

APPENDIX 4.

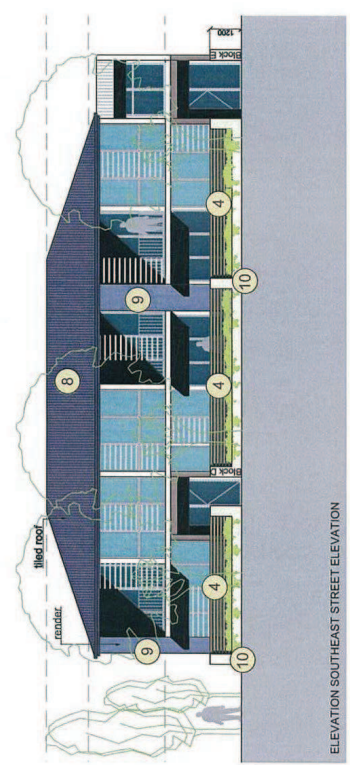
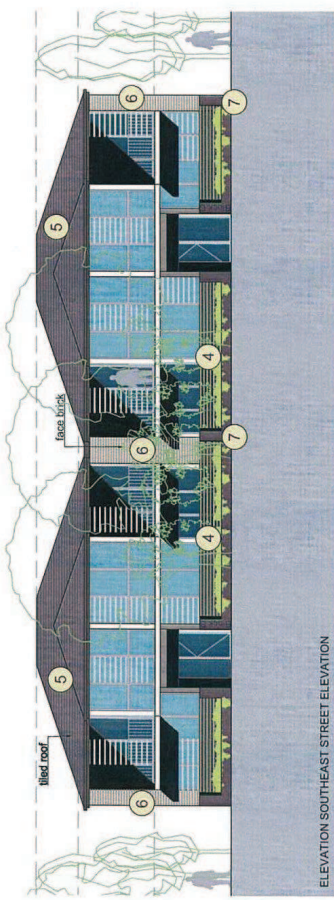
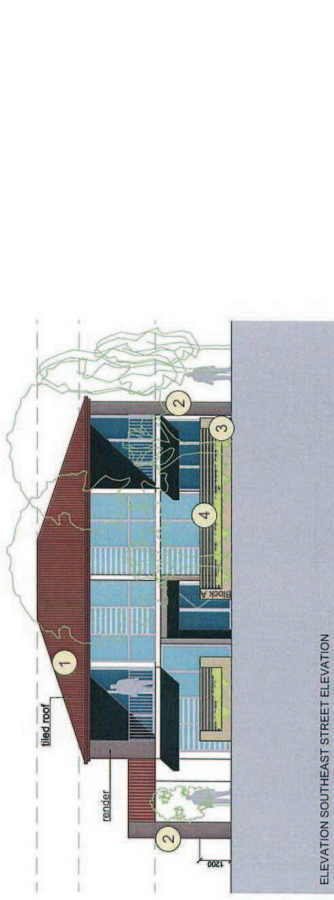
Revised External Finishes Schedule

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NOTES:
 1. DO NOT SCALE THE DRAWING. READ ALL DIMENSIONS SHOWN.
 2. THE CONTRACTOR SHALL CHECK AND VERIFY ALL DIMENSIONS BEFORE COMMENCING NEW WORK, AND SHALL ASK IF IN DOUBT.
 3. THE CONTRACTOR SHALL COMPLY WITH ALL RELEVANT AUSTRALIAN STANDARDS.
 4. THE CONTRACTOR SHALL COMPLY WITH THE BUILDING CODE OF AUSTRALIA (BSA).
 5. PLEASE NOTE THAT GROUND LEVELS MAY VARY DUE TO SITE CONDITIONS.

ISSUE	AMENDMENTS	DATE
A	DEVELOPMENT APPLICATION	APR 2011
B	DESIGN REVISION	MAY 2011
C	DESIGN REVISION	OCT 2011
D	DESIGN REVISION AFTER APP MEETING	MAR 2012
E	DESIGN REVISION AFTER MEETING WITH COUNCIL	JUN 2012

- 1 **Roof Tiles**
Terracotta roof tiles
Boral - swiss modern
(crimson blaze) or similar
- 2 **Rendered Bricks**
Dulux Harold P15B7 or similar
- 3 **Rendered Bricks**
Dulux Tibetan Silk P16D7 or similar
- 4 **Fencing**
horizontal aluminium slats or similar
- 5 **Roof Tiles**
Boral in Dark Chocolate or similar
- 6 **Austral Bricks**
Symmetry
Asphalt or similar
- 7 **Rendered Bricks**
Dulux Ploughed Earth P14B7 or similar
- 8 **Roof Tiles**
Boral in feldspar or similar
- 9 **Rendered Bricks**
Dulux Oceanic A359 or similar
- 10 **Rendered Bricks**
Dulux Natural White PN1E1 or similar



SCHEDULE OF EXTERNAL FINISHES



ISSUE	DESIGN REVISION AFTER MEETING WITH COUNCIL	JUN 2012
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 australian consultant architects
 1-412 3-4633 5-111 1-412 3-4633 5-111
 12 main street perth west wa 6160

Project:	No 33 Wilford Street Drive, North Fremantle W.A.	01/01
Sheet:	-	
Scale:	As Shown	
Author:	AKS-1488	
Check:	AKS-1488	
Drawn by:	AKS-1488	
Project No.:	2011-1-13	External Finishes Schedule

Our Ref LJ2946/L2563 :sge

Contact P.D. Treloar



Cardno
Shaping the Future

28 June 2012

Australian Consultant Architects
12 Union Street
PARRAMATTA NSW 2150

Attention: Ms Hui Zhu

Dear Madam,

**LOT 1 DP862588 & LOT 76 227174
WILFRED BARRETT DRIVE, THE ENTRANCE NORTH**

Preamble

Acting upon your instructions we have investigated the ocean inundation level against which protection must be provided for this development proposal located at Lot 1 DP862588 and Lot 76 227174 on Wilfred Barrett Drive, The Entrance North, see **Figure 1**. This has not been a detailed study, but rather it has drawn information from other reports and publications in order to provide a realistic basis for this assessment.

A site visit was undertaken at 1200 on 10 March 2011. Site characteristics are shown on **Figures 2, 3 and 4**. **Figure 5** shows the elevated floor levels of properties constructed to the north of this site.

Flood Levels

Wyong Shire Council's (WSC) current flooding plan is based on the 1994 Tuggerah Lakes Flood Study undertaken by Lawson and Treloar for WSC. At a meeting between Cardno, Office of Environment and Heritage and WSC on 13 December 2011 (on another matter), Cardno were advised that the 1994 report is still current and was consistent with the June 2007 flood event in the Tuggerah Lakes catchment. A 1% AEP, or 100-years average recurrence interval (ARI) flood level in Tuggerah Lake is 2.2m AHD. Increasing this level by 0.9m for the current NSW government policy based on projected sea levels leads to 3.1m AHD. In actual fact the 1% AEP 2100 flood level would be lower because of the greater storage offered by the lake system as water levels rise. That is, the plan area of the lake system increases with level and a relatively greater volume of water is required to cause increasingly higher flood levels. Hence the 'simple' approach of increasing the 2.2m AHD flood level by 0.9m is very conservative.

Climate Change Issues

Projected climate change processes may:-

- cause an increase in mean sea level (MSL) – DECCW (2009) advises projected sea level rises of 0.5 and 0.9m for 2050 and 2100;

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- cause a change in rainfall/runoff. However, there is no substantial data on this issue – some reports suggesting more severe and others less severe floods, McInnes et al (2007). This issue can not be addressed realistically at present.

Hence, wave overtopping and wave run-up to the site were addressed for a MSL rise scenario to 2100 – 0.9m. Although tidal ranges within the lake may change with sea level rise the mean lake level will rise by 0.9m. However, investigations undertaken for Gosford City Council in Brisbane Water have shown that peak flood level would be unlikely to rise to 3.1m AHD (2.2m AHD +0.9m) because of the change in storage characteristics at the higher mean lake level. However, a conservative 100-years ARI flood level at 2100 has been adopted to be 3.1m AHD.

Site Survey

A survey of the site prepared by Everitt & Everitt, Consulting Surveyors was provided for this investigation, see **Annexure 1**. This survey provided adequate details of the site. Annexure 1 also includes the footprint of the development overlying the contours.

Lake bed survey was available from a 1975 survey of Tuggerah Lake (Microfilm No. - 811946).

Wave Climate

Wave conditions at the site will be caused by local sea. There will be no penetration of ocean waves to this site. **Table 1** describes wind conditions for this general region based on wind data recorded at Mascot Airport from 1939 to 1992. It was applied to this study with no terrain correction. Note that calms occur for about 17% of the time.

The Sydney Airport wind data was analysed in terms of the standard directional octants to provide peak storm wind speeds at selected average recurrence intervals (ARI).

These analyses were undertaken by ranking recorded wind speeds in each octant and then undertaking an extremal analysis using the maximum likelihood method. Other wind data is available from Norah Head, but that site is too elevated and the record has more data gaps. Although the Sydney Airport wind records will not match those at The Entrance on a record by record basis, it will provide a reasonable description of the wind climate in terms of severe storms and peak event wind speeds.

Table 1: Peak Event Wind Speeds Based on Wind Records from Sydney Airport

Octant	Average Recurrence Interval (years)					
	5	10	20	50	100	1000
N	16.4	17.1	17.8	18.7	19.3	23.5
NE	17.0	17.3	17.6	18.0	18.3	20.3
E	15.4	16.5	17.5	18.8	19.8	26.3
SE	17.9	18.8	19.7	20.8	21.7	27.4
S	26.2	27.5	28.8	30.5	31.7	39.9
SW	21.2	22.3	23.3	24.6	25.6	32.1
W	22.2	23.3	24.3	25.6	26.6	33.1
NW	20.1	20.9	21.7	22.6	23.5	24.6

The site is exposed to the west and north-west.

Local sea wave conditions at the site were investigated using a SWAN wave model of Tuggerah Lake, see **Figure 6**. SWAN was developed at the Delft Technical University and includes wind input, (local sea cases), combined sea and swell, offshore wave parameters (swell cases), refraction, shoaling, non-linear wave-wave interaction, a full directional spectral description of wave propagation, bed friction, white capping, currents and wave breaking. Model bathymetry was based on a PWD survey of 1975. A grid size of 25m was adopted. The very shallow area lying to the north of the site will normally protect the site from wind waves. However, at a flood level of 2.2m AHD, together with a lake level rise of 0.9m, much of the site would be flooded and these wind waves will propagate onto the site and



increase design water level requirements. This flood level rise is conservative because, as shown by Taylor et al (2008) for Lake Illawarra, the full climate change MSL rise does not increase flood levels by the MSL rise because of increased lake storage at higher levels. On the other hand, mean lake level would increase generally by the MSL rise.

It is not likely that the 100-years ARI flood would be associated with 100-years ARI wind speeds, which would be more likely to be associated with an ocean storm – east coast low. Hence the 50-years ARI wind speeds were adopted for simulation at the 2100 peak flood level of 3.1m AHD. Based on the site inspection and the very shallow water depths that were observed in normal, present-day conditions, water depths in front of the site were set at 2.9m AHD for the 2100 flood case.

Recommendations

Based on these analyses, waves of height (H_s) = 0.8 to 0.9m can propagate onto the site. However, the future flooded depth on the lake side of the block would be about 1.7m, limiting breaking wave heights to about 0.9m. The limited filling of the floodplain proposed for this development will have no identifiable effect on flood levels in the Tuggerah Lakes system overall, or near the site.

Annexure 2 shows the proposed development plans for the site. They include a perimeter fence and raised land levels. The perimeter fence will prevent these waves from entering the site and must extend about 25m along the southern and northern sides of the site to prevent outflanking, and beyond the car par entrance. The design wave load on the seaward fence/wall is 10kN/m. An inspection of the DA plans and the western fence line proposed shows that any wave energy reflected from those structures would be directed lakeward and not towards neighbouring residents, see **Annexure 2**. There may be some diffractive wave energy that propagates towards them as part of this reflection process, but less than would be reflect from the flooded shoreline of this site in an undeveloped state

We note that the proposed development includes filling behind the wave protection fence to render the site flood free and suitable for evacuation in a flood event. The effect of this small area of fill in terms of flood storage within the lake system would be unidentifiable and is insignificant when compared with the conservative nature of the flood level estimate and the effect of the larger lake storage volumes at higher levels, which has not been included in estimating the 2100 flood level.

The entrance to the car par is sheltered from these waves and there is to be a hump at the entrance set to 3.1m + 0.3m (freeboard) = 3.4m AHD at the entrance to the car park. This hump must connect to walls at each end. The land level is also raised to 3.4m AHD along a berm to prevent flood water ingress to the car park.

For site evacuation, the ground level car park must be at 2.9m AHD or higher to allow egress in water no deeper than 0.2m to Wilfred Barrett Drive. Tuggerah lake floods rise slowly and this will allow occupants to walk to the Wilfred Barrett Drive footpath at 3.1m AHD and then north-east from the site.

Flood Risk and Mitigation

The flood evacuation plan for this site allows for residents and visitors to evacuate the site with 'dry feet'. It is important to note that the rate of flood level rise in the design 100-years ARI flood is only in the order of 0.1m/hour and there would be ample scope for evacuation over several hours.

Yours faithfully,

A handwritten signature in black ink, appearing to read 'P. D. Treloar'.

P.D. Treloar
Manager - Coastal, Ocean & Estuarine Studies
for Cardno (NSW/ACT) Pty Ltd

References

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DECCW (2009): Sea Level Rise Policy Statement. Prepared by the NSW Department of Environment and Climate Change.

Lawson and Treloar Pty Ltd (1994): Tuggerah Lakes Flood Study. Report Prepared for Wyong Council.

McInnes, K.L., Macadam, I., Abbs, A.J., O'Farrel, S.P., O'Grady, J. and Ranasinghe, R. (2007): Projected Changes in Climatological Forcing Conditions for Coastal Erosion in NSW. Proceedings of Coasts and Ports Conference 2007, Melbourne.

Taylor, D.R., Treloar, P.D. and Collier, L.C. (2008): Lake Illawarra Entrance Studies – Flooding and Potential Climate Change Issues. Paper Accepted for 2008 NSW Coastal Conference, Wollongong.

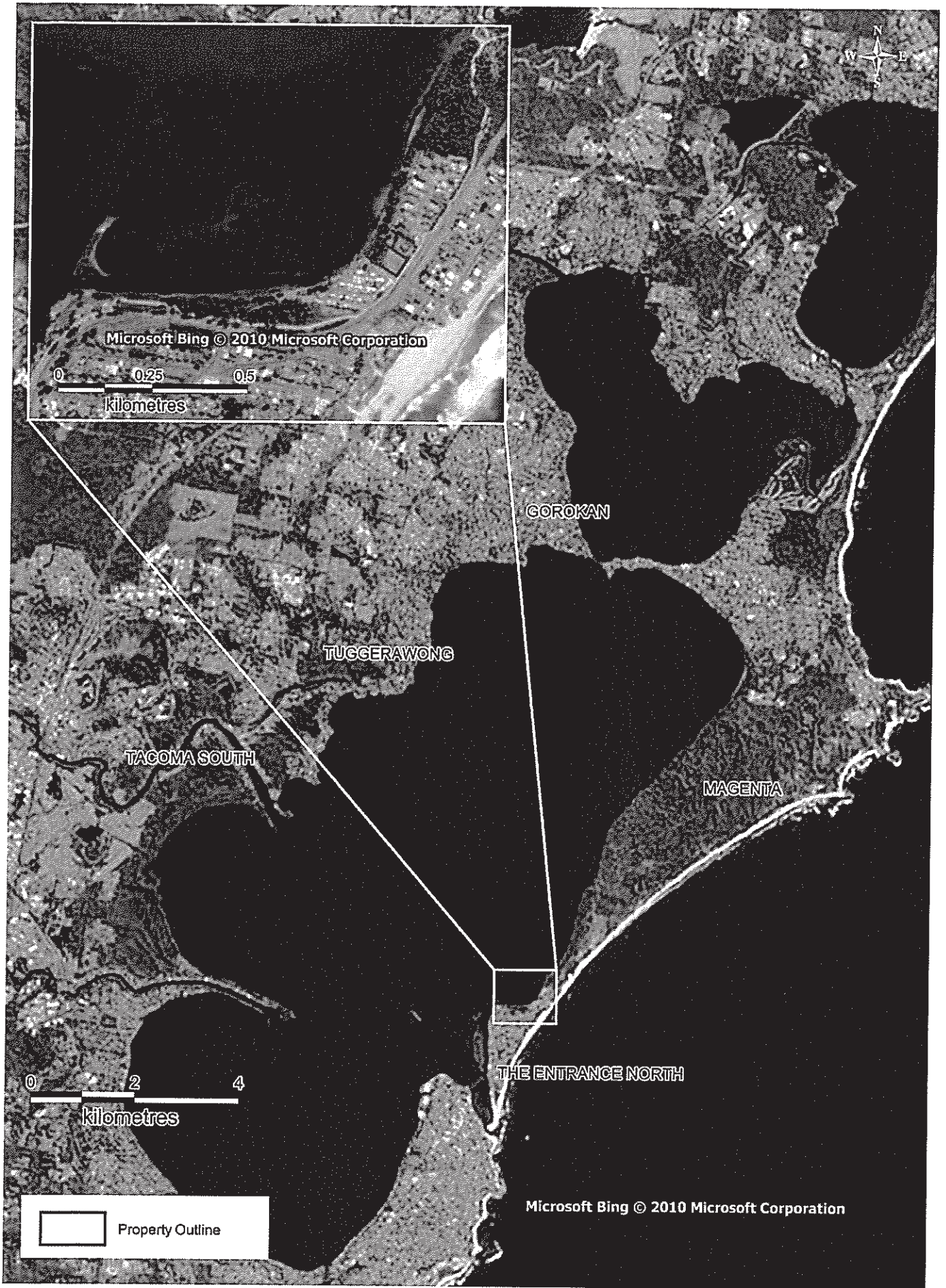




Figure 2



Figure 3



Figure 4



Figure 5

Wilfred Barrett Drive – The Entrance

- 4. Vegetated Area of Property Facing Tuggerah Lake
 - 5. Elevated Floors of Neighbouring Properties
- Figures 4 and 5

