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Your Ref:

Cardno Forbes Rigby
Shaping the Future

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RE: PEER REVIEW OF DOCUMENTATION BY BROWN CONSULTING VISAVIS AUTHORITY COMMENTS ON SANDON POINT PROJECT

At the invitation of Don Fox Planning, we are pleased to provide peer review comments on documentation prepared by Brown Consulting Pty Ltd in support of the Concept Plan Application for the Sandon Point Project:

Capacity of CFR & the Reviewer

In making such peer review comments we would like to outline the capacity and experience of Cardno Forbes Rigby Pty Ltd, and the reviewer (Paul Nichols, a Director of the firm).

Cardno Forbes Rigby has considerable local experience in the investigation of flooding in the Illawarra region. We have a keen interest in the fields of hydrology and hydraulics, with current senior staff involved in the ongoing development of WBNM hydrology software. We have also carried out numerous flood studies for government and private-sector clients alike, and have prepared designs for flood mitigation works, ranging from the single lot scale to major projects valued in the millions of dollars.

We conducted some 40 assessments of flood-related insurance claims after the August 1998 floods in Wollongong, so we are well aware of the trauma caused to the community as a result of flooding and the duty of engineers to reduce flood risk to acceptable levels in accordance with the State Government's Floodplain Development Manual.

We have a detailed understanding of local flooding issues in the Illawarra, with key staff having made extensive inspections in the aftermath of the August 1998 flood. Thus we know what really happens locally in large floods. We were able to make good use of this local knowledge in recently advising the RTA of a deficiency in drainage designs for the Northern Distributor Extension, where two separate studies by Sydney-based consultants did not take into account cross-catchment overflows originating from an area outside the catchment they were studying.

Cardno Forbes Rigby (under its former name, Forbes Rigby) prepared the Hewitts Creek Flood Study (Dec 2002) and the Hewitts Creek Floodplain Risk Management Study (Dec 2002) under the direction of the Hewitts Creek Floodplain Management Committee. We thus have an intimate knowledge of the Hewitts Creek catchment.

We have also been closely involved with flooding and water quality aspects of the 1500-lot Tullimbar Village project, which is regarded as a high quality outcome by DNR in terms of creek rehabilitation. Cardno Forbes Rigby was initially responsible for the preparation of the DA and comprehensive water studies, and also supported the client through two L&E Court cases to achieve Development Consent. We then prepared full designs for 2 km of creek rehabilitation including 6 large wetlands ($4m construction cost).

The creek was realigned in sections that were in poor geomorphic and ecologic condition, and/or where urban design dictated its best location. An inlet control structure sends flows up to the 3 month ARI through the wetlands, and bypasses higher flows to protect plantings from destructive flows. As well as providing a water quality benefit, the village ponds provide an ornamental feature for the future pub/restaurant helping to make a vibrant community centre. Over 250,000 native plants have been planted within the creek and floodplain, with a greater than 90% survival rate.

The peer reviewer is a chartered professional engineer (civil college, NPER Membership No.370140) with some 30 years of experience in Australia, the Middle East and South East Asia in hydrology, flood assessment and modelling, water resource planning, urban infrastructure development, and environmental engineering, and was the CFR director responsible for the Tullimbar Village Project.

Familiarity with State Government's Floodplain Development Manual

We are very familiar with the State Government's *Floodplain Development Manual* (FPDM) and have also provided support to the Urban Development Institute of Australia in commenting on the extent to which draft floodplain management Development Control Plans conform with the FPDM.

We are aware that the FPDM acknowledges the economic and social benefits of development on floodplains and seeks to balance these benefits with flood risk. One of the key underlying philosophies advocated in the FPDM is to avoid the unnecessary sterilisation of flood prone land. This is highlighted in the Foreword of the Manual, which indicates that the NSW Government's Flood Prone Land Policy promotes:

> *'the use of a merit approach which balances social, economic, environmental and flood risk parameters to determine whether particular development or use of the floodplain is appropriate and sustainable. In this way the policy avoids the unnecessary sterilisation of flood prone land……'*

The FPDM further reinforces its position on wishing to avoid sterilising land in its discussion on zoning, stating (in section 1.1.1):

> *'the New South Wales Government's Flood Prone Land Policy does not support the use of zoning to unjustifiably restrict development simply because land is flood prone. Zoning of flood prone land should be based on an objective assessment of land suitability and capability, flood risk, environmental and other factors'.*
>
> *'In many cases it is possible to develop flood prone land sympathetically to the natural characteristics of the land without resulting in undue risk to life and property'.*

The FPDM also indicates that government policy provides for (s.1.1.2):

> *'…… a merit based approach to selection of appropriate flood planning levels (FPLs). This recognises the need to consider the full range of flood sizes, up to and including the probable maximum flood (PMF) and the corresponding risks associated with each flood, whilst noting with few exceptions, it is neither feasible nor socially or economically justifiable to adopt the PMF as the basis for FPLs'.*

Peer Review Comments

We are pleased to make the following peer review comments with respect to Sandon Point:

1. We confirm that Brown Consulting has used appropriate peak flows with respect to Woodlands Creek. The Hewitts Ck Flood Study (Table 6.3) indicates that under existing conditions a peak flow of 28.2 m^3/sec passes to Woodlands Ck downstream of the railway line in the 100 year event, with 23.8 m^3/sec being diverted to Hewitts Creek from upstream of the railway. In the future, following the upgrade of the culvert under the railway and associated flood mitigation works recommended for Woodlands Ck in the FPRMS, the peak flow in Woodlands Ck downstream of the railway line increases to 49.4 m^3/sec. The May 2006 'Stormwater Concept Plan' report by Brown Consulting (Table 3.3) indicates a peak flow of 51.6 m^3/sec several hundred metres downstream of the railway, thus is wholly consistent with both the Hewitts Creek Flood Study and the Hewitts Creek Floodplain Risk Management Study.

2. We also confirm that Brown Consulting has used appropriate peak flows with respect for Hewitts Creek. As part of our peer review we queried whether the peak flows stated in Browns Tables 3.2 and 3.3 were derived from those relating to the 'Fully Blocked' scenario in the Hewitts Ck Flood Study, rather than the more critical 'Mixed Mode' case which allows for the Lachlan St culvert being unblocked (which is a more critical case as it prevents cross-catchment overflows to the adjoining Thomas Gibson catchment, thus results in higher flows in Hewitts Ck). Mr Robert Peterson of Brown Consulting has clarified this matter with the following advice:

   > *Please note that in Table 3.2 of our Report, incorrect values for the peak flows in Hewitts Creek are quoted. In the Hewitts Creek Flood Study December 2002, Table 6.3 states the peak flows in Zone 1.03 as 117.7 m^3/s and Zone 1.02 as 122.3 m^3/s (whereas our table quotes these flows as 110.7 m^3/s and 115.3 m^3/s respectively). Although the incorrect values were shown in the table, the flood study values for the peak mixed 100 year ARI flows were used in the hydraulic modelling of the existing and proposed creek, see Appendix B of the Report.*

3. We confirm that Brown Consulting has used Manning's 'n' values consistent with the Hewitts Creek Flood Study (Dec 2002, refer Table 5.1) and the Hewitts Creek Floodplain Risk Management Study (Dec 2002).

4. We also confirm that Brown Consulting has included a sensitivity analysis in Appendix C of the May 2006 'Stormwater Concept Plan' report showing the effects on flooding behaviour of the high Manning's 'n' value of 0.2 as promoted by DNR. This was also done in the Hewitts Ck Flood Study (refer s.7.2.2 and Appendix 6.2). We also note that Brown Consulting considered this sensitivity analysis and further site-specific advice from highly-regarded fluvial geomorphologist Dr Mark Taylor from Macquarie University in determining appropriate Manning's n values and setting the width of the riparian corridor.

5. We confirm that the proposed riparian corridors nominated in the Stockland proposal do not compromise future flood mitigation works recommended for Woodlands Ck, in that appropriate peak flows have been adopted and Manning's n values used for numerical modelling of flood hydraulics in Woodlands Ck are consistent with the Hewitts Creek Floodplain Risk Management Study (Dec 2002).

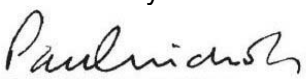
6. We confirm that the limits of inundation of flooding in the 100 year ARI event can be contained within the width of the corridors and (in part) the abutting roads. We further observe that preliminary designs prepared by Brown Consulting provide for no residential property being affected even in a PMF event, which goes beyond the requirement of the FPDM and Council's DCP54.

7. We confirm that the proposed works will not result in any unacceptable flood impacts on other properties within the floodplain.

8. We confirm that the proposed water quality ponds are outside the nominated core riparian zone shown on Figures 2, 3 and 4 of Appendix A of the May 2006 'Stormwater Concept Plan' report by Brown Consulting.

9. We understand that detailed designs of the creek rehabilitation works are to be developed with due regard for stability in accord with detailed advice from Dr Mark Taylor. Long term stability will thus be ensured in the detailed designs, which will reflect an appropriate degree of sinusoidal treatment and adherence to threshold values for shear stresses and stream power nominated by Dr Taylor, once the final detail design for the corridors is determined.

Yours faithfully



Paul Nichols (Director)
for **Cardno Forbes Rigby**