Attachment 1

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25 February, 2004

Moonee Valley City Council
PO Box 126
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Attention: [redacted]

Dea[redacted]

RE: TECHNICAL REVIEW OF FLEMINGTON RACECOURSE FLOOD PROTECTION REPORT

GHD prepared a report for the Victoria Racing Club (VRC) to quantify the effects of a proposed flood protection scheme for the Flemington racecourse and to identify and analyse appropriate measures to mitigate impacts from the flood protection works. The May 2003 report is titled "Flemington Racecourse Flood Protection – Investigation of Maribyrnong River Flood Protection – Final Report." The report number is 31/12638/2642. GHD sought the services of [redacted] of RJ Keller & Associates for technical input during the study and to review the report.

The Moonee Valley City Council engaged WBM Oceanics Australia to undertake a technical review of the report. [redacted] undertook the review with input from [redacted] The review was limited to the technical aspects documented in the report. The computer models used by GHD were not supplied to WBM Oceanics Australia and therefore, the model setup and parameters were not reviewed. The review does not address planning requirements. [redacted] undertook a site visit on the 22 February 2004.

The Flemington Racecourse is located on the floodplain of the Maribyrnong River. The report notes that inundation of the racecourse prior to the Melbourne Cup could lead to cancellation of the carnival. A floodwall is proposed to protect the racecourse from river flooding in events up to a 100 year ARI Maribyrnong River flood. The construction of the flood walls has the potential to impact on flooded areas not protected by the flood walls through a loss in floodplain storage and changes to flooding patterns.

Methodology Overview

Melbourne Water supplied an existing conditions HEC-RAS model of the Maribyrnong River from just upstream of the Footscray Road to Maribyrnong Village. HEC-RAS is a one-dimensional hydraulic modelling software package. The development of this model is documented in Melbourne Water Corporation: "Maribyrnong River Hydraulic Model, Final Report, February 2003", by GHD. This report was not reviewed as part of this technical review. It is noted in the current report that

"The resultant calibrated steady state model has Manning's 'n' values that are generally smoother than theory would suggest." Although this is not desirable, it will not significantly affect the analysis of the impact of the proposed flood walls.

The report correctly notes that the two-dimensional flow patterns in the Fisher Parade to Lynchs Bridge reach cannot be adequately modelled in HEC-RAS for the purposes of this study. Therefore a methodology was adopted that utilised the two-dimensional hydraulic modelling software Delft-FLS to analyse the local effects in the Fisher Parade to Lynchs Bridge reach and HEC-RAS was used to assess the impacts on the broader system. Limitations in the FLS software required a separate analysis of the impacts of change in storage and change in conveyance.

HEC-RAS was used to assess options to mitigate identified impacts from the proposed floodwalls.

Change in Peak Flow due to Loss of Floodplain Storage

A change in floodplain storage can lead to a change in flow rates. The proposed floodwalls will remove floodplain storage thereby increasing flow rates. The analysis of this effect is reported in Section 3 of the report.

The report suggests that limitations in the FLS package would result in an overestimate of the storage affect of the racecourse because backup through local drainage systems could not be modelled. To demonstrate this, a flood level versus storage relationship determined from FLS is presented in the report in Figure 3.1. The figure shows greater storage on the falling limb at equivalent flood levels than on the rising limb, and the report states that this is primarily because backup through local drains is not modelled. It is concluded in the report that FLS cannot be used to analyse the storage effects and RORB was adopted for this purpose. RORB requires a stage (flood level) versus storage relationship. The adopted relationship was midway between the rising limb and falling limb storage relationships in Figure 3.1. The report states "based on engineering judgement and discussion with [redacted] it was therefore considered appropriately conservative to adopt a storage relationship midway between the rising and falling limbs of the FLS based stage storage curves." The analysis indicated that the loss of storage would increase the peak flow rate downstream of Lynchs Bridge by 8.2 m^3/s, an increase of about 1%.

It is considered that this approach is not sufficiently rigorous as there are other factors as follows that could contribute to this observed difference in storage.

1. The hydraulic gradient between the river and floodplain can cause this effect. On the rising limb the flood level in the river would be higher than on the floodplain as water flows from the river onto the floodplain, and on the falling limb the flood level in the floodplain is higher as water drains back into the river. In adopting a relationship midway between the rising and falling limbs, the implied assumption is that there will be no significant gradient between the river and the floodplain at any stage.

2. The longitudinal hydraulic gradient is normally flatter on a receding flood than on the rising flood. This significance of this effect will depend on the hydraulic controls in the reach under consideration.

3. A floodplain may continue to fill after the peak if all storages were not filled and the flood level is above the bank level. This does not appear to be the case in this floodplain because Figure 3.1 shows that the peak flood level and peak storage occurs simultaneously.

Further, Figure A.9 in the report shows the racecourse filling from its Smithfield Road end. Along this boundary of the racecourse there is a fence that would significantly reduce the flow into the racecourse. Therefore, unless this restriction was modelled in FLS, the flow into the racecourse, and hence the storage utilised earlier in the flood, would be lower than indicated in Figure 3.1. If this is a more significant effect than the backup through the local drainage, the rising limb storage relationship would be understating rather than overstating the storage effects.

It is concluded that sensitivity testing and/or further rigorous analysis is required to demonstrate the significance of this decision.

Unmitigated Effect on Flood Levels

Downstream Impact due to Loss of Floodplain Storage

An increase in the peak flow rate downstream of Lynchs Bridge will increase flood levels. The magnitude of the increase in flood levels was analysed using the HEC-RAS model. The existing case HEC-RAS model was modified by shifting the downstream boundary of the HEC-RAS model from upstream to downstream of Footscray Road, and by adjusting the flows to the revised (lower) flows determined in Section 3 of the report. The report refers to the revised model as the base case model. Boundary conditions were set so that the base case model flood level approximated the published Melbourne Water flood level upstream of Footscray Road.

The unmitigated impacts of the proposed floodwalls on food levels downstream of Lynchs Bridge were assessed by modifying the base case model to include the proposed condition attenuated peak flood flows. Increases in flood level were determined to be typically 30 to 35 mm.

It is concluded that the adopted approach in determining flood level changes downstream of Lynchs Bridge due to loss of floodplain storage is sound. However, the magnitude of the impacts should be reviewed following the recommended sensitivity testing of the storage effects.

Upstream Impact due to Loss of Conveyance

FLS was used to assess the impact in the reach from Fishers Road to Lynchs Bridge of the proposed floodwalls. The model was run in steady state (constant flow over time) with and without the floodwall in place to determine the change in flood level as a result of the loss of conveyance only. Both the with and without floodwall models were run with the same flow and the same flood level at the downstream boundary.

The results of this analysis are presented in Figure A.8 in the report. A colour copy of this figure was not available for WBM to review the figure for inconsistencies. The adoption of a steady state analysis for this type of assessment can lead to an underestimate of the afflux if the floodplain storage is still filling at the peak of the flood. In a steady state analysis the floodplain storage will be at a maximum based on the local hydraulic gradient. Therefore, a steady state analysis may underestimate the flow from the river into the floodplain at the peak of the flood, and hence, underestimate the impact of the loss of conveyance. This issue is not addressed in the report, although the data presented in Figure 3.1 indicates that the peak utilisation of storage coincides with the peak of the flood, in which case a steady state analysis is appropriate.

The downstream boundary is in close proximity to the proposed floodwalls. The adoption of the same downstream boundary condition for both cases may result in an underestimate of the impacts of the proposed wall due to loss of conveyance in the vicinity of the downstream boundary and possibly further upstream. The report should address this.

To determine the impacts of loss of conveyance upstream of Fishers Road, the HEC-RAS model with floodwalls was adjusted to match the afflux (not flood levels) determined from FLS. The with floodwalls HEC-RAS model was then run with revised flows to assess the impacts upstream of Fishers Road. This approach is considered appropriate for the assessment of flood level impacts upstream of Fishers Road.

In Section 4.5 the afflux as a result of the proposed floodwall are summarised as changes in Total Energy Level (TEL). The change in water level should also be presented, as was done in Table 4.3.

It is concluded that the change in flood levels upstream of Lynchs Bridge cannot be considered reliable until the report adequately addresses the issues identified relating to the adoption of a *steady state FLS model and the proximity of the downstream boundary in the FLS model to the proposed floodwalls.*

Mitigation Works

The removal of a remnant abutment on the eastern abutment and the construction of flow training walls upstream and downstream of the eastern abutment are proposed to reduce the total energy loss through the bridge. The benefits of this proposal were modelled using the HEC-RAS model by reducing the contraction loss coefficient from 0.15 to 0.10 and the expansion loss coefficient from 0.35 to 0.15. A review of the literature for guidance on loss coefficients with training walls has not been possible within the timeframe for this review. However, the reduction of the expansion coefficient from 0.35 to 0.15 seems large given that the training wall is only being constructed at one abutment. The report should provide further comment on the basis for this assumption.

Conclusion

A number of shortcomings were identified that has led to the conclusion that the impacts presented in the report cannot be considered reliable until these issues are addressed. They are summarised below.

- Sensitivity testing and/or further rigorous analysis is required to demonstrate the significance of the assumed stage-storage relationship.
- Flood level impacts downstream of Lynchs Bridge may need to be reviewed subject to the outcomes of the above sensitivity test.
- The assessment of impacts in the Fisher Road to Lynchs Bridge reach may be underestimated because of the location of the downstream boundary and the assumed water level at the boundary. The report should also provide comment on the affect of adopting a steady state model on flood level impacts.
- The reduction in the expansion loss coefficient at the Footscray Bridge may be too large given that the training wall is not being constructed at both abutments.
- The afflux should be presented as change in water level as well as change in TEL for all cases assessed.

A complicated methodology combining HEC-RAS, FLS and RORB was required to assess the impacts of the proposed floodwalls because neither HEC-RAS nor FLS could adequately model the system in its entirety for the purposes of this study. Hydraulic modelling software is available (and has been for some years) that could model the system within one package by utilising dynamic links between one-dimensional and two-dimensional domains. The use of such software would have eliminated the first three concerns raised above.

Yours sincerely

WBM Oceanics Australia

[redacted]

[redacted]
Manager, Water & Environment
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