EMGA Mitchell McLennan

Georges Cove Marina

Transport Planning Assessment

Prepared for Benedict Industries Pty Ltd | 28 July 2015

Planning + Environment + Acoustics

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Ground Floor, Suite 01, 20 Chandos Street
St Leonards, NSW, 2065

T +61 2 9493 9500
F +61 2 9493 9599
E info@emgamm.com

emgamm.com

Georges Cove Marina

Final

Report J14149RP2T | Prepared for Benedict Industries Pty Ltd | 28 July 2015

Prepared by	**Tim Brooker**	Approved by	**Philip Towler**
Position	Associate – Transport Planner	Position	Associate Director
Signature		Signature	
Date	28 July 2015	Date	28 July 2015

Document Control

Version	Date	Prepared by	Reviewed by
V1	28 July 2015	Tim Brooker	Philip Towler

EMM
EMGA Mitchell McLennan

T +61 (0)2 9493 9500 | F +61 (0)2 9493 9599

Ground Floor | Suite 01 | 20 Chandos Street | St Leonards | New South Wales | 2065 | Australia

emgamm.com

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1 Introduction

1.1 Introduction

EMGA Mitchell McLennan Pty Ltd (EMM) has been commissioned by Benedict Industries Pty Ltd (Benedict) to assess the traffic and parking impacts of the proposed Georges Cove Marina at 146 Newbridge Road (Figure 1.1).

The marina site development plans are shown in Appendix A (extracts relating to vehicular access and car parking). The plans were prepared by Michael Fountain Architects and show the proposed marina development of wet and dry storage berths, clubhouse and bar, function centre with kiosk, cafe and restaurant uses, boat sales showroom and workshop area.

The proposed configuration of the Maritime Building, Private Clubhouse, carparks and mooring berths are also shown in Figure 1.2 and Figure 1.3. The undercover car parking will be provided on two basement levels below the Maritime Building with vehicular access to be provided from flood-free sections of the access roadway. The development will also provide a public walkway along approximately 480 m of the Georges River frontage on its western side.

Access to the marina carparks from Newbridge Road will be via Brickmakers Drive and an approved (Liverpool City Council DA-61/2014 and DA 1552/2006/B) link road which has not yet been constructed.

There will be a total of 637 car parking spaces at the marina site. This parking will be provided as a combination of 267 surface level car parking spaces located in parking areas A, B and C and 370 undercover car parking spaces located in two basement car park levels (Level 1 and a sub-basement level) within the proposed Maritime Building.

1.2 Assessment scope

Brickmakers Drive will provide the primary access route for the marina site. This transport planning assessment reviews the likely effect of the proposed marina development traffic movements (including the function centre and restaurant traffic) on weekdays and during the main weekday morning and afternoon traffic peak hours on the following roads:

- the intersection of the new link road to Brickmakers Drive;
- Brickmakers Drive to the north and south of the link road intersection; and
- Newbridge Road and Governor Macquarie Drive to the east, west and north of Brickmakers Drive.

The report also assesses:

- compliance of the proposed site car parking spaces with the capacity and safety requirements of the with Australian/New Zealand Standard AS 2890.1:2004 - *Parking Facilities - Off-street Car Parking* (AS 2890.1) and Liverpool City Council Development Control Plan (DCP) requirements;
- public transport accessibility; and
- cycle and pedestrian movement.

Site layout plan showing access from Newbridge Road and Brickmakers Drive

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Figure 1.1

Figure 1.2 **Overall marina development layout concept**

Figure 1.3 **Marina development view showing the proposed maritime building and restaurants**

1.3 Background

Consent for the Georges Cove Marina was granted to Tanlane Pty Ltd by the Sydney West Joint Region Planning Panel (JRPP) as the Consent Authority on 22 August 2014 with support from Liverpool City Council. The validity of the Consent was challenged by the proposal's sole objector, Moorebank Recycling Pty Ltd in the NSW Land and Environment Court. The court ruled in favour of the objector, declaring that the Consent was invalid. The judge ruled that Tanlane should commission a Preliminary Investigation, reapply for a consent and supply the Preliminary Investigation to the JRPP as part of the application.

Benedict is therefore re-applying for consent for the proposed Georges Cove Marina. The proposal is unchanged from that approved by the JRPP on 22 August 2014.

The marina proposal is located on part of lot 7 DP 1065574. There has been extensive consultation with Liverpool City Council and the potential developers of other nearby sites, to determine the future design requirements for the link road and intersection at Brickmakers Drive.

NSW Land and Environment Court proceedings (NSWLEC No 30141, 2013) approved an intersection design prepared by Cardno (2013) for the link road intersection on Brickmakers Drive. The proposed access to the Georges Cove Marina (ie the link road and its intersection with Brickmakers Road) will be physically identical to the access which has been approved by the NSW Land and Environment Court.

The new link road will be a shared access road which will carry traffic from a number of potential developments, including from 190 dwellings on adjacent land to the north (also part of lot 7 DP 1065574), where a future Mirvac residential development is planned. A development control plan (DCP) for the local road network (Part 2.10) has been prepared by Liverpool City Council. This shows the future local road network which will provide vehicular access for the marina and the Mirvac development site (Figure 1.4).

Land south of the marina site, which is currently zoned for open space recreation, is proposed to be used for a concrete recycling facility. This concrete recycling facility, if approved, would generate additional truck traffic which would generally be accommodated by additional ramp connections to be provided at the approved link road and Brickmakers Drive intersection. There is a also plant nursery (Flower Power) site to the north-east of the marina site and planned Mirvac development for which the vehicular access is currently from Newbridge Road. The nursery site also has the potential to be developed for more intensive commercial, retail and/or residential land uses but the future extent of these uses and any traffic which may use the new link road for vehicular access, is not known currently.

1.4 History of the site and adjoining properties

The development site is currently used for extractive industry and concrete recycling operations. Mirvac's Georges Cove residential estate containing 190 dwellings is planned for the remaining Benedict land to the north of the marina. The Mirvac development will not have any vehicular access to Newbridge Road and will use the link road to Brickmakers Drive for vehicular traffic access.

On the land to the west of Brickmakers Drive, which was formerly a Boral quarry, a large residential estate (Georges Fair) containing 967 dwellings is nearing completion. The additional residential traffic from this completion will increase the future peak hourly traffic using Brickmakers Drive, by approximately 15%, in comparison to the peak hourly traffic flows which were using Brickmakers Drive in April 2013. This has recently been confirmed by an EMM 'check' traffic survey on Brickmakers Drive in June 2015 which found there has been a general 15% increase in the peak hour traffic flows since the April 2013 survey. The New Brighton golf club, a new residential estate and golf course clubhouse to the south if the marina site has been recently approved. The additional traffic using Brickmakers Drive from these sites has included as additional background traffic growth in this assessment.

Figure 1.4 Liverpool DCP extract showing future local road network

2 Existing traffic conditions

2.1 Location

The marina development will be constructed on the southern portion of the land at 146 Newbridge Road, Moorebank, and the future vehicular access will be via Brickmakers Drive and the link road. The intersection of these roads will be constructed approximately 300 m south of Newbridge Road (Figure 1.1).

2.2 Site access

The Benedict Industries operations on the site are currently accessed by vehicles directly from Newbridge Road. This vehicular access would not be used for the future marina development, which would only use the access via Brickmakers Drive and the new link road.

2.3 Road network

The major roads and future DCP planned local roads in the locality are shown in Figure 1.1 and Figure 1.4. The DCP planned local roads would have a standard sealed width of 8 m.

Brickmakers Drive is sufficiently wide for four traffic lanes north of the proposed link road intersection and three lanes (two lanes with an additional turning lane) or a two lane road with wide sealed shoulders to the south. The southern section of Brickmakers Drive also has traffic management devices and roundabouts installed which will limit the future potential use of this route by large trucks and other heavy vehicles.

Newbridge Road is typically at least six lanes wide, both to the east and the west of the intersection with Governor Macquarie Drive. Governor Macquarie Drive is typically at least four lanes wide in the Moorebank locality. The additional marina development generated traffic, travelling to either local or regional destinations would be dispersed onto a number of traffic routes with generally minimal potential traffic impacts likely to occur on the external major roads including Newbridge Road and Governor Macquarie Drive.

Davy Robinson Drive is a small cul-de-sac road which is located on the southern side of Newbridge Road. It provides access to a boat ramp and recreation area north of the marina site. It would not generally be utilised for vehicular access to the proposed marina development but may form part of the future DCP locality road network and also provide future pedestrian access to the Georges River foreshore.

2.4 Traffic surveys

This traffic assessment is based on the morning, afternoon and evening peak hourly traffic movements which were surveyed on Brickmakers Drive in April 2013 (CBHK 2013) and additional traffic volume data for Newbridge Road and Governor Macquarie Drive which was surveyed at the intersection of these roads with Brickmakers Drive in March 2013.

The Brickmakers Drive traffic volumes recorded in 2013 have been adjusted by +15% to account for the additional residential traffic movements which are now using Brickmakers Drive in June 2015 with the effective completion of the Georges Fair residential estate (967 dwellings).

However, the recently completed M5 West Motorway Widening, between Moorebank Avenue and King Georges Road will have potentially reduced the existing traffic flows on Newbridge Road and Governor Macquarie Drive compared to the flows which were recorded in 2013. This factor would tend to balance any additional traffic which may be using these roads via Brickmakers Drive from the completion of the Georges Fair residential estate. Therefore the current traffic volumes which are using these roads in June 2015 are considered to be equivalent to the surveyed traffic volumes in 2013.

The existing daily traffic volumes on the major roads in the locality (Newbridge Road and Governor Macquarie Drive) have been estimated from the morning and afternoon peak hourly traffic volumes from the 2013 survey as follows:

- Newbridge Road east of Governor Macquarie Drive has about 54,000 vehicle movements daily which corresponds to 4,930 vehicles during the morning peak hour and 4,843 vehicles during the afternoon peak hour;
- Newbridge Road west of Governor Macquarie Drive has about 40,000 vehicle movements daily which corresponds to 3,568 vehicles during the morning peak hour and 3,606 vehicles during the afternoon peak hour; and
- Governor Macquarie Drive north of Newbridge Road has about 16,000 vehicle movements daily which corresponds to 1,441 vehicles during the morning peak hour and 1,529 vehicles during the afternoon peak hour.

2.5 Additional Brickmakers Drive future traffic growth

The current hourly traffic volumes for Brickmakers Drive, including the June 2015 adjustments to the surveyed traffic volumes for the completion of the Georges Fair residential estate, are summarised in Table 2.1.

Table 2.1 Brickmakers Drive traffic volumes

Time and day	April 2013 northbound	April 2013 southbound	April 2013 combined	June 2015 traffic northbound	June 2015 traffic southbound	June 2015 traffic combined
Weekday morning peak	685	170	855	788	195	983
Weekday afternoon peak	165	715	880	190	822	1,012
Friday late evening (8-9 pm)	120	300	420	138	345	483
Saturday late evening (8-9 pm)	105	175	280	121	201	322

Brickmakers Drive south of Newbridge Road in June 2015 is carrying approximately 983 vehicles during the morning peak hour and 1,012 vehicles during the afternoon peak hour (Table 2.1). These volumes correspond to about 11,000 vehicle movements daily.

With further short-term traffic growth on this section of Brickmakers Drive from the recently approved New Brighton golf course developments (GHD 2011) and (GHD 2014), the additional Brickmakers Drive traffic volumes travelling to and from Newbridge Road would increase by +45 vehicles southbound and +98 vehicles northbound during the morning peak hour and by +109 vehicles southbound and +40 vehicles northbound during the afternoon peak hour (excluding the Stage 2 clubhouse development which is not proposed to be constructed until 2025). During the later Friday and Saturday evening periods, the additional New Brighton development traffic was not quantified in the assessments but is likely to be of the order of +100 hourly vehicle movements in total using Brickmakers Drive on the section south of Newbridge Road.

With this additional short-term future locality background traffic growth, the total Brickmakers Drive hourly traffic volumes south of Newbridge Road would increase to approximately 1,126 vehicles during the morning peak hour and 1,161 vehicles during the afternoon peak hour (Table 2.1). These hourly volumes correspond to about 12,500 vehicle movements daily.

2.6 Intersections

There is no existing intersection at the future location of the Brickmakers Drive and link road intersection. There are consequently no existing intersection traffic volumes to consider, except for the northbound and southbound traffic which is currently using Brickmakers Drive at this location.

2.7 Car parking

On-street car parking is generally not available on most of the existing major roads in the locality, eg Newbridge Road and Brickmakers Drive, due to the road widths and the peak hourly traffic capacity requirements.

Vacant on-street car parking will not generally be available within the locality outside the marina site so the marina site design will need to incorporate sufficient spare capacity for car parking to fully accommodate the highest development car parking demand which is likely to occur, which would generally be higher than the theoretical DCP car parking demand. This is discussed further in Section 3.3 and Section 4.5.

2.8 Pedestrian and cycling access

Existing pedestrian and cycling access routes are not well defined in the locality. However, pedestrian and cycle access to the Georges River foreshore on the western side, is generally feasible via Davy Robinson Drive currently.

2.9 Public transport access and services

The Moorebank area is relatively well served by the M90 high frequency bus route, which travels via Newbridge Road. It provides connections to other bus routes and rail services via Liverpool, Bankstown, Padstow or Revesby train stations.

The most accessible eastbound and westbound bus stops to the site are located on Newbridge Road, about 100 m west of the Brickmakers Drive intersection. Bus stops are also located in the vicinity of Flower Power, approximately 400 m east of the intersection.

2.10 Other developments in the locality

In addition to the completion of the Georges Fair residential development (967 dwellings) to the west of Brickmakers Drive and the potential additional traffic movements which would be using Brickmakers Drive in this locality from the recently approved New Brighton Golf Course residential and club house developments, the following additional potential developments in the locality have also been considered in terms of their potential additional traffic movements.

These other developments are considered in terms of their potential generated peak hourly traffic movement which would be using the proposed new link road at the intersection at Brickmakers Drive, in a cumulative traffic impact assessment with the proposed Marina development traffic:

- The planned development of the Georges Cove residential estate by Mirvac containing approximately 190 dwellings, to the north of the marina site, which would generate approximately 162 peak hourly traffic movements travelling via the link road and Brickmakers Drive during both the morning and the afternoon traffic peak hours; and

- potential additional truck traffic, 18 trucks per hour each way in the morning peak hour and 11 trucks per hour each way in the afternoon peak hour, plus between 2 and 5 car traffic movements each way in these peak hours, from the development of a concrete recycling facility on the adjoining land to the south of the marina site.

The potential additional traffic movements from a re-development of the Flower Power nursery site for a range of more intensive commercial, retail and potential residential land uses has not been specifically considered in this traffic impact assessment. The future traffic movements from this site are not known and the new DCP road network (Figure 1.4) could also include a road connection to Davy Robinson Drive which would permit some future traffic from that site to enter and leave via Davy Robinson Drive.

3 Proposed development

3.1 Site layout

The overall site layout plan and plans showing the proposed buildings and car parking areas are provided in Appendix A.

The two main site buildings (the Maritime Building and Private Clubhouse) will be located along a 6.5 m wide access roadway, with landscaped verges and footpaths on both sides. This roadway will extend about 600 m from the roundabout which will be located at the eastern end of the link road, and will continue past the marina buildings, to the two surface car parking areas A and B which are at the southern end of the site.

This roadway will be dedicated as a public road. Two separate entry driveways will be provided to each basement level of the Maritime Building car park. The lower basement 'sub-level' car park will be accessed by vehicles via a long ramp between the building level 2 (RL 7.3 m) and the lower basement car park sub level (RL 1.65 m) The Private Clubhouse car parking will be provided in the surface car parking area C alongside the western side of the building.

3.2 Link road

NSW Land and Environment Court proceedings (No 30141 of 2013) have approved an intersection design for the link road intersection on Brickmakers Drive by Cardno (2013). The design includes provision for traffic signals which are detailed in a plan of the intersection prepared by McLaren (2013).

The proposed vehicular access to the marina (ie the link road and its intersection with Brickmakers Road) will be physically identical to that approved by the NSW Land and Environment Court (ie the layout prepared by Cardno).

It is proposed to install traffic signals during the initial construction of the intersection. These are not specifically required for the marina development as the first stage of development of the land on the eastern side of Brickmakers Drive at Moorebank, as outlined in the Liverpool DCP (Figure 1.4). However, as the intersection is likely to require traffic signals in the near future due to the ongoing locality background traffic growth which is using Brickmakers Drive and the future traffic from the planned Mirvac residential development, installing the traffic signals during the initial intersection construction would be less disruptive than installing the signals at a later date after the link road is opened to traffic.

The locations of the traffic signal posts, the intersection signage and line markings will be determined as part of detailed design of the intersection.

3.3 Driveways and parking

The car parking within the marina site will be provided by a combination of undercover car parks at the Maritime Building and other surface car parks for the Private Clubhouse and other site visitors (Table 3.1). There will be about 637 car parking spaces provided within the marina site. This will include 370 undercover car parking spaces and 267 surface car parking spaces for general use by the site employees, customers and other visitors.

Table 3.1 Proposed car parking provision

Car park	Number of parking spaces
Car park A	73
Car park B	134
Car park C	60
Maritime Building level 1	251
Maritime Building basement sub level	119
Total parking	637

The widths and gradients of the site driveways and car park ramps will meet the requirements of the AS 2890.1 for building car park access driveways and ramps for commercial uses.

Detailed development design will consider accessible car parking and bicycle parking.

3.4 Traffic circulation

A vehicle turnaround area for delivery trucks will be provided by the internal site roadway within the Level 2 area of the Maritime Building which also provides the ramp to the basement sub level car park.

Trucks and other vehicles larger than a normal car will be able to turn around here when making deliveries to the site. This will permit site service vehicles, up to a large rigid truck, 12.5 m long, to enter and leave the site while travelling forwards.

3.5 Pedestrian and cycling access

A combined pedestrian and cycle access path from Brickmakers Drive will be constructed along the marina access road and the northern side of the link road connection to Brickmakers Drive. These paths will provide the primary pedestrian and cycle access route between the site and Newbridge Road, where the existing traffic signals would assist pedestrians to safely cross Newbridge Road at the Governor Macquarie Drive and Brickmakers Drive intersection.

As previously agreed with Liverpool City Council, the path along the link road will extend to the Georges River foreshore. In combination with the foreshore path within the Flower Power site (also agreed with the Council), these paths will together provide public access to the Georges River foreshore from the marina site to the recreation area on Davy Robinson Drive, which connects to the southern side of Newbridge Road.

3.6 Access to public transport

The main site buildings will be within between 600 to 800 m walking distance from the nearest existing bus stops on Newbridge Road which are used by the M90 bus route. This route provides a high frequency bus service for the Moorebank area with weekday service frequencies of 10 minutes typically during the peak hours and service frequencies of 20 minutes typically throughout the daytime on weekdays, Saturdays, Sundays and public holidays.

The accessibility of the site by public transport is relatively good given the high frequency of the M90 bus route services, and the connections which these services provide to other bus routes and train services from Revesby, Padstow, Bankstown and Liverpool railway stations, for access to destinations in other parts of the Sydney metropolitan area, including the Sydney central business district (CBD).

The typical journey times for peak hour peak direction combined bus-rail journeys between the M90 bus stops on Newbridge Road at Moorebank and the Sydney CBD (Town Hall railway station) are between 1 hour and 1 hour 20 minutes during the weekday morning and afternoon peak hours.

4 Traffic and parking impact assessment

4.1 Traffic generation and distribution

The marina site traffic volumes have been assessed for weekday and weekend traffic conditions. The marina site weekday traffic generation for both daily and peak hour periods, has been calculated according to the NSW standard traffic generation rates for the proposed land uses, which are summarised in Table 4.1 and Table 4.2.

The NSW RTA traffic generation rates, RTA (2002) have been used in this traffic impact assessment as they provide traffic generation rates for a wider range of development types, including marinas and general commercial type land uses, than the more recent RMS traffic surveys (Technical Direction 2013/04a) which were published in August 2013.

The RTA (2002) general commercial traffic generation rates have been used to calculate weekday peak hourly and daily traffic generation volumes in Table 4.1 and Table 4.2, for all the commercial type site land uses which include the boat sales showrooms and offices, the boat repair workshops, the function centre rooms, and the clubhouse/cafe and kiosk land uses. The RTA (2002) standard marina traffic generation rates were used for all the marina wet and dry storage berths.

Table 4.1 Daily site traffic generation

Land Use	Daily traffic generation rate*	Proposed development land use units and floor areas	Daily vehicle movements
Dry boat storage	1.4 per berth	250	350
Wet berth marina	1.4 per berth	186	260
Function centre, cafes and kiosks	10 per 100 m^2 GFA	4,938 m^2	494
Boat sales showroom	10 per 100 m^2 GFA	1,605 m^2	161
Boat repair workshops	10 per 100 m^2 GFA	236 m^2	24
Total for all site buildings			**1,289**

*Notes: * Traffic Generation Rates are determined from the RTA (now RMS) Guide to Traffic Generating Developments, RTA (2002). GFA = Gross Building Floor Area.*

Table 4.2 Hourly site traffic generation

Land Use	Hourly traffic generation rate*	Proposed development land use units and floor areas	Hourly vehicle movements
Dry boat storage	0.14 per berth	250	35
Wet berth marina	0.14 per berth	186	26
Function centre, cafes and kiosks	2 per 100 m^2 GFA	4,938 m^2	99 (1)
Boat sales showroom	2 per 100 m^2 GFA	1,605 m^2	32
Boat repair workshops	2 per 100 m^2 GFA	236 m^2	5
Total for all site developments (am peak hour)	**Total**	**(excluding function centre, kiosks and cafes)**	**98**
Total for all site developments (pm peak hour)	**Total**	**All**	**197**

*Notes: *. Traffic Generation Rates are determined from the RTA (now RMS) Guide to Traffic Generating Developments, RTA (2002). (1) Afternoon peak hour only.*

The daily traffic changes following the proposed development (Table 4.1) will result in an increase of approximately 1,289 daily vehicle traffic movements in the local area compared to the traffic volumes without the marina development.

There will be approximately 98 additional peak hourly vehicle movements during the morning traffic peak hours as the site function centre, cafe and kiosk uses would not generally be operating at this time of the day (Table 4.2). There will be approximately 197 additional peak hourly vehicle movements during the afternoon traffic peak hours when the marina function centre, cafe and kiosk uses would also generally be operating in addition to the site employee and daytime marina customer and visitor traffic.

The future traffic distribution of the Marina site daily and peak hour traffic movements would be approximately 80% travelling inbound and 20% travelling outbound during the morning peak hour and 50% both inbound and outbound during the afternoon peak hour. The geographic distribution would be comparable to the Liverpool LGA residential journey to/from work traffic distribution, which gives the following future geographic distribution for the marina site traffic:

- 40% to and from the east;
- 20% to and from the north;
- 30% to and from the west; and
- 10% to and from the south.

During the late evenings on Fridays and on weekends, the site would potentially generate its highest hourly traffic movements, during the periods between 8 and 9 pm when up to 220 vehicle movements per hour (mainly traffic leaving the site) would potentially be generated by the site function centre and restaurant land uses. This traffic volume has been calculated based on an average rate of 4.5 vehicle trips per hour per 100 m^2 for club/restaurant type facilities which was determined from extensive surveys of other significant club/restaurant facilities in Sydney at Penrith, Ashfield, Wentworthville and Revesby, CBHK (2010).

The future peak hourly site generated traffic movements for the four main traffic distribution routes for the marina traffic are summarised in Table 4.3.

Table 4.3 Marina site generated peak hour traffic increases on weekdays

Direction	Approach route	Morning peak hour vehicle movements	Afternoon peak hour vehicle movements
East	Newbridge Road (east)	39	79
North	Governor Macquarie Drive	20	39
West	Newbridge Road (west)	29	59
South	Brickmakers Drive (south)	10	20
Total	**All routes**	**98**	**197**

4.2 Impacts to the road network and traffic safety

The existing and future locality base daily traffic usage (includsing the locality background traffic growth) for Newbridge Road, Governor Macquarie Drive and Brickmakers Drive has been summarised in Section 2.5. These daily traffic volumes and the corresponding future marina site traffic using each route are summarised in Table 4.4.

Table 4.4 Marina site generated traffic increases on the surrounding road network

Route	Locality base daily traffic volume (vehicles)	Daily traffic (vehicles) for proposed development	Increase to existing traffic for proposed development
Newbridge Road (east)	54,000	516	1.0%
Governor Macquarie Drive	16,000	257	1.6%
Newbridge Road (west)	40,000	387	1.0%
Brickmakers Drive (to Newbridge Road)	12,500	1,160	9.3%
Brickmakers Drive (south)	12,500	129	1.0%

On Newbridge Road, Governor Macquarie Drive and the section of Brickmakers Drive south of the link road intersection, the marina generated traffic increases (Table 4.4) would be minimal compared to the locality base traffic (+1% typically). These traffic increases would have minimal impacts to the vehicular traffic flow, traffic safety or residential amenity of these routes.

On the 300 m section of Brickmakers Drive, north of the link road intersection, the marina generated daily traffic increases would be more noticeable, being about a 9.3% increase in comparison to the future locality base daily traffic volume of 12,500 vehicle movements. However with this traffic increase, the future daily total traffic usage of Brickmakers Drive would remain well within the overall daily traffic capacity for an urban road such as Brickmakers Drive where the continuous two lane road carriageway has a capacity of between 20,000 to 25,000 vehicle movements daily.

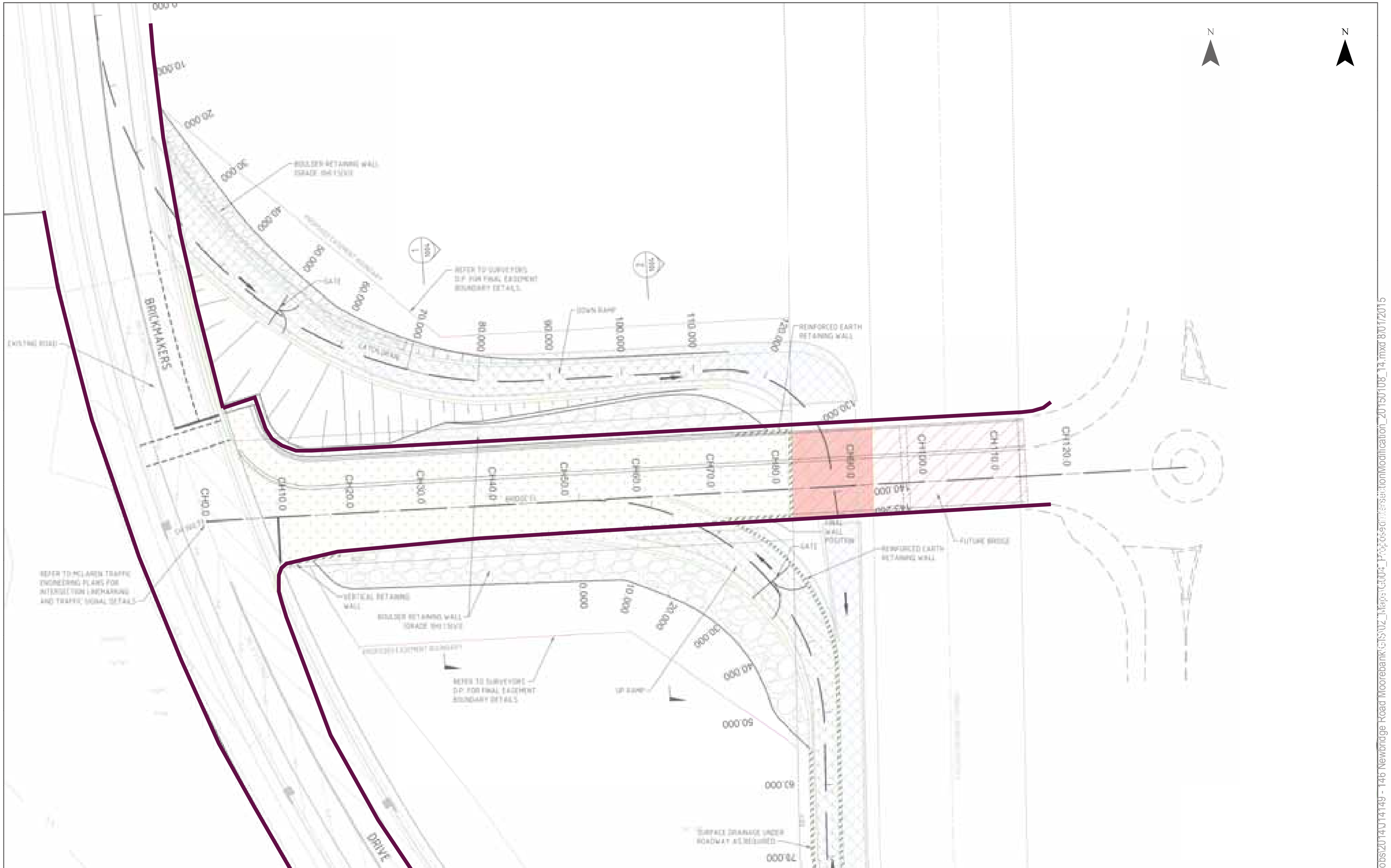
Also, as the future increased daily traffic usage from the marina site would primarily only affect the 300 m section of Brickmakers Drive north of the future link road intersection. It would not affect either the traffic flow, traffic safety or residential amenity of other sections of the route such that additional traffic calming or traffic management mitigation measures would be required.

4.3 Impacts at intersections

The future traffic performance of the Brickmakers Drive and link road intersection has been assessed for the marina site generated traffic movements (including the predicted locality background traffic growth from the New Brighton residential and clubhouse developments) for the weekday morning and afternoon peak and the Friday and Saturday evening peak traffic flows.

The performance of either traffic signal controlled or un-signalised intersections is normally quantified in terms of the Level of Service (LOS), which is based on the average delay per vehicle at the intersection. LOS ranges from A = very good to F = highly congested travel conditions (Table 4.5). The SIDRA intersection analysis program has been used to analyse the future peak hour operating conditions of the proposed intersection in accordance with LOS standards.

The proposed intersection design for the Brickmakers Drive and link road intersection, approved by the NSW Land and Environment Court proceedings (No 30141 of 2013), is shown in Figure 4.1.



Source: EMM (2014); Cardno (2013); McLaren Traffic Engineering (2013)

Approved link road and intersection with Brickmakers Drive

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Figure 4.1

Table 4.5 Intersection Level of Service definitions (RTA/RMS)

Description	LOS (RMS definition)	Average Vehicle Delay (s)
Very Good	A	<14.5
Good	B	14.5 to ≤28.5
Satisfactory	C	28.5 to ≤42.5
Near Capacity	D	42.5 to ≤56.5
At Capacity	E	56.5 to ≤70.5
Over Capacity	F	≥70.5

The operating performance of traffic signal controlled intersections is also quantified in terms of the following factors:

- Degree of Saturation (DOS) which is the ratio of the traffic volume to the capacity of the intersection;
- the Average Vehicle Delay (AVD) in seconds per vehicle for all traffic movements at the intersection; and
- the length of the maximum traffic queue (95th percentile traffic queue) for any traffic movement at the intersection.

The intersection analysis results for the four hourly traffic periods considered are summarised in Table 4.6 and detailed SIDRA output results are included in Appendix B.

Table 4.6 Future SIDRA intersection performance with the marina site traffic

Intersection	Peak hour	Operation	With traffic from the proposed Marina including the locality background traffic growth from New Brighton developments
Brickmakers Drive/Link Road	Weekday am peak hour	DOS	0.588
		LOS	A
		Average delay	5.4 s
		Maximum queue length	153 m
	Weekday pm peak hour	DOS	0.674
		LOS	A
		Average delay	10.1 s
		Maximum queue length	168 m
	Friday late evening period	DOS	0.429
		LOS	A
		Average delay	12.0 s
		Maximum queue length	46 m
	Saturday late evening period	DOS	0.364
		LOS	A
		Average delay	12.5 s
		Maximum queue length	27 m

The busiest traffic operations at the intersection will generally be during the weekday morning and afternoon peak hour traffic periods. At these times, the traffic signal operations will generally require a longer intersection cycle time (between 100 to 150 seconds) compared to during the later evening and weekend traffic periods when much shorter intersection cycle times (40 to 50 seconds typically) would normally be the optimum cycle time.

From the signalised intersection analysis results in Table 4.6, the intersection will be operating at Level of Service A with the base locality traffic growth and proposed marina development traffic for each of the four intersection traffic periods considered.

The intersection will be operating with average traffic delays for all traffic movements at the intersection of between 5.4 to 12.5 seconds during the four traffic periods considered.

The maximum intersection traffic queue lengths will be 153 and 168 m in the northbound and southbound directions respectively on Brickmakers Drive in the weekday morning and afternoon traffic peak hours. The maximum intersection traffic queue lengths would be much shorter (between 20 and 27 m approximately) on the intersection link road approach during the weekday peak periods and the later Friday and Saturday evening peak periods, when the intersection traffic queues would be highest on this approach.

The intersection traffic degrees of saturation will be highest at 0.588 and 0.674 respectively during the weekday morning and afternoon traffic peak hours. These results indicate that the intersection would continue to have spare capacity to accommodate additional peak hourly traffic movements from other developments in the locality in the future. This is discussed in further detail with additional SIDRA intersection traffic analysis results for defined additional 'cumulative development' traffic impact assessment scenarios in Section 4.4.

4.4 Cumulative traffic impacts with other developments in the area

Other potential developments in the locality are not specifically assessed in the core traffic impact assessment analysis for the proposed marina traffic in Table 4.6 as they are subject to separate development assessment and approval processes. However, additional SIDRA intersection analysis was undertaken that considered the cumulative traffic impacts of a number of development scenarios. The results are presented in Table 4.7 for the marina site traffic together with the additional planned Mirvac residential site development traffic for 190 dwellings and the proposed recycling centre traffic.

The additional New Brighton residential and golf course club house traffic movements are included in all of the cumulative development traffic impacts scenarios considered.

Table 4.7 Future SIDRA intersection performance for cumulative development traffic

Peak hour	Operation	With traffic from the proposed marina including New Brighton development traffic	With traffic from the proposed marina and 190 residential dwellings including New Brighton development traffic	With traffic from the proposed marina, 190 residential dwellings and the recycling centre, including New Brighton development traffic
Weekday am peak hour	DOS	0.588	0.714	0.769
	LOS	A	A	A
	Average delay	5.4 s	11.5s	12.3
	Maximum queue length	153 m	164 m	166 m
Weekday pm peak hour	DOS	0.674	0.700	0.717
	LOS	A	A	A
	Average delay	10.1 s	13.4	14.1
	Maximum queue length	168 m	169 m	169 m

The additional cumulative traffic impacts assessment results for the three scenarios which are presented in Table 4.7 confirm that the proposed traffic signal controlled intersection will be continuing to operate at level of service A, during both the morning and afternoon traffic peak hours for all of the scenarios considered.

The peak hour intersection degrees of saturation for the three traffic scenarios will increase from 0.588 to 0.769 for the morning peak hour traffic and from 0.674 to 0.717 during the afternoon peak hour. These results indicate that the intersection would also continue to have spare capacity to accommodate additional peak hourly traffic movements from other developments in the locality if required in the future.

4.5 Site car parking

The proposed parking capacity of 637 spaces will provide an approximate 20% margin of spare capacity, above the amount of car parking which would normally be necessary under the DCP for the proposed marina berths and related land uses.

This additional site car parking capacity is considered to be desirable for potential peak event additional car parking usage as there may not be additional on street car parking available in the locality to accommodate any potential overflow parking demand during the busiest times such as potential summer peak period usage of the marina site facilities.

Also, some of the car parking spaces will need to be designated as accessible car parking spaces, which will require a vacant area between two car parking space, of equivalent width to a normal car parking space, as is described in the Australian Standard AS 2890.6.

This car park modification will reduce the proposed site car parking provision by one car parking space for every two accessible car parking spaces which are provided. The future total number of accessible car parking spaces for the site will be determined in accordance with the relevant Australian Standard, RMS and Council car parking requirements.

All the site off-street car parking spaces should have minimum dimensions 2.5 m by 5.5 m clear of columns which will comply with the car park design standards for commercial buildings in AS 2890.1.

4.6 Pedestrian and cycling access

A combined pedestrian and cycle access path along the northern side of the link road will be 2.5 m wide and the joining path along the entire foreshore will be 3.0 m wide. These will meet the Liverpool DCP 2008 (Part 2.10) requirements. Site footpaths will be at least 1.5 m wide to meet the DCP requirements. The proposed site footpath widths will be adequate for the anticipated future level of pedestrian access and circulation within the marina site.

Bicycle parking, designed in accordance with RMS, Austroads or Australian Standard design guidelines, will be determined for the site as part of the development application and assessment process.

4.7 Public transport services

The future Maritime Building and Private Clubhouse will be approximately 600 to 800 m walking distance from the nearest existing bus stops on Newbridge Road which will provide adequate public transport accessibility to and from the development.

5 Summary and conclusions

5.1 Site access and traffic circulation

Access to the marina site will be via the new link road which is to be constructed between the site and Brickmakers Drive, where an intersection will be constructed 300 m south of Newbridge Road. All internal site roads will comply with the Council's design standards (DCP 2008 Part 2.10) and AS 2890.1. As such, internal site access arrangements will be efficient and safe.

5.2 Impacts on road traffic

The proposed development of the marina site boat storage, boat showroom, function centre, cafe, clubhouse and boat repair workshop uses will generate approximately 1,289 additional daily traffic movements.

There will be approximately 98 additional car traffic movements during the weekday morning peak hours and 197 additional car traffic movements during the weekday afternoon peak hours. During the 8-9 pm evening peak periods on both Friday and Saturday evenings there would also be potentially higher peak site generated traffic movements from the site club/restaurant and function centre uses, which may potentially generate up to 220 hourly car traffic movements.

The short term future locality base case daily traffic volumes (including traffic growth from the approved New Brighton residential and golf clubhouse developments) using Brickmakers Drive, Newbridge Road and Governor Macquarie Drive will be approximately:

- 54,000 vehicle movements daily for Newbridge Road east of Governor Macquarie Drive;
- 40,000 vehicle movements daily for Newbridge Road west of Governor Macquarie Drive;
- 16,000 vehicle movements daily for Governor Macquarie Drive north of Newbridge Road; and
- 12,500 vehicle movements daily for Brickmakers Drive south of Newbridge Road.

The assessment of future site daily traffic increases for Newbridge Road, Governor Macquarie Drive and the section of Brickmakers Drive south of the link road intersection shows that the proposed marina development will have minimal traffic impacts, generating +1% traffic increases typically along these routes, which will have negligible impacts to either traffic flows, traffic safety or residential amenity and no additional traffic calming or traffic management measures would be required for the road.

The marina development traffic will be more noticeable on the 300 m section of Brickmakers Drive to north of the link road intersection, which connects to Newbridge Road, generating a +9.3% increase above existing traffic volumes. However, after this increase, the future traffic volumes would remain well within the typical daily traffic capacity for this type of road as Brickmakers Drive is a continuous priority two lane road.

5.3 Impacts on intersections

NSW Land and Environment Court proceedings (No 30141 of 2013) approved an intersection design, Cardno (2013) for the link road intersection on Brickmakers Drive. The proposed access to the Georges Cove Marina will be physically identical to that approved by the NSW Land and Environment Court.

It is proposed to install traffic signals during the initial construction of the intersection. The locations of the traffic signal posts, intersection signage and line markings will be determined as part of detailed design of the intersection.

The intersection is likely to require traffic signals in the near future due to background traffic growth on Brickmakers Drive from approved New Brighton developments, the proposed Marina, a planned Mirvac residential development of 190 dwellings and a proposed recycling centre (if approved) on the adjoining land to the south of the marina. Installing the signals during the initial intersection construction will provide greater capacity for the intersection to cater for traffic from future developments and will be less disruptive than installing signals at a later date after the link road is opened to traffic.

The initial effects of the proposed additional traffic on the link road and Brickmakers Drive intersection have been assessed for the hourly marina development traffic for the normal weekday morning and afternoon traffic peak periods and the Friday and Saturday evening restaurant/club house peak traffic flows. The assessment has also included the additional traffic flows which would be using Brickmakers Drive from the completion of the Georges Fair residential development (967 dwellings) and the recently approved New Brighton residential and golf clubhouse (stage 1) redevelopments.

The initial marina intersection traffic assessment shows that the intersection traffic operations, will be Level of Service A (with the average intersection traffic delay for all movements being between 5.4 and 12.5 seconds respectively) for the four hourly traffic periods considered.

The future cumulative intersection traffic assessments which include the proposed Marina, a planned Mirvac residential development of 190 dwellings and a proposed recycling centre (if approved) on the adjoining land to the south show the weekday peak hour degrees of saturation will be up to 0.759 (am) and 0.717 (pm) although the intersection traffic operations will still be Level of Service A (with the average intersection traffic delay for all movements being up to 14.1 seconds respectively).

These intersection traffic assessment results confirm that the intersection would also continue to have spare capacity to accommodate additional peak hourly traffic movements from other developments in the locality if this was required in the future.

5.4 Assessment of car parking

The future site car parking which is proposed to be provided for the marina uses and related components of the overall site development is 637 spaces.

This is approximately 20% higher than the amount of car parking that is considered to be necessary (530 spaces) in the formal assessment of the required car parking supply for the previously approved marina development (LCC 2014). The additional spare 20% car parking capacity which is proposed to be provided for the site is considered to be appropriate in order to provide spare “special event’ car parking capacity for any proposed peak event or summer period peak usage car parking demand which may occur with the proposed marina facilities at the site in the future.

The detailed design of the site car parks will be undertaken in accordance AS 2890.1 and will also consider applicable RMS and Council design requirements for the provision of bicycle parking and accessible car parking.

5.5 Pedestrian and cycling access

The proposed site footpaths along the main site access roadway and the proposed link road to Brickmakers Drive will comply with the DCP requirements and will be adequate for the anticipated volumes of pedestrian movement and circulation between relevant locations within the site.

Cyclists will also be able to use the proposed link road to Brickmakers Drive pedestrian/cycle path and the riverfront pedestrian/cycle path. These paths will be 2.5 m or 3.0 m wide and will meet the DCP design width standard (2.5 m) to permit use by both pedestrians and cyclists.

The proposed marina site uses will include the provision of bicycle parking at specific locations within the site according to the Council's requirements.

5.6 Public transport

There is appropriate public transport access available to and from the development for the future site employees, customers and other visitors.

References

Cardno 2013, *Site Plan* Drawing showing Brickmakers Drive access easement and intersection, prepared at the Completion of Land & Environment Court Proceedings No 30141 of 2013, for Concrete Recyclers, June 2013.

CBHK 2010, *Traffic Report for Proposed Georges Cove Marina, Moorebank, NSW,* prepared by Colston Budd Hunt & Kafes Pty Ltd for Benedict Industries Pty Ltd, July 2010.

CBHK 2013, *Proposed Marina and Club/Function Facilities at Moorebank. Additional Traffic Impact Assessment Report,* prepared by Colston Budd Hunt & Kafes Pty Ltd for Benedict Industries Pty Ltd, 4 November 2013.

GHD 2011, *New Brighton Golf Club Rezoning Specialist Studies, Transport Assessment,* prepared by Gutteridge Haskins and Davey Pty Ltd for New Brighton Golf Club.

GHD 2014, *New Brighton Golf Club, Proposed Clubhouse Traffic Impact Assessment,* prepared by Gutteridge Haskins and Davey Pty Ltd for Mirvac Homes (NSW) Pty Ltd.

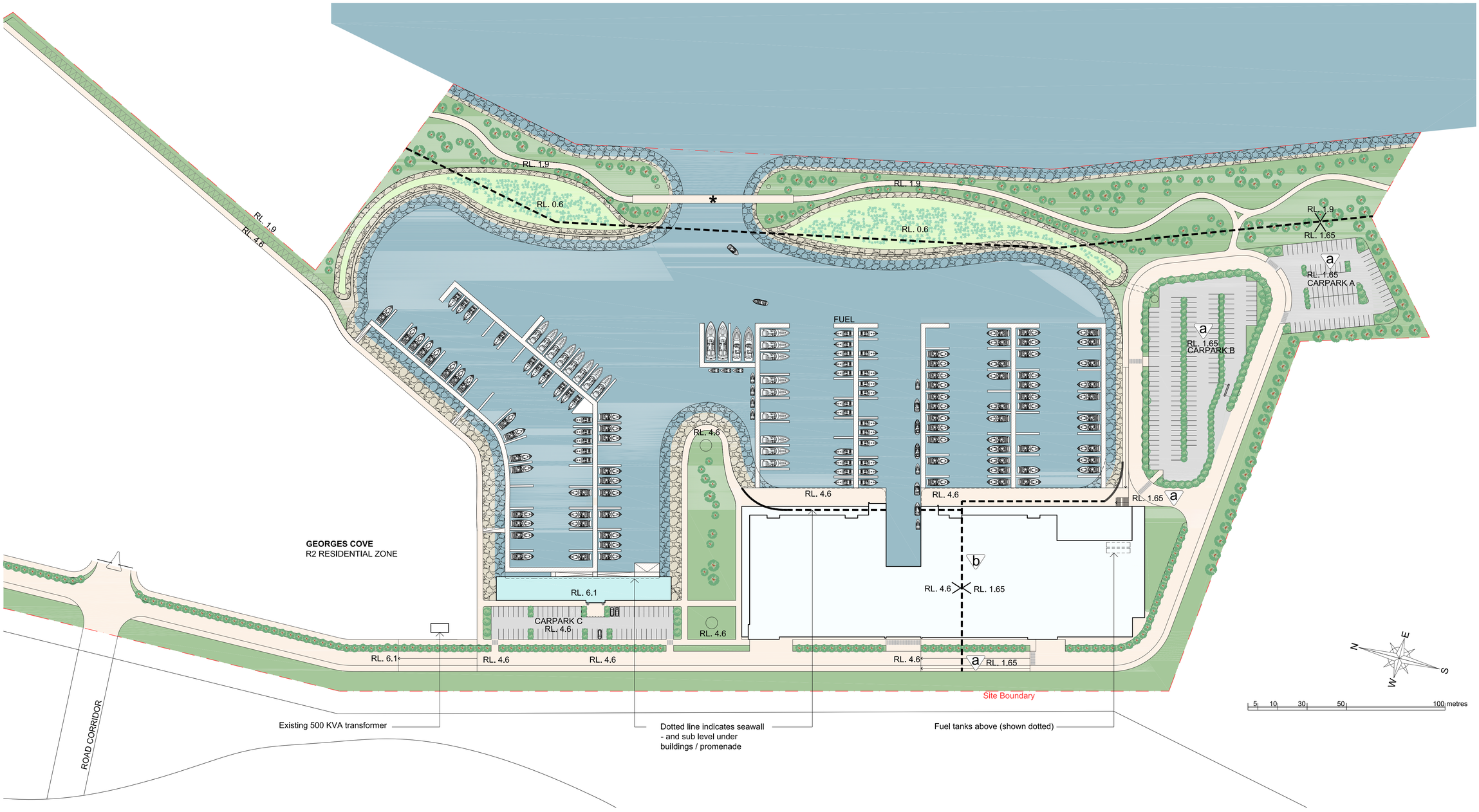
LCC 2014, *Sydney West Joint Regional Planning Panel Report,* by Liverpool City Council, 22 August 2014.

McLaren Traffic Engineering 2013, *Signalised Intersection LT Bay,* Drawing showing Brickmakers Drive access signalised intersection, prepared for Land & Environment Court Proceedings No 30141 of 2013, for Moorebank Concrete Recyclers, 23 May 2013.

Roads and Traffic Authority (RTA) 2002, *Guide to Traffic Generating Developments.*

Appendix A

Site plans



01 Site - Plan
1: 1000

Legend

- Water
- Seawall
- Wetlands
- Landscape
- Circulation
- Carparking
- Private Marina Clubhouse
- Maritime Building

NOTE:

* **BRIDGE -** If required by Council

amendment:

Mar. 2015 — Level modification - Level change between RL 4.6 & RL 1.65 - moved North so extending the RL 1.65 an additional 24 metres into the area RL 4.6 providing an additional 4780m3 of flood storage - as requested by Liverpool City Council.

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MICHEAL FOUNTAIN ARCHITECTS PTY. LTD.
2/ 5 NARABANG WAY BELROSE NSW 2085
TEL (02) 9450 2070 FAX (02) 94502757

ISSUE	REV	AMENDMENTS	DATE
A		Issue for Development Application	16.11.10
B		Amendments following Liverpool Council design review panel meeting	29.06.12
C		Issue for Development Application	26.10.12
D		Re-issue for Development Application	26.03.15
E		Re-issue for Development Application	01.04.15

ISSUE	REV	AMENDMENTS	DATE

CLIENT
Benedict Industries Pty. Ltd.

PROJECT
Georges Cove Marina
Newbridge Road
Moorebank NSW 2170

PRINTED: Apr 01, 2015 - 12:12pm
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DRAWING
Site - Plan
General Layout

DRAWN	CHKD	APPROVED
MF		
SCALE 1 : 1000 @ A1 1: 2000 @ A3	DATE 01/04/15	CAD FILE No
JOB NO 0914	DRAWING NO DA- 001	ISSUE E

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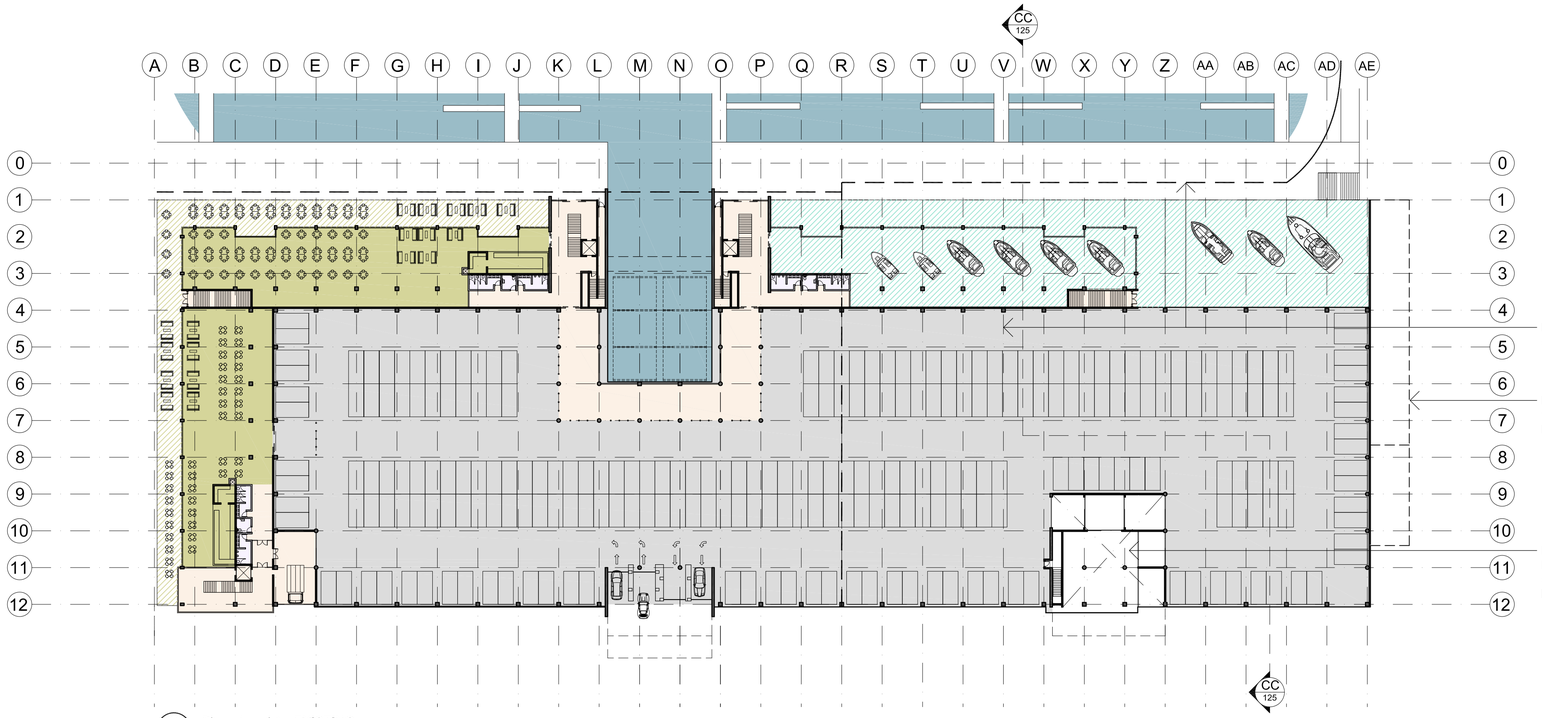

01 Plan - Level 1 - **EXISTING**
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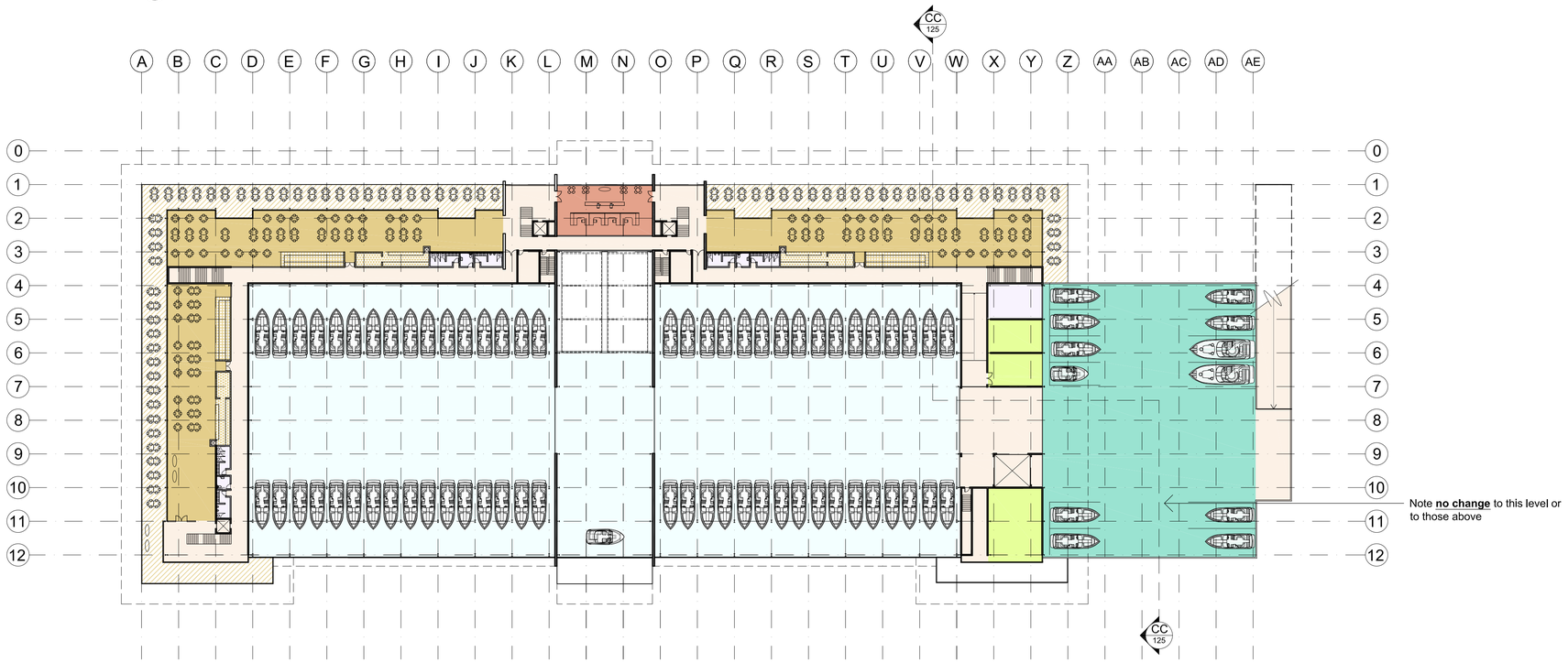

02 Plan - Level 2 - **EXISTING**
1: 500

Legend

- **Water**
- **Circulation:** 3,119.17m²
- **Carparking:** 11,994.42m²
- **Dry Berth Store:** 5,946.43m²
- **Workshops:** 248.97m²
- **Amenities:** 270.96m²
- **Hardstand Storage:** 1848.20m²
- **Small Craft Display:** 1,605.87m²
- **Kiosks, Commercial, Tourist, Recreational & Club Facilities:** 1,201.87m²
- **Undercroft - Kiosks, Commercial, Tourist, Recreational & Club Facilities:** 543.27m²
- **Function Centre - Kitchen:** 110.28m²
- **Function Centre - Bar/ Servery:** 95.76m²
- **Function Centre - Terrace:** 1,059.19m²
- **Function Centre:** 1,354.99m²
- **Marina Office:** 150.73m²
- **Public Marina Club Lounge:** 449.64m²
- **Public Marina Club Lounge - Terrace:** 127.26m²

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TEL (02) 9450 2070 FAX (02) 94502757

ISSUE	REV	AMENDMENTS	DATE
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C		Issue for Development Application	26.10.12
D		Re-issue for Development Application	26.03.15
E		Re-issue for Development Application	22.04.15

ISSUE	REV	AMENDMENTS	DATE

CLIENT
Benedict Industries Pty. Ltd.

PROJECT
Georges Cove Marina
Newbridge Road
Moorebank NSW 2170

PRINTED: Apr 22, 2015 - 12:48pm
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DRAWING
Maritime Building
Plans - Levels 1 & 2

DRAWN	CHKD	APPROVED
MF		
SCALE 1: 1000 @ A3, 1 : 500 @ A1	DATE 26.03.15	CAD FILE No
JOB NO 0914	DRAWING NO DA- 100	ISSUE E

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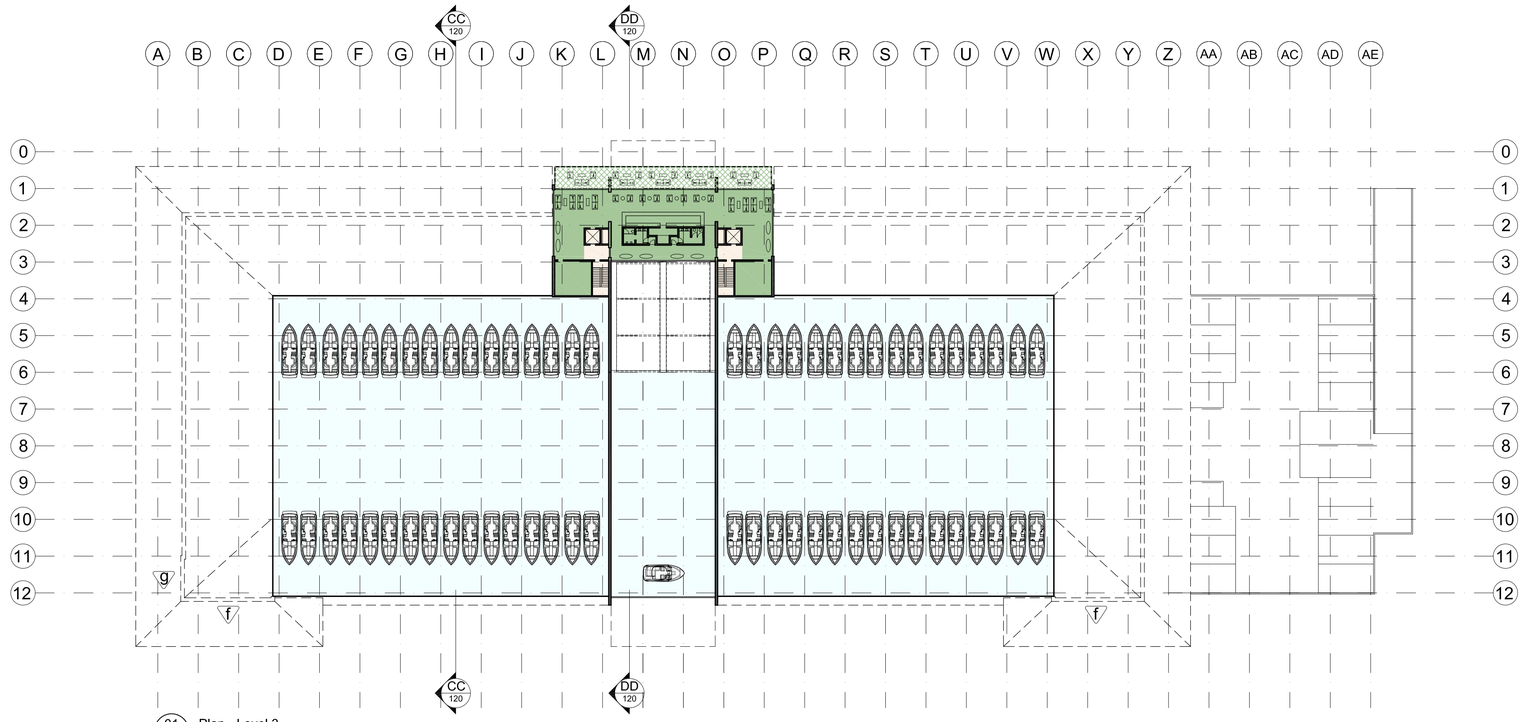

01 Plan - Level 3
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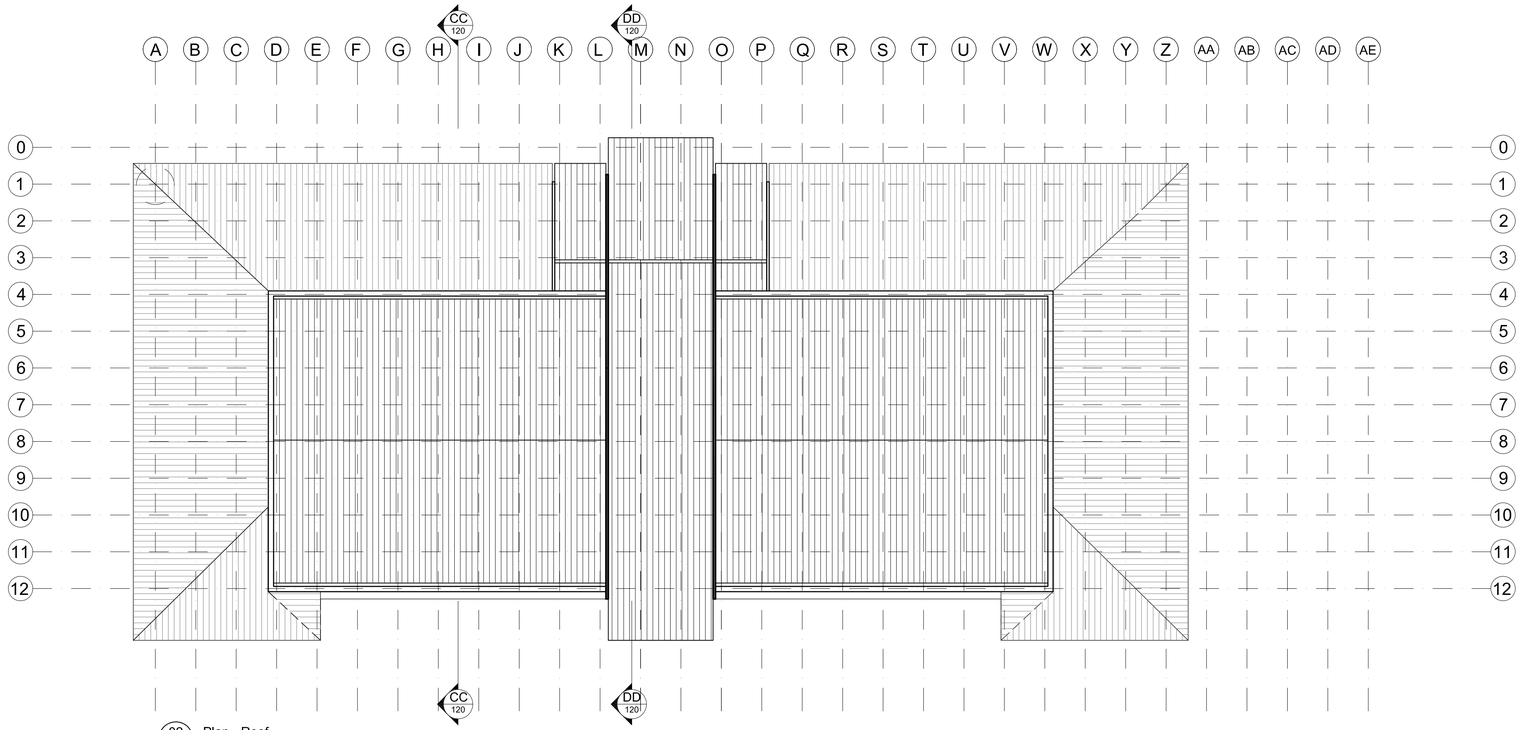

02 Plan - Roof
1: 500

Legend

- **Water**
- **Circulation:** 3,119.17m²
- **Carparking:** 11,994.42m²
- **Dry Berth Store:** 5,946.43m²
- **Workshops:** 248.97m²
- **Amenities:** 270.96m²
- **Hardstand Storage:** 1848.20m²
- **Small Craft Display:** 1,605.87m²
- **Kiosks, Commercial, Tourist, Recreational & Club Facilities:** 1,201.87m²
- **Undercroft - Kiosks, Commercial, Tourist, Recreational & Club Facilities:** 543.27m²
- **Function Centre - Kitchen:** 110.28m²
- **Function Centre - Bar/ Servery:** 95.76m²
- **Function Centre - Terrace:** 1,059.19m²
- **Function Centre:** 1,354.99m²
- **Marina Office:** 150.73m²
- **Public Marina Club Lounge:** 449.64m²
- **Public Marina Club Lounge - Terrace:** 127.26m²

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TEL (02) 9450 2070 FAX (02) 94502757

ISSUE	REV	AMENDMENTS	DATE
A		Issue for Development Application	16.11.10
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C		Re-issue for Development Application	26.03.15
D		Re-issue for Development Application	22.04.15

ISSUE	REV	AMENDMENTS	DATE

CLIENT
Benedict Industries Pty. Ltd.

PROJECT
Georges Cove Marina
Newbridge Road
Moorebank NSW 2170

DRAWING
Maritime Building
Plans - Level 3 & Roof

DRAWN	CHKD	APPROVED
MF		

SCALE	DATE	CAD FILE No
1: 1000 @ A3 1 : 500 @ A1	26.03.15	

JOB NO	DRAWING NO	ISSUE
0914	DA- 101	D

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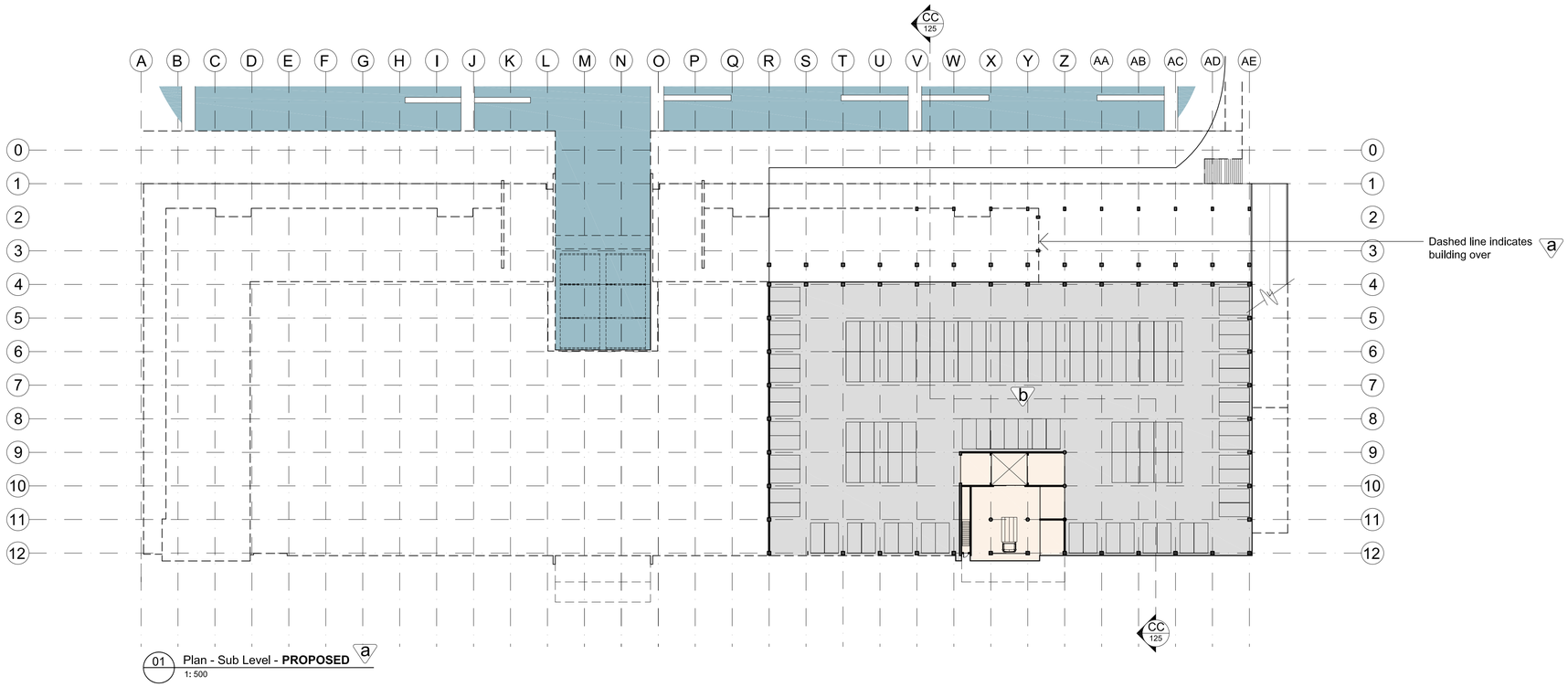

01 Plan - Sub Level - **PROPOSED** a
1: 500

Legend

- **Water**
- **Circulation:** 3,119.17m²
- **Carparking:** 11,994.42m²
- **Dry Berth Store:** 5,946.43m²
- **Workshops:** 248.97m²
- **Amenities:** 270.96m²
- **Hardstand Storage:** 1848.20m²
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ISSUE	REV	AMENDMENTS	DATE
C		Issue for Development Application	26.10.12
D		Re-issue for Development Application	26.03.15
E		Re-issue for Development Application	10.04.15
F		Re-issue for Development Application	22.04.15

ISSUE	REV	AMENDMENTS	DATE

CLIENT
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PROJECT
Georges Cove Marina
Newbridge Road
Moorebank NSW 2170

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DRAWING
Maritime Building
Plans - Sub Level - Carpark

DRAWN	CHKD	APPROVED
MF		
SCALE 1: 1000 @ A3 1 : 500 @ A1	DATE 26.03.15	CAD FILE No

JOB NO	DRAWING NO	ISSUE
0914	DA- 102	F

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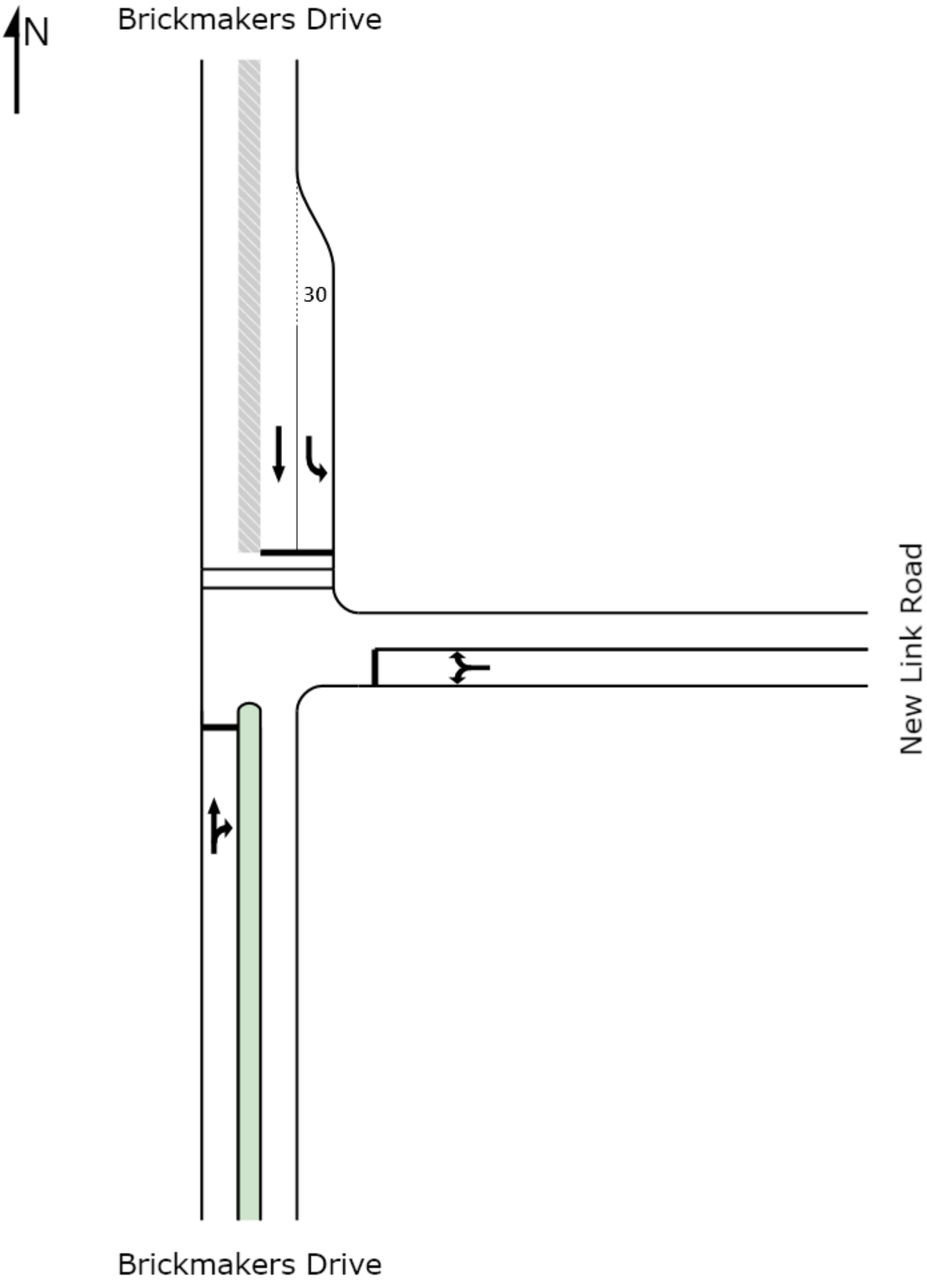
Appendix B

SIDRA intersection results


N
Brickmakers Drive
30
New Link Road
Brickmakers Drive

MOVEMENT SUMMARY

Site: Traffic Signals Weekday AM Peak Marina Traffic

New T Intersection
Signals - Fixed Time Cycle Time = 150 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Brickmakers Drive											
2	T	933	1.0	0.588	4.3	LOS A	21.9	154.3	0.36	0.33	44.3
3	R	8	1.0	0.588	10.9	LOS A	21.9	154.3	0.36	0.98	40.5
Approach		941	1.0	0.588	4.3	LOS A	21.9	154.3	0.36	0.34	44.2
East: New Link Road											
4	L	2	1.0	0.132	76.0	LOS F	1.5	10.3	0.96	0.71	17.6
6	R	19	1.0	0.132	76.2	LOS F	1.5	10.3	0.96	0.71	17.6
Approach		21	1.0	0.132	76.1	LOS F	1.5	10.3	0.96	0.71	17.6
North: Brickmakers Drive											
7	L	74	1.0	0.165	8.7	LOS A	0.9	6.4	0.18	0.64	41.4
8	T	253	1.0	0.156	2.5	LOS A	3.4	24.2	0.21	0.18	46.5
Approach		326	1.0	0.165	3.9	LOS A	3.4	24.2	0.20	0.28	45.2
All Vehicles		1288	1.0	0.588	5.4	LOS A	21.9	154.3	0.33	0.33	43.4

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model used.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P5	Across N approach	53	69.1	LOS F	0.2	0.2	0.96	0.96
All Pedestrians		53	69.1	LOS F			0.96	0.96

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: Traffic Signals Weekday PM Peak Marina Traffc

New T Intersection
Signals - Fixed Time Cycle Time = 100 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Brickmakers Drive											
2	T	242	1.0	0.209	5.9	LOS A	4.4	31.0	0.39	0.33	42.6
3	R	11	1.0	0.209	12.6	LOS A	4.4	31.0	0.39	0.93	39.3
Approach		253	1.0	0.209	6.2	LOS A	4.4	31.0	0.39	0.36	42.5
East: New Link Road											
4	L	11	1.0	0.435	51.2	LOS D	4.9	34.3	0.97	0.78	22.3
6	R	94	1.0	0.435	51.4	LOS D	4.9	34.3	0.97	0.78	22.3
Approach		104	1.0	0.435	51.4	LOS D	4.9	34.3	0.97	0.78	22.3
North: Brickmakers Drive											
7	L	93	1.0	0.209	9.9	LOS A	1.2	8.2	0.28	0.66	40.4
8	T	980	1.0	0.674	6.7	LOS A	23.8	168.0	0.55	0.51	41.6
Approach		1073	1.0	0.674	7.0	LOS A	23.8	168.0	0.53	0.53	41.5
All Vehicles		1429	1.0	0.674	10.1	LOS A	23.8	168.0	0.53	0.51	39.2

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model used.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P5	Across N approach	53	44.2	LOS E	0.1	0.1	0.94	0.94
All Pedestrians		53	44.2	LOS E			0.94	0.94

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: Traffic Signals Friday Late PM Peak Marina Traffc

New T Intersection
Signals - Fixed Time Cycle Time = 50 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Brickmakers Drive											
2	T	198	1.0	0.215	7.6	LOS A	2.8	19.7	0.59	0.49	40.7
3	R	4	1.0	0.215	14.3	LOS A	2.8	19.7	0.59	0.89	38.6
Approach		202	1.0	0.215	7.8	LOS A	2.8	19.7	0.59	0.50	40.7
East: New Link Road											
4	L	19	1.0	0.386	23.5	LOS B	3.9	27.4	0.87	0.79	31.8
6	R	166	1.0	0.386	23.7	LOS B	3.9	27.4	0.87	0.79	31.8
Approach		185	1.0	0.386	23.7	LOS B	3.9	27.4	0.87	0.79	31.8
North: Brickmakers Drive											
7	L	42	1.0	0.097	13.3	LOS A	0.5	3.7	0.53	0.68	37.9
8	T	416	1.0	0.429	8.7	LOS A	6.6	46.3	0.68	0.59	39.7
Approach		458	1.0	0.429	9.1	LOS A	6.6	46.3	0.67	0.60	39.5
All Vehicles		845	1.0	0.429	12.0	LOS A	6.6	46.3	0.69	0.62	37.8

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model used.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P5	Across N approach	53	19.4	LOS B	0.1	0.1	0.88	0.88
All Pedestrians		53	19.4	LOS B			0.88	0.88

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: Traffic Signals Saturday Late PM Peak Marina Traffc

New T Intersection
Signals - Fixed Time Cycle Time = 40 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Brickmakers Drive											
2	T	180	1.0	0.259	9.6	LOS A	2.6	18.2	0.73	0.60	38.8
3	R	4	1.0	0.259	16.3	LOS B	2.6	18.2	0.73	0.86	37.5
Approach		184	1.0	0.259	9.8	LOS A	2.6	18.2	0.73	0.60	38.8
East: New Link Road											
4	L	19	1.0	0.309	17.8	LOS B	2.8	20.0	0.79	0.77	34.9
6	R	166	1.0	0.309	18.0	LOS B	2.8	20.0	0.79	0.78	34.9
Approach		185	1.0	0.309	18.0	LOS B	2.8	20.0	0.79	0.78	34.9
North: Brickmakers Drive											
7	L	42	1.0	0.098	15.2	LOS B	0.5	3.8	0.67	0.70	36.6
8	T	264	1.0	0.364	10.1	LOS A	3.9	27.3	0.77	0.64	38.5
Approach		306	1.0	0.364	10.8	LOS A	3.9	27.3	0.75	0.65	38.2
All Vehicles		676	1.0	0.364	12.5	LOS A	3.9	27.3	0.76	0.67	37.4

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model used.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P5	Across N approach	53	14.5	LOS B	0.1	0.1	0.85	0.85
All Pedestrians		53	14.5	LOS B			0.85	0.85

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: Traffic Signals Weekday AM Peak Marina+Residential Traffic

New T Intersection
Signals - Fixed Time Cycle Time = 85 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Brickmakers Drive											
2	T	933	1.0	0.714	7.9	LOS A	23.3	164.2	0.64	0.60	40.4
3	R	22	1.0	0.714	14.6	LOS B	23.3	164.2	0.64	0.95	38.5
Approach		955	1.0	0.714	8.1	LOS A	23.3	164.2	0.64	0.60	40.3
East: New Link Road											
4	L	57	1.0	0.560	43.8	LOS D	6.3	44.6	0.97	0.80	24.3
6	R	101	1.0	0.560	44.0	LOS D	6.3	44.6	0.97	0.80	24.3
Approach		158	1.0	0.560	43.9	LOS D	6.3	44.6	0.97	0.80	24.3
North: Brickmakers Drive											
7	L	94	1.0	0.212	10.5	LOS A	1.2	8.3	0.33	0.67	39.9
8	T	253	1.0	0.185	4.5	LOS A	3.5	24.6	0.36	0.31	44.1
Approach		346	1.0	0.212	6.1	LOS A	3.5	24.6	0.35	0.41	42.9
All Vehicles		1459	1.0	0.714	11.5	LOS A	23.3	164.2	0.61	0.58	38.1

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model used.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P5	Across N approach	53	36.7	LOS D	0.1	0.1	0.93	0.93
All Pedestrians		53	36.7	LOS D			0.93	0.93

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: Traffic Signals Weekday AM Peak Marina+Residential +Recycling Traffic

New T Intersection
Signals - Fixed Time Cycle Time = 75 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Brickmakers Drive											
2	T	933	1.0	0.759	9.1	LOS A	23.6	166.3	0.73	0.68	39.3
3	R	24	0.9	0.759	15.7	LOS B	23.6	166.3	0.73	0.94	37.9
Approach		957	1.0	0.759	9.2	LOS A	23.6	166.3	0.73	0.68	39.2
East: New Link Road											
4	L	58	1.0	0.601	38.9	LOS C	6.4	48.9	0.97	0.82	25.8
6	R	121	16.5	0.601	39.5	LOS C	6.4	48.9	0.97	0.82	25.8
Approach		179	11.5	0.601	39.3	LOS C	6.4	48.9	0.97	0.82	25.8
North: Brickmakers Drive											
7	L	94	1.0	0.213	11.1	LOS A	1.2	8.4	0.37	0.68	39.5
8	T	253	1.0	0.196	5.1	LOS A	3.5	24.7	0.41	0.35	43.4
Approach		346	1.0	0.213	6.7	LOS A	3.5	24.7	0.40	0.44	42.2
All Vehicles		1482	2.3	0.759	12.3	LOS A	23.6	166.3	0.68	0.64	37.5

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model used.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P5	Across N approach	53	31.7	LOS D	0.1	0.1	0.92	0.92
All Pedestrians		53	31.7	LOS D			0.92	0.92

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: Traffic Signals Weekday PM Peak Marina + Residential Traffc

New T Intersection
Signals - Fixed Time Cycle Time = 90 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Brickmakers Drive											
2	T	242	1.0	0.416	13.1	LOS A	7.6	53.9	0.63	0.55	36.4
3	R	52	1.0	0.416	19.7	LOS B	7.6	53.9	0.63	0.88	34.9
Approach		294	1.0	0.416	14.2	LOS A	7.6	53.9	0.63	0.61	36.2
East: New Link Road											
4	L	38	1.0	0.648	47.7	LOS D	7.5	53.3	0.99	0.83	23.2
6	R	135	1.0	0.648	47.9	LOS D	7.5	53.3	0.99	0.83	23.2
Approach		173	1.0	0.648	47.9	LOS D	7.5	53.3	0.99	0.83	23.2
North: Brickmakers Drive											
7	L	154	1.0	0.348	10.4	LOS A	2.0	14.1	0.32	0.68	40.0
8	T	980	1.0	0.700	7.5	LOS A	23.9	168.7	0.61	0.57	40.8
Approach		1134	1.0	0.700	7.9	LOS A	23.9	168.7	0.57	0.58	40.7
All Vehicles		1600	1.0	0.700	13.4	LOS A	23.9	168.7	0.63	0.61	36.8

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model used.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P5	Across N approach	53	39.2	LOS D	0.1	0.1	0.93	0.93
All Pedestrians		53	39.2	LOS D			0.93	0.93

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: Traffic Signals Weekday PM Peak Marina + Residential + Recycling Traffc

New T Intersection
Signals - Fixed Time Cycle Time = 85 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Brickmakers Drive											
2	T	242	1.0	0.436	14.5	LOS A	7.8	55.2	0.68	0.59	35.5
3	R	53	1.0	0.436	21.1	LOS B	7.8	55.2	0.68	0.88	34.2
Approach		295	1.0	0.436	15.6	LOS B	7.8	55.2	0.68	0.64	35.2
East: New Link Road											
4	L	40	0.9	0.701	46.2	LOS D	8.0	59.4	1.00	0.86	23.6
6	R	149	8.6	0.701	46.6	LOS D	8.0	59.4	1.00	0.86	23.6
Approach		189	7.0	0.701	46.5	LOS D	8.0	59.4	1.00	0.86	23.6
North: Brickmakers Drive											
7	L	154	1.0	0.349	10.7	LOS A	2.0	14.2	0.34	0.68	39.8
8	T	980	1.0	0.717	7.9	LOS A	24.0	169.1	0.65	0.60	40.4
Approach		1134	1.0	0.717	8.3	LOS A	24.0	169.1	0.61	0.61	40.3
All Vehicles		1618	1.7	0.717	14.1	LOS A	24.0	169.1	0.66	0.65	36.3

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model used.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P5	Across N approach	53	36.7	LOS D	0.1	0.1	0.93	0.93
All Pedestrians		53	36.7	LOS D			0.93	0.93

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

EMM
EMGA Mitchell McLennan

SYDNEY
Ground floor, Suite 1, 20 Chandos Street
St Leonards, New South Wales, 2065
T 02 9493 9500 F 02 9493 9599

NEWCASTLE
Level 5, 21 Bolton Street
Newcastle, New South Wales, 2300
T 02 4927 0506 F 02 4926 1312

BRISBANE
Suite 1, Level 4, 87 Wickham Terrace
Spring Hill, Queensland, 4000
T 07 3839 1800 F 07 3839 1866