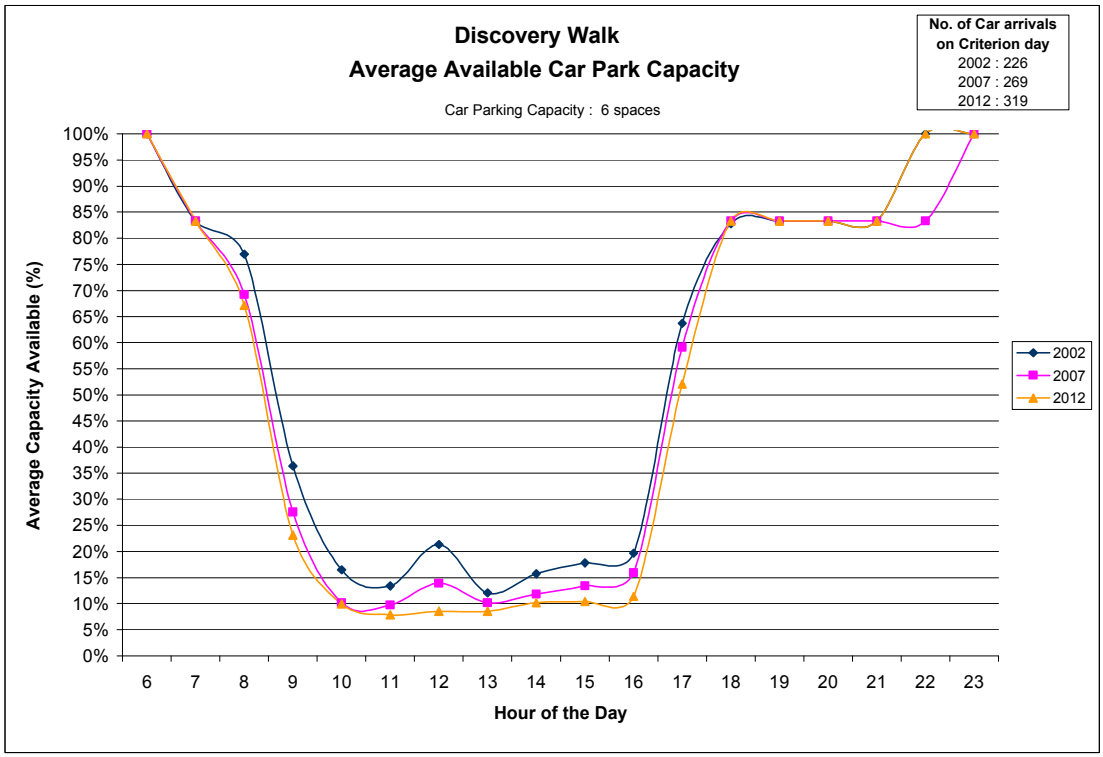


Figure 23. Discovery Walk Average Available Car Park Capacity

From the above figures it can be seen that due to the small size of the car park (6 spaces) the average available capacity is already quite low, from 10am to 4pm there is an average of 1 space available. This average capacity available does not show further deterioration in future years even with additional arrivals because of the very low car parking capacity with no queuing time and short length of stay. Therefore minimum car parking capacity is better to examine emerging problems.

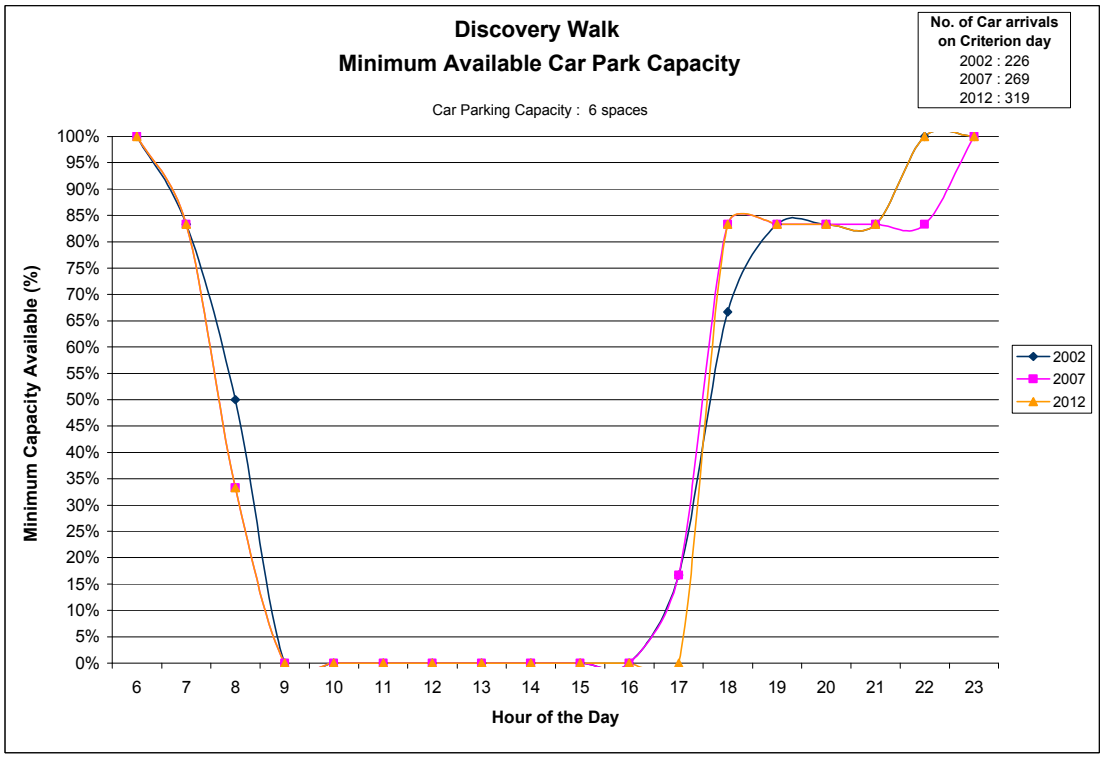


Figure 24. Discovery Walk Minimum Available Car Park Capacity

The minimum available car park capacity (Figure 30) shows that between 9am and 4pm the car park is currently full, and that with increased car arrivals (226 in 2002, to 319 in 2012) this will lead to a rise in trip failures.

4.4.3 Queuing Times

4.4.3.1 Queuing Times for Cars

There is no queuing for either average or maximum queuing times at the Discovery Walk car park. However this is a consequence of the fact that the single car park is close to the Great Ocean Road. Agents arriving either immediately go to a vacant car park or will have a failed trip if all car parks are full. This is reflected in the high number of trip failures in Figure 25.

4.4.4 Trip Completion Rates

4.4.4.1 Completion Rates for Cars

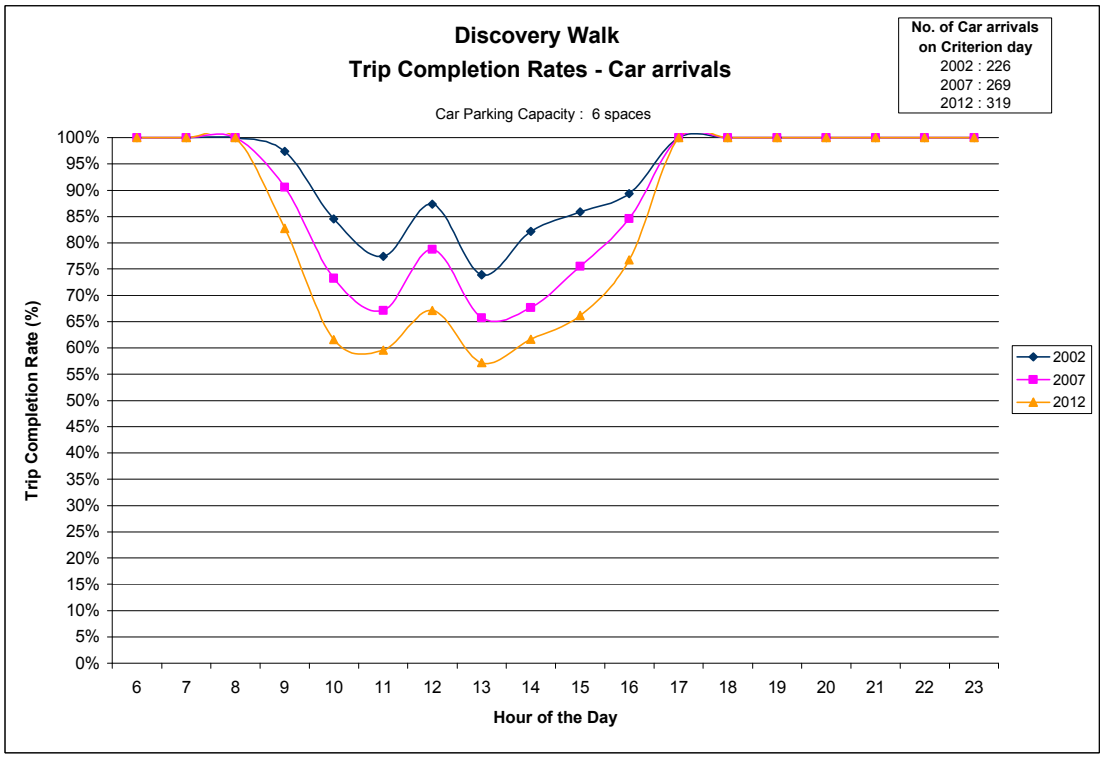


Figure 25. Discovery Walk Trip Completion Rates - Car Arrivals

Trip completion rates during 10am to 4pm, the busiest hours of the day, at the site currently average at 83%, with failures at the peak hours at 11am (23%) and 1pm (26%). This is projected to worsen in 2007 to an average of 73% (between 10am and 4pm), and 33% and 34% peak failures, and again in 2012 to average 64%, and 40% and 43% peak hour failures.

4.4.5 Length of Stay

4.4.5.1 Cars

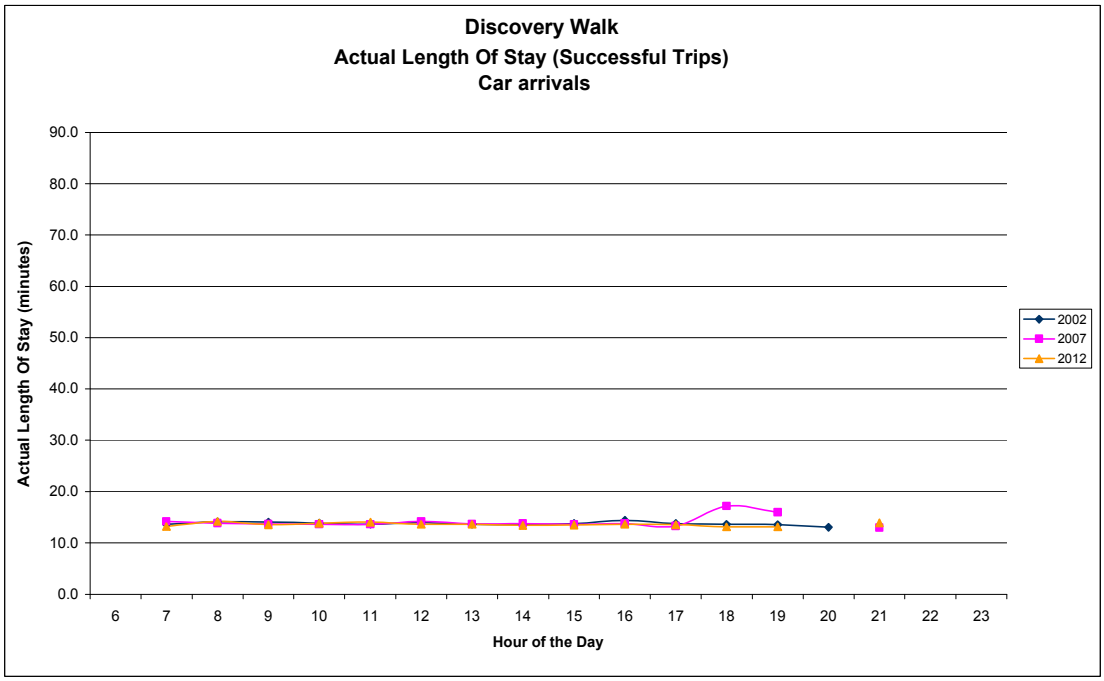


Figure 26. Discovery Walk Actual Length of Stay Successful Trips Car Arrivals

The average length of stay calculated from accumulated arrivals from traffic counts is 10 minutes for cars. The simulator generated trip durations fluctuating between 13 and 17 minutes with little variation over the periods from 2002 to 2012

4.4.6 Encounters

4.4.6.1 Overall

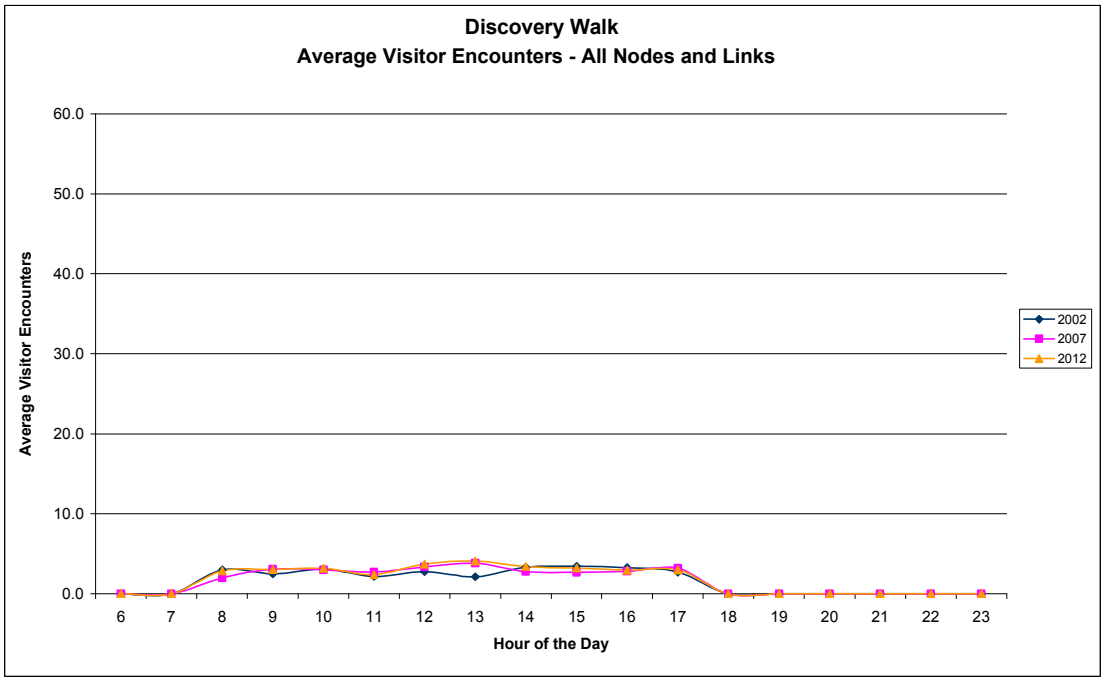


Figure 27. Discovery Walk Average Visitor Encounters – All Nodes and Links

Visitor encounters throughout the day are predicted to stay consistent with 2002 numbers, which are around 3 people for the entire day (8am to 6pm).

4.5 Gibsons Steps

4.5.1 Car and Bus Arrivals

Figure 28 shows arrivals for cars peaking at 2:00pm and dropping off until 7:00 pm.

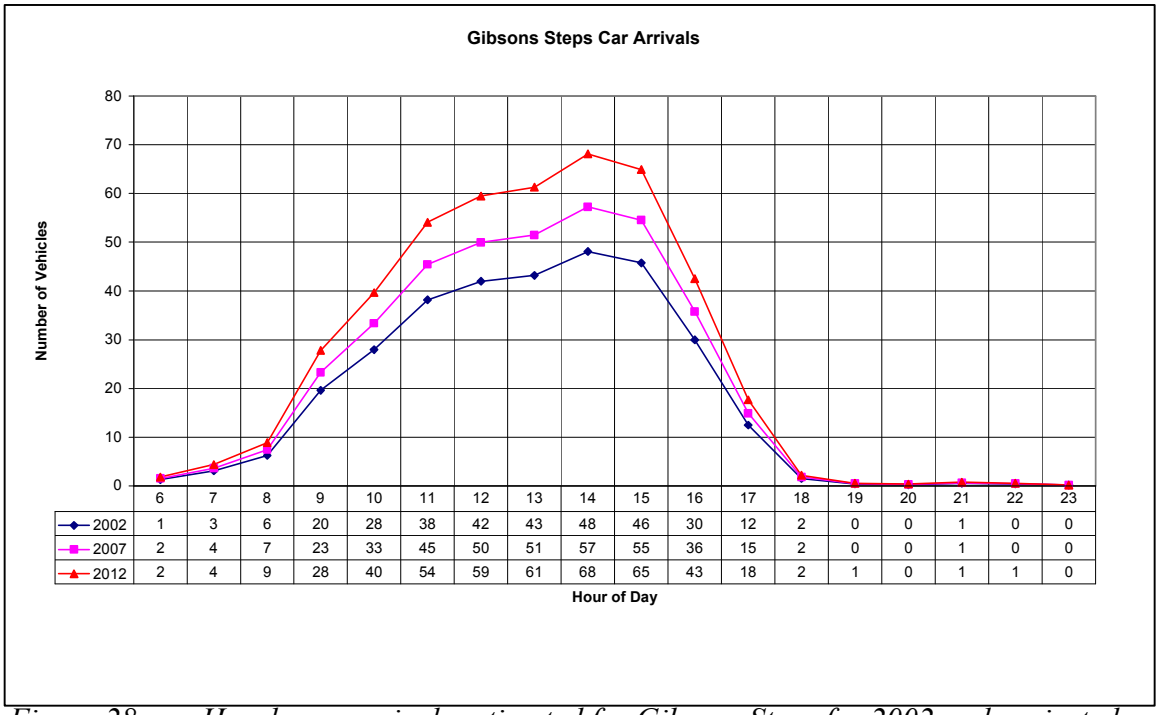


Figure 28. Hourly car arrivals estimated for Gibsons Steps for 2002 and projected for 2007 and 2012.

Figure 29 shows arrivals for buses peaking at 10:00 am declining until 12:00 noon with a secondary peak at 2:00pm. Arrivals continue to drop off until 6:00pm.

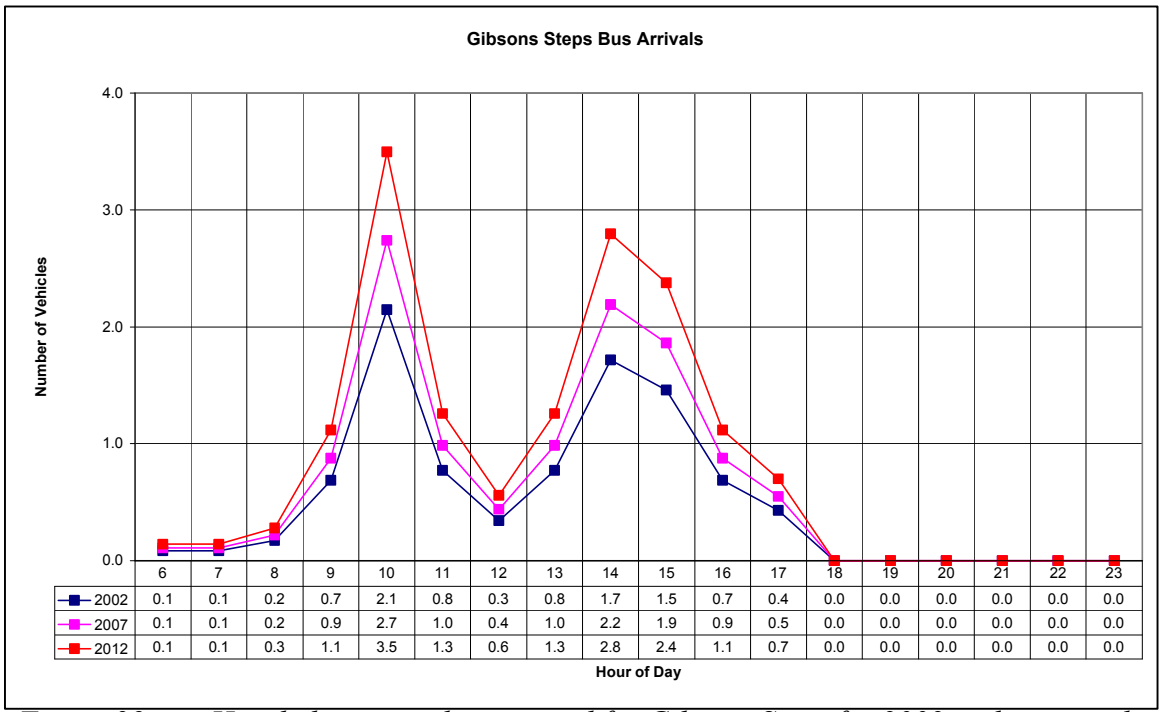


Figure 29. Hourly bus arrivals estimated for Gibsons Steps for 2002 and projected for 2007 and 2012.

4.5.2 Parking Capacity and Loading

Gibson Steps has parking for 13 cars and 2 buses.

4.5.2.1 Parking Capacity for Cars

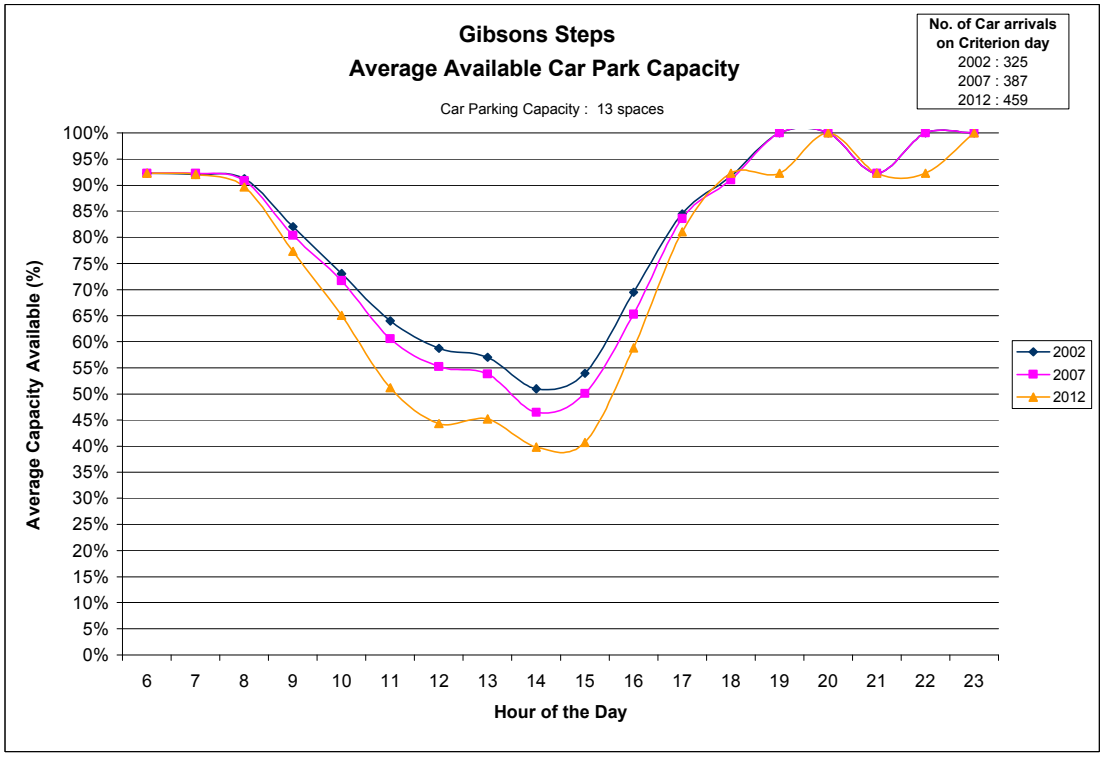


Figure 30. Gibsons Steps Average Available Car Park Capacity

Figure 30 shows average available parking at Gibsons Steps. Currently during peak hours between 2pm and 4pm there is 50% available. This is projected to decrease slightly to 45% or higher in 2007 for the day, and 40% in 2012.

Figure 31 shows the minimum available parking available at Gibsons steps. Currently the car park's minimum capacity never reaches zero, meaning it isn't full during any time of the day. At the busiest hour there are still 3 empty spaces out of 13. The car park is not predicted to be full in future years either, with similar numbers to the 2002 rates in 2007, and a slight decrease in 2012 to 2 spaces free from 1pm to 4pm.

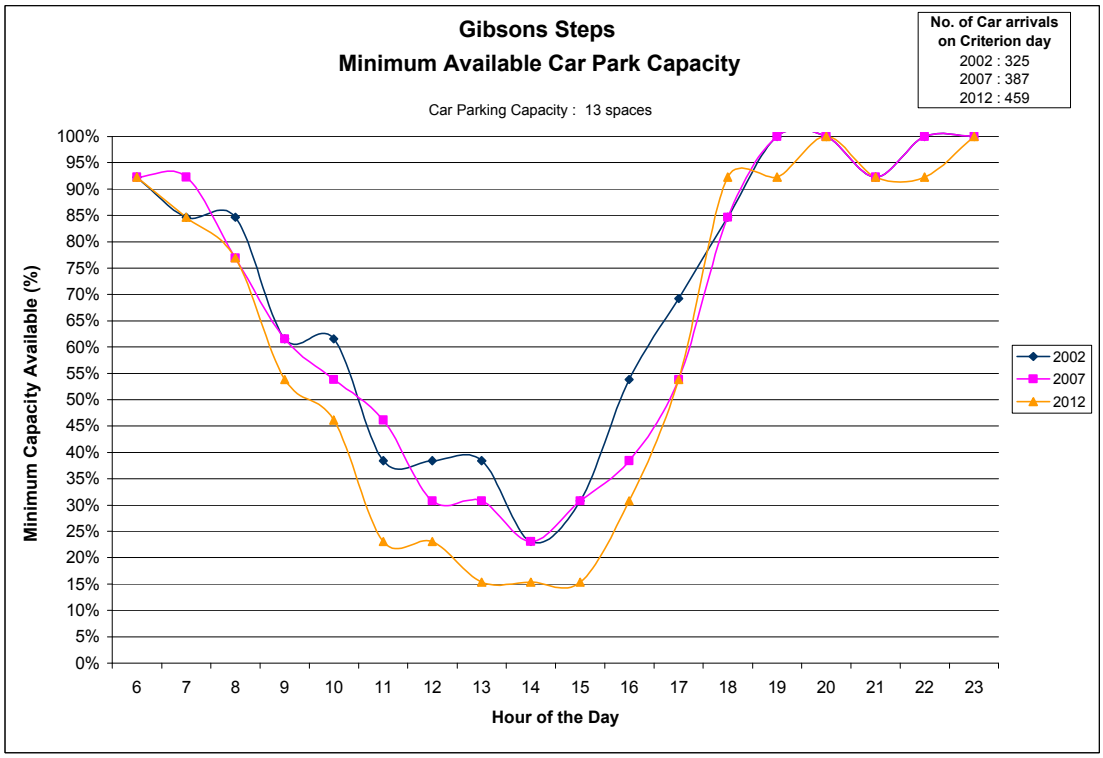


Figure 31. Gibsons Steps Minimum Available Car Park Capacity

4.5.2.2 Parking Capacity for Buses

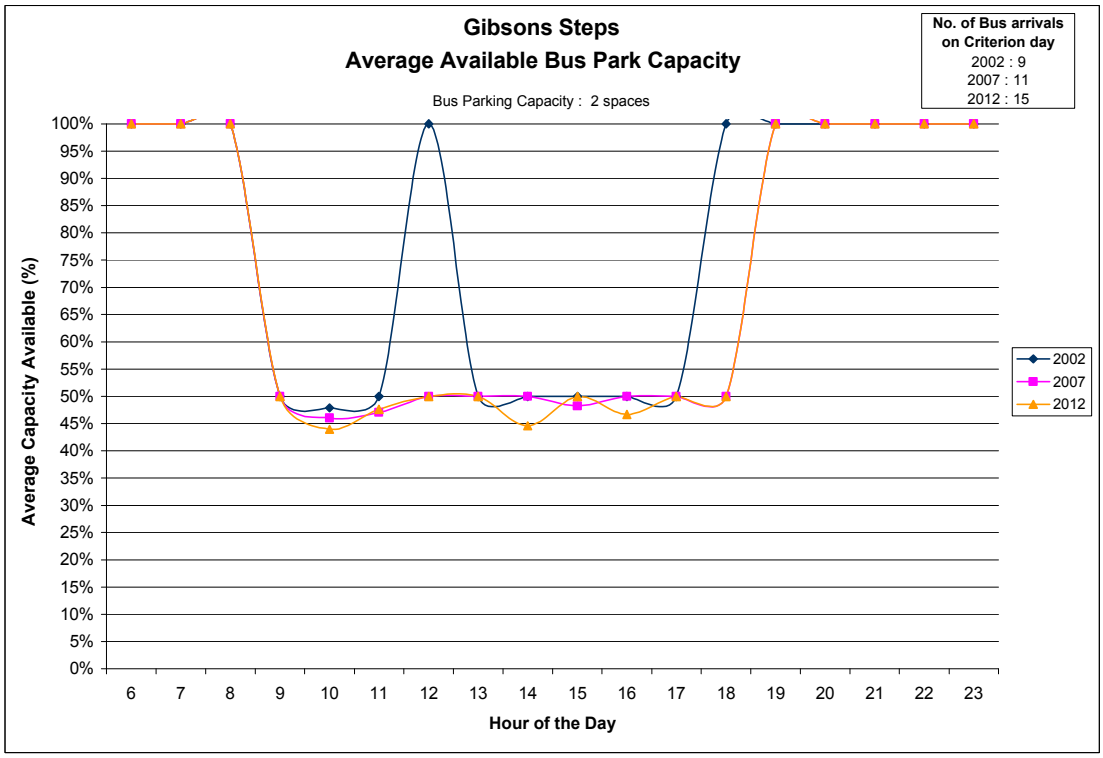


Figure 32. Gibsons Steps Average Available Bus Park Capacity

Figure 32 shows the average available capacity for bus parking at Gibsons Steps. There is on average 1 space free (of 2 spaces) in the Gibsons Steps bus park for the

majority of the day according to 2002 figures, and this is expected to stay the same for future years.

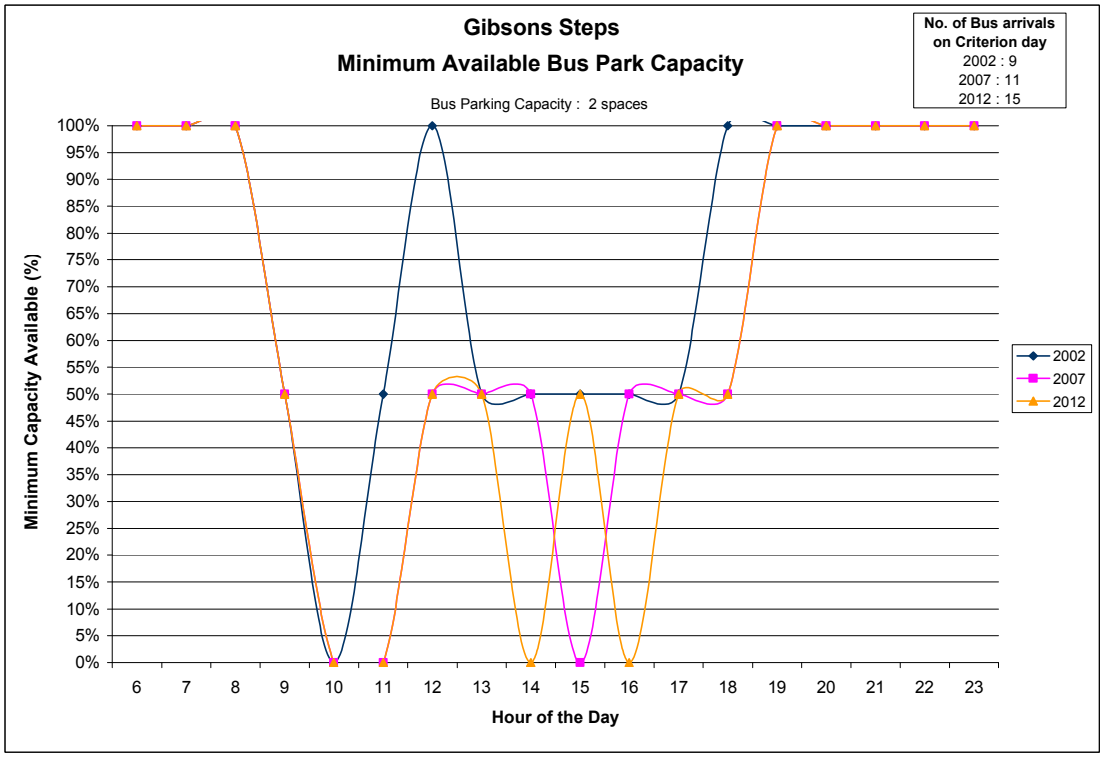


Figure 33. Gibsons Steps Minimum Available Bus Park Capacity

The minimum available bus parking shown in Figure 33. Currently only from 10am to 11am the bus park is periodically full at Gibsons Steps, this is expected to become more frequent in future years but does not effect trip failures (refer below).

4.5.2.3 Capacity at Viewing Platforms

Gibsons Steps has a single viewing platform with a capacity of 12 people.

Average capacity for the viewing platform at Gibsons Steps in shown in Figure 34. Viewing platforms at Gibsons steps at present average between 55% and 80% for the day, and is not expected to increase in the future

The minimum capacity at the Gibsons Steps viewing platform is shown in Figure 35. Between 9am and 5pm the Gibsons Steps viewing platforms are periodically over capacity in 2002, with the problem increasing over the next 10 years. This phenomena is typical of many low capacity viewing platforms at Port Campbell National Park where high numbers of visitor all want to use a small platform at the same time; this often occurs when a bus arrives and disgorges many passengers.

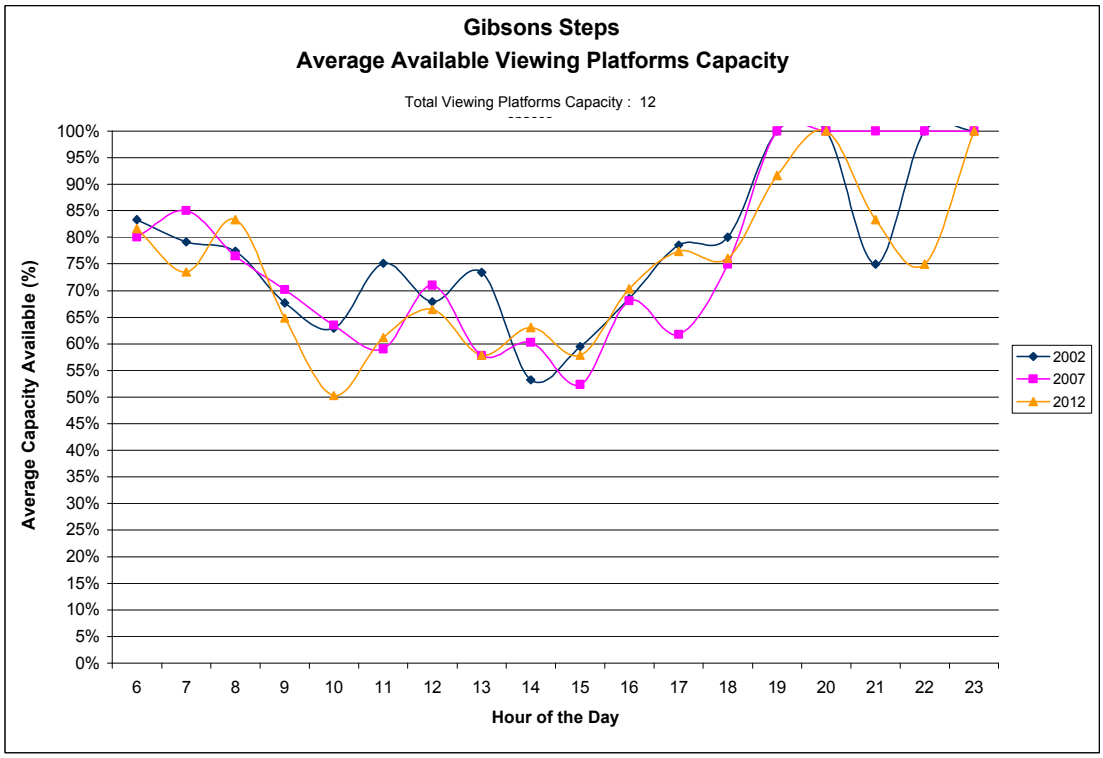


Figure 34. Gibsons Steps Average Available Viewing Platform Capacity

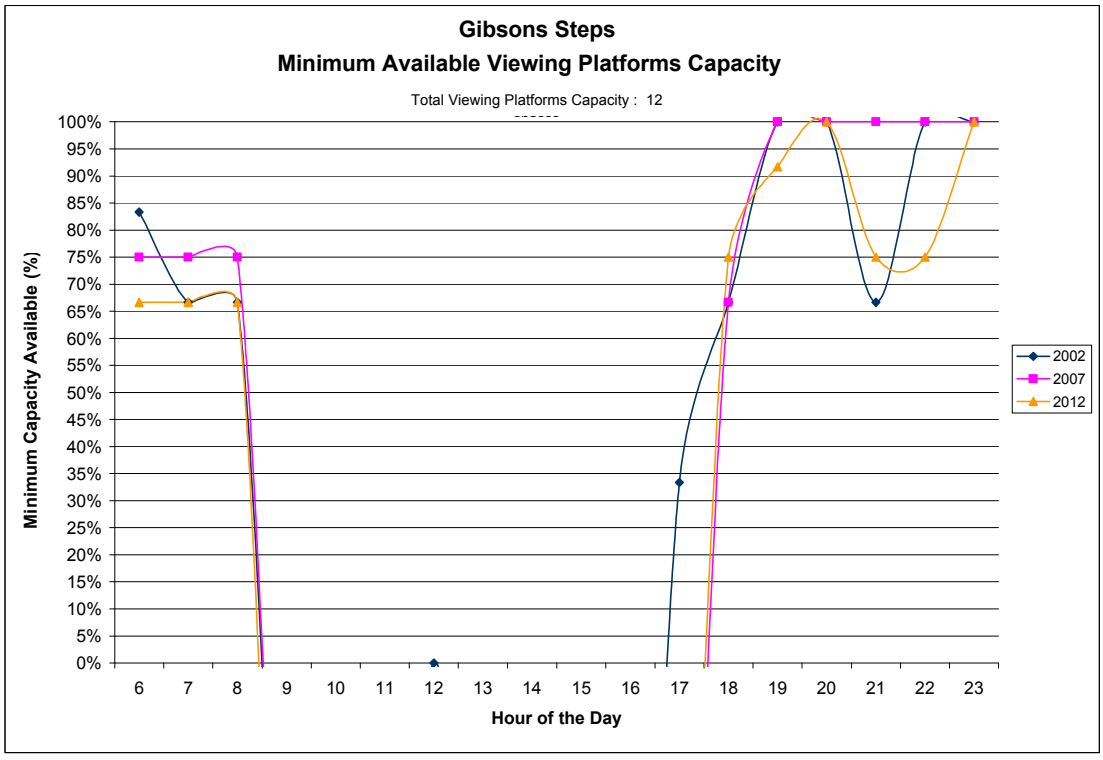


Figure 35. Gibsons Steps Minimum Available Viewing Platform Capacity

4.5.3 Queuing Times

4.5.3.1 Queuing times Cars

There is no queuing for cars over the 10 year simulation period either for average or maximum queuing times; hence the figure is not shown.

4.5.3.2 Queuing times for Buses

There is no queuing in bus parks over the 10 year simulation period either for average or maximum queuing times; hence the figure is not shown.

4.5.4 Trip Completion Rates

4.5.4.1 Cars

There are no trip failures for cars predicted for the 10 year period of the simulation; hence the figure is not shown.

4.5.4.2 Buses

There are no trip failures for buses predicted for the 10 year period of the simulation; hence the figure is not shown.

4.5.4.3 Overall

For all arrivals the are no trip failures currently or projected.

4.5.5 Length of Stay

4.5.5.1 Cars

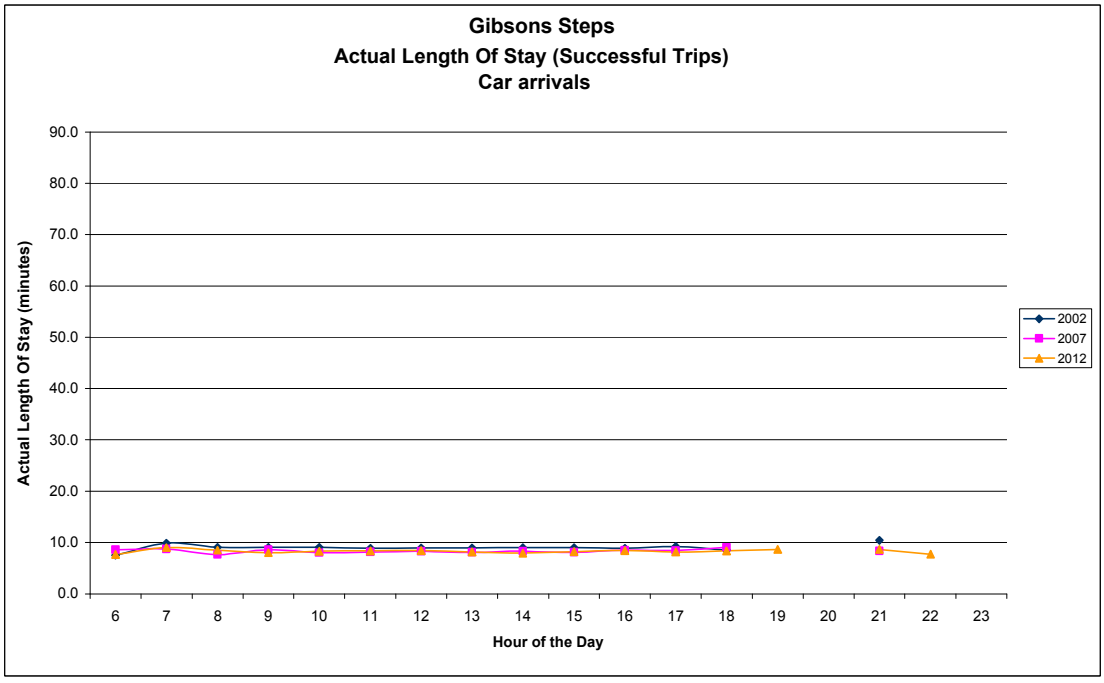


Figure 36. Gibsons Steps Actual Length of Stay Successful Trips Car Arrivals

The average length of stay calculated from actual accumulated arrivals and departures from traffic counts is 10 minutes for cars. The simulator generated very similar trip

durations fluctuating between 8 and 9 minutes with little variation over the periods from 2002 to 2012.

4.5.5.2 Buses

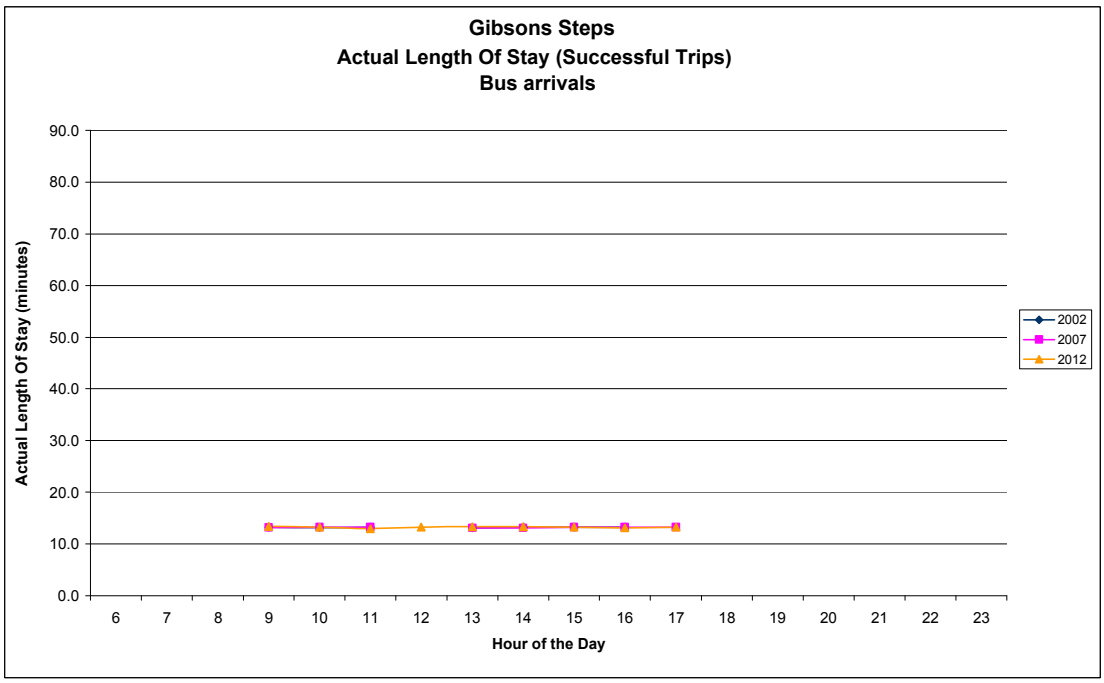


Figure 37. Gibsons Steps Actual Length of Stay Successful Trips Bus Arrivals

The average length of stay calculated from actual accumulated arrivals and departures from traffic counts is 20 minutes for buses. The simulator generated slightly higher trip durations fluctuating between 22 and 28 minutes with little variation over the periods from 2002 to 2012

4.5.6 Encounters

4.5.6.1 Overall

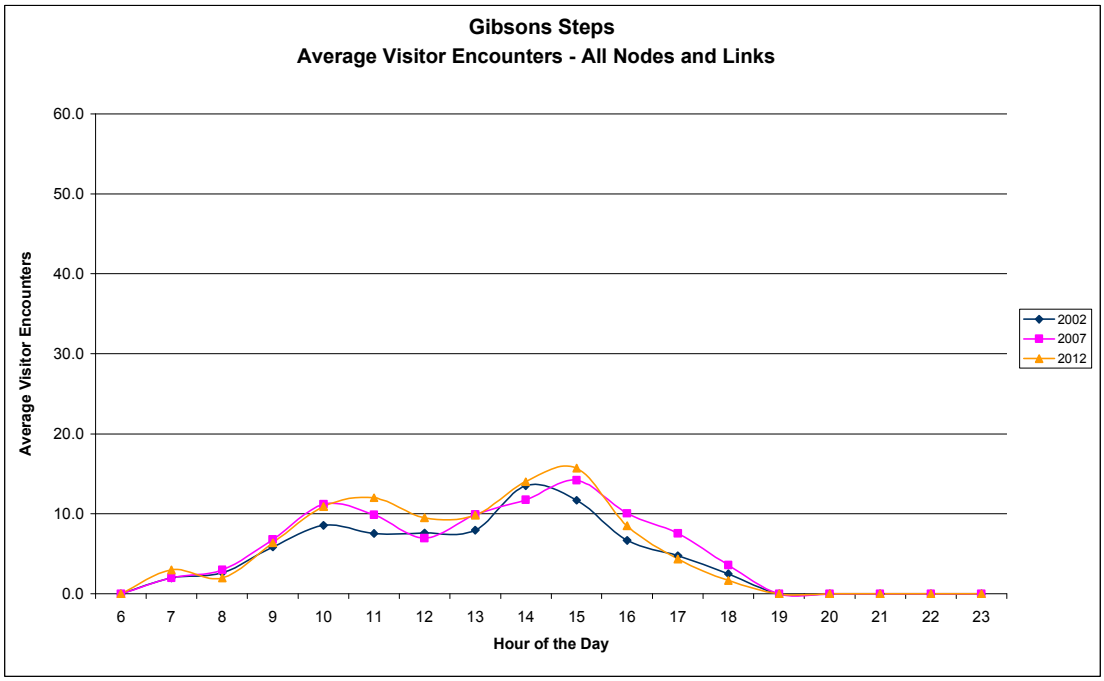


Figure 38. Gibsons Steps Average Visitor Encounters – All Nodes and Links

Visitor encounters for Gibsons Steps are currently around 8 people, increasing to 13 people at the 2pm peak. This is expected to increase gradually over the next 10 years to 10 people for most of the day, and 15 at a 3pm peak.

4.5.6.2 Viewing Platforms

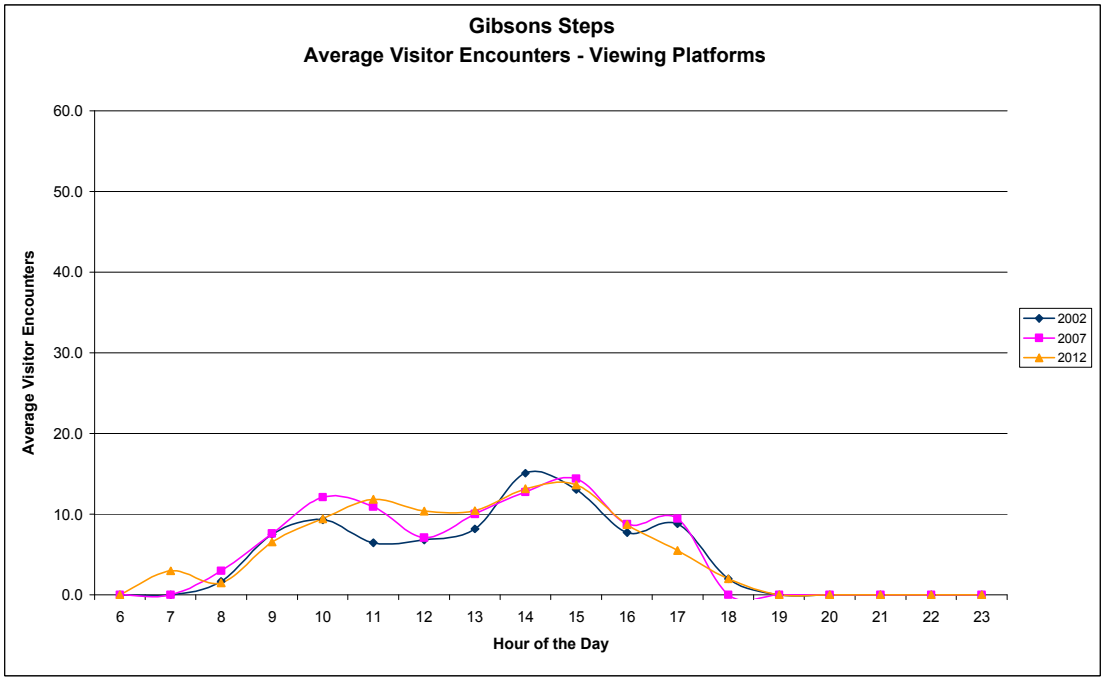


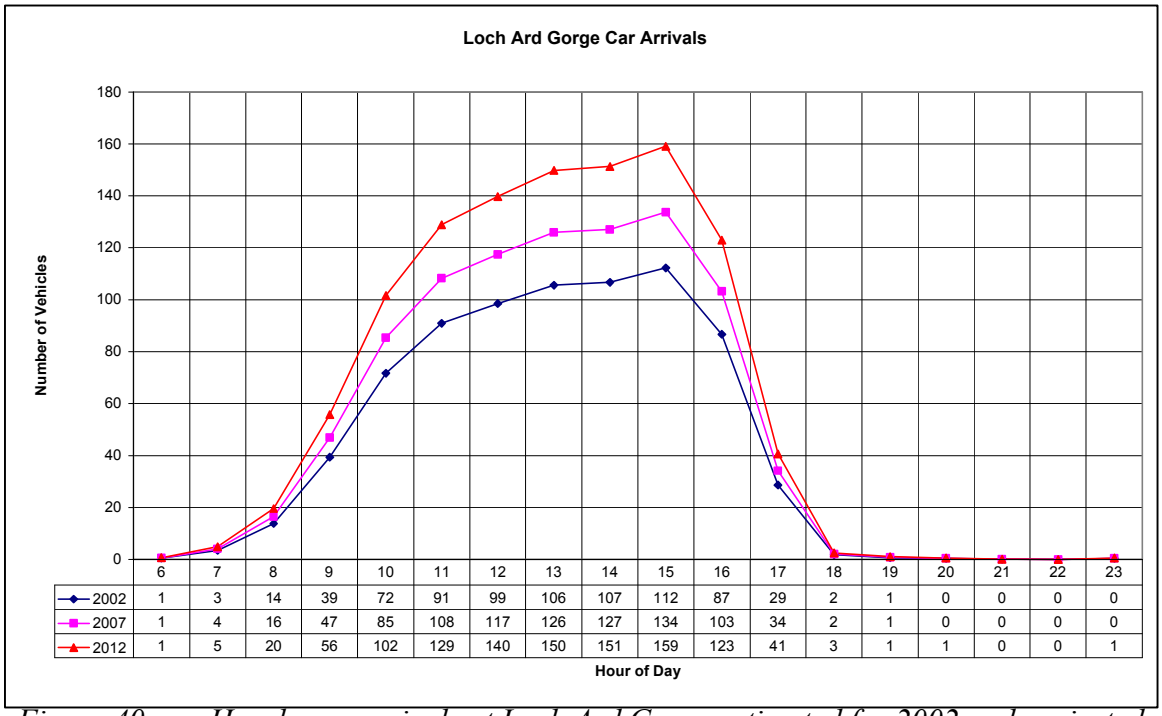
Figure 39. Gibsons Steps Average Visitor Encounters – Viewing Platforms

Viewing platform's visitor encounters are expected to stay similar to 2002 statistics, with a slight rise in encounters between 10am and 1pm for future years.

4.6 Loch Ard Gorge

4.6.1 Car and Bus Arrivals

Figure 40 and 41 shows the arrival curves for cars and buses for 2002, 2007 and 2012 for Loch Ard Gorge.



	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
2002	1	3	14	39	72	91	99	106	107	112	87	29	2	1	0	0	0	0
2007	1	4	16	47	85	108	117	126	127	134	103	34	2	1	0	0	0	0
2012	1	5	20	56	102	129	140	150	151	159	123	41	3	1	1	0	0	1

Figure 40. Hourly car arrivals at Loch Ard Gorge estimated for 2002 and projected for 2007 and 2012.

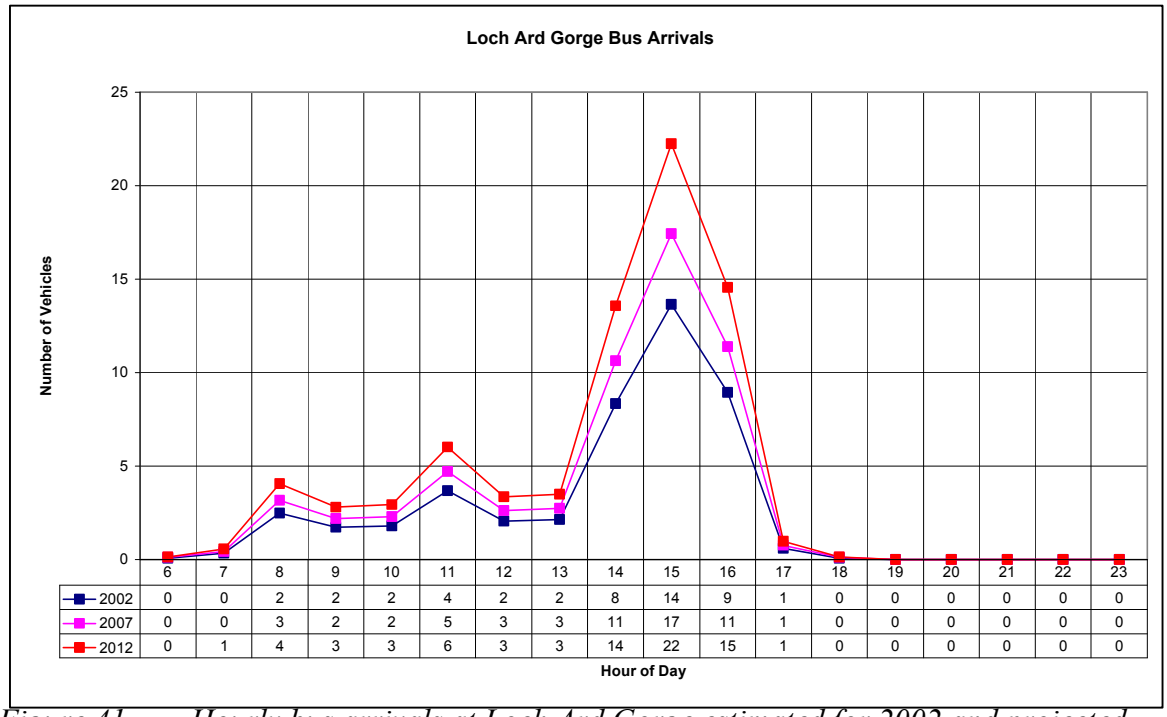


Figure 41. Hourly bus arrivals at Loch Ard Gorge estimated for 2002 and projected for 2007 and 2012.

4.6.2 Parking Capacity and Loading

Loch Ard Gorge has 5 car parking areas with a total capacity of 122 Spaces. There is also designated parking for 14 buses.

4.6.2.1 Parking Capacity for Cars

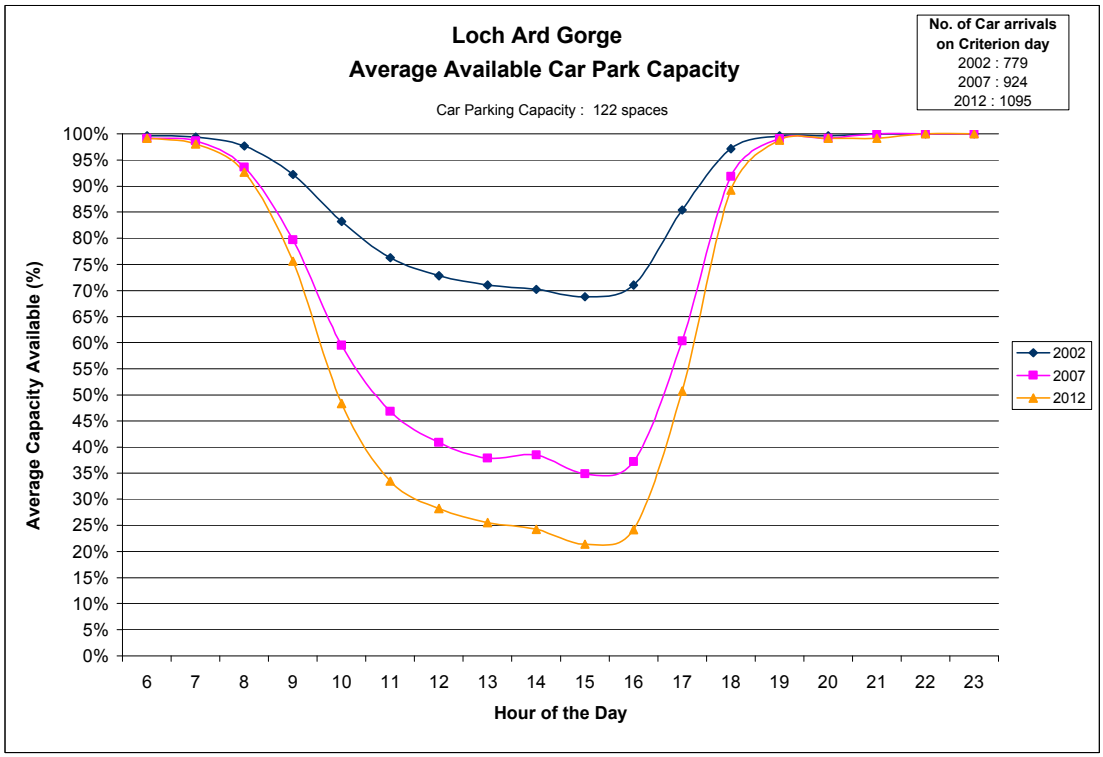


Figure 42. Loch Ard Gorge Average Available Car Park Capacity

Average capacity the Loch Ard Gorge is currently above 68% for the entire day, leaving the car park at the peak time (3pm) with more than 83 free spaces for most hours. This is expected to decrease greatly to 2007, when at 3pm 35% (or 43 spaces) of the car park will be empty on average, and again in 2012 when 21% (or 27 spaces) will be free on average.

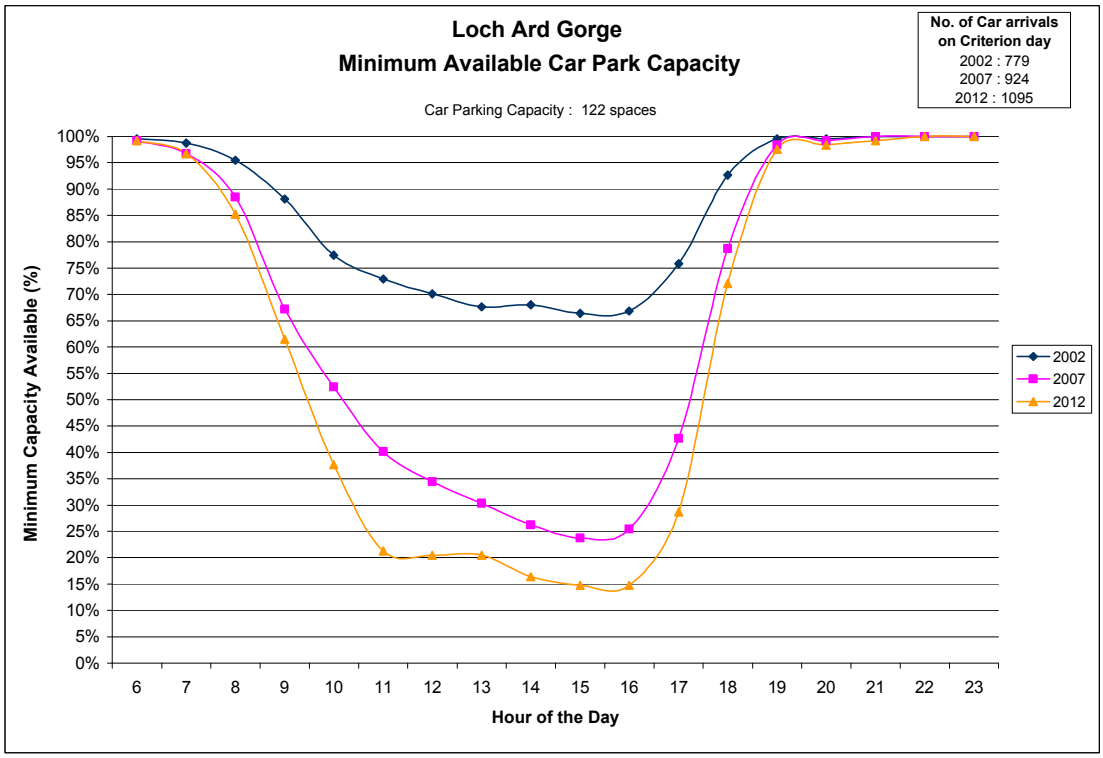


Figure 43. Loch Ard Gorge Minimum Available Car Park Capacity

The minimum available capacity of Loch Ard Gorge shows that currently the car park always has at least 81 free spaces at the peak time of 3pm; this is predicted to drop to 29 spaces in 2007 and 18 spaces in 2012. This shows that according to the figures the car park should never be full on the 95 percentile day provided that both the east and west car spaces are utilised.

4.6.2.2 Parking Capacity for Buses

The average available bus parks at Loch Ard Gorge (Figure 44) at present is around 12 free spaces for most of the day with only 3 spaces free at the 3pm to 5pm peak. These numbers are projected to drop steeply to 2007 when 11 spaces will be free at most times, and at the peak at 1pm to 3pm 2 only spaces will be free. This is expected to drop again to 2012 when 10 spaces will be free for most of the day and 1 space free at a 3pm to 5pm peak.

Minimum capacity (Figure 45) is currently never below 50%, this is expected to drop sharply during the peak hours in the future. The bus park will be periodically full to 2007 between 1pm and 3pm, and in 2012 between 3pm and 6pm.

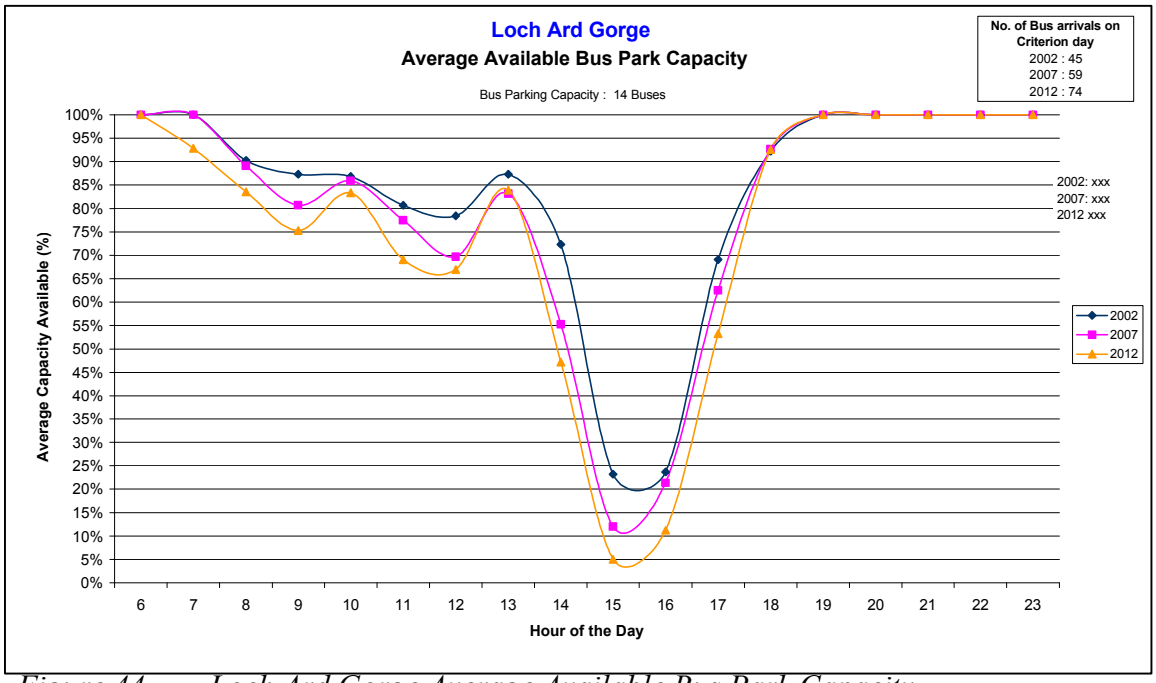


Figure 44. Loch Ard Gorge Average Available Bus Park Capacity

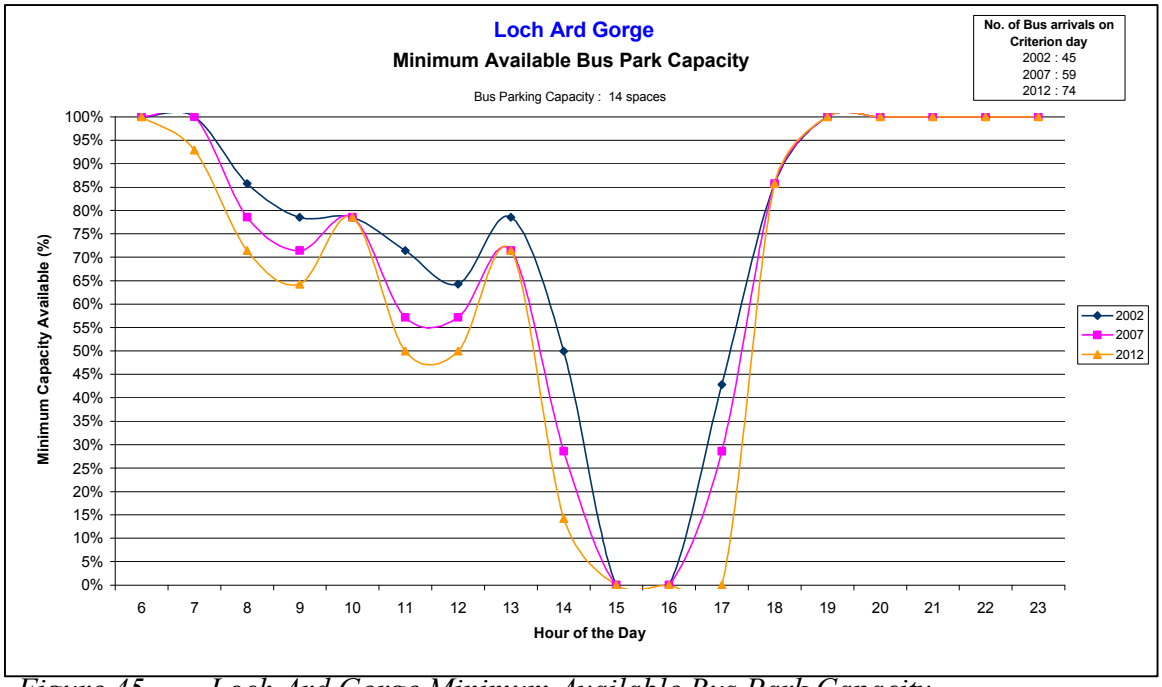


Figure 45. Loch Ard Gorge Minimum Available Bus Park Capacity

4.6.2.3 Capacities at Viewing Platforms

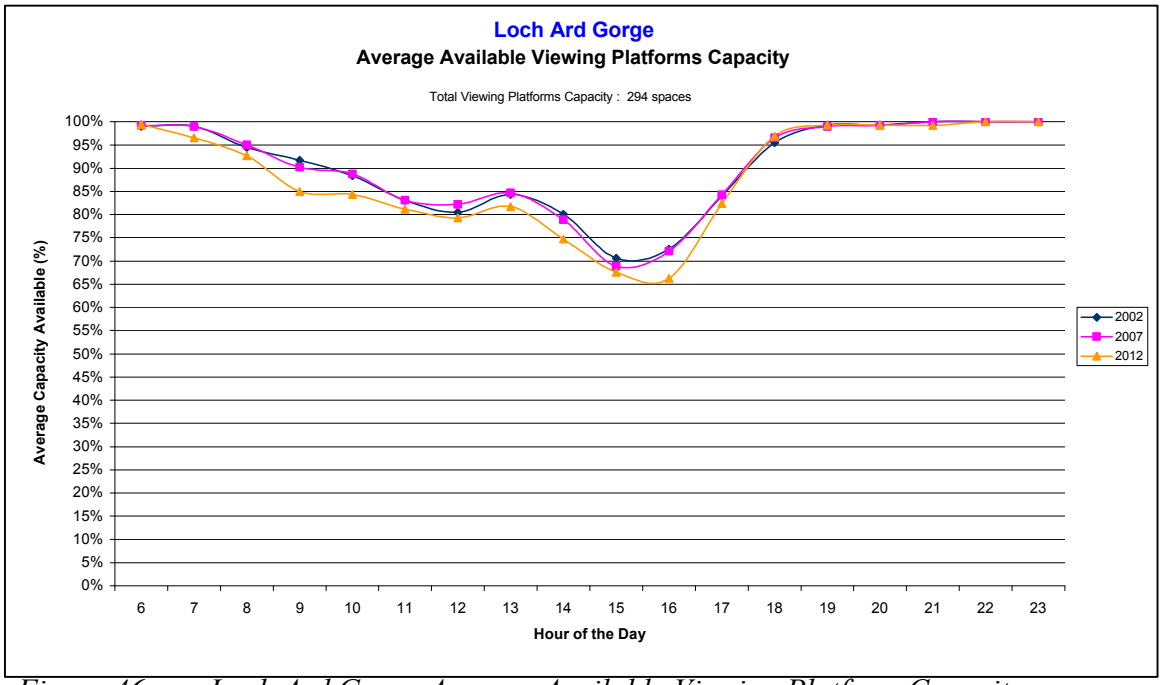


Figure 46. Loch Ard Gorge Average Available Viewing Platform Capacity

Viewing platform's average capacity (Figure 46) is currently above 85% for the entire day, dropping a little to 2012 to 65% capacity.

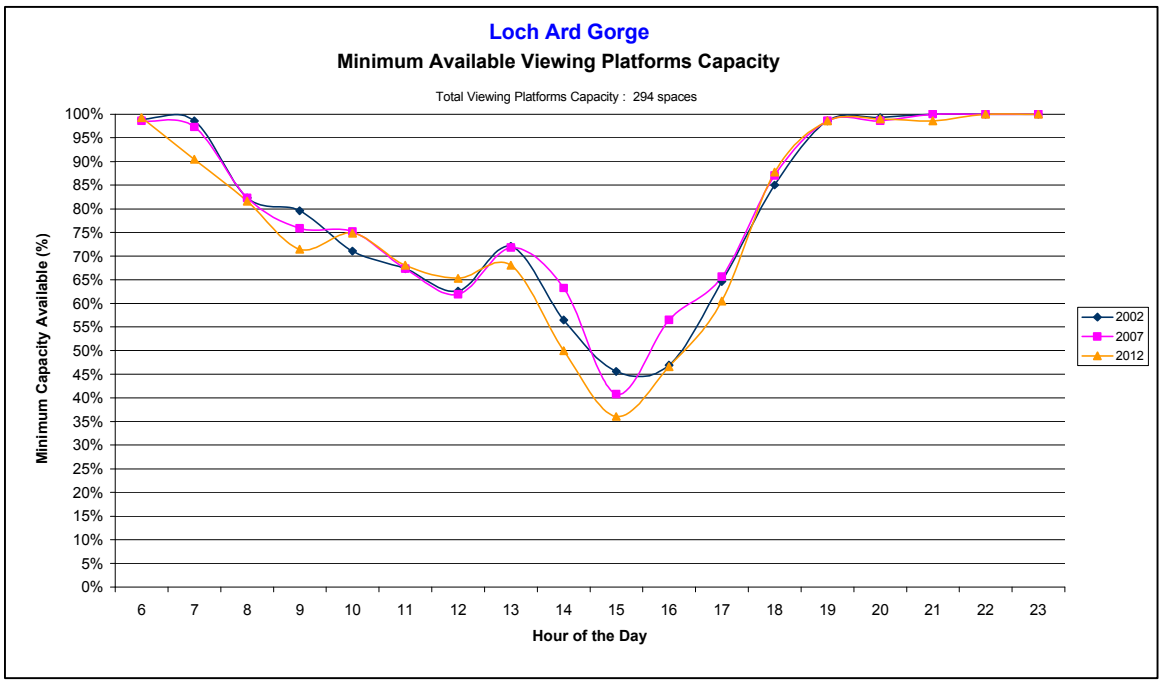


Figure 47. Loch Ard Gorge Minimum Available Viewing Platform Capacity

Minimum capacity (Figure 47) in viewing platforms is expected to drop from its current levels of around 75% at peak times, to 45% in 2007, and 35% in 2012. This

shows that the platforms are not operating at full capacity at any time in the day, nor projected for the future.

4.6.3 Queuing Times

4.6.3.1 Queuing Times for Cars

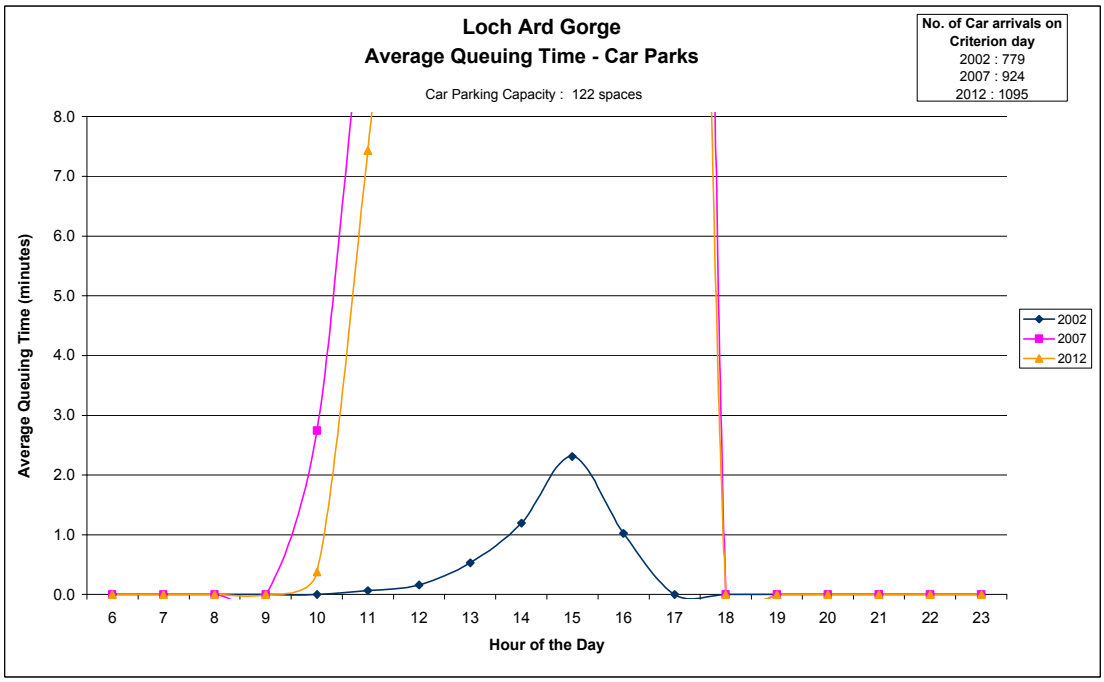


Figure 48. Loch Ard Gorge Average Queuing Time – Car Parks

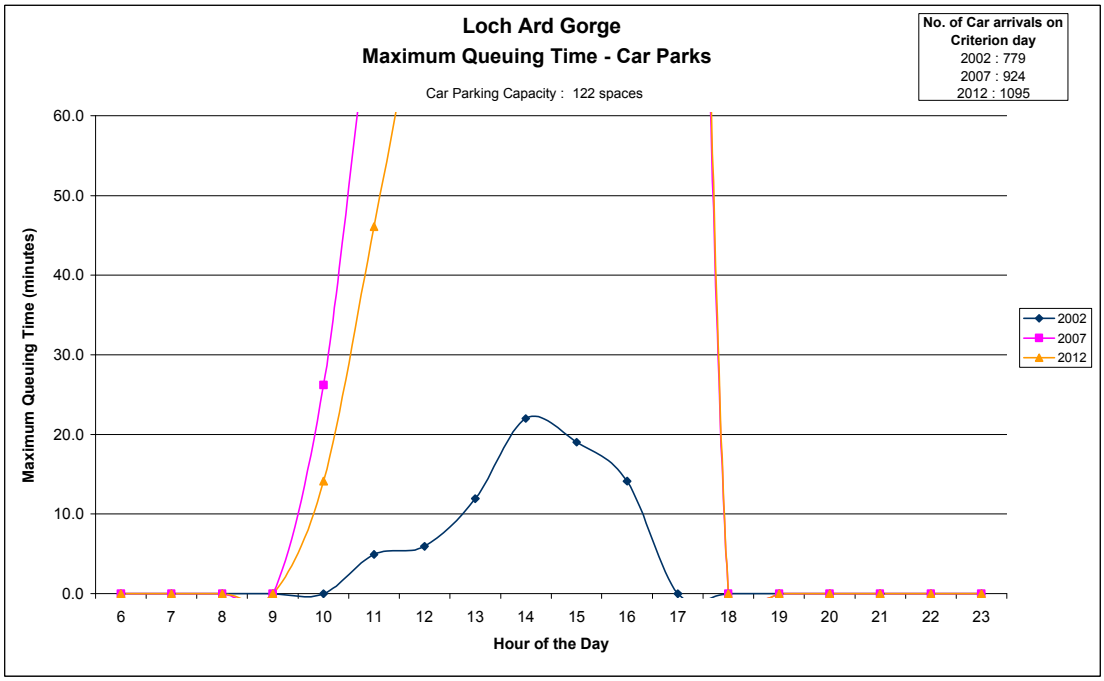


Figure 49. Loch Ard Gorge Maximum Queuing Time – Car Parks

Excessive queuing times shown in Figure 48 and Figure 49 are a result of long duration of stay. These times are not representative since there are excess car parking spaces throughout the simulation. The queuing times reported here are for the east parking areas where most traffic goes first. If the parking is full on arrival, cars must queue regardless of whether or not there are other parking areas free. This indicates that there should be on-site traffic management during peak periods to avoid this type of congestion at individual parking areas.

4.6.3.2 Queuing Times for Buses

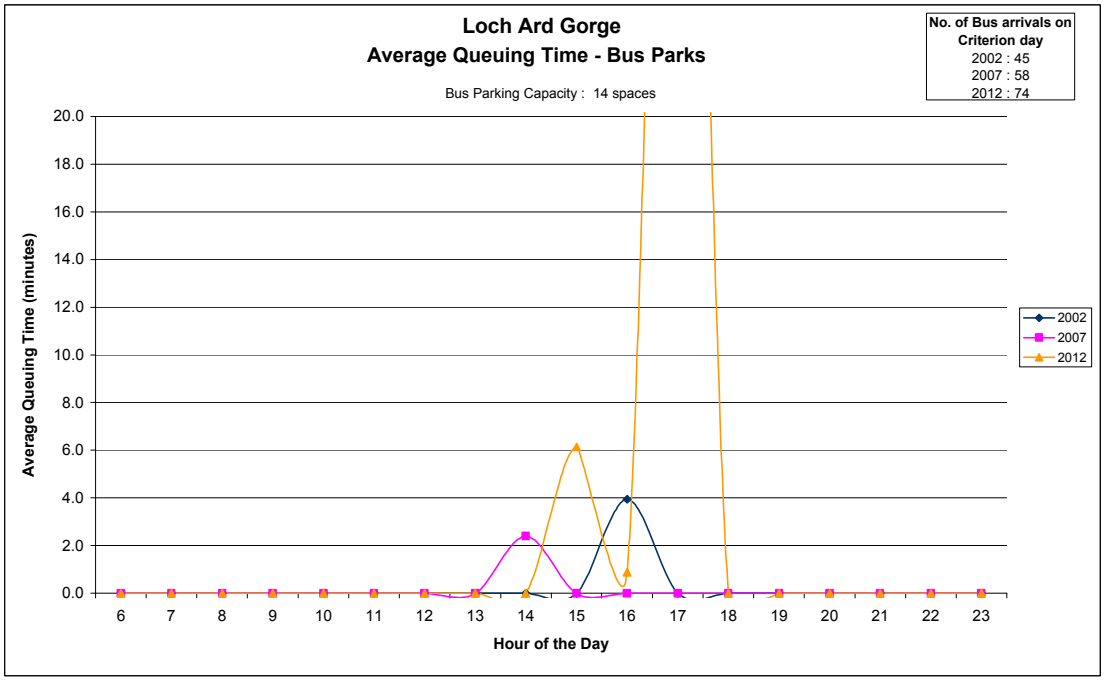


Figure 50. Loch Ard Gorge Average Queuing Time – Bus Parks

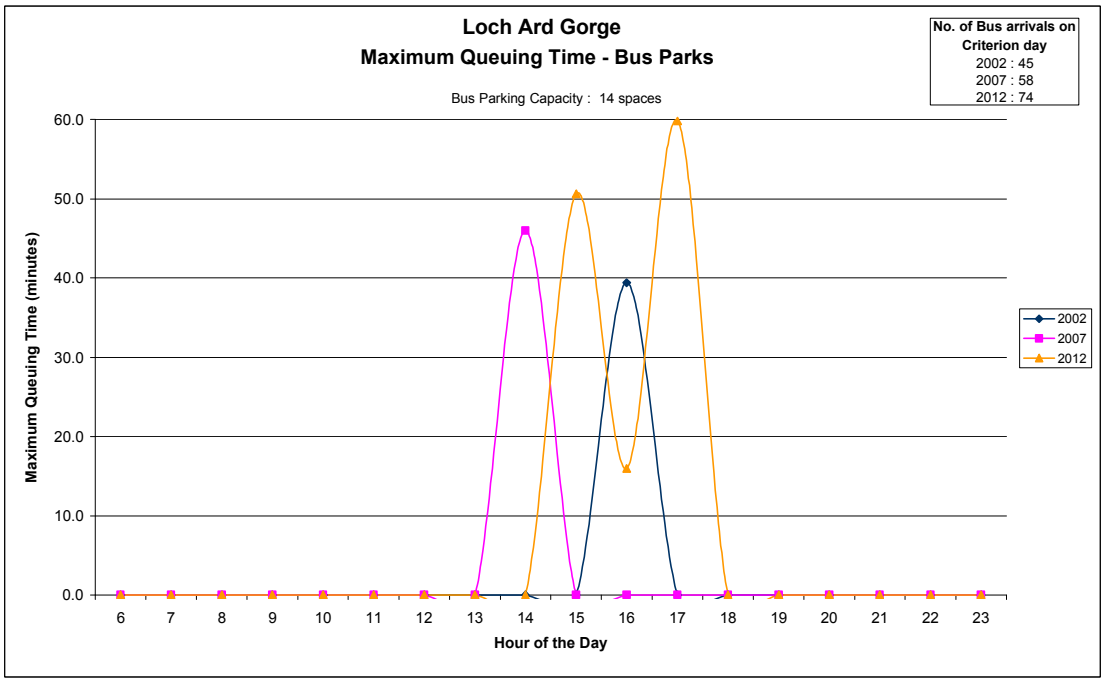


Figure 51. Loch Ard Gorge Maximum Queuing Time – Bus Parks

The interpretation of queuing times for buses as shown in Figure 50 and Figure 51 is similar to that of cars since all buses completed their trips. The only concern may be by 2012 when bus parking is occasionally full during peak periods of the day.

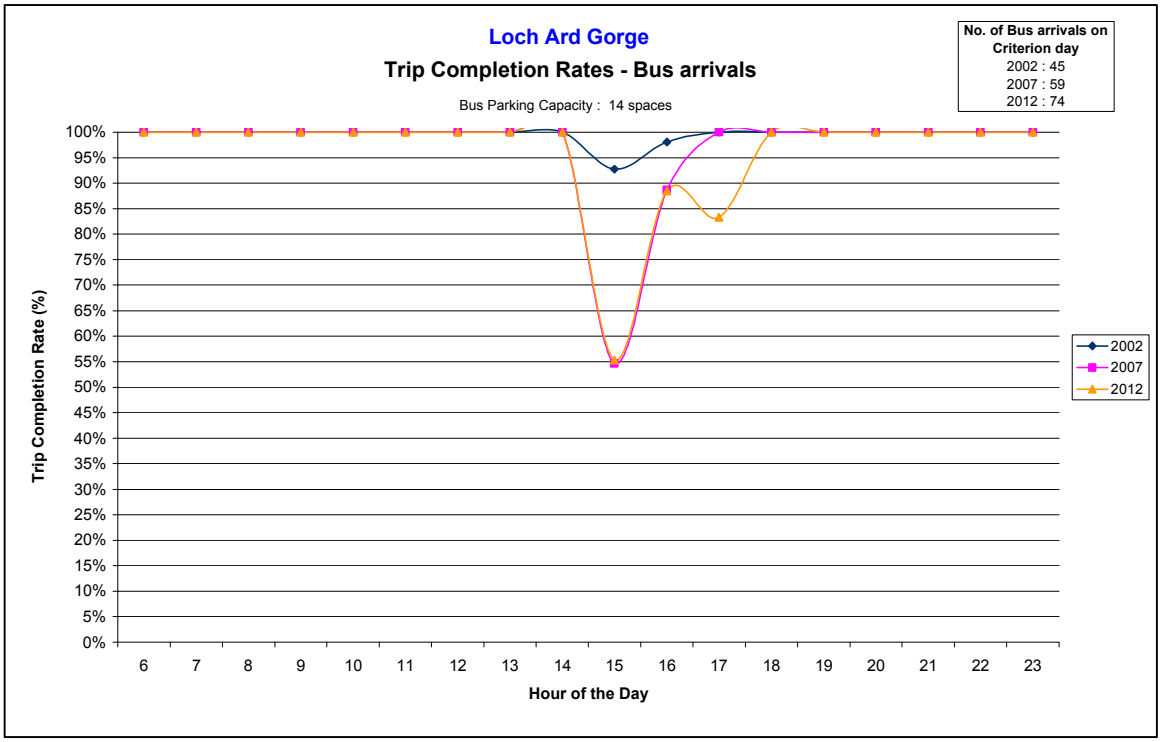
4.6.4 Trip Completion Rates

4.6.4.1 Cars

There are no trip failures for car arrivals at Loch Ard Gorge for the three time periods; hence, figure is not shown.

4.6.4.2 Buses

There is a shortage of bus parking during the peak hours from 3:00pm to 4:00pm from 2002 thru 2007 and extending to 5:00pm by 2012. At present there is 1 bus trip failing at 3:00pm. By 2007, 8 bus trips fail for the peak hour increasing to 10 trip failures by 2012.



4.6.4.3 Overall

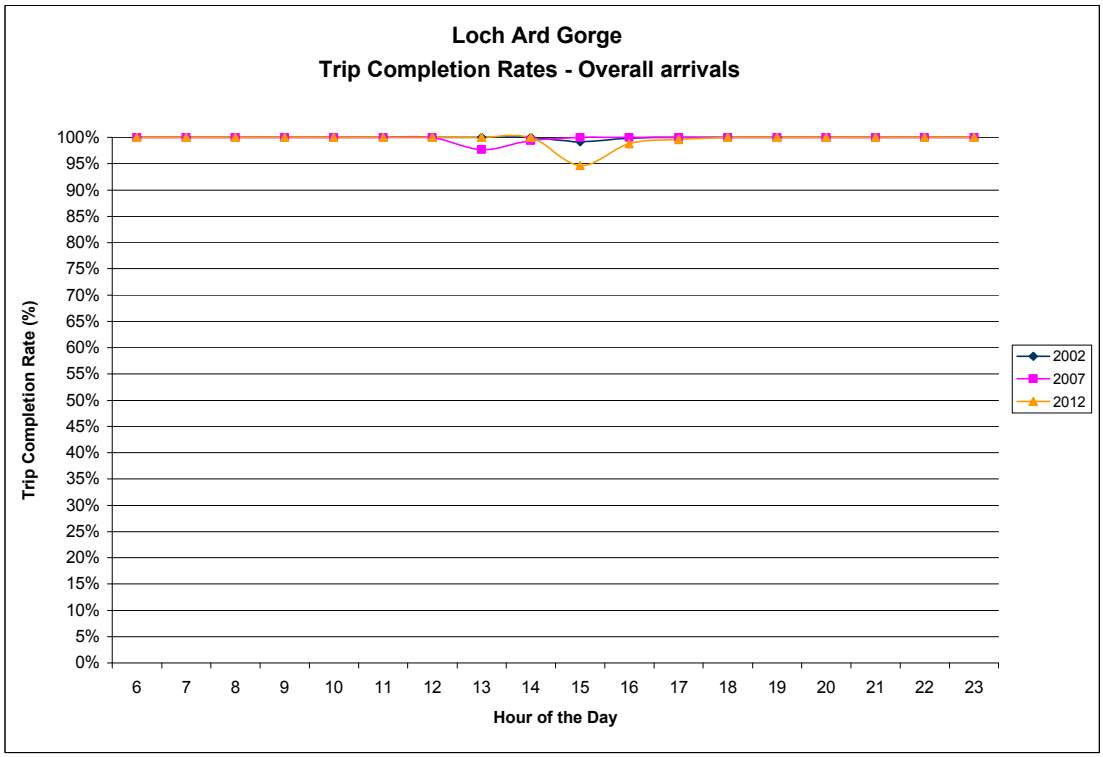


Figure 52. Loch Ard Gorge Trip Completion Rates -Overall Arrivals

The overall trip completions are currently very close to 100%; this is expected to drop slightly over the projected years to 98% in 2006 at 1pm, and to 95% in 2012 at 3pm. This is as a result of trip failures by buses.

4.6.5 Length of Stay

4.6.5.1 Cars

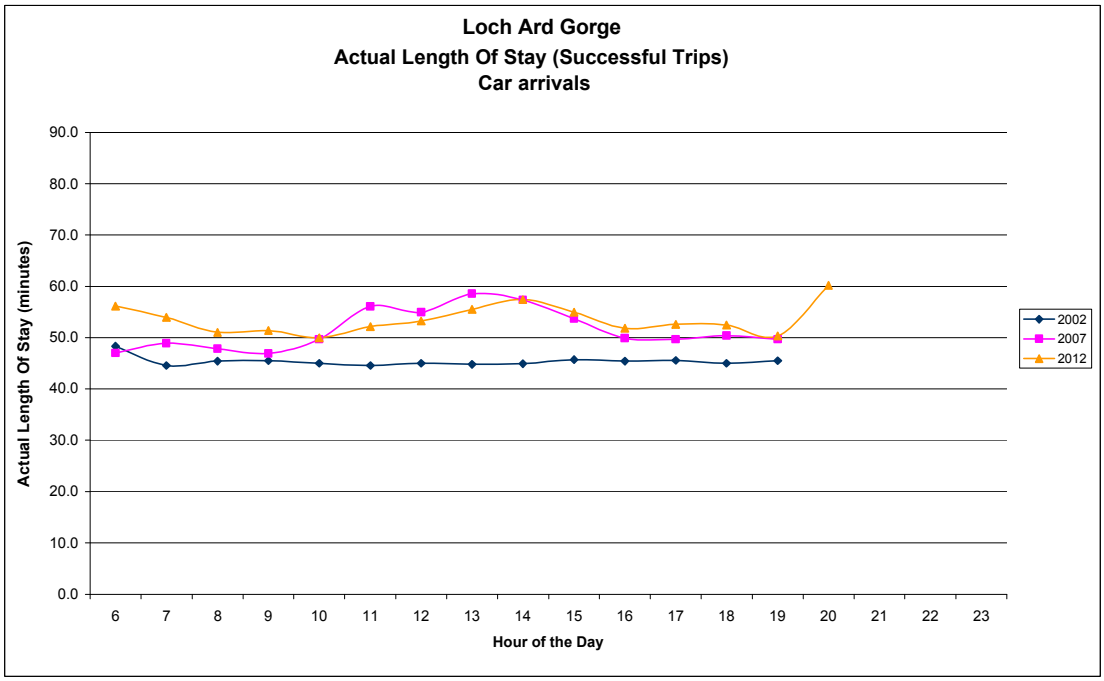


Figure 53. Loch Ard Gorge Actual Length of Stay Successful Trips Car Arrivals

The average length of stay calculated from actual accumulated arrivals and departures from traffic counts is 45 minutes for cars. The simulator generated trip durations were the sameaveraging around 45 minutes for the entire day for 2002, with average length of stay increasing for 2007 and 2012 with average length of stay peaking in early afternoon. Further surveys were done to examine whether summer length of stay was longer. This analysis (not shown) indicated that summer length of stay was only marginally longer (approx 5 to 10 minutes).

4.6.5.2 Buses

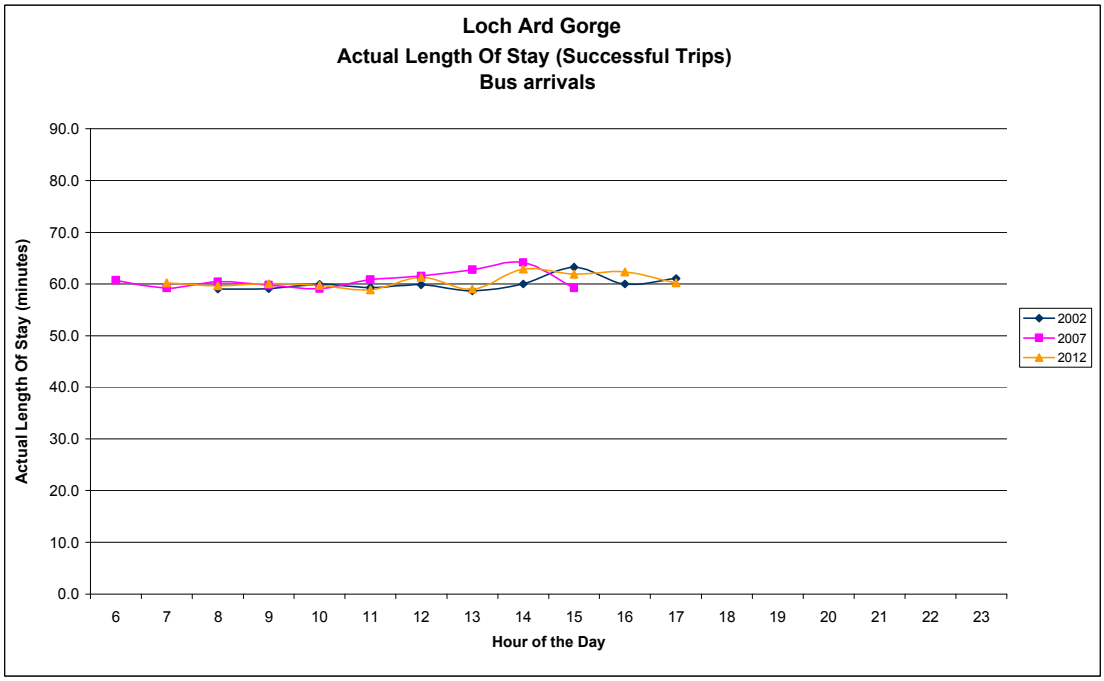


Figure 54. Loch Ard Gorge Actual Length of Stay Successful Trips Bus Arrivals

Length of stay for bus arrivals is expected to stay at 2002 levels in the future of 1 hour.

4.6.6 Encounters

4.6.6.1 Overall

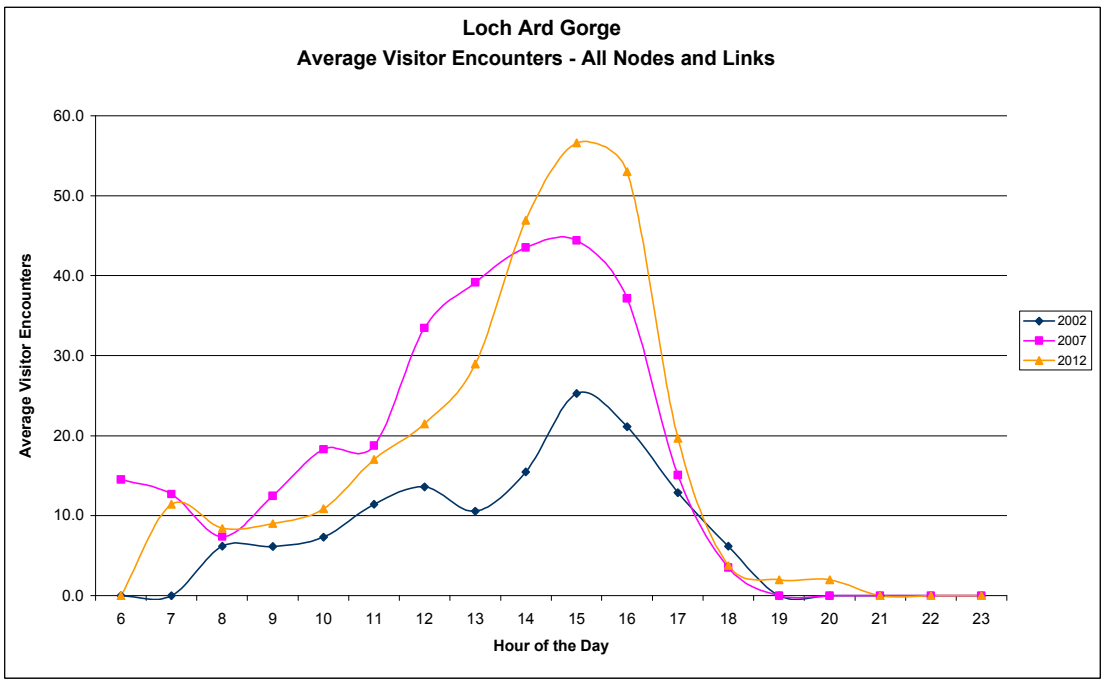


Figure 55. Loch Ard Gorge Average Visitor Encounters – All Nodes and Links

Encounters at Loch Ard Gorge are expected to rise from 2002 numbers of around 12 people for most of the day and a peak of 25 people at 3pm, to 25 people on average for

the day and a peak of 44 people (at 3pm) in 2007, and 25 people on average in 2012 and a peak of 57. This demonstrates a large increase in visitor numbers in the future from bus traffic growth.

4.6.6.2 Viewing Platforms

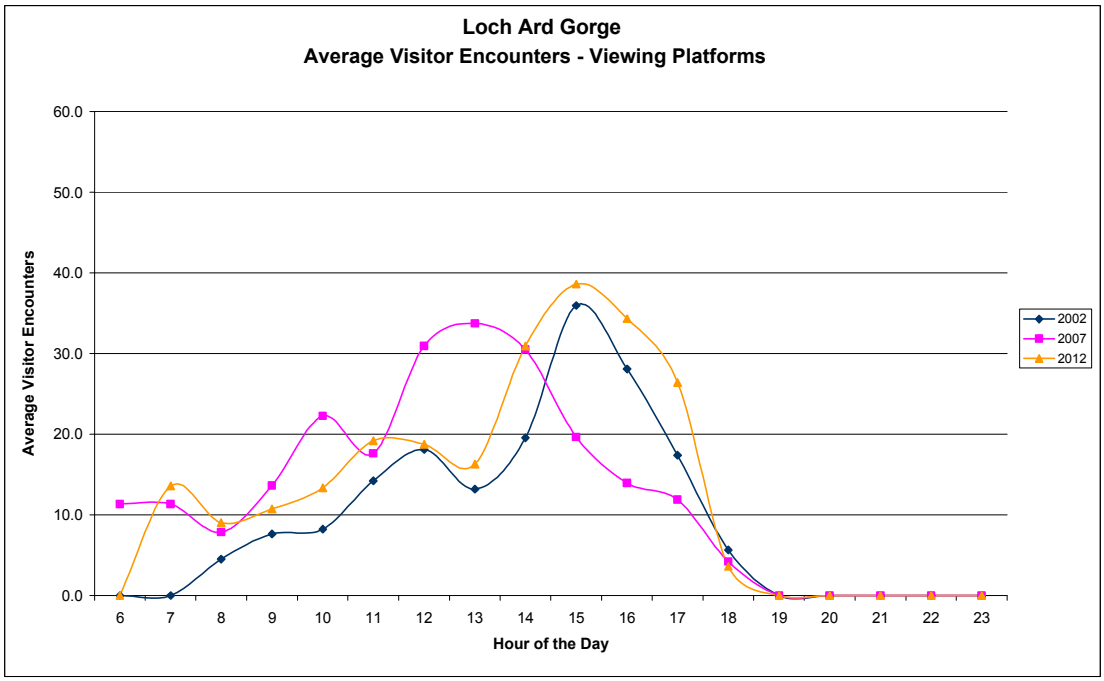


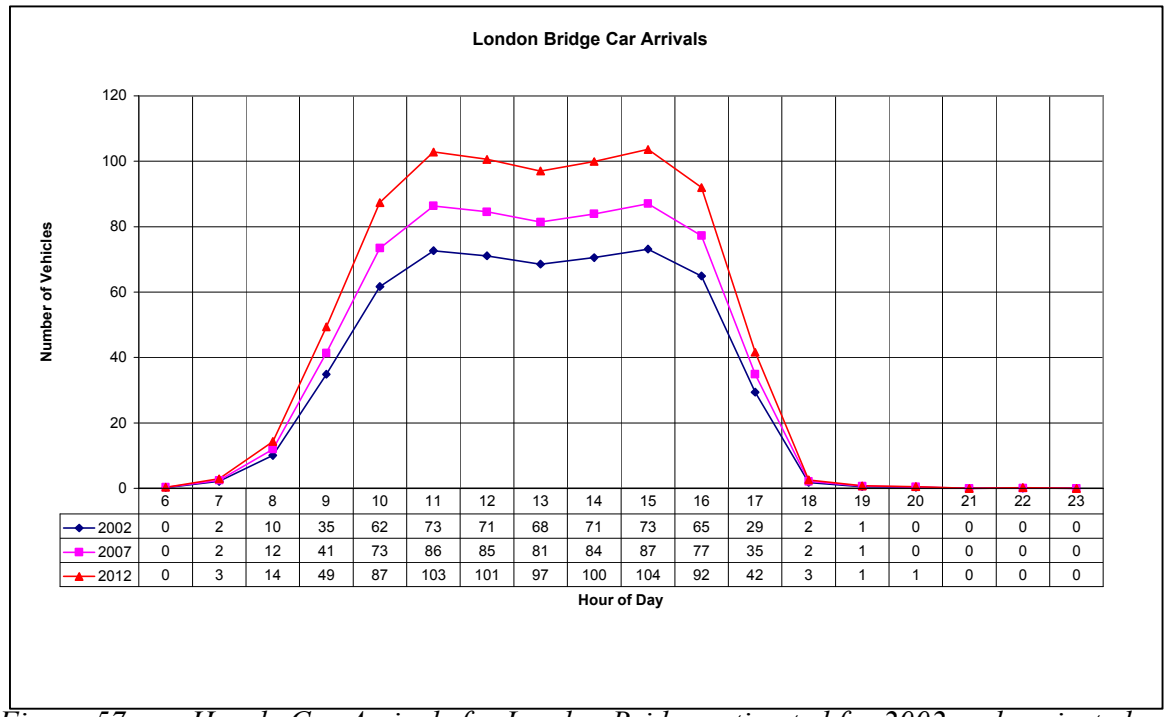
Figure 56. Loch Ard Gorge Average Visitor Encounters – Viewing Platforms

Visitor encounters are expected to remain similar to 2002 levels with only minimal increases in the future. This indicates there is high dispersal of visitors after arriving at the site; ie not all going to one viewing platform unlike Gibson steps.

4.7 London Bridge

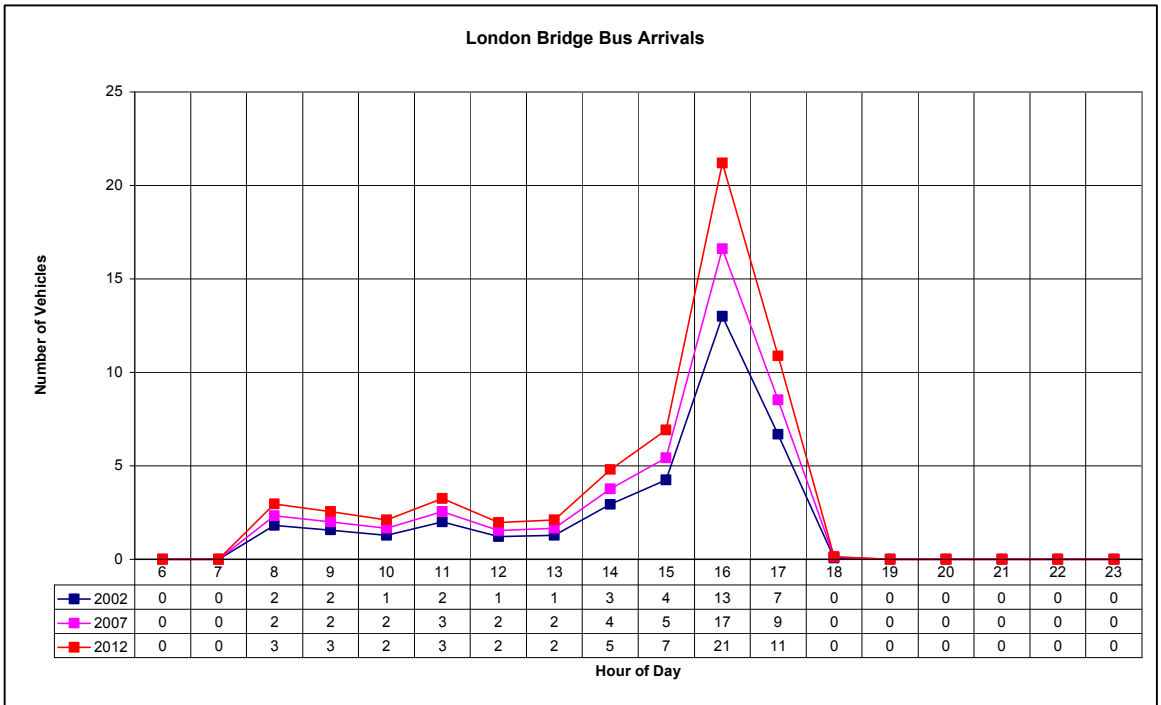
4.7.1 Car and Bus Arrivals

Figures 57 and 58 shows the arrival curves for cars and buses for 2002, 2007 and 2012 at London Bridge.



	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
2002	0	2	10	35	62	73	71	68	71	73	65	29	2	1	0	0	0	0
2007	0	2	12	41	73	86	85	81	84	87	77	35	2	1	0	0	0	0
2012	0	3	14	49	87	103	101	97	100	104	92	42	3	1	1	0	0	0

Figure 57. Hourly Car Arrivals for London Bridge estimated for 2002 and projected for 2007 and 2012.



	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
2002	0	0	2	2	1	2	1	1	3	4	13	7	0	0	0	0	0	0
2007	0	0	2	2	2	3	2	2	4	5	17	9	0	0	0	0	0	0
2012	0	0	3	3	2	3	2	2	5	7	21	11	0	0	0	0	0	0

Figure 58. Hourly bus arrivals for London Bridge estimated for 2002 and projected for 2007 and 2012.

4.7.2 Parking Capacity and Loading

London Bridge has 12 car parking spaces and 6 Bus Parking spaces.

4.7.2.1 Parking Capacity for Cars

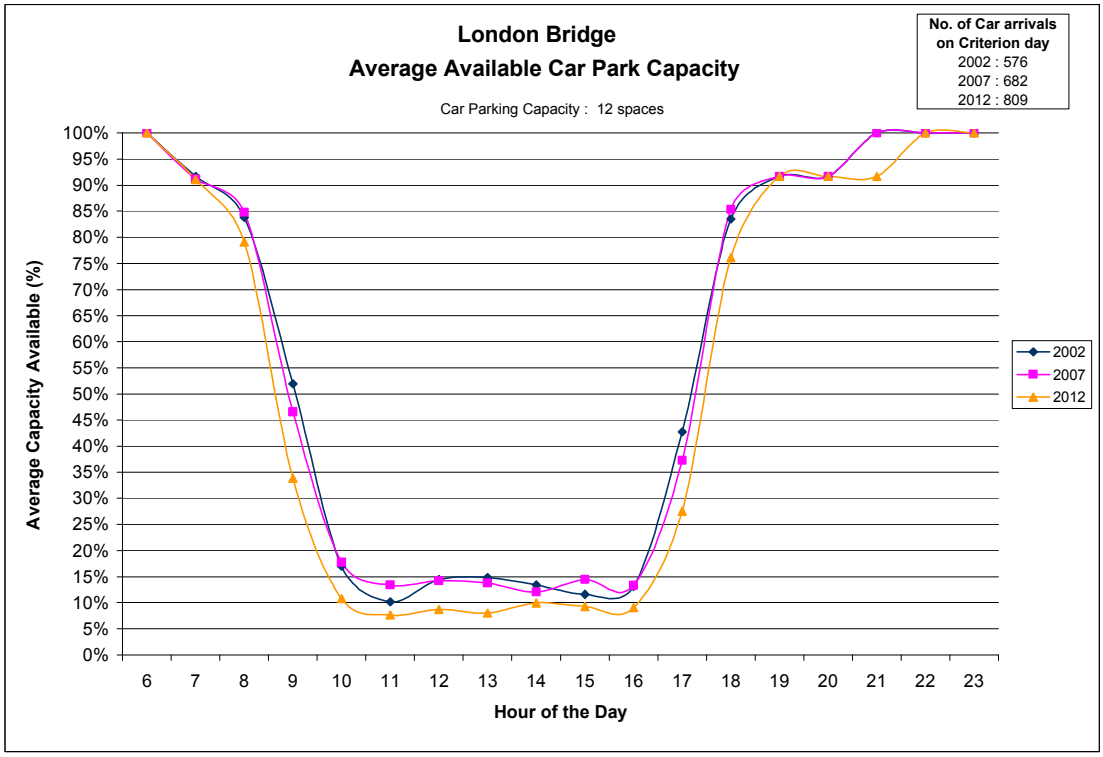


Figure 59. London Bridge Average Available Car Park Capacity

Figure 59 shows the average available parking capacity for London Bridge parking. The car park at London Bridge on average, currently has 2 spaces or less free (of 12 total) from 11am to 4pm. This is predicted to stay the same to 2007, and drop to 1 space in 2012.

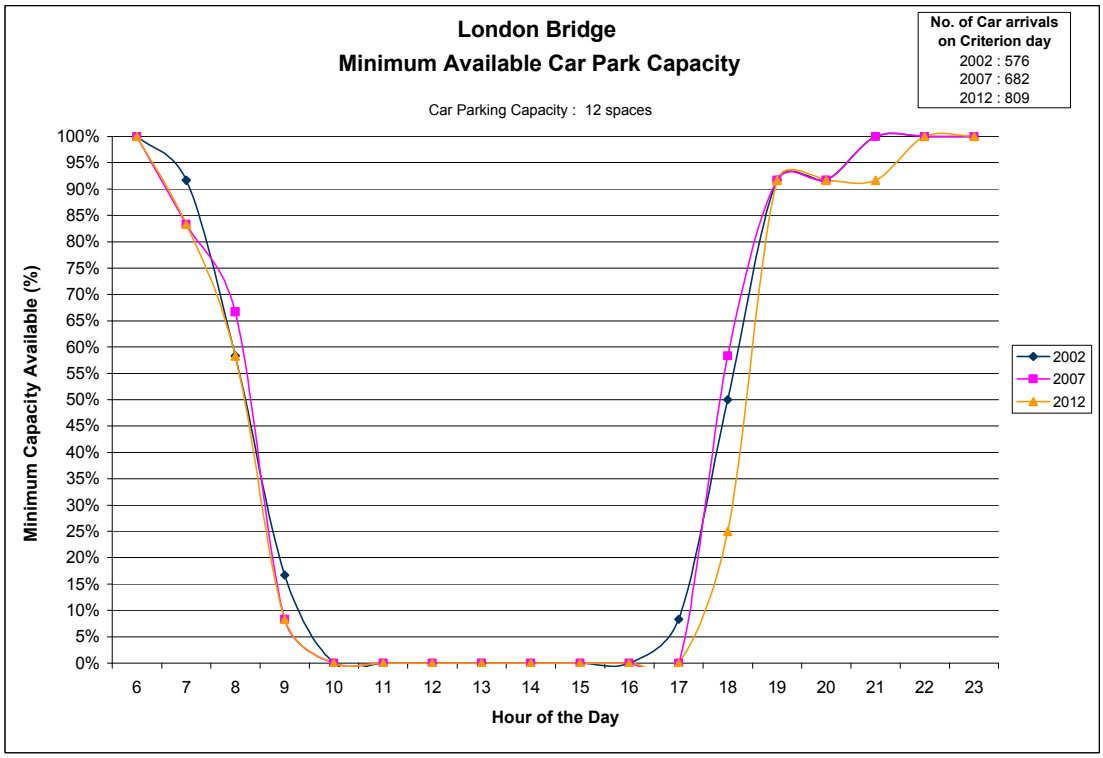


Figure 60. London Bridge Minimum Available Car Park Capacity

The minimum available capacity (Figure 60) in the car park shows that at present it is full periodically during every hour from 10am to 4pm. The future projections show this trend continuing and extending to 5pm. This represents a problem for trip completions, and to a lesser extent queuing times due to the car park's low capacity.

4.7.2.2 Parking Capacity for Buses

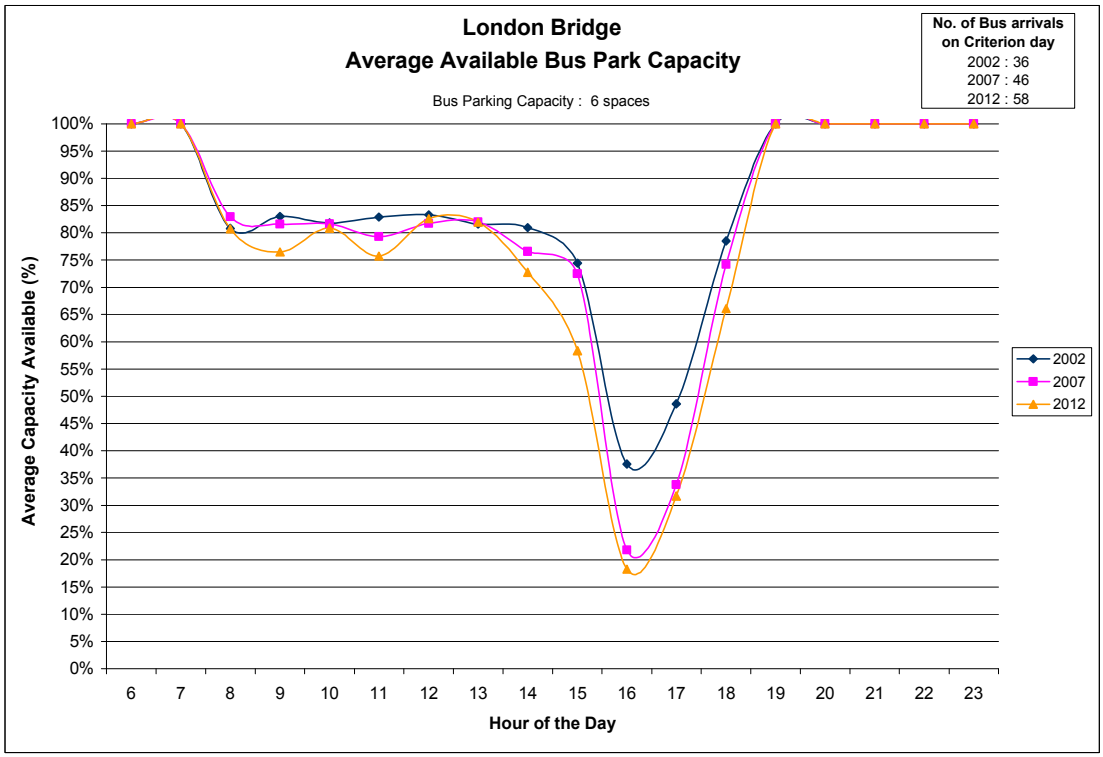


Figure 61. London Bridge Average Available Bus Park Capacity

The London bridge bus park has 4 to 5 spaces (of 6) free for most of the day, excluding a peak between 4pm and 6pm where there are 2 to 3 available on average. The future trends show only the peak time dropping in capacity to 1 space to 2007 and 2012.

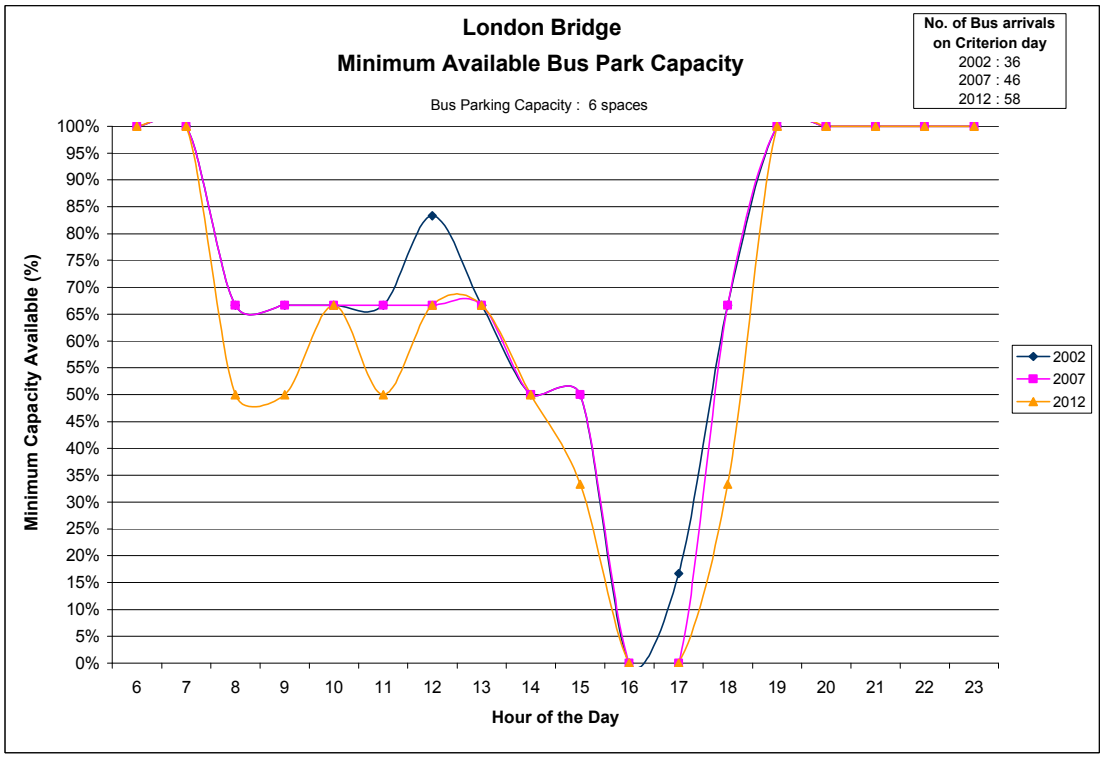


Figure 62. London Bridge Minimum Available Bus Park Capacity

Minimum capacity at the bus park only shows a significant drop at the peak time between 4pm and 6pm, where in 2002 there is no spaces periodically during the hour available at 4pm, and 1 space at 5pm. This situation is expected to worsen at 5pm in 2007, and drop further across the day in 2012.

4.7.2.3 Capacities at Viewing Platforms

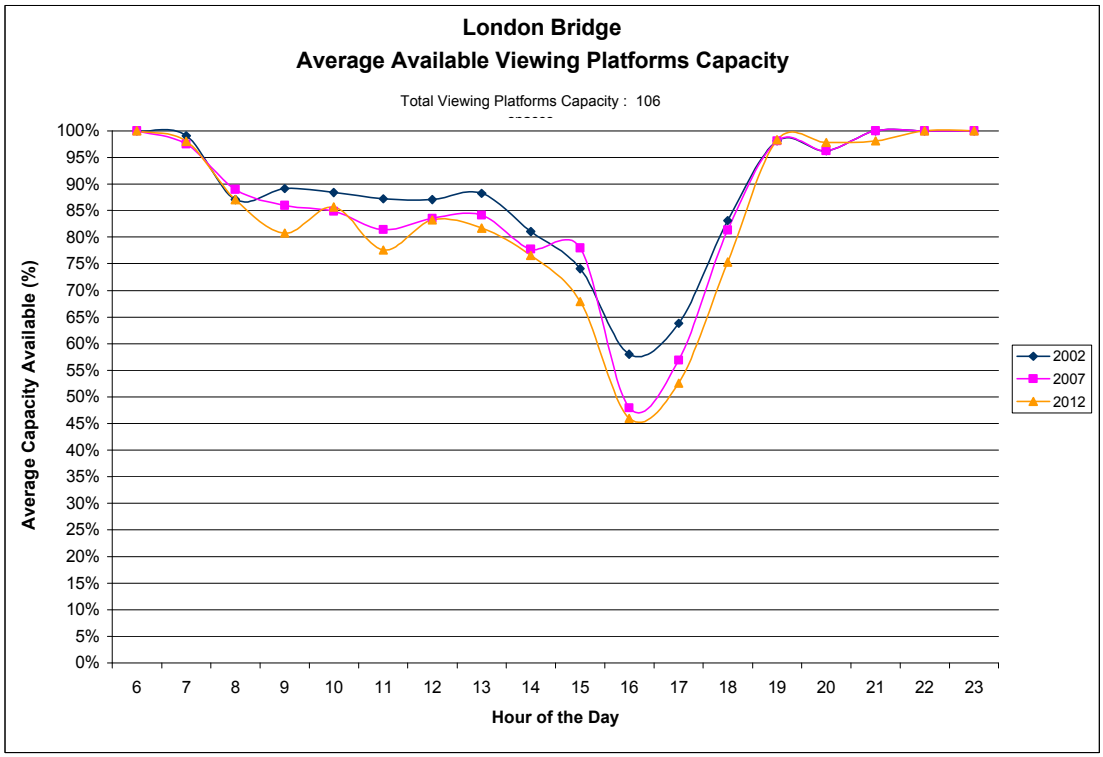


Figure 63. London Bridge Average Available Viewing Platform Capacity

The average viewing platform capacity at London Bridge is not predicted to vary much on 2002 levels with only a slight decrease at the 4pm peak in 2007 and 2012, taking average capacity to just below 50% for those years.

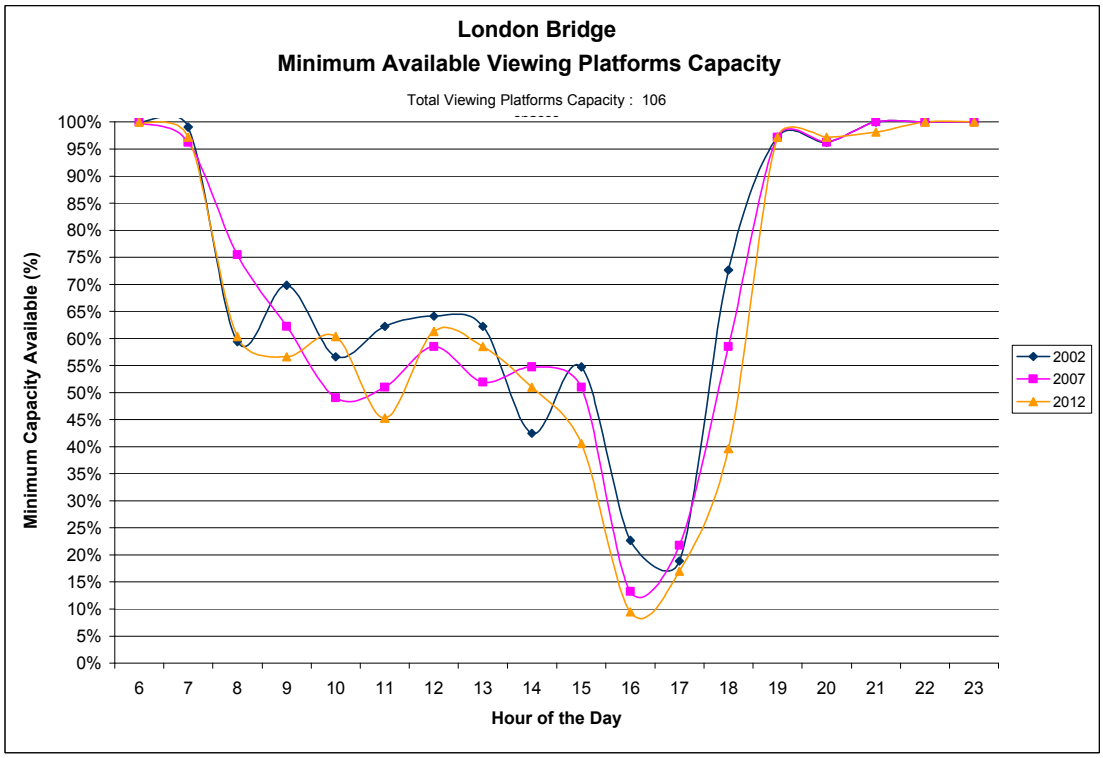


Figure 64. London Bridge Minimum Available Viewing Platform Capacity

Minimum capacity is also expected to follow a very similar trend again only dropping significantly at the 4pm peak to a minimum of 13% in 2007, and 9% in 2012.

4.7.3 Queuing Times

4.7.3.1 Queuing Times for Cars

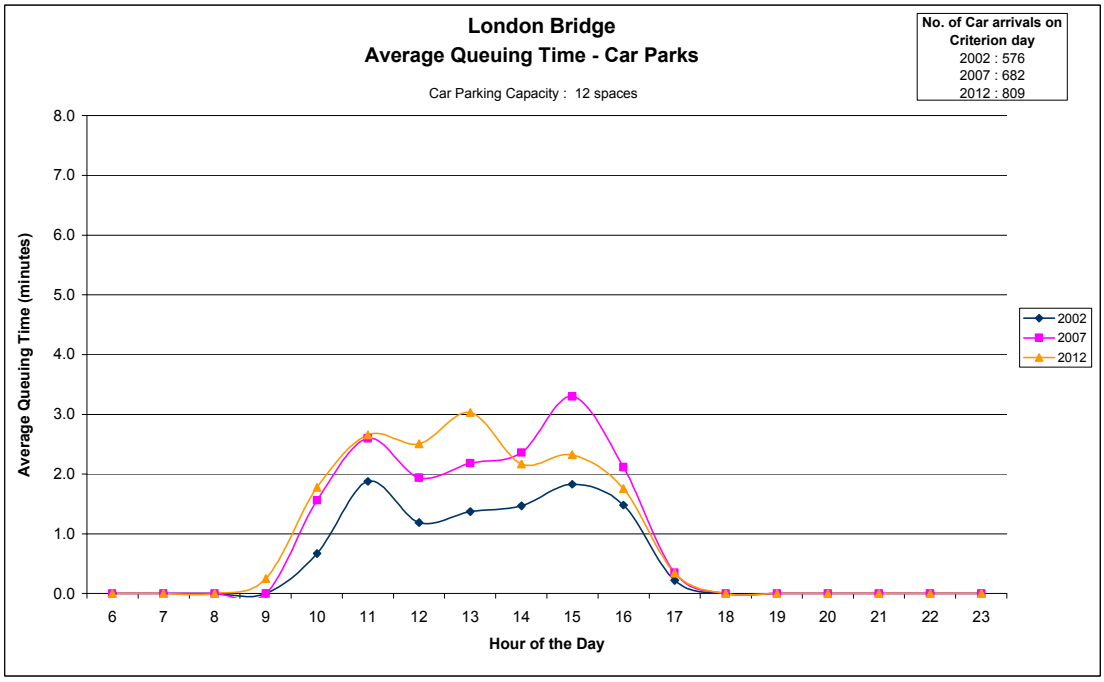


Figure 65. London Bridge Average Queuing Time – Car Parks

Queuing times at the London bridge car park average at present between 1 and 2 minutes between 11am and 5pm. In future years average queuing times are expected to rise to around 2.5 minutes in 2007 and 2012.

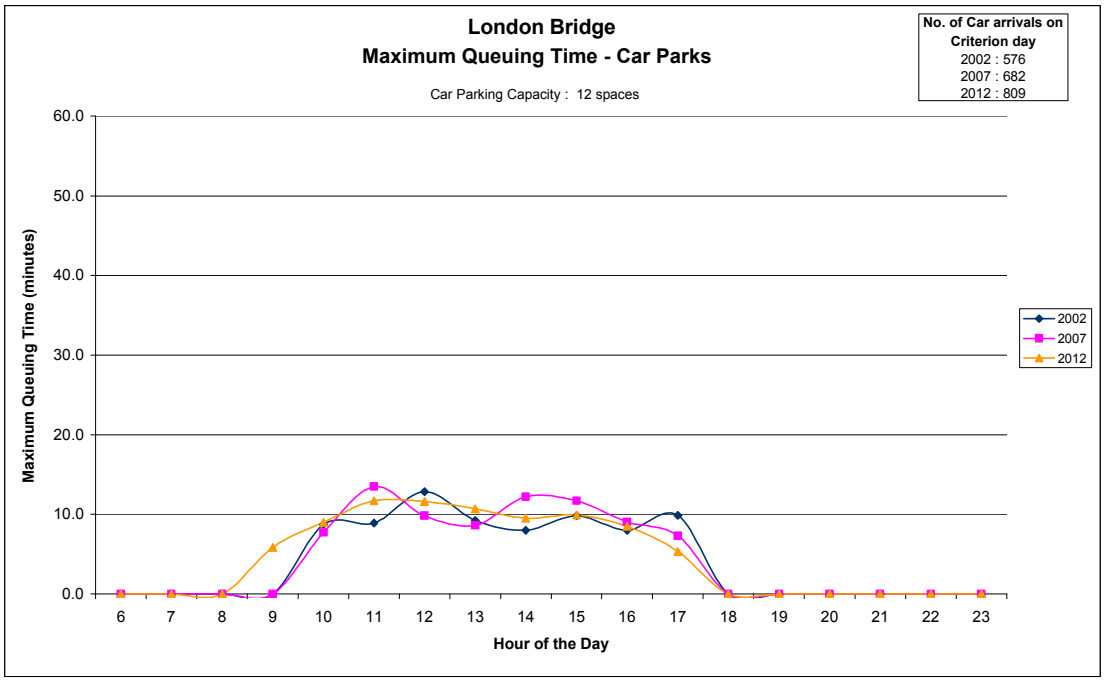


Figure 66. London Bridge Maximum Queuing Time – Car Parks

Maximum queuing times in the future are not expected to increase greatly on 2002 figures which average at around 10 minutes between 10am and 5pm.

4.7.3.2 Queuing Times for Buses

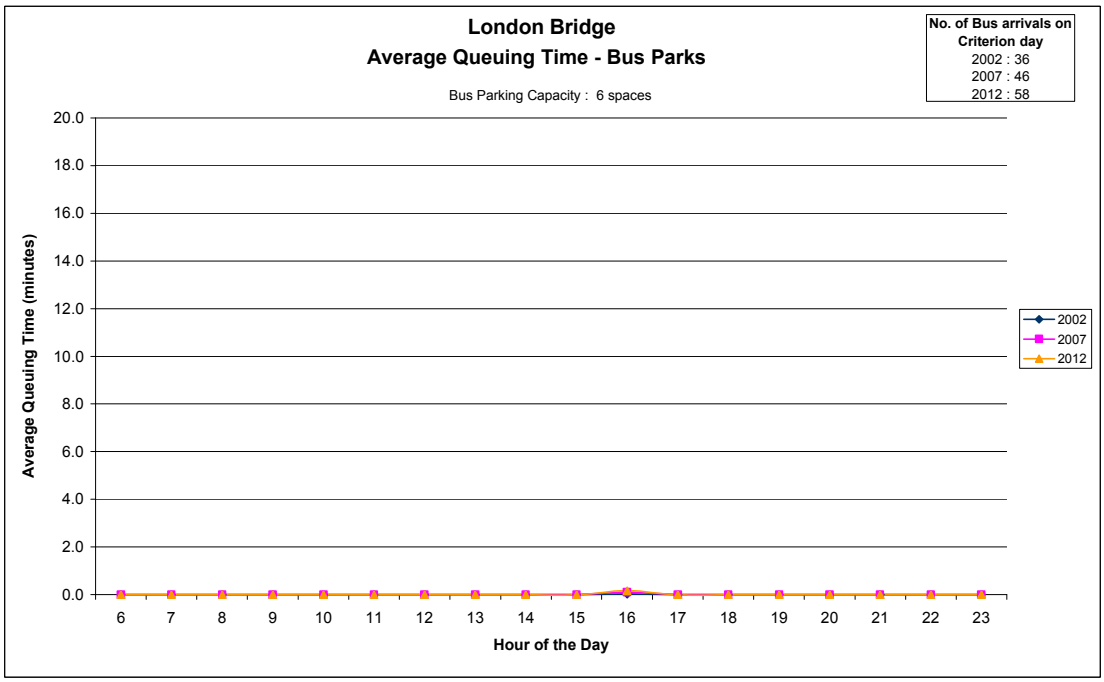


Figure 67. London Bridge Average Queuing Time – Bus Parks

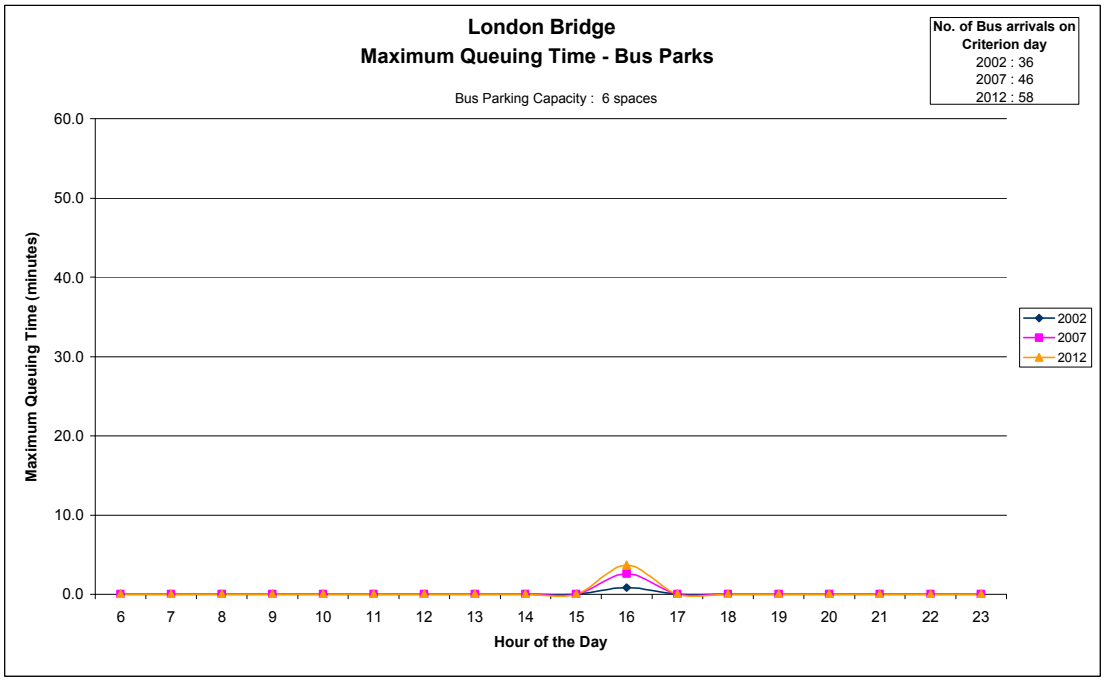


Figure 68. London Bridge Maximum Queuing Time – Bus Parks

Queuing times for the bus park are not expected to become a problem, with average times virtually at 0 zero, and maximum queuing times in 2007 expected to be 2.5 minutes.

4.7.4 Trip Completion Rates

4.7.4.1 Cars

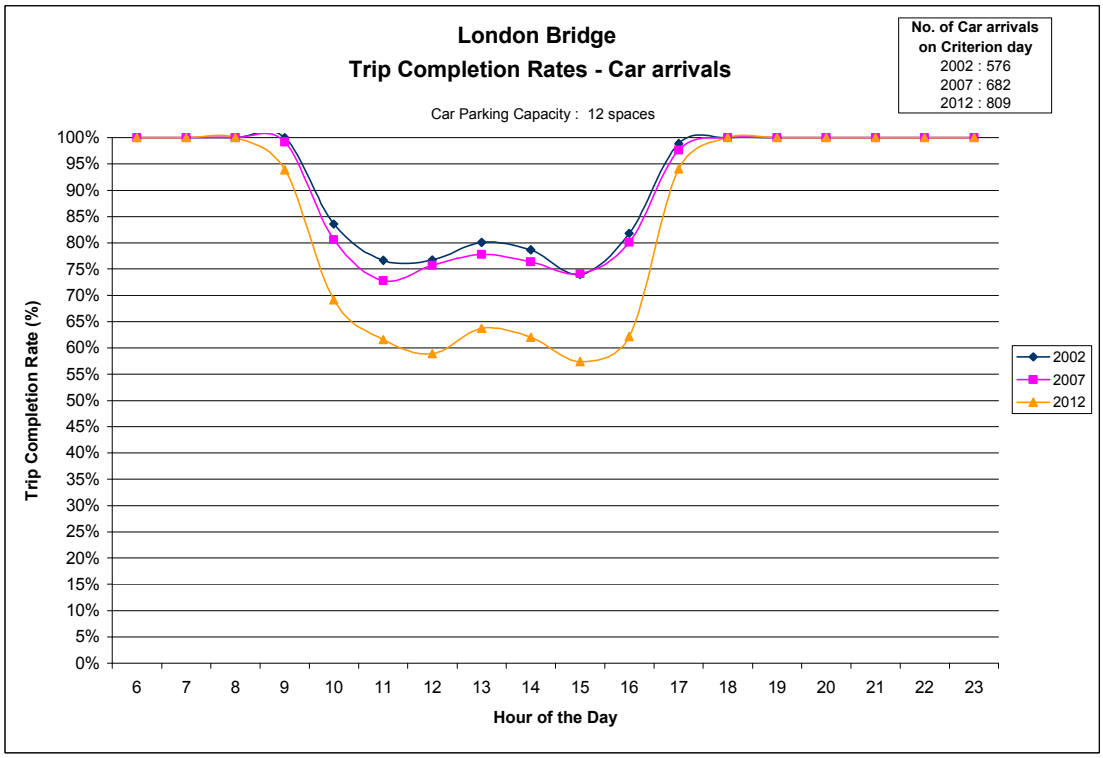


Figure 69. London Bridge Trip Completion Rates -Car Arrivals

Trip completion rates for car arrivals average at 78% for the peak hours of the day (between 11am and 5pm) currently. This is expected to stay similar to 2002 figures in 2007, but drop further to 2012 when the average during this time is expected to be 60%.

4.7.4.2 Buses

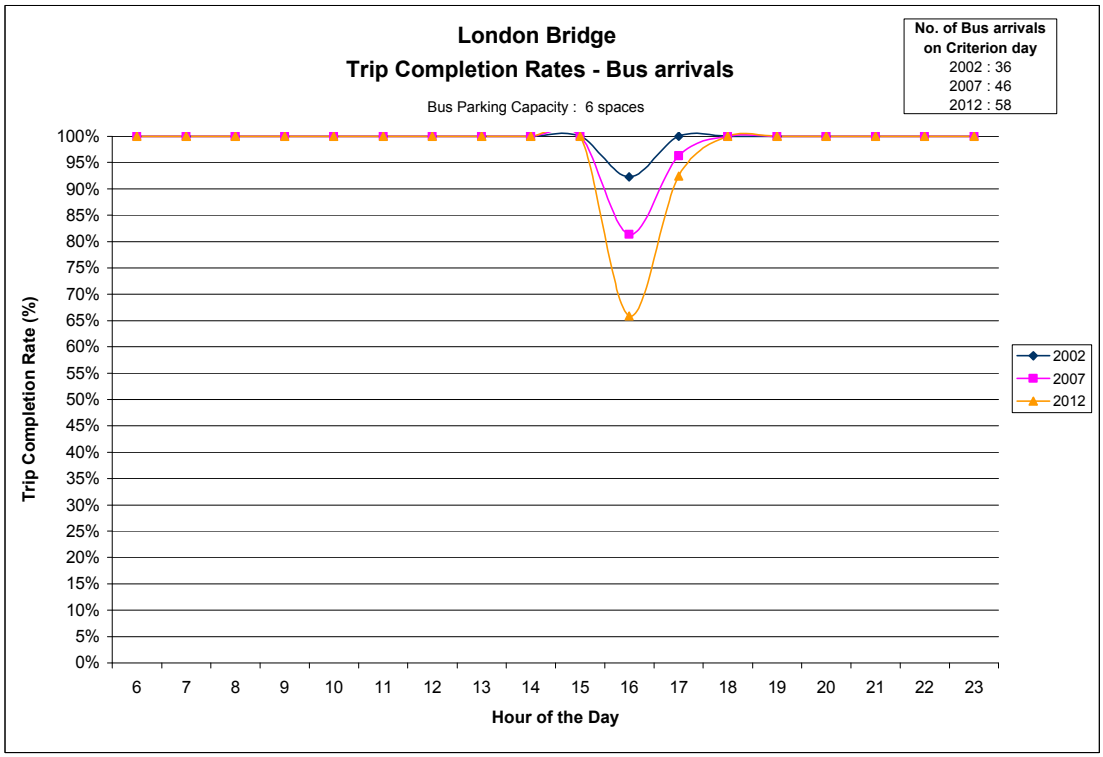


Figure 70. London Bridge Trip Completion Rates -Bus Arrivals

Trip completions for buses only show a problem the 4pm peak where currently 8% fail, this will rise in 2007 to 19% fail rate, and still further in 2012 to 34% failure rate.

4.7.4.3 Overall

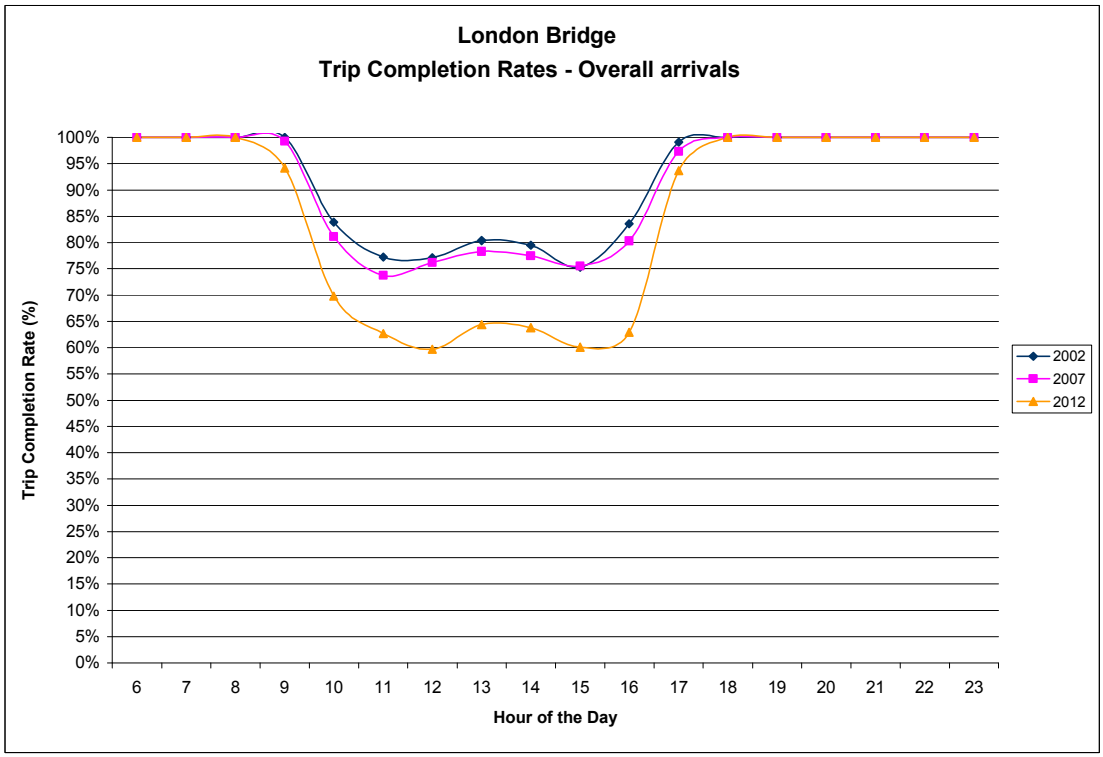


Figure 71. London Bridge Trip Completion Rates -Overall Arrivals

The fail rate for all arrivals is skewed significantly by the car arrival trip failures

4.7.5 Length of Stay

4.7.5.1 Cars

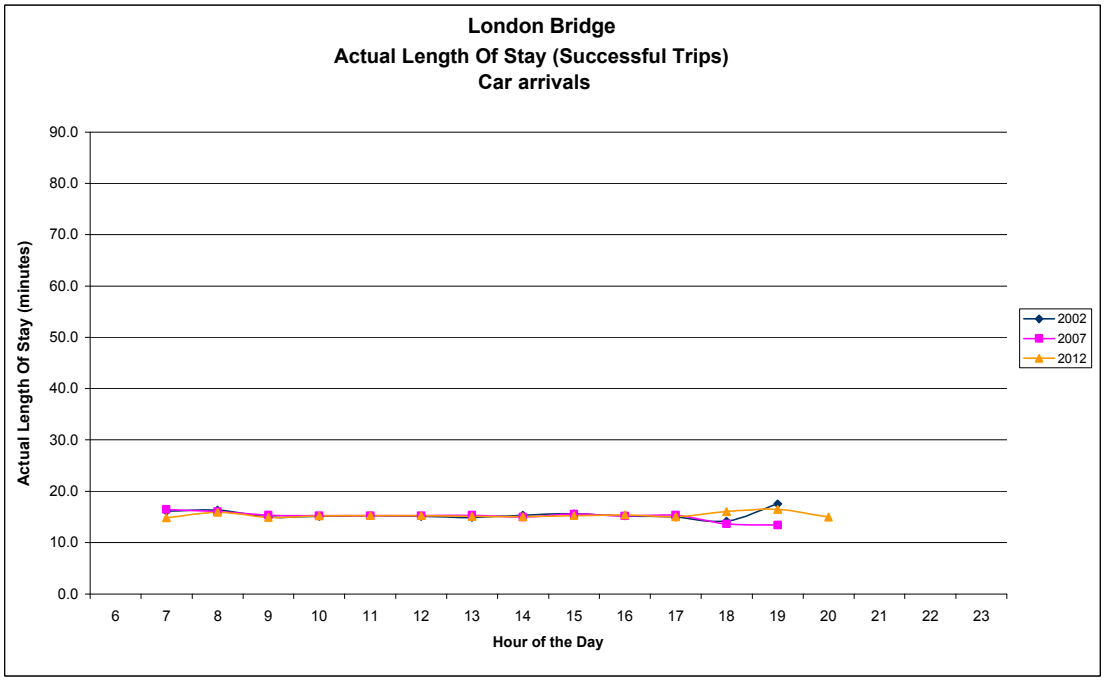


Figure 72. London Bridge Actual Length of Stay Successful Trips Car Arrivals

An average length of stay of 15 minutes for cars agrees with length of stay measured from traffic count data. The length of stay is not expected to change through the year 2012.

4.7.5.2 Buses

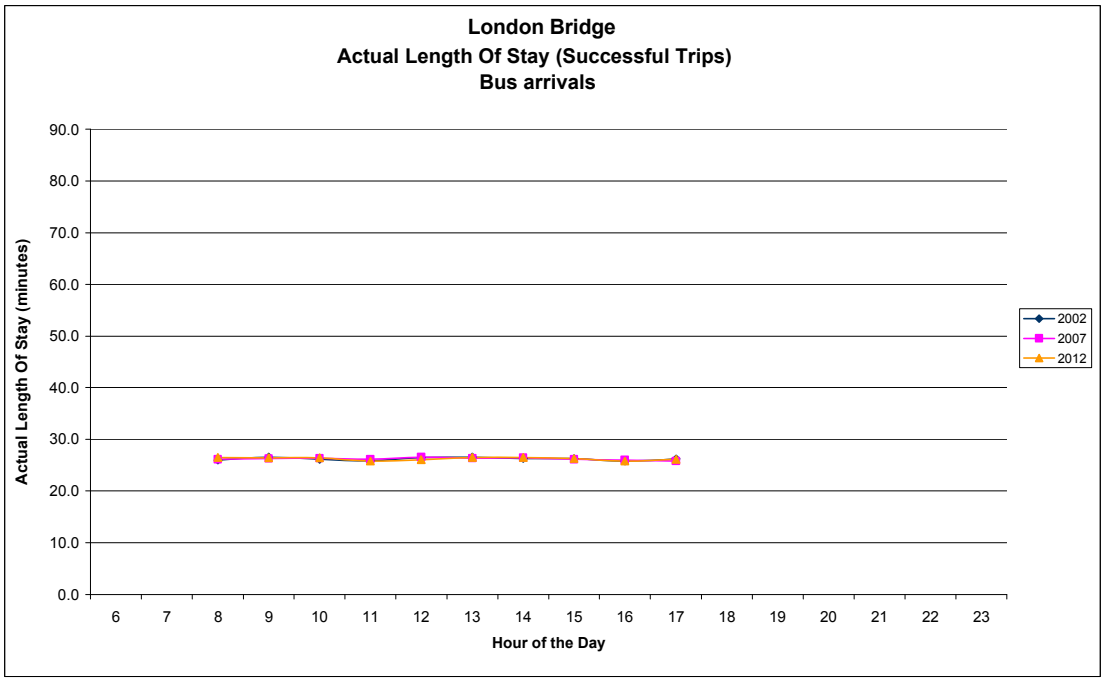


Figure 73. London Bridge Actual Length of Stay Successful Trips Bus Arrivals

The length of stay for bus arrivals is also expected to stay the same in the future at around 26 minutes for the entire day.

4.7.6 Encounters

4.7.6.1 Overall

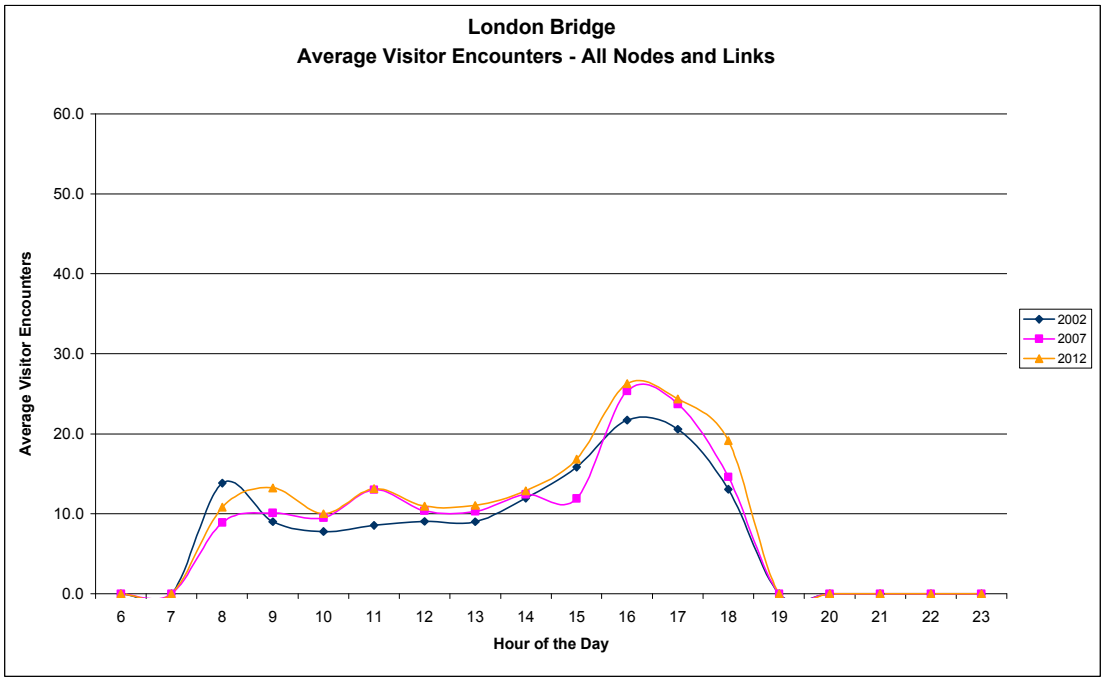


Figure 74. London Bridge Average Visitor Encounters – All Nodes and Links

Encounters for London Bridge are only expected to rise slightly on 2002 figures with an increase of around an average of 20 people for the day.

4.7.6.2 Viewing Platforms

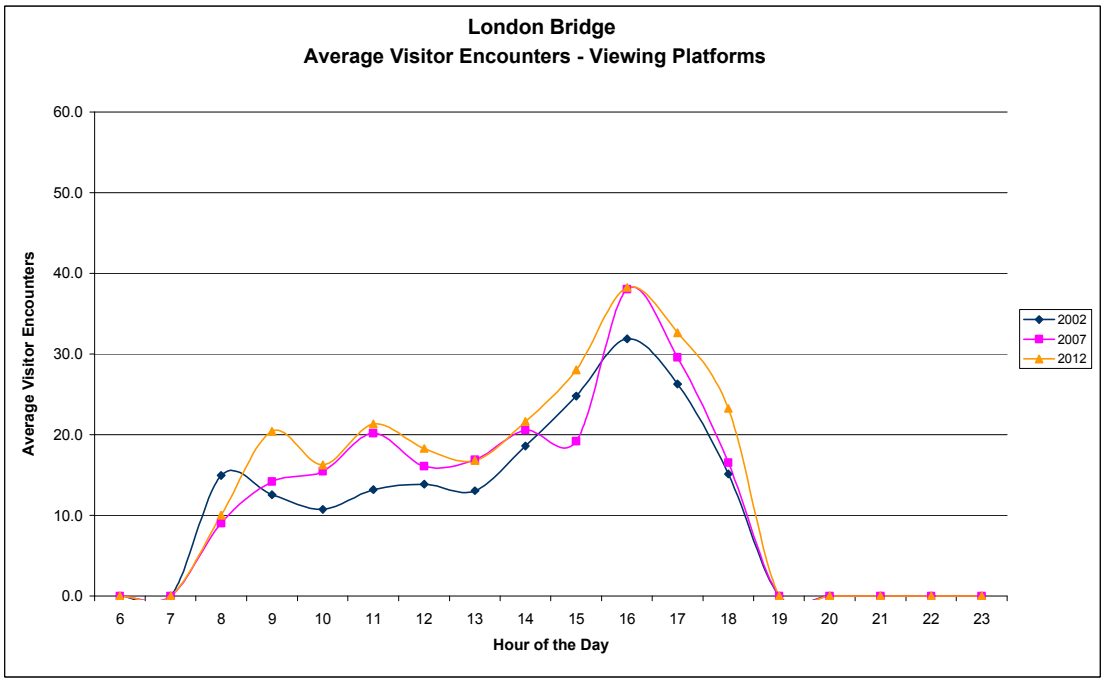


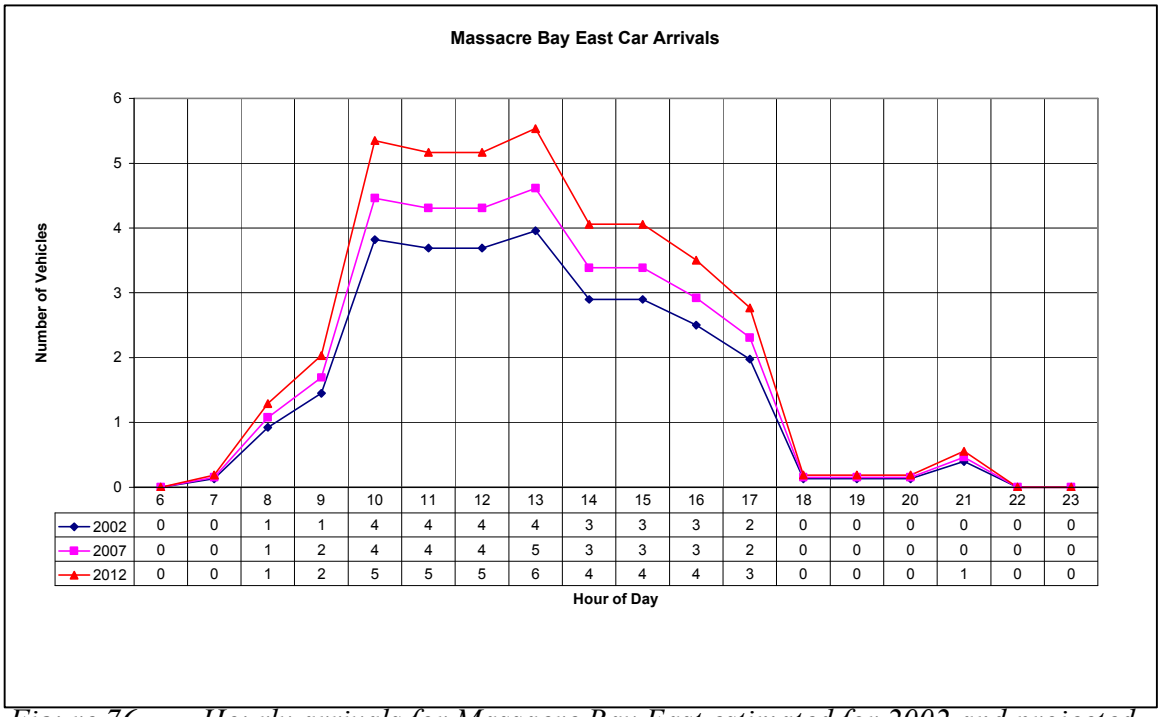
Figure 75. London Bridge Average Visitor Encounters – Viewing Platforms

Visitor encounters at viewing platforms are expected to rise slightly on 2002 numbers, 10 to 30, by between 2 and 5 people across the whole day.

4.8 Massacre Bay East

4.8.1 Car Arrivals

Figure 76 shows the arrival curves for cars for 2002, 2007 and 2012 at Massacre Bay East.



	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
2002	0	0	1	1	4	4	4	4	3	3	3	2	0	0	0	0	0	0
2007	0	0	1	2	4	4	4	5	3	3	3	2	0	0	0	0	0	0
2012	0	0	1	2	5	5	5	6	4	4	4	3	0	0	0	1	0	0

Figure 76. Hourly arrivals for Massacre Bay East estimated for 2002 and projected for 2007 and 2012.

4.8.2 Parking Capacity and Loading

Massacre bay has 5 spaces for car parking and no bus parking.

4.8.2.1 Parking Capacity for Cars

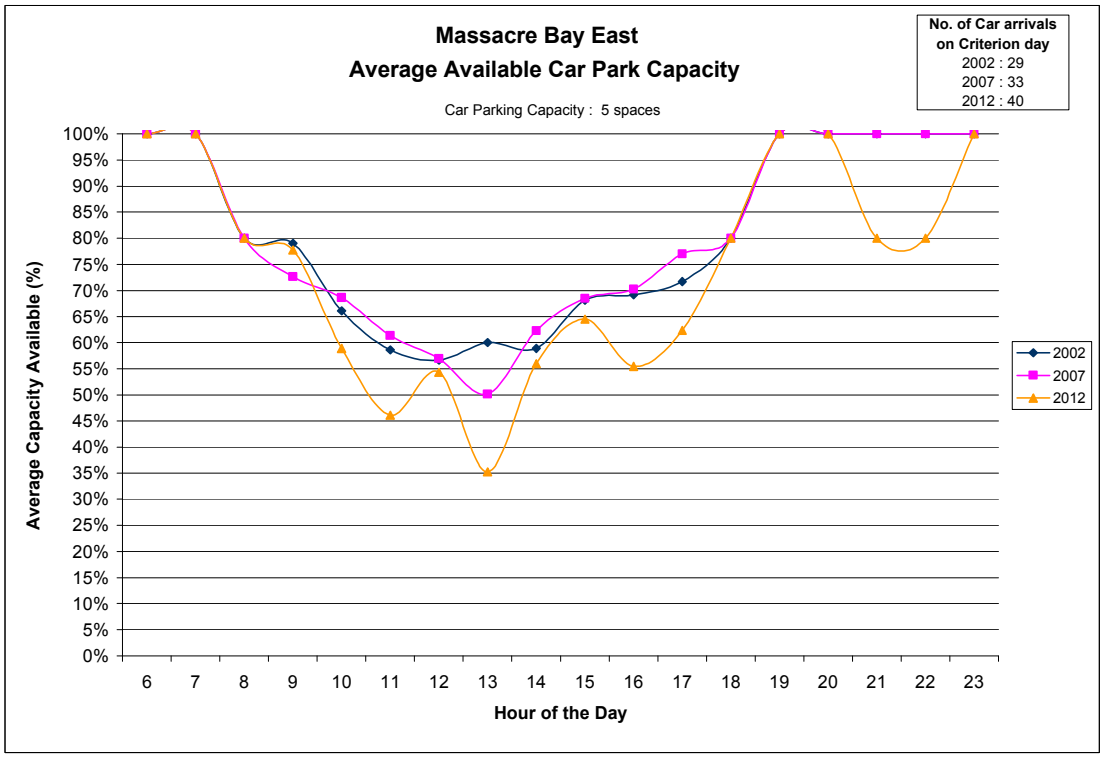


Figure 77. Massacre Bay East Average Available Car Park Capacity

There isn't a large change in average available capacity predicted in the future, with 2007 figures staying similar to 2002 figure, and a slight drop in capacity in 2012.

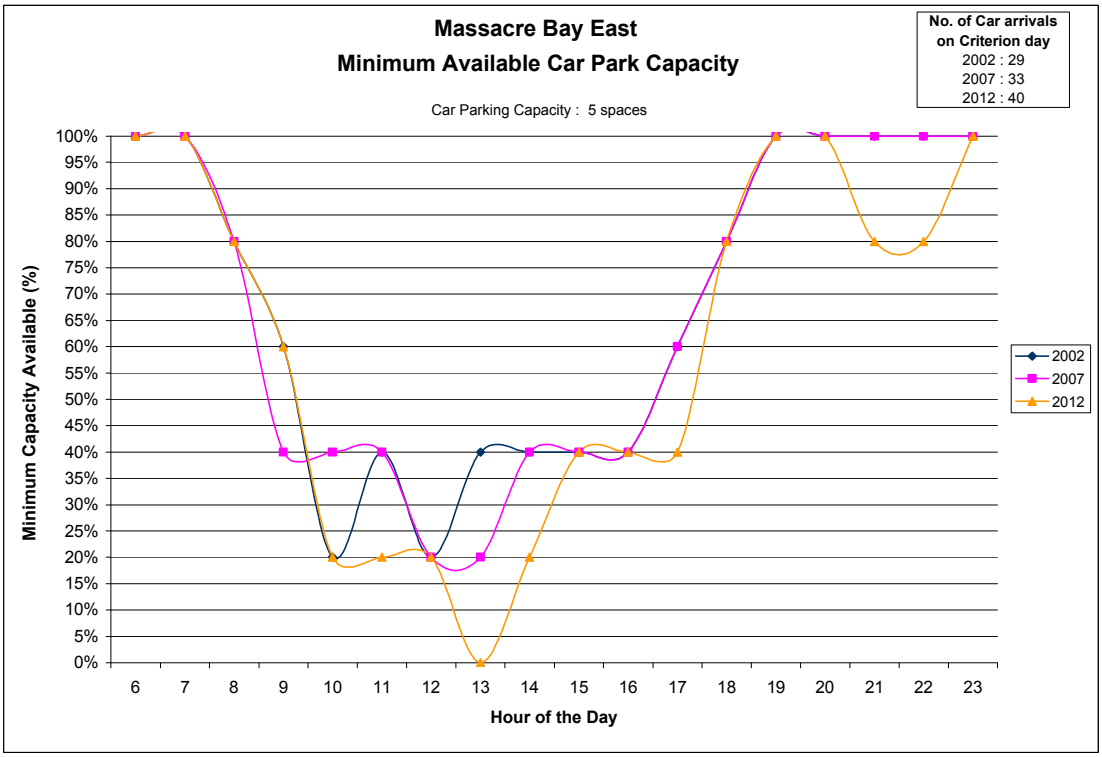


Figure 78. Massacre Bay East Minimum Available Car Park Capacity

Minimum capacity is expected to stay around 40% or 2 spaces for most of the day, with drops to 1 space for busier hours in 2007, and drop again in 2012 to zero spaces at the 1pm peak.

4.8.3 Queuing Times

4.8.3.1 Queuing Times for Cars

There is no queuing currently or predicted at the Massacre Bay East car park for either average or maximum queuing times over the 10 year simulation period, hence figure is not shown.

4.8.4 Trip Completion Rates

4.8.4.1 Cars

There are no trip failures expected at the site for any of the years, hence figure is not shown.

4.8.5 Length of Stay

4.8.5.1 Cars

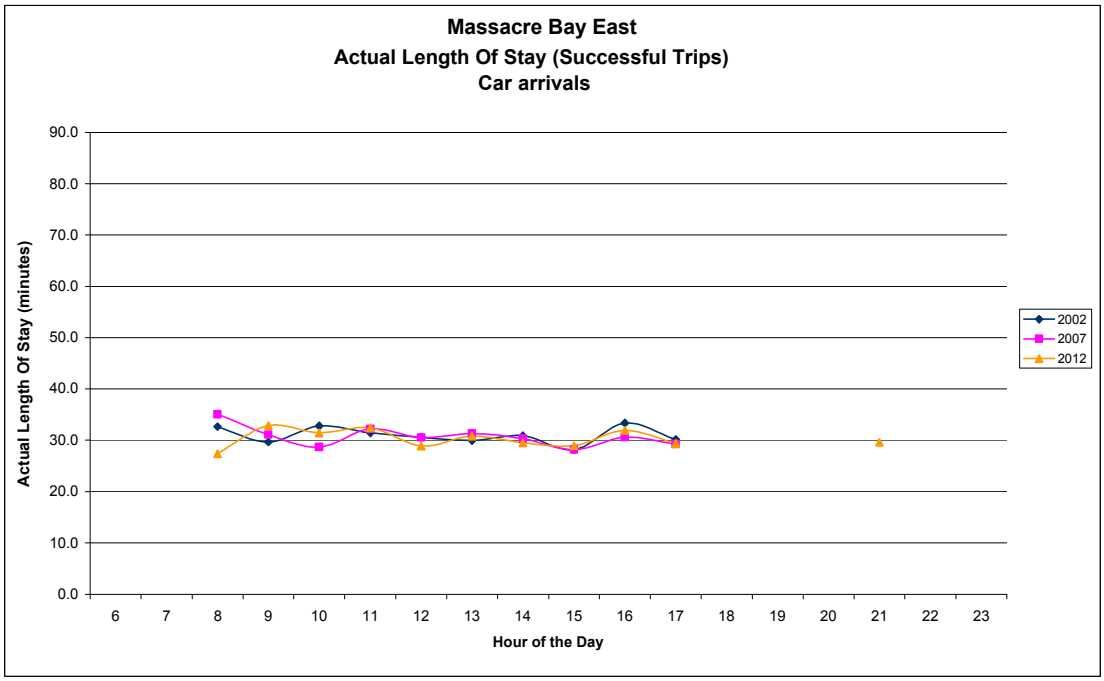


Figure 79. Massacre Bay East Actual Length of Stay Successful Trips Car Arrivals

An average length of stay of 30 minutes is expected to remain the same through 2012. This agrees with the length of stay measured from traffic count data for the site.

4.8.6 Encounters

4.8.6.1 Overall

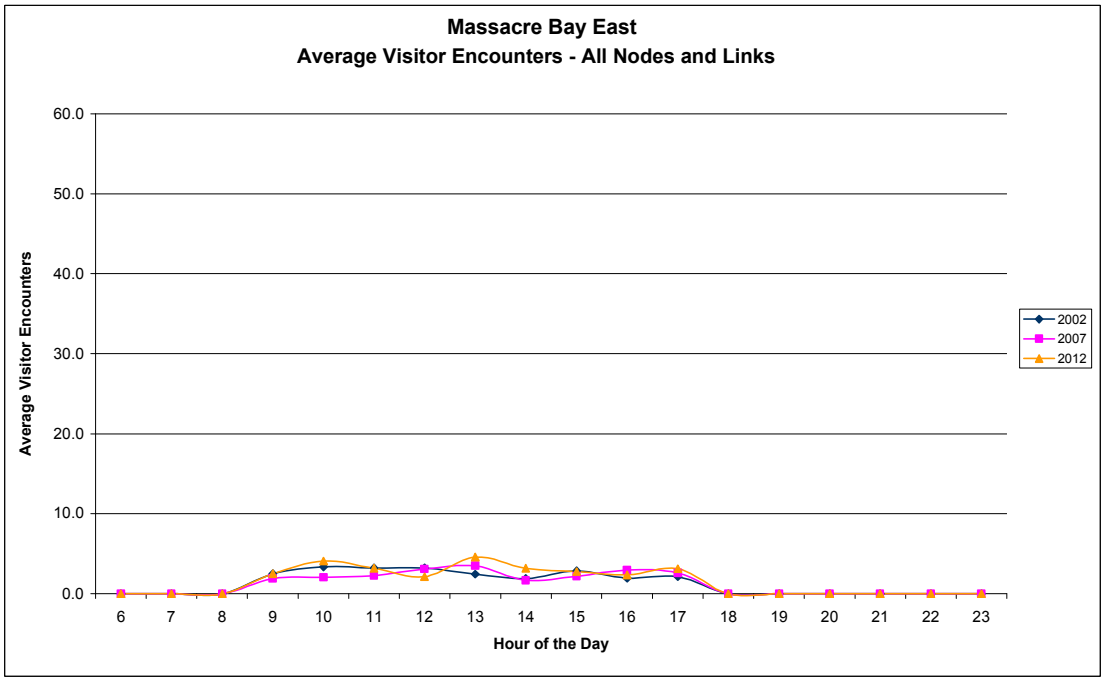


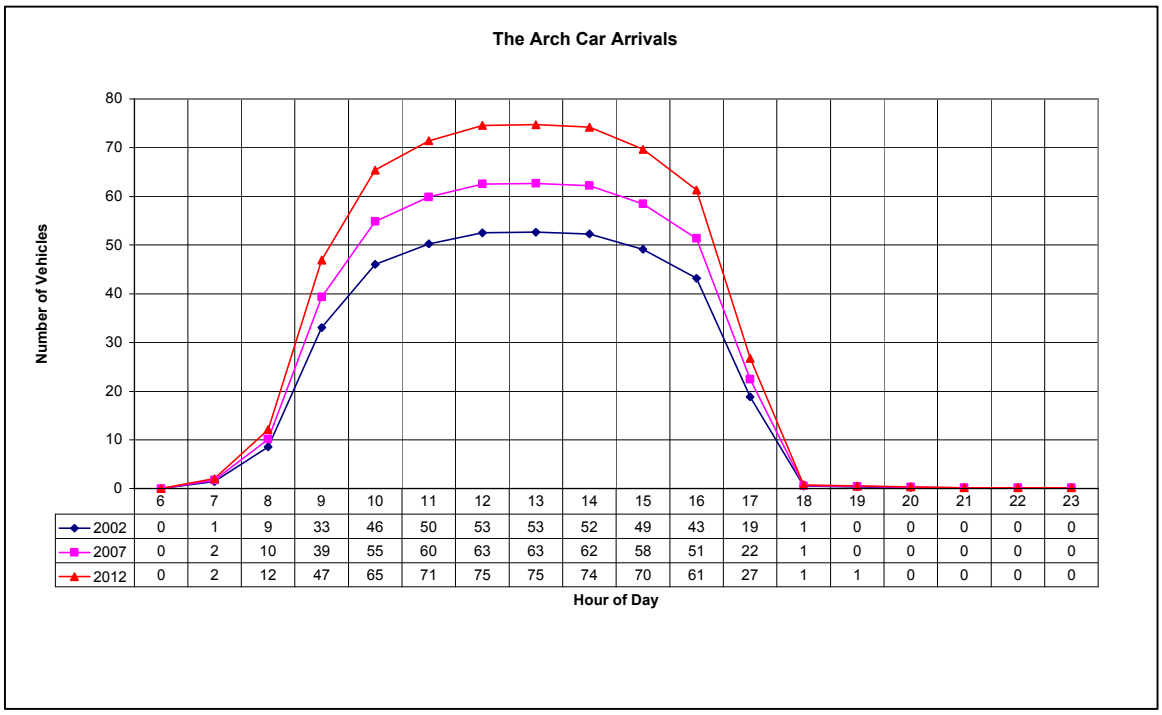
Figure 80. Massacre Bay East Average Visitor Encounters – All Nodes and Links

Encounters at the site are predicted to stay close to 2002 numbers of around 3 people across the day.

4.9 The Arch

4.9.1 Car Arrivals

Figure 81 shows the arrival curves for cars for 2002, 2007 and 2012 at The Arch.



	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
2002	0	1	9	33	46	50	53	53	52	49	43	19	1	0	0	0	0	0
2007	0	2	10	39	55	60	63	63	62	58	51	22	1	0	0	0	0	0
2012	0	2	12	47	65	71	75	75	74	70	61	27	1	1	0	0	0	0

Figure 81. Hourly car arrivals for The Arch estimated for 2002 and projected for 2007 and 2012.

4.9.2 Parking Capacity and Loading

The arch has 9 spaces for car parking and no bus parking.

4.9.2.1 Parking Capacity for Cars

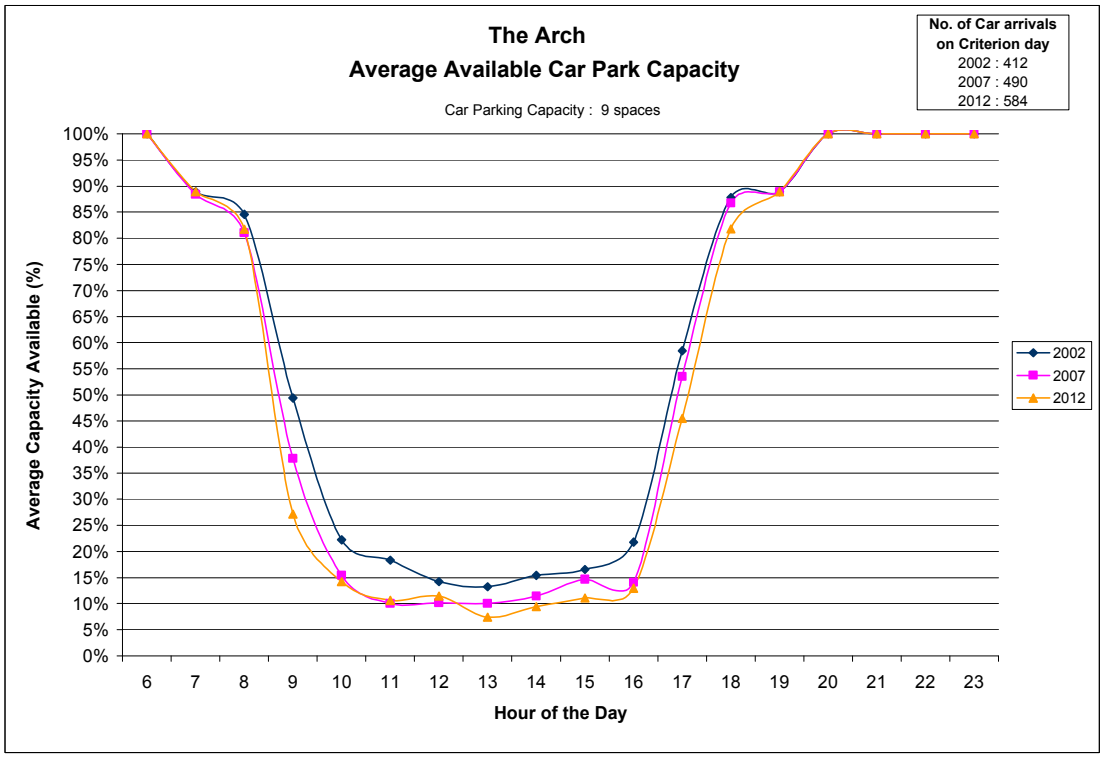


Figure 82. The Arch Average Available Car Park Capacity

The average available capacity at The Arch car park is currently below 25% or 2 spaces between 10am and 5pm; this is expected to drop to 1 space or less in 2007 and 2012. This is due to 42% rise in car arrivals from 412 in 2002 to 584 in 2012, and the small capacity of the car park.

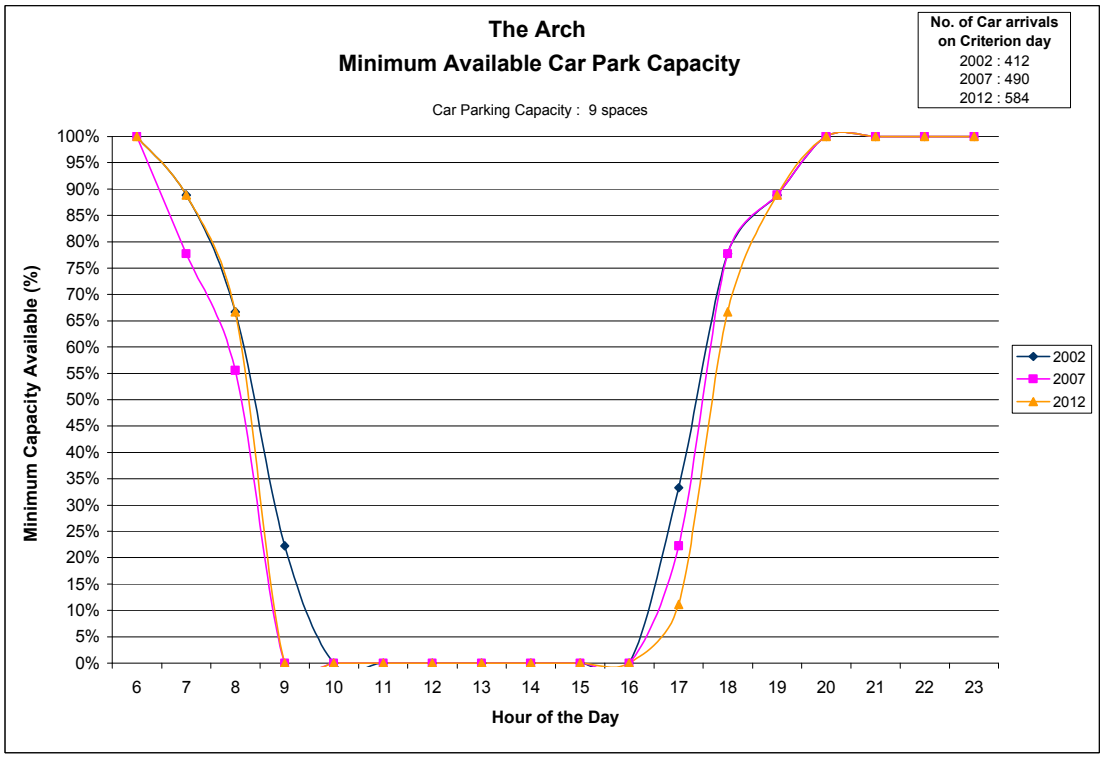


Figure 83. The Arch Minimum Available Car Park Capacity

The car park is currently full at periodically in every hour from 10am to 5pm; minimum capacity will be zero for longer periods in 2007 and 2012.

4.9.2.2 Capacities at Viewing Platforms

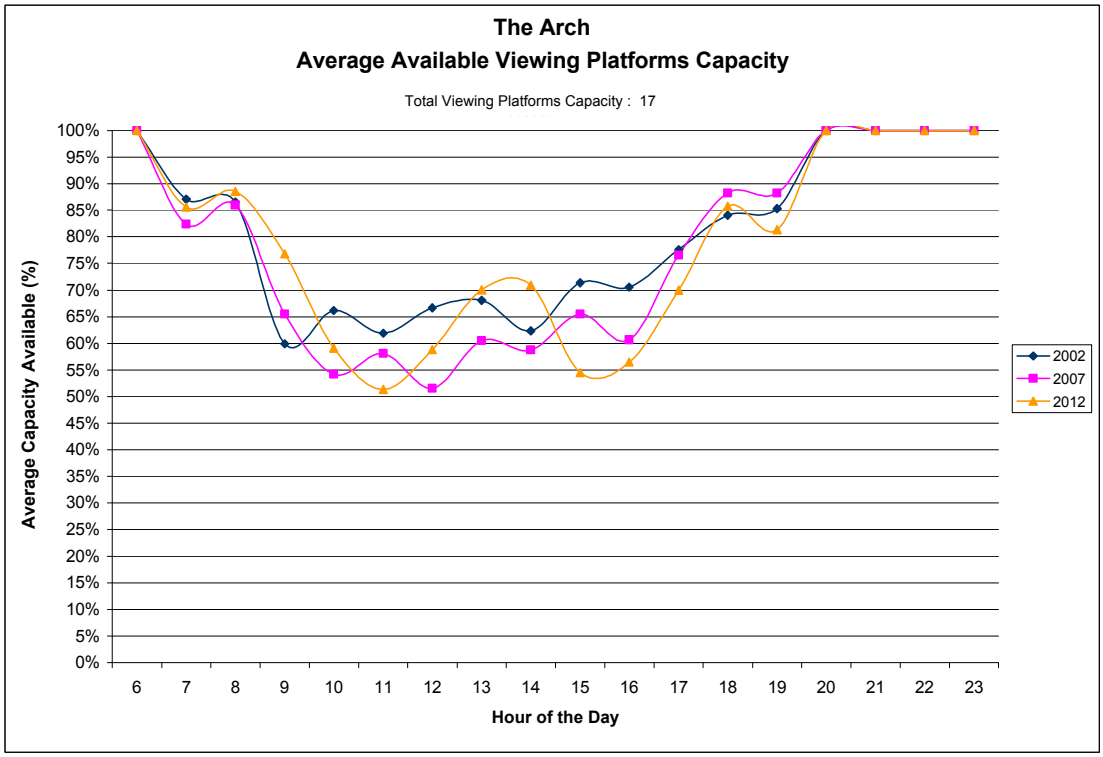


Figure 84. The Arch Average Available Viewing Platform Capacity

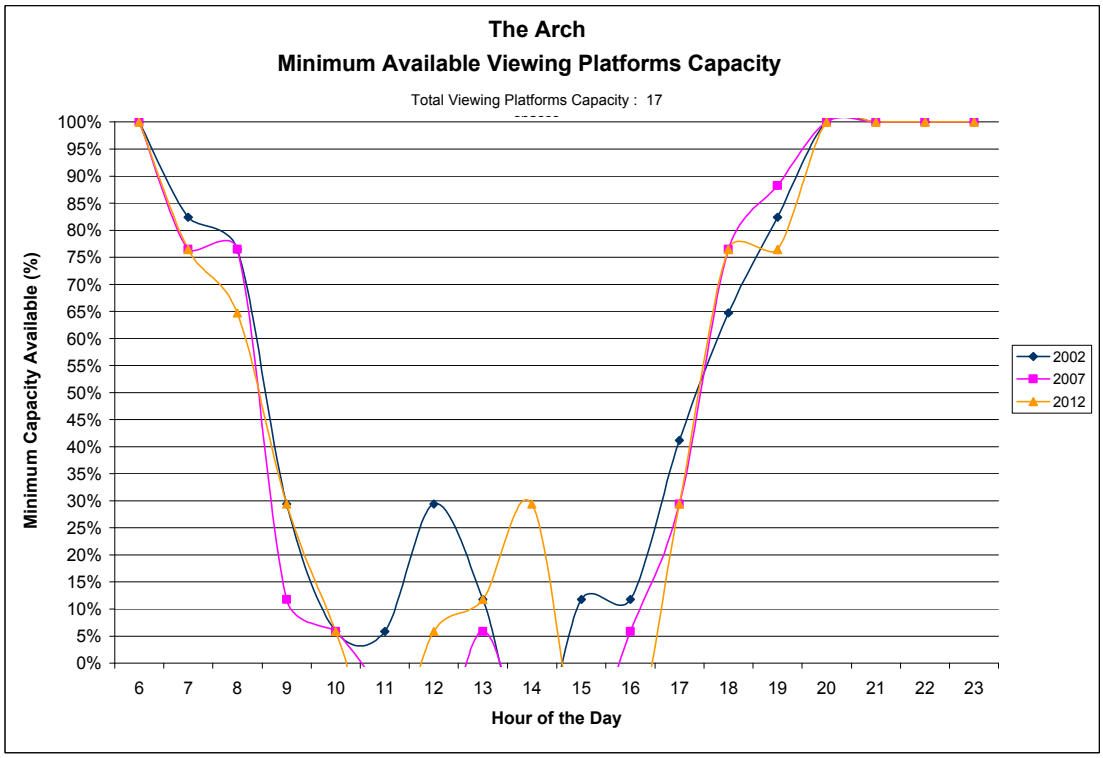


Figure 85. The Arch Minimum Available Viewing Platform Capacity

Viewing platform capacity is predicted to decrease in the future marginally on 2002 figures but still be above 50%. Minimum capacity will periodically be below 15% for all years between 10am and 5pm. These periods are longer in 2007 and 2012.

4.9.3 Queuing Times

4.9.3.1 Queuing Times for Cars

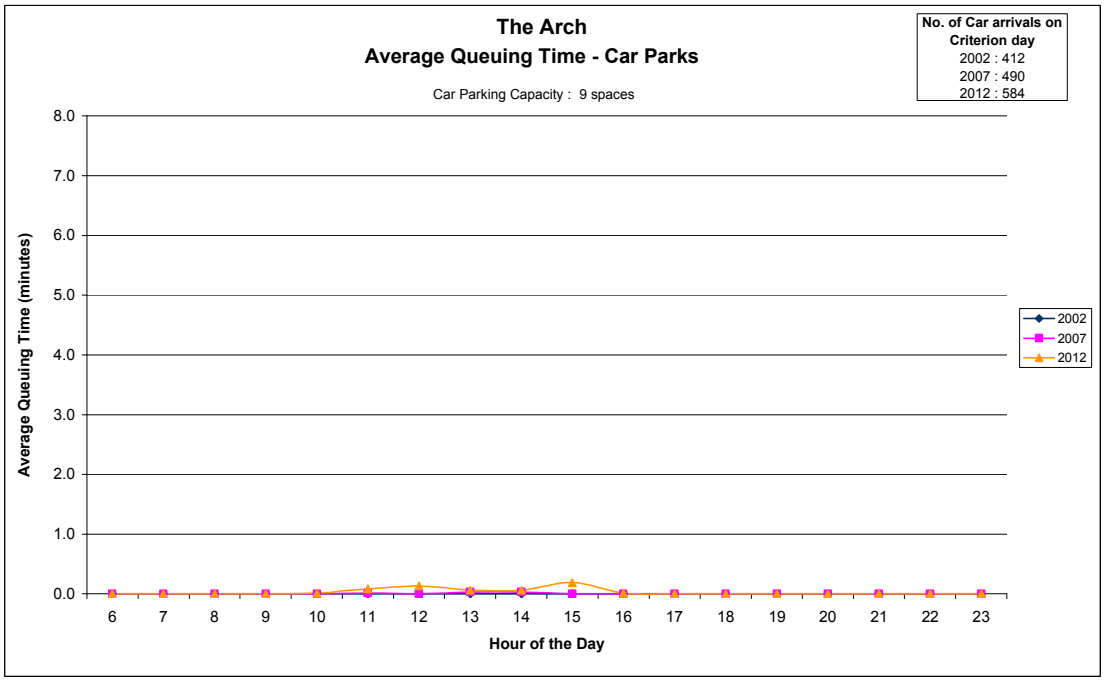


Figure 86. The Arch Average Queuing Time – Car Parks

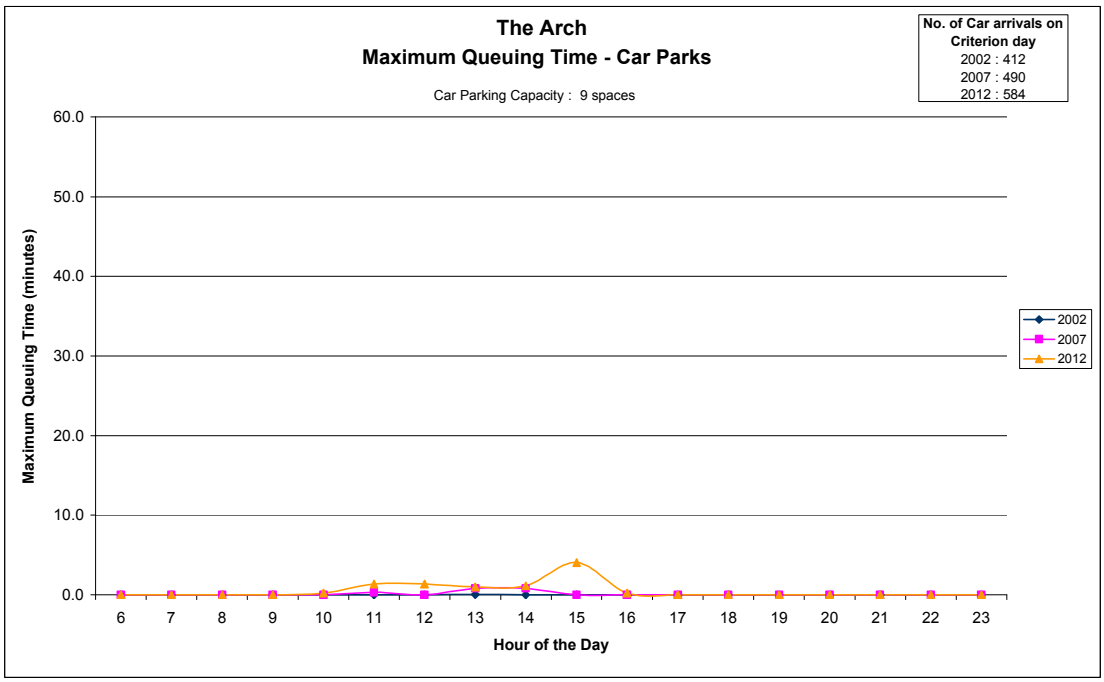


Figure 87. The Arch Maximum Queuing Time – Car Parks

Average queuing times for the car park are not expected to exceed 30 seconds for all years. Maximum queuing time is expected to be under 1 minute to 2007, and rise to a peak of 4 minutes in 2012 at 3pm.

4.9.4 Trip Completion Rates

4.9.4.1 Cars

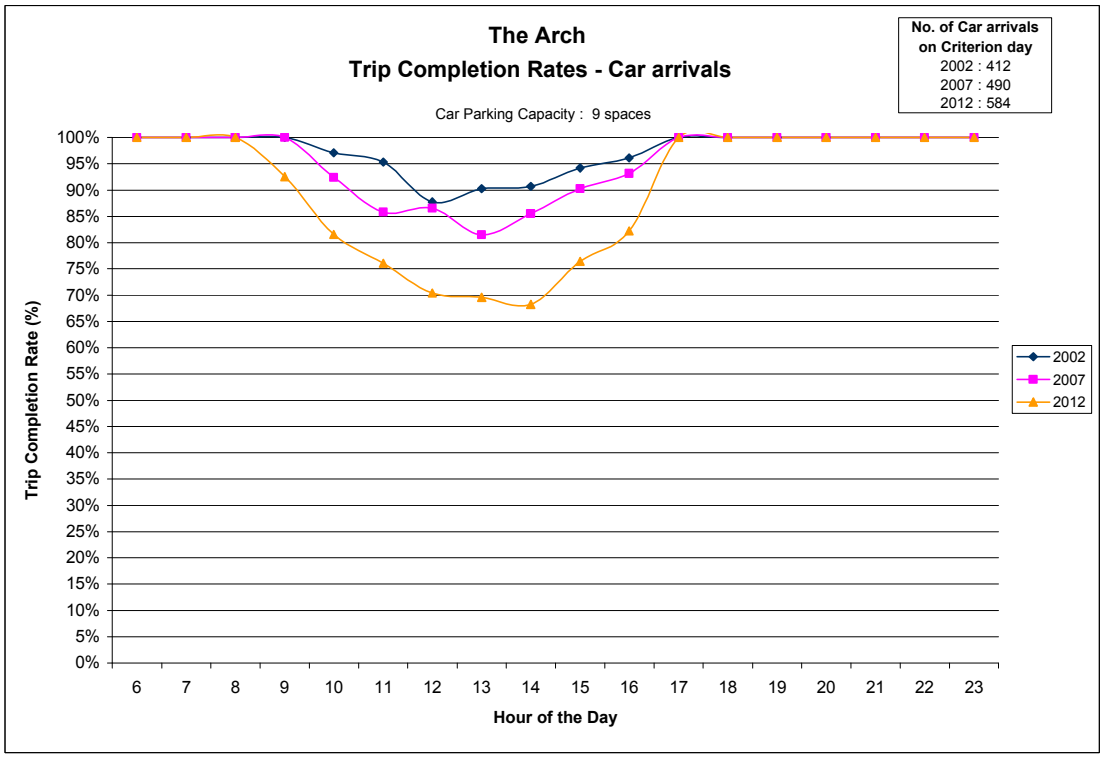


Figure 88. The Arch Trip Completion Rates -Car Arrivals

Trip completion rates at The Arch car park are currently as low as 88% at a 12pm peak, rates are projected to fall to as low as 81% at 1pm in 2007, and 68% at 2pm in 2012. This drop is to be expected due to the capacity of the car park and increase in arrivals.

4.9.5 Length of Stay

4.9.5.1 Cars

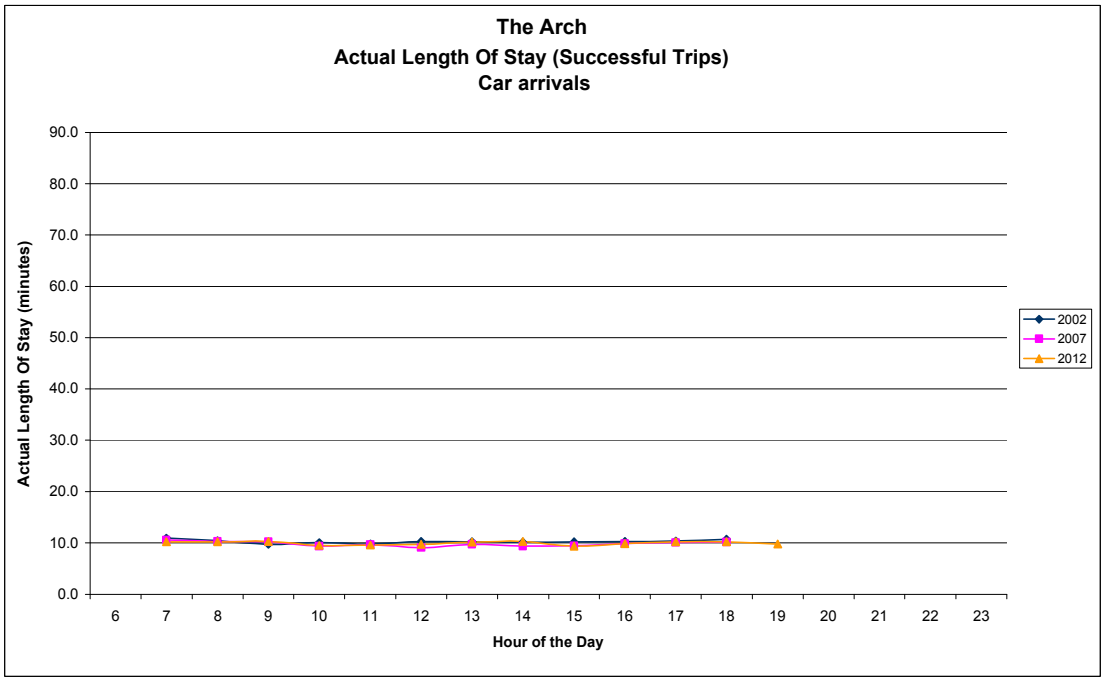


Figure 89. The Arch Actual Length of Stay Successful Trips Car Arrivals

An average length of stay of 10 minutes is expected to remain stable through the year 2012. This agrees with the length of stay measured from traffic count data for the site.

4.9.6 Encounters

4.9.6.1 Overall

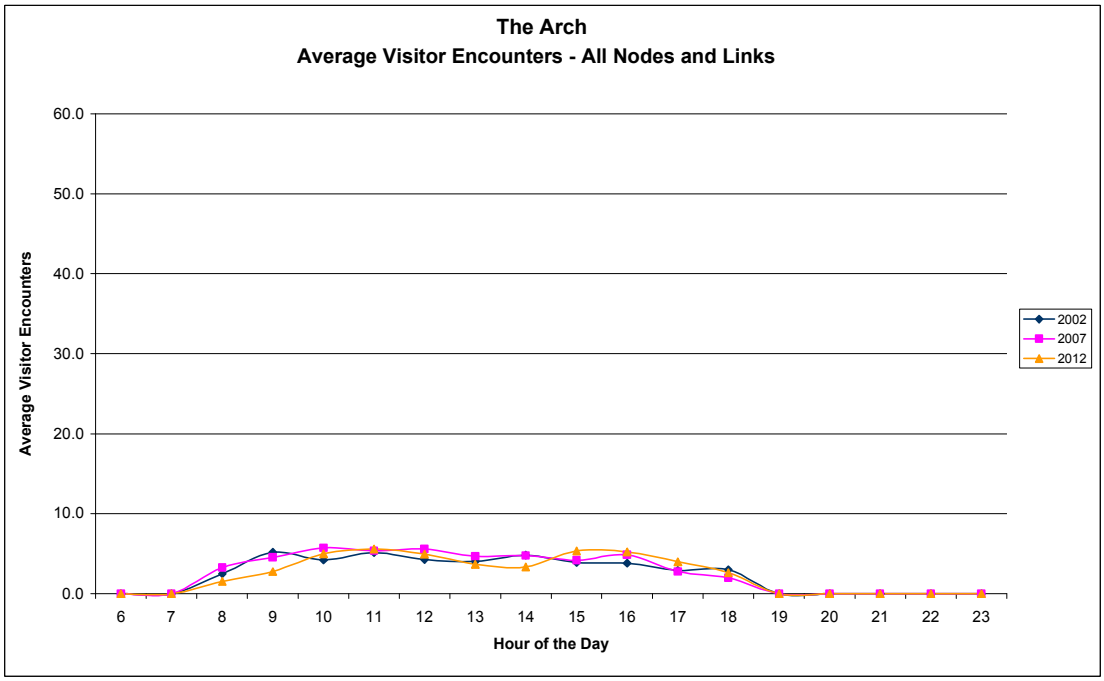


Figure 90. The Arch Average Visitor Encounters – All Nodes and Links

Encounters are expected to remain at 2002 levels of around 5 people for most hours of the day for all years.

4.9.6.2 Viewing Platforms

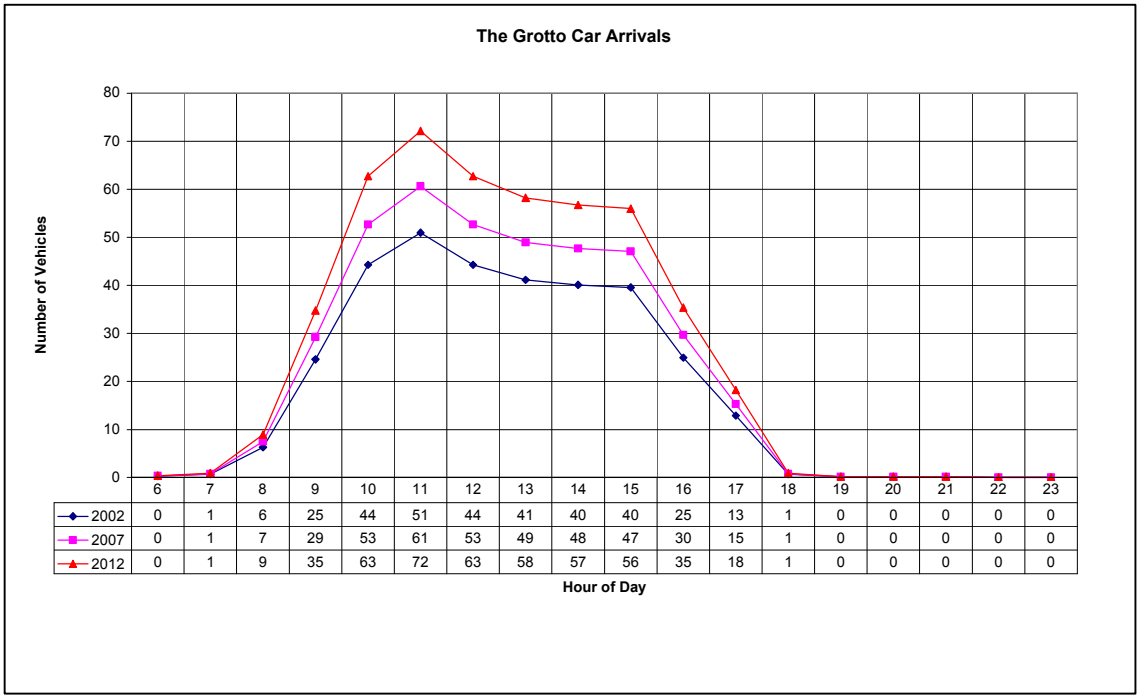
Figure 91. The Arch Average Visitor Encounters – Viewing Platforms

Viewing platform encounters are predicted to rise slightly on 2002 figure of 5 people by between 1 and 2 people across the day.

4.10 The Grotto

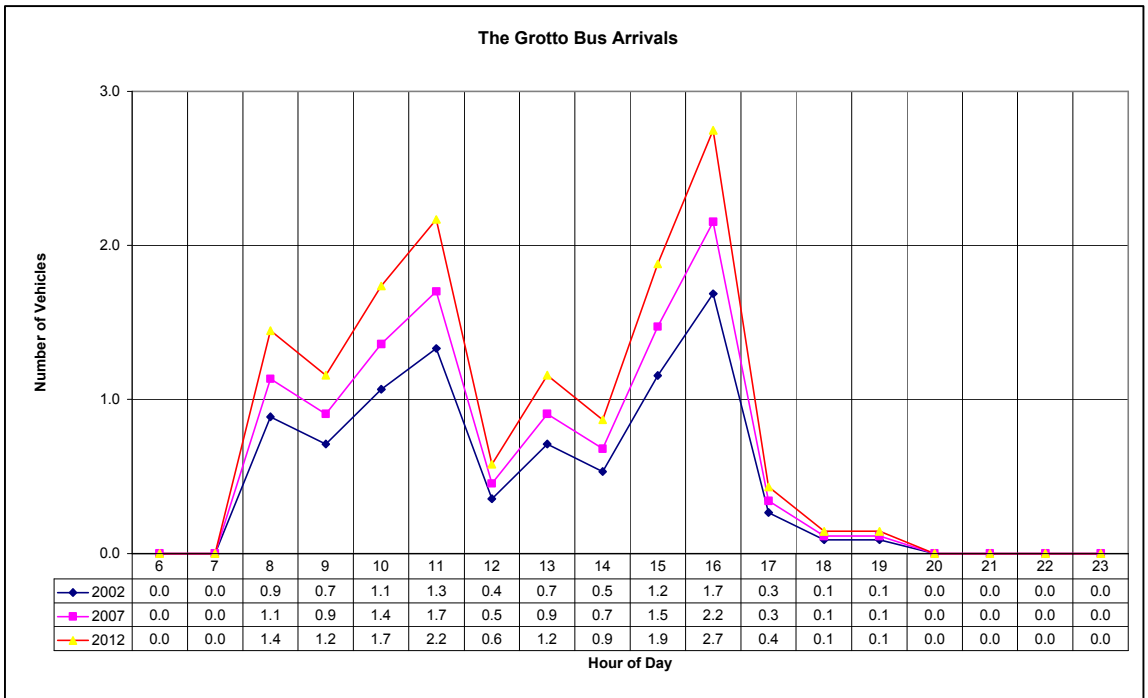
4.10.1 Car and Bus Arrivals

Figures 92 and 93 shows the arrival curves for cars and buses for 2002, 2007 and 2012 at The Grotto.



	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
2002	0	1	6	25	44	51	44	41	40	40	25	13	1	0	0	0	0	0
2007	0	1	7	29	53	61	53	49	48	47	30	15	1	0	0	0	0	0
2012	0	1	9	35	63	72	63	58	57	56	35	18	1	0	0	0	0	0

Figure 92. Hourly Car Arrivals for The Grotto estimated for 2002 and projected for 2007 and 2012.



	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
2002	0.0	0.0	0.9	0.7	1.1	1.3	0.4	0.7	0.5	1.2	1.7	0.3	0.1	0.1	0.0	0.0	0.0	0.0
2007	0.0	0.0	1.1	0.9	1.4	1.7	0.5	0.9	0.7	1.5	2.2	0.3	0.1	0.1	0.0	0.0	0.0	0.0
2012	0.0	0.0	1.4	1.2	1.7	2.2	0.6	1.2	0.9	1.9	2.7	0.4	0.1	0.1	0.0	0.0	0.0	0.0

Figure 93. Hourly Bus Arrivals for The Grotto estimated for 2002 and projected for 2007 and 2012.

4.10.2 Parking Capacity and Loading

The Grotto has 34 spaces for car parking and 5 bus parking spaces.

4.10.2.1 Parking Capacity for Cars

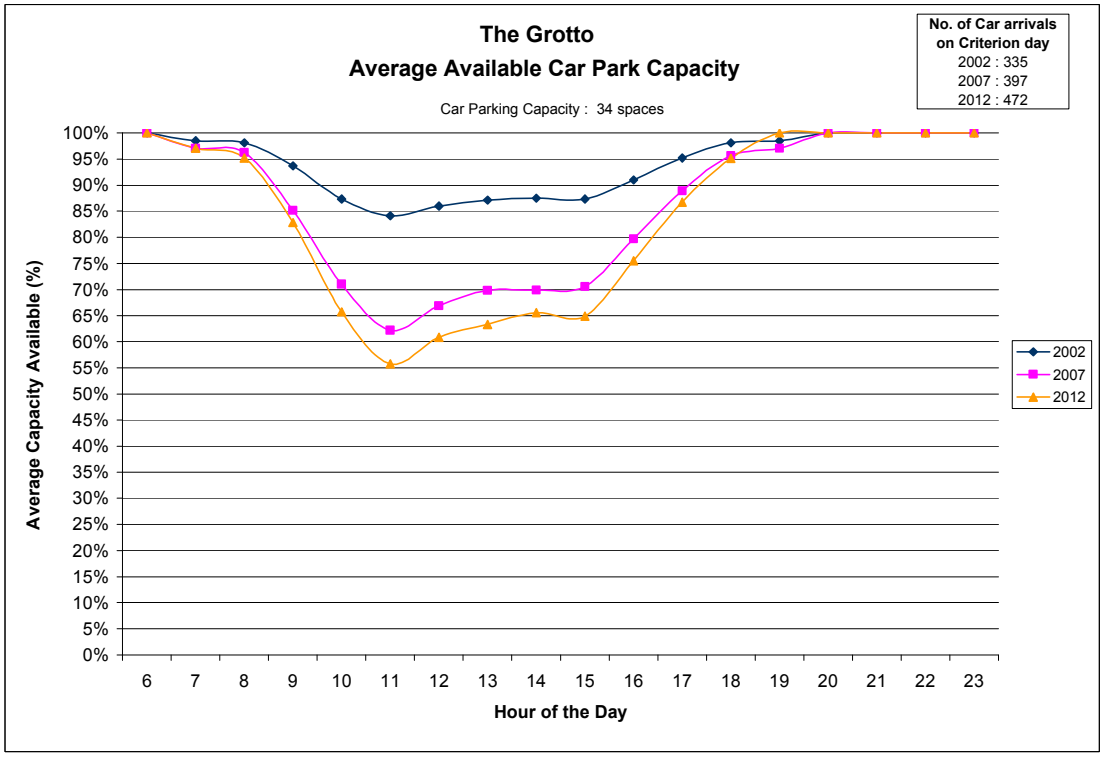


Figure 94. The Grotto Average Available Car Park Capacity

The average car park capacity at The Grotto doesn't drop below 84% or 29 free spaces. Future years are predicted to drop to troughs of 62% or 21 spaces in 2007 and 55% or 18 spaces in 2012.

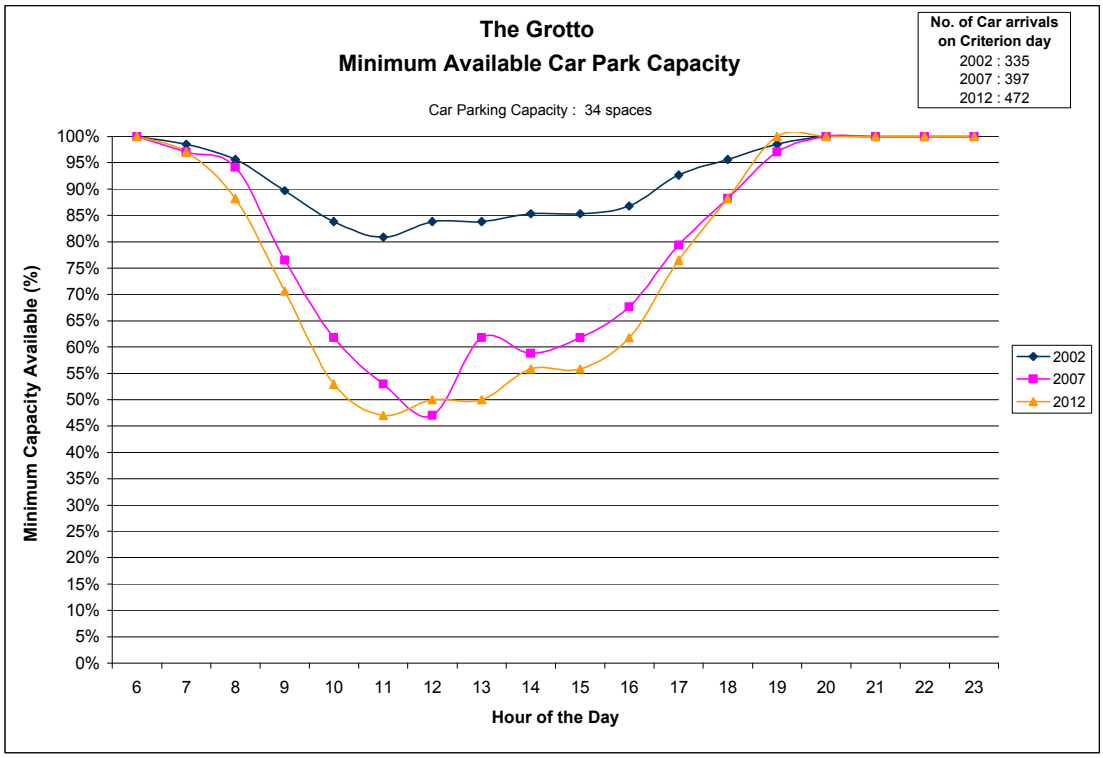


Figure 95. The Grotto Minimum Available Car Park Capacity

At no point in any year is the car park expected to be at capacity, with 2002 levels always above 80% (27 spaces), and future years predicted to be at 46% (15 spaces) or greater.

4.10.2.2 Parking Capacity for Buses

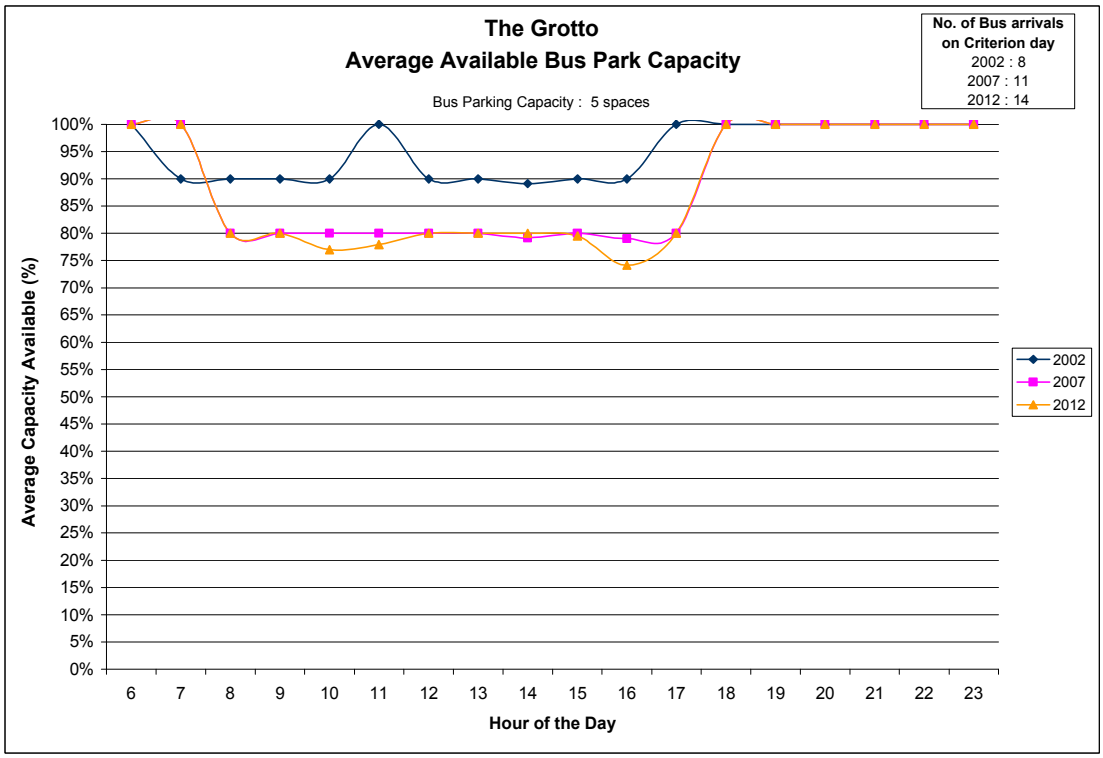


Figure 96. The Grotto Average Available Bus Park Capacity

Average bus parking at The Grotto is currently at 90% or higher (4 or 5 spaces), this is expected to drop to 80% in 2007 (4 spaces), and a similar average capacity in 2012.

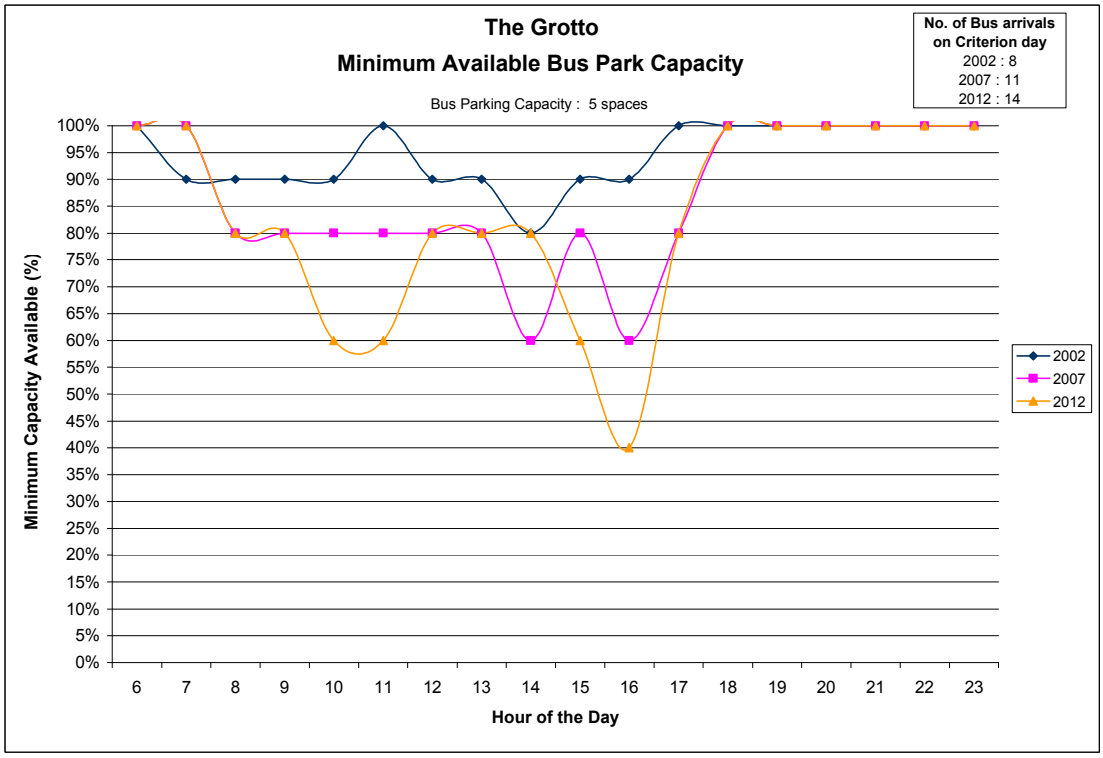


Figure 97. The Grotto Minimum Available Bus Park Capacity

Minimum capacity in the bus park is expected to drop slightly at 2pm and 4pm in 2007 to 3 spaces, and in 2012 to a minimum of 2 spaces. The bus parks are therefore not expected to be full for period out to 2012.

4.10.2.3 Capacities at Viewing Platforms

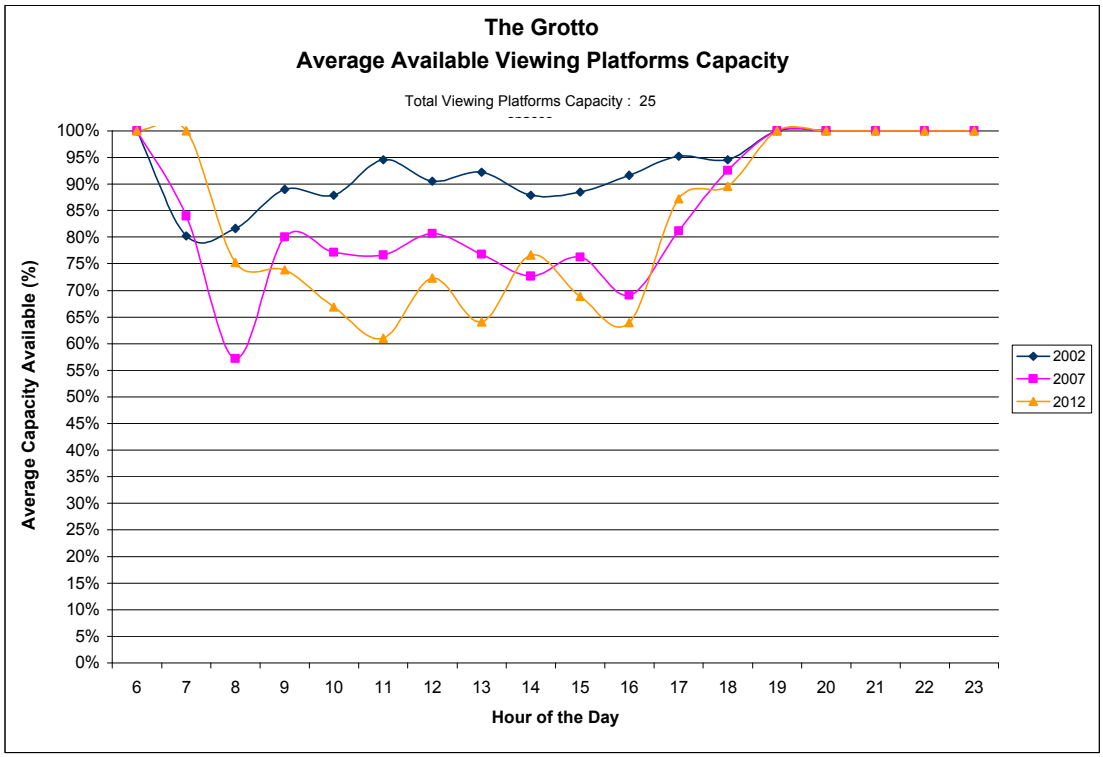


Figure 98. The Grotto Average Available Viewing Platform Capacity

Viewing platform average capacity is expected to drop from 2002 figures of between 80% and 95% for the majority of the day, to between 55% and 80% in 2007 and slightly lower in 2012 to between 60% and 75%.

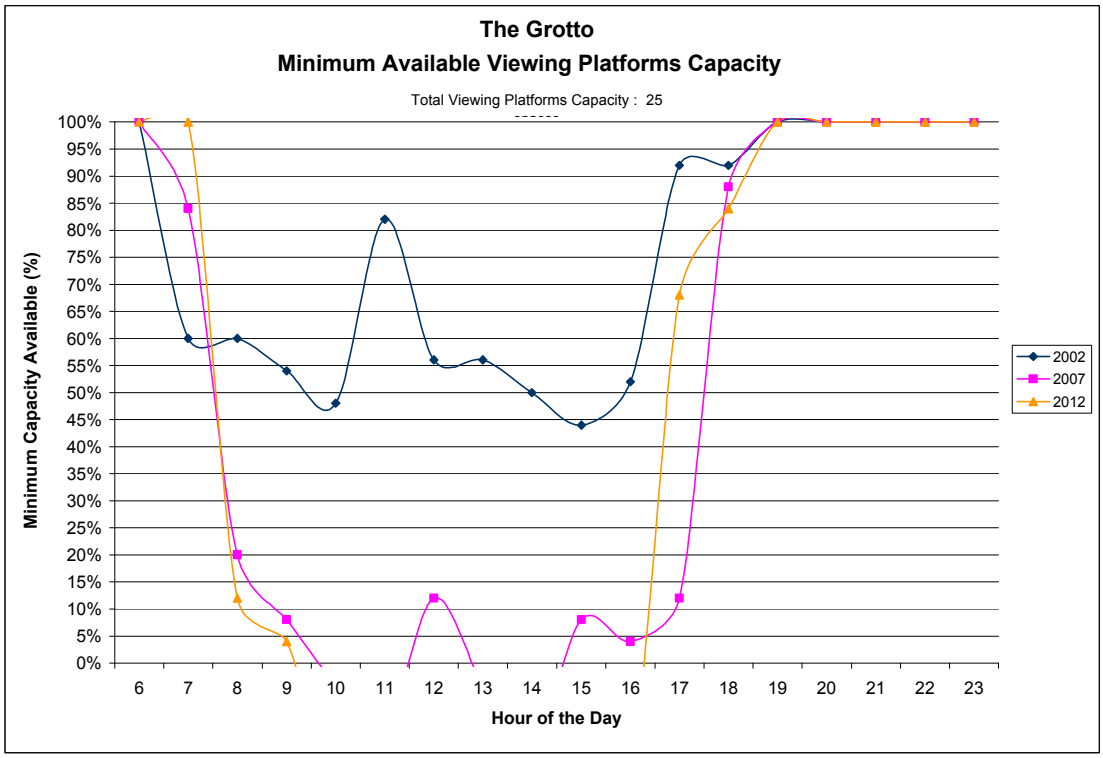


Figure 99. The Grotto Minimum Available Viewing Platform Capacity

Minimum capacity at the viewing platforms currently doesn't drop below 45% but is predicted to drop sharply in future years. So that between 9am and 5pm the viewing platforms close to or above capacity in 2007, and in 2012 the platforms will be over capacity for all of those hours at peak times. This is a similar phenomena to the Gibson Steps (see above).

4.10.3 Queuing Times

4.10.3.1 Queuing Times for Cars

There is no queuing projected for The Grotto's car park either for average or maximum queuing times over the 10 year simulation period, hence the figures are not shown.

4.10.3.2 Queuing Times for Buses

There is no queuing projected for The Grotto's bus park either for average or maximum queuing times over the 10 year simulation period, hence the figures are not shown.

4.10.4 Trip Completion Rates

4.10.4.1 Cars

There are no trip failures expected for The Grotto car park for all years, hence the figure is not shown.

4.10.4.2 Buses

Trip completion rates are expected to be 100% for the next 10 years, hence the figure is not shown.

4.10.4.3 Overall

As both car and bus trip completions are 100%, the overall rate is also 100%, hence the figure is not shown.

4.10.5 Length of Stay

4.10.5.1 Cars

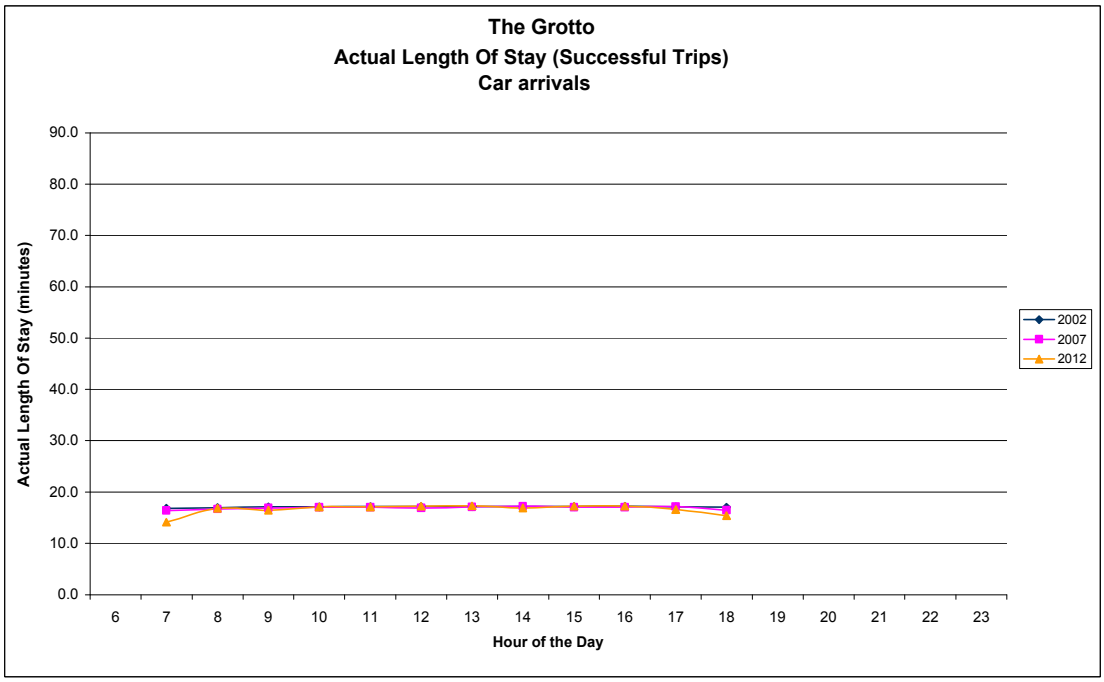


Figure 100. The Grotto Actual Length of Stay Successful Trips Car Arrivals

An average length of stay of 17 minutes for cars is expected to remain constant over the next 10 years. This is 2 minutes longer than the time measured from traffic data collected on site.

4.10.5.2 Buses

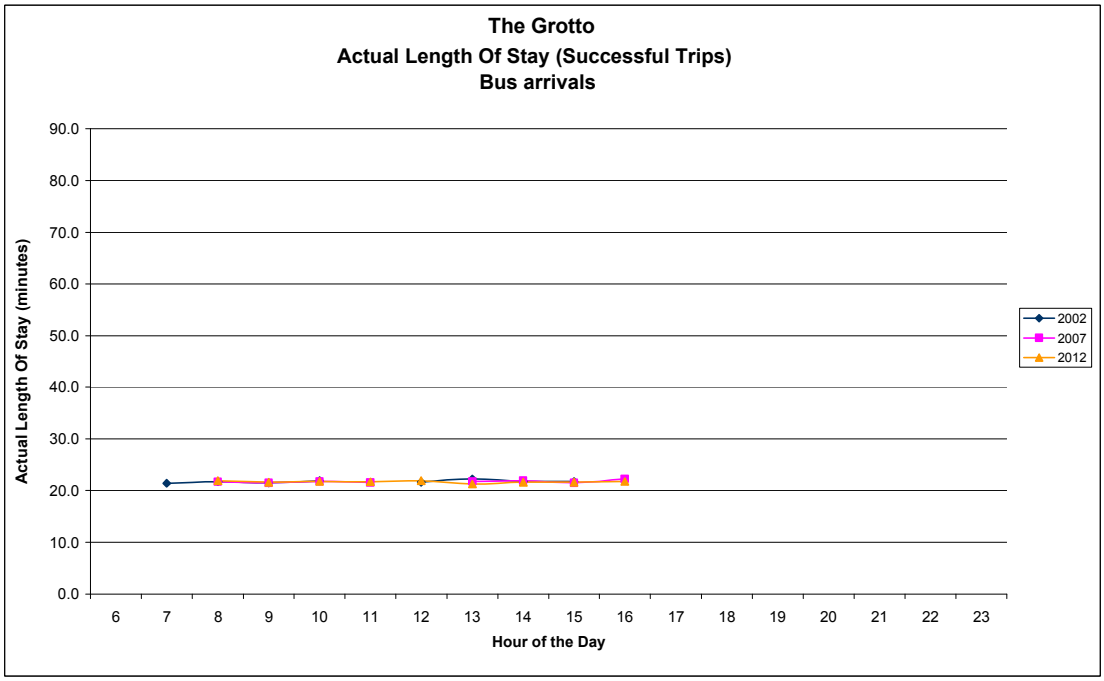


Figure 101. The Grotto Actual Length of Stay Successful Trips Bus Arrivals

An average length of stay of 22 minutes for buses is expected to remain constant over the next 10 years. This is 2 minutes longer than the time measured from traffic data collected on site.

4.10.6 Encounters

4.10.6.1 Overall

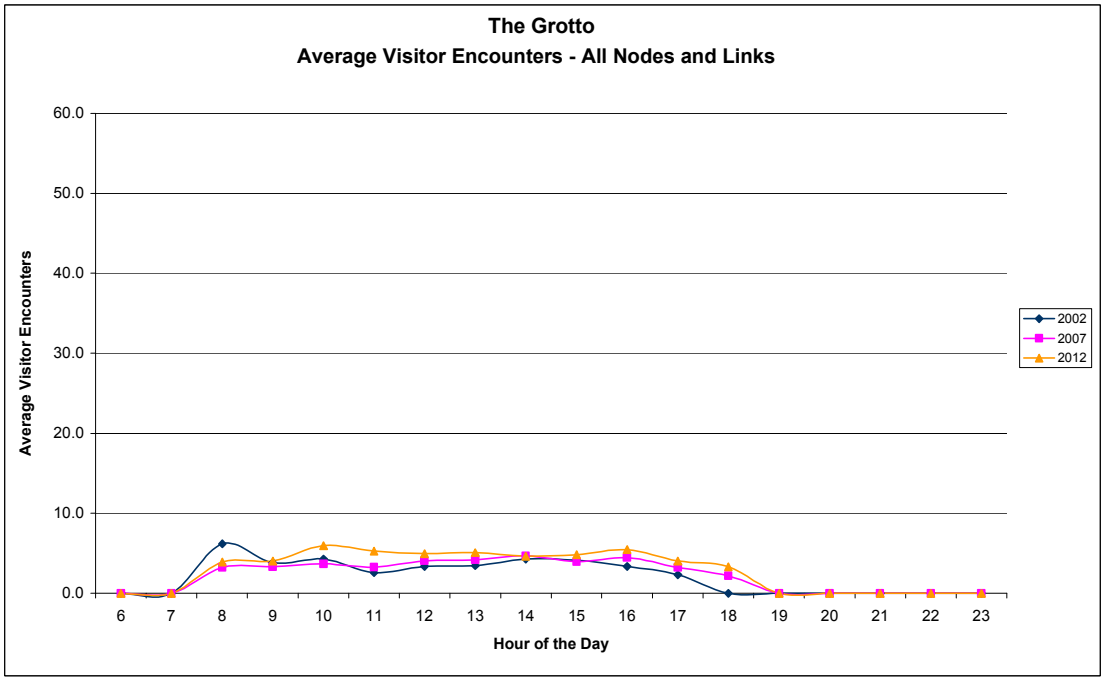


Figure 102. The Grotto Average Visitor Encounters – All Nodes and Links

Encounters at the site are only predicted to rise by 1 person over the next 10 years to an average of 5 people between 9am and 6pm.

4.10.6.2 Viewing Platforms

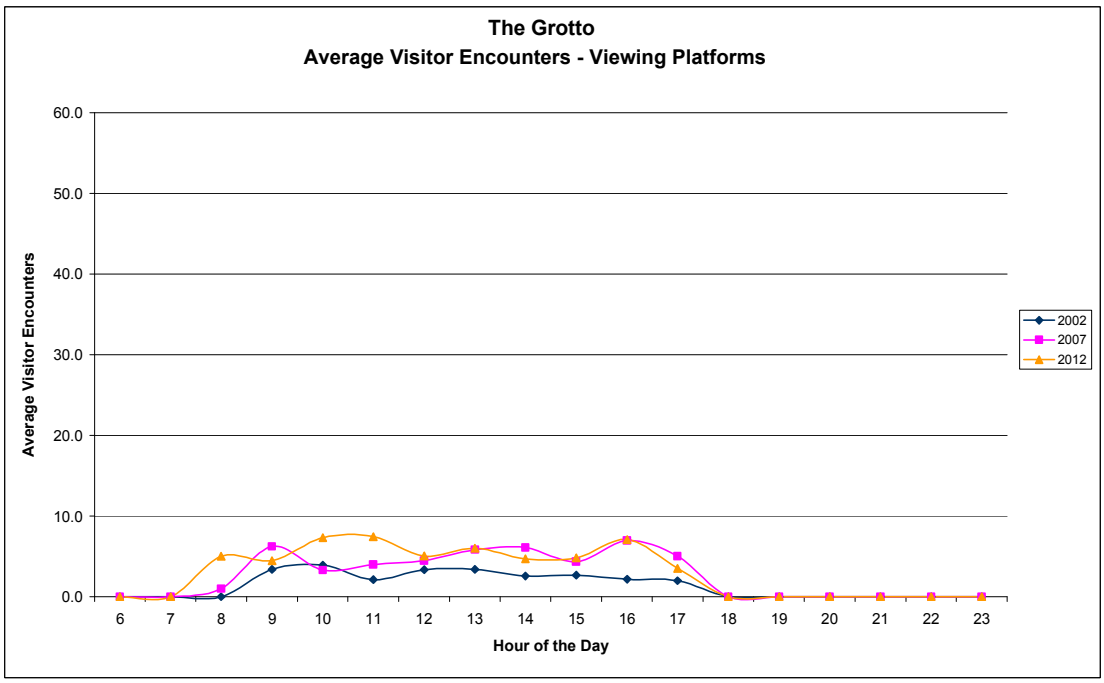


Figure 103. The Grotto Average Visitor Encounters – Viewing Platforms

Visitor encounters at viewing platforms are expected to rise from and average of 3 people for the day to 5 people in 2007 and 6 people in 2012. Note that this appears to be inconsistent with low viewing platform capacity (ie zero see above) however it is not inconsistent. That is because encounters is always computed from other groups of people (ie from another vehicle) encountered during the site visit. Therefore a large group alighting from a bus will not encounter other members of the bus group (they are excluded). This means that a bus will often cause a problem with viewing platform capacity (ie make to fall to zero) but may not effect average encounters as much.

5 Management Conclusions and Recommendations

5.1 Interpretation of simulation results

Interpretation of the results of each simulation needs to take into account the way RBSim simulates individual trips along with the interrelationship between key variables. These are summarised below:

5.1.1 Trip completion rates and queuing times

As soon as parking areas are filled to capacity, an agent that must park a vehicle will find no available parking and will abandon the visit to the site. When this occurs, RBSim records the trip as a trip failure. As trip failures increase, it would be expected that in reality, queuing times for parking and other facilities would also increase. This is compounded for those sites with longer duration of stay as described in 5.1.3.

5.1.2 Trip completion rates and parking capacity

When capacities for parking drop to 0%, trip completion rates should be examined for the corresponding periods. Trip completion rates will provide a measure of the extent by which parking capacity is exceeded.

5.1.3 Queuing times and length of stay

Queuing times for parking generally increase with the layout size of the car park and average length of stay. Therefore as parking areas reach capacity, problems with illegal parking and a drop in visitor satisfaction, due to long waits for parking, can be expected for those sites with longer duration of stay.

5.2 Summary of results

Table 1 shows the key output measures for the peak hour for each site. The peak hour may be different for cars versus buses and for visual encounters (see Table 14 in Appendix 2). Average parking available during the peak hour is shown rather than minimum parking since the trip failures for cars and buses is a more direct measure of the number of vehicles that are turned away during the heaviest visitation times.

	Average Car Parking Available during peak hour			Average Bus Parking Available during peak hour			Average Queuing Times during peak hour (minutes)			Car Trip Failures during peak hour			Bus Trip Failures during peak hour			Average Encounters during peak hour			Length of Stay in minutes		
Site/Locale	2002	2007	2012	2002	2007	2012	2002	2007	2012	2002	2007	2012	2002	2007	2012	2002	2007	2012	2002	2007	2012
Bay of Islands	6	4	3	NA	NA	NA	0	0.08	0.67	0	4	15	NA	NA	NA	5	6	6	17.7	17.7	17.9
Bay of Martyrs	36	32	25	NA	NA	NA	0	0	0	0	0	0	NA	NA	NA	8	8	11	26.7	26.8	28.5
Discovery Walk	1	1	1	NA	NA	NA	0	0	0	8	12	18	NA	NA	NA	2	4	4	13.6	13.6	13.6
Gibson Steps	7	6	5	1	1	1	0	0	0	0	0	0	0	0	0	11	14	15	8.9	8.1	8.2
Loch Ard Gorge	46	45	25	3	2	1	2	20	26	0	0	0	1	8	10	25	42	56	45.7	48.2	54.9
London Bridge	1	2	1	2	1	1	1.8	3.3	2.3	20	23	45	1	3	7	21	25	26	15.6	15.6	15.3
Massacre Bay	3	3	2	NA	NA	NA	0	0	0	0	0	0	NA	NA	NA	3	4	5	29.9	31.3	30.8
The Arch	1	1	1	NA	NA	NA	0	0.01	0.09	5	12	23	NA	NA	NA	4	5	5	10.2	9.4	10.2
The Grotto	28	21	19	NA	NA	NA	0	0	0	0	0	0	NA	NA	NA	3	4	5	17.0	17.0	17.0

Table 1. Summary of results for peak hour for each site.

Average queuing times are reported for cars only. Trip failures measure the number of vehicles that were turned away due to all parking spaces being full on arrival to the site. Average encounters per hours is a measure of crowding at the site.

5.3 How well will the existing facilities at the nine sites handle growing visitor loads?

5.3.1 Car Parks

No problems are anticipated for car parking at Bay of Martyrs, Loch Ard Gorge, Gibsons Steps, Massacre Bay and The Grotto for the entire 10-year period. However Loch Ard Gorge has the potential to have queuing problems during peak periods if traffic is not directed to vacant parking spaces to the west as traffic enters from the entry road.

Bay of Islands will begin seeing problems with a shortage of car parking during peak periods by 2007 with 4 cars unable to park during peak hours and 15 cars by 2012. With 19 car parks in the current facility, provision should be made for overflow parking in the short term, with a long term requirement for a facility nearly double the current facility.

Discovery Walk, which has only 6 parking spaces for cars, is beginning to experience problems now during peak periods with 8 trips failing during the peak hours with this number increasing to 15 cars by 2012. The difficulty of the terrain, the dangerous approach on the Great Ocean Road coming from Port Campbell make enlarging this parking area difficult. Consideration should be given to improving facilities at Two Mile Bay.

Gibson Steps should be monitored. Though there are no problems anticipated over the next 10 years, the small size of the car park compared to the large number of arrivals is possible only because of short duration of stay. Development of facilities at this site might increase duration of stay and would require expanding the parking area from its current size.

At London Bridge there is a current problem with car parking during the entire day for cars. With only 12 car spaces there is a clear shortage of parking for cars. The simulation shows 18 trip failures in 2002, 23 failures by 2007 and 45 trip failures by 2012.

There are similar problems at The Arch which has only 9 car parks. Trip failures are beginning to occur now with 5 trips failing during the peak hour of the day. However this more than doubles by 2007 and quadruples by 2012 with 23 trip failures.

5.3.2 Bus Parking

Bus parking is available at three of the nine sites: Gibson Steps, Loch Ard Gorge and London Bridge. Surprisingly, with only 2 bus parking spaces, Gibson Steps seems to be coping with the traffic until 2012.

Loch Ard Gorge currently has a small problem with bus parking during the peak hour of the day with short queuing times and a single trip failure. However this problem

increases rapidly with queuing times increasing to 20 minutes in 2007 with 8 failed trips. By 2012 queuing times increase to 26 minutes with 10 bus trips failing.

London Bridge has parking for 6 buses, with short queuing times during the peak hour of 2002. However trip failures will increase in 2007 and 2012 to 3 and 7 buses respectively.

5.4 How is length of stay affected by the increasing number of visitors?

The only site that shows a significant change in length of stay is at Loch Ard Gorge. Generally the length of stay for cars increases as the number of visitors increase. This is in accordance with the increase in encounters and queuing times at that site.

5.5 How will visitor satisfaction be affected by the new facilities and growing visitor numbers

Visual encounters with other tourists are a function of the number of visitors on site, the size of the site, the dispersion of attractions within the site, and the visual separation between attractions. Loch Ard Gorge, is the only site that shows a significant increase in visual encounters over the 10 year period with the average number of visual encounters more than doubling by 2012.

Other sites fluctuate slightly over the 10-year period but do not show dramatic increases with the projected increase in visitors. However The Arch has undersized parking areas and only two small viewing platforms. With the high trip failure rate by 2012 during peak periods, it will be necessary to provide more parking. However, if parking areas are enlarged and visitor numbers increase, crowding and an increase of visual encounters will likely be a problem. If parking areas are increased, it may be necessary to enlarge viewing areas.

The Grotto has adequate parking to accommodate increasing visitors over the 10 year period examined, however the simulation clearly shows that current viewing platforms will not accommodate the anticipated numbers of visitors by 2007 and 2012. Because of the steepness of the site, and the dead end at the end of the main trail, it is expected that there may be serious problems with crowding on the stairways and at the main viewing area at the Grotto.

5.6 Recommendations

Table 2 shows a summary of recommendations for each of the 9 sites studied. Each site is discussed in detail in this section. Note that the columns for additional car and bus parking is based on trip failures which is a pessimistic measure, that is, it reflects the worst case scenario. If parking is redesigned to these figures peak loads should be satisfactorily handled (assuming of course that traffic projections for cars and buses are realised). Additional viewing platform capacity is related to increase of car and bus traffic and current capacities at peak times. Determining capacity of viewing platforms is complex as sizing is determined by location, site configuration and pedestrian traffic flows. Because of these complexities it is generally recommended that alternative designs for parking and viewing platforms be tested using RBSim.

	Additional Car Parking Required			Additional Bus Parking Required			Additional Viewing Platform capacity Required	Simulation recommended for redesign
Site/Locale	2002	2007	2012	2002	2007	2012		
Bay of Islands	0	4	15	NA	NA	NA	No	No
Bay of Martyrs	0	0	0	NA	NA	NA	Yes	Yes
Discovery Walk	8	12	18	NA	NA	NA	NA	No
Gibson Steps	0	0	0	0	0	0	No	No
Loch Ard Gorge	0	0	0	1	8	10	Yes	Yes
London Bridge	20	23	45	1	3	7	Yes	Yes
Massacre Bay	0	0	0	NA	NA	NA	NA	No
The Arch	5	12	23	NA	NA	NA	Yes	Yes
The Grotto	0	0	0	0	0	0	Yes	Yes

Table 2. Summary of Recommendations

5.6.1 Bay of Islands

Bay of Islands has parking for 19 cars, 3 buses and one disabled car park. There are two small viewing platforms with capacity for 5 people each. The site is associated with a coastal trail of about 800 metres. The site has good coastal views with current average visit durations of 15 minutes. Peak visitation is at 11:00 in the morning with 64 cars arriving during that hour in 2002, 76 cars in 2007 and 91 cars in 2012.

Provision should be made for overflow parking in the next 5 years during peak periods for 4 cars. By 2012 however, parking for an additional 15 cars is needed during peak periods.

5.6.2 Bay of Martyrs

Bay of Martyrs is a large site with good beach access, walking trails and parking areas. There are four access points from the Great Ocean Road at Bay of Martys, Worm Bay, the Wells, and Wild Dog Cove West. At the west end of the site at Bay of Martyrs there is parking for 18 cars and 4 buses with a viewing platform for 5 visitors with beach access and access to walking. At Worm Bay there is parking for 8 cars with beach access and walking trails. At The Wells, there is parking for 12 cars with a viewing platform for 5 people and access to walking trails. At the east end (Wild Dog Cove West) there is parking for 20 cars and a viewing platform for 5 cars. Average visit duration is currently around 20 minutes.

Bay of Martyrs is currently well serviced with capacity to handle increasing visitor numbers until 2012. The only potential problem is undersized viewing platforms. These should be monitored during the peak hour (11:00 am) during peak seasons to determine specific site requirements at each viewing platform.

5.6.3 Discovery Walk

Discovery walk is comprised of a small parking area for 6 cars immediately off the Great Ocean Road. Its main attraction is a coastal walking trail with good views of the town of Port Campbell and ocean views. Visit duration averages around 10 minutes. The peak hour of visitation is at 1:00 pm. This site is well publicised in park literature and parking is already inadequate during peak periods.

The simulation shows there is currently a shortage of 8 car parks increasing to 12 cars by 2007 and 18 cars by 2012. Because of the difficult terrain, the dangerous approach from the Great Ocean Road it may be impractical to upgrade the current parking area. It may be necessary to re-locate the parking area or perhaps provide separate overflow parking. Alternatively efforts could be made to spread visitation across the day to reduce visitation during peak hours.

5.6.4 Gibson Steps

Gibsons Steps is known for its excellent views and is one of the few places with access to the beach near the vertical cliffs typical of the coastline near 12 Apostles. The site has parking for 4 cars, 2 buses and a single disabled parking bay. There is a viewing platform that accommodates 12 people. The peak visitation hour is at 2:00pm with 48 cars arriving at that hour in 2002, 57 cars in 2007 and 68 cars in 2012. Visit durations average 10 minutes for cars and 15 minutes for buses.

The simulation for Gibson Steps shows that the current parking facilities for cars and buses is adequate to handle increasing traffic to 2012. However, if any changes to the site are made which might encourage visitors to stay longer, this will cause an immediate shortage of parking for cars and buses.

5.6.5 Loch Ard Gorge

Loch Ard Gorge is the largest and most complex visitation site in Port Campbell National Park. On entry, visitors have the choice of turning left (east) to the Loch Ard Gorge area or right (west) to Mutton Bird Island, The Blow Hole, Thunder Cave and Sherbrooke River. There is parking for 49 cars and 10 buses near Loch Ard Gorge, 24 cars, 4 buses, and 2 disabled parking at Mutton Bird Island lookout and parking for 49 cars along the west access road. There is good interpretation throughout the site with dramatic coastline views and interesting historic and geologic sites of interest. The peak hour of visitation is 3:00pm for cars and buses with an average duration of stay of 45 minutes for cars and 1 hour for buses. At 3:00pm 112 cars arrive in 2002, 134 cars in 2007 and 159 cars in 2012. In the same hour there are 14 buses arriving in 2002, 17 buses in 2007 and 22 buses in 2012.

The simulation shows that there is adequate car parking through 2012, however bus parking is already a problem during peak periods with 1 failed trip in 2002, 8 trips in 2007 and 10 trips by 2012.

More on-site bus parking will be required or a system for dropping off passengers on-site and providing off-site parking should be investigated. This off-site solution would have the additional benefits of addressing the same bus parking problem anticipated at the 12 Apostles (see Stage 1 Report) and maybe London Bridge. The off-site parking would also minimise the footprint of bus parks on the whole park which may otherwise increase substantially in future.

In addition, on-site parking management may be required during peak periods to avoid excessive queuing times.

A more detailed examination of individual viewing platform capacities may be made to determine potential bottlenecks. If there are major changes in the current site configuration it is highly recommended that the new designs be simulated because of the complexity of visitor flows in this large and complex site.

5.6.6 London Bridge

London Bridge is a well-known popular site. It has large viewing platforms with parking for 12 cars and 6 buses. There is good interpretation on site with excellent coastal views and the site is interesting geologically. Peak visitation is 3:00pm for cars and 4:00 pm for buses. At 3:00pm there are 73 cars arriving in 2002, 87 cars in 2007 and 104 cars arriving in 2012. At 4:00pm there are 13 buses arriving in 2002, 17 buses arriving in 2007 and 21 buses arriving in 2012. Average length of stay is currently 15 minutes for cars and 25 minutes for buses.

With these arrival rates, it is not surprising that the car park is inadequate. The simulation shows 18 cars unable to park in 2002, 23 cars in 2007 and 45 cars by 2012. The problem for buses is currently manageable with only 1 bus failing to park in 2002, but by 2007 3 buses fail to park increasing to 7 in 2012. Car and bus parking will have to be increased accordingly. The increasing numbers will also have an impact on viewing platforms. It is recommended that alternative design solutions be tested by simulation.

5.6.7 Massacre Bay

Massacre Bay is a small site with parking for 5 cars. Visitation rates are low for this site and parking facilities are adequate through 2012. No action is required for the next decade.

5.6.8 The Arch

The Arch has parking for 9 cars with two viewing platforms. The west viewing platform accommodates 8 people and the east viewing platform holds 9 people. The site is known for its natural arch and excellent coastal views. The peak visitation occurs at 1:00pm with visit durations of 10 minutes. During the peak hour there are 53 cars arriving in 2002, 63 in 2007 and 75 in 2012.

Simulation shows there is already inadequate parking during the peak hour of the day. There is a need for an additional 6 spaces in 2002, 11 by 2007 and 24 by 2012. These increasing visitor numbers will also have an impact on viewing platforms. It is recommended that new designs are simulated to determine appropriate sizing of new facilities.

5.6.9 The Grotto

The Grotto has parking for 34 cars and 5 buses. There is a viewing platform at the top of the cliff for 4 people and space for 13 people at the Grotto. Peak visitation is 11:00 am for cars and 4:00pm for buses. Average visitation is 15 minutes for cars and 20 minutes for buses.

Simulation shows that the current parking facilities are adequate for both cars and buses. No action is required.

6 Acknowledgements

David Downer assisted in the analysis of traffic count data, and automating the charting of statistical summaries from RBSim. Nathan Zanon assisted in the preparation of the final report.

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8 Appendix 1 – Simulation parameters for 9 sites

8.1 Facilities

Facilities for the simulations are presented in this section. Facility capacities remained the same for each locale for the 3 simulation time periods 2002, 2007 and 2012.

8.1.1 Bay of Islands

NodeID	Facility	Capacity	NodeLabels
93	Viewing Platform	5	Node 93
236	Viewing Platform	5	Node 236
497	Car Park	19	Bay of Islands Parking
497	Bus Park	3	Bay of Islands Parking
497	Disabled Car Park	1	Bay of Islands Parking

Table 3. Facilities and capacities for Bay of Islands

8.1.2 Bay of Martyrs

NodeID	Facility	Capacity	NodeLabels
195	Car Park	18	Parking
195	Bus Park	4	Parking
218	Car Park	12	The Wells
218	Viewing Platform	5	The Wells
219	Car Park	20	Wild Dog Cove West
220	Car Park	8	Worm Bay
222	Viewing Platform	5	Hallandale Point
468	Viewing Platform	5	Viewing Platform

Table 4. Facilities and Capacities for Bay of Martyrs

8.1.3 Discovery Walk

NodeID	Facility	Capacity	NodeLabels
442	Car Park	6	Discovery Walk Car

Table 5. Facilities and Capacities for Discovery Walk

8.1.4 Gibson Steps 2002

NodeID	Facility	Capacity	NodeLabels
482	Viewing Platform	12	Node 482
483	Informal Lookout	100	Beach at Gibson's
485	Car Park	13	Car Park Gibson's
485	Disabled Car Park	1	Car Park Gibson's
486	Bus Park	2	Bus Parking Gibsons

Table 6. Facilities and Capacities for Gibsons Steps

8.1.5 Loch Ard Gorge

NodeID	Facility	Capacity	NodeLabels
165	Attractor	1000	Node 165
166	Viewing Platform	5	Broken Head
167	Viewing Platform	20	Shipwreck Walk
209	Car Park	24	Mutton Bird Island
209	Bus Park	4	Mutton Bird Island
209	Disabled Car Park	2	Mutton Bird Island
210	Viewing Platform	164	Mutton Bird Island 1
211	Disabled Car Park	1	Node 211
212	Informal Lookout	10	Cemetery
213	Viewing Platform	20	Mutton Bird Island 2
228	Viewing Platform	9	Thunder Cave
244	Informal Lookout	50	Sherbrooke River
246	Viewing Platform	8	Blow Hole 1
248	Viewing Platform	36	Viewing Platform
250	Viewing Platform	10	Informal viewpoint
251	Viewing Platform	3	Node 251
252	Viewing Platform	3	Razor Back viewpoint
424	Bus Park	10	Bus Parking
425	Car Park	29	Car Parking
426	Car Park	20	Car Park
429	Viewing Platform	8	Viewing Platform at
430	Informal Lookout	50	Beach in Loch Ard
433	Viewing Platform	3	Viewing Platform
435	Informal Lookout	22	Viewpoint looking east
436	Informal Lookout	9	View to Limestone
437	Informal Lookout	10	Lookout to Arch
439	Car Park	21	Roadside Parking
440	Car Park	20	Roadside Parking
473	Car Park	8	Node 473
478	Viewing Platform	5	Blow Hole West

Table 7. Facilities and Capacities for Loch Ard Gorge

8.1.6 London Bridge

NodeID	Facility	Capacity	NodeLabels
227	Viewing Platform	38	Central Viewing
444	Bus Park	6	Bus/Trailer Parking
445	Car Park	4	Car Parking
447	Viewing Platform	17	West Viewing Platform
448	Viewing Platform	51	East Viewing Platform
498	Car Park	4	Node 498
499	Car Park	4	Node 499

Table 8. Facilities and Capacities for London Bridge

8.1.7 Massacre Bay

NodeID	Facility	Capacity	NodeLabels
99	Car Park	5	Node 99

Table 9. Facilities and Capacities for Massacre Bay

8.1.8 The Arch

NodeID	Facility	Capacity	NodeLabels
73	Car Park	9	The Arch Car Park
79	Viewing Platform	8	Viewing Platform West
441	Viewing Platform	9	Viewing Platform

Table 10. Facilities and Capacities for The Arch

8.1.9 The Grotto

NodeID	Facility	Capacity	NodeLabels
459	Viewing Platform	13	View at the Grotto
460	Viewing Platform	8	Stairway deck
461	Viewing Platform	4	Overlook
463	Bus Park	5	Bus Parking
464	Car Park	28	Car Parking
465	Car Park	6	Car Parking

Table 11. Facilities and Capacities for The Grotto

8.2 Agent Profiles

8.2.1 Agent Rules

Table 5 shows the agent rules used in the scenarios. Rules 1,2 and 3 applies to Car trips and rules 5,2 and 3 apply to Bus trips respectively (in that order). For Loch Ard Gorge rule 4 also applies for both car trips and bus trips.

RuleID	Rule
1	If Arriving at a Locale in a Car then find a Car Park
2	At any Locale find Viewing Platform (repeatedly)
3	IF At a Locale THEN Visit informal Lookout
4	IF Entering Loch Ard Gorge THEN go to Attractor
5	IF Arrive at Locale in a Bus THEN Find Bus Parking

Table 12. Rules used by agents during the simulation runs. Scenario 1 uses only rules 1, 2 and 5, Scenario 2 uses all 5 rules.

8.3 Typical Tips

Two typical trips were assigned to each scenario: one for buses, the second for cars. The table below shows the length of stay for each locale in minutes. In each case, buses were assigned a fixed duration, cars were assigned a duration at runtime using a Poisson distribution using the average length of stay in this table as the mean for the distribution. The trip durations shown in Table 5 were used for 2002, 2007 and 2012 scenarios. These durations were derived from a traffic survey for each site. The

survey data enabled cumulative arrival curves to determine a vehicle's approximate length of stay at each site. These estimates are presented in Table 13.

Locale	Cars	Buses
Bay of Islands	15	
Bay of Martyrs	20	
Discovery Walk	10	
Gibsons Steps	10	15
Loch Ard Gorge	45	60
London Bridge	15	25
Massacre Bay East	30	
The Arch	10	
The Grotto	15	20

Table 13. Trip durations for Cars and Buses for 9 Locales. Trip durations are in minutes, these durations were used for 2002, 2007 and 2012.

8.4 Simulation Runs

RBSim randomises many parameters during each run. It is therefore necessary to run each scenario more than once in order to ensure conclusions are not drawn from artefacts that result from a specific random event from a single run. To buffer these effects, each scenario was run 6 times with the same simulation parameters and then the results averaged before interpreting the results. Each simulation was run from 6:00 am to 11:00 pm

9 Appendix 2 – Peak hour for Cars, Buses and visual encounters

Table 14 shows the peak hour of the day for cars, buses and visual encounters. The peak hour for vehicles is the hour when the most vehicles arrive for that hour. The peak hour for visual encounters is the hour when the highest number of visual encounters occurs. These are used in the summary of results in Table 1.

Locale	Cars	Buses	Encounters
Bay of Islands	11:00am		3:00pm
Bay of Martyrs	11:00am		11:00am
Discovery Walk	1:00pm		1:00pm
Gibsons Steps	3:00pm	10:00am	3:00pm
Loch Ard Gorge	3:00pm	3:00pm	3:00pm
London Bridge	3:00pm	4:00pm	4:00pm
Massacre Bay East	1:00pm		1:00pm
The Arch	1:00pm		3:00pm
The Grotto	11:00am	4:00pm	4:00pm

Table 14. Peak hour of day for Cars and Buses for each locale used in Table 1.