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Waterway Management Consultants

24 December 2021

Ms Sonia Turnbull
HWL Ebsworth
(By email)

Dear Sonia,

RE: WONTHAGGI NE PSP - PRELIMINARY DRAINAGE REVIEW

The Engeny and Alluvium strategies are essentially similar to that put forward by Pat Condina and Neil Craigie back in 2007.

In general the strategy approach is supported although we do have some suggestions for layout of assets.

1. Reports and models considered:
   - Engeny October 2019 and November 2021
   - Alluvium November 2021
   - MUSIC models by Alluvium and Engeny (same subareas but with different arrangement to suit split of WLRB1 into WLRB1a and b, some modification of sediment basins and different wetland sizing.

2. Due to time limitations we have focussed on WLRB1 and its inlet waterways given these are by far the largest individual cost items in the PSP. In the Alluvium report the wetland alone accounts for 35% of total PSP base drainage costs (ie., excluding overheads and contingencies).

3. There are very significant differences in quantity estimates between Engeny and Alluvium for WLRB1 (5.8 ha water area versus 10.34 ha). There are also very significant differences in cost estimating rates.

4. The reasons for the differences in quantity estimates have to be resolved first.

5. In regard to wetland sizing it appears there is a fundamental difference in the Engeny design approach to that of Alluvium.

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Discussion of Wetland Sizing

Engeny MUSIC modelling using the MUSIC model shows the 5.8 ha WLRB1 meets best practice for the PSP area, has 90%ile residence time of 3 days, with peak discharge at top of extended detention depth (TEDD) of 0.09 m3/s.

Alluvium uses the same MUSIC model with modifications to suit the splitting of WLRB1 into 2 parts. They report far more than best practice outcomes for the same PSP and external catchment area, 90%ile residence time of 3 days for both WLRB1a and WLRB1b, and with combined peak discharge at TEDD of 0.3 m3/s. The over-treatment performance is due to the large wetland area increase.

Alluvium have recommended that the wetland areas have to be significantly increased cf. Engeny estimates, so as to meet velocity constraints. The Alluvium wetland sizing appears to be principally based on ensuring width is adequate to meet the 0.05 m/s limit velocity in the 4EY (3 month) peak flow and then getting a length to width ratio of at least 4:1, all as per the MWC deemed to comply (DTC) requirements.

For WLRB1a they estimate the 4EY flow to be 1.61 m3/s so that width has to be about 93 m. To get a length to width ratio of about 4:1 this makes average length about 370 m and area about 35,000 m2.

For WLRB1b they estimate the 4EY flow to be 2.76 m3/s so that width has to be about 158 m. To get a length to width ratio of about 4:1 this makes average length about 300 m and area about 47,500 m2. To optimise the area they split the macrophyte zone into 2 parallel segments, each with width of 79 m.

Inlet pond areas are also vastly increased in the Alluvium design to a total of 2.09 ha.

The total water surface area for the combined asset ends up being almost double that estimated by Engeny.

Given the very high costs proposed, strict adherence to the very conservative MWC DTC guidelines should be tempered with practical considerations. We acknowledge the DTC approach may have proved the easiest pathway to project approvals in greater Melbourne, but in this regional setting longer term maintenance costs for over-sized assets will be a significant burden on limited Council budgets.

Particularly in a location such as this where the wetland area is well and truly drowned out in events less than 1EY (1 year) the DTC approach taken by Alluvium should be revisited to better acknowledge the reality of the site environment and to scale back the treatment outcomes. 1EY flood level is 15.4 m cf. wetland NWL of 13.6 m and TEDD of 13.95 m.

The 4EY flow estimates should be checked first. These appear to have been adopted as 40% of 1EY flows entering the basins (although this is hard to confirm from the report).

Given the large size of the inlet sediment ponds and hydraulic control separation from the macrophyte zones, the retarding effects of the inlet ponds could be incorporated into a separate version of the RORB model to determine peak outflow rate into the macrophyte zones in the 4EY event. The ARR 2019 rainfall data allows direct simulation of events less than 1 EY. (It should be noted that this model structure would not be suited to large flood event simulations).

Based on our experience it is likely that 4EY flow peaks entering the macrophyte zone would be significantly mitigated with this design approach. Reduction in flows would directly reduce macrophyte zone width and then length and hence overall area. We recommend this be done.

Macrophyte areas could also be reduced by about 25% just by adopting a length to width ratio of 3 which should still be sufficient to ensure plug flow through the wetland. We recommend this be adopted.

Lastly a 2D model such as Tuflow can be used to confirm actual hydraulic behaviour in the macrophyte zone during the 4EY event and show the velocity criteria of 0.05 m/s will be achieved. This work should form part of final design.

Discussion of Cost Items and Rates

The bottom line is that Alluvium estimates total base construction cost of WLRB1 (a+b) at $49.1M cf. Engeny at $7.8M. Doubling the wetland area as they propose can't explain all of the difference so estimating items and rates must be different.

The designs for the East and West Waterways are similar so that quantities should be about the same for both consultants. Despite this Alluvium estimated base costs of $38.6M cf. Engeny at $16.4M, an increase of 235%.

> *(Note: Alluvium report high flow capacity of the lower reaches of both waterways as the same at 31.4 m3/s whereas Engeny get 21 m3/s for E-WW. This needs to be clarified given the same RORB model is used. If Alluvium have over-estimated the required capacity then this will be reflected in higher quantities and costs)*

One partial explanation for cost differentials would be that the Engeny cost estimates are from the 2019 report. Their November 2021 update didn't include new cost estimates. We accept that construction rates are likely to have been significantly increased from 2019 but certainly not by 235%.

On reviewing the listed costs we make the following points:

- The excavation rate of $38 per cubic metre for the bulk excavation of the retarding basins, wetlands and waterways appears to be high and needs to be justified. We understand rates around $25 or less are currently used in south eastern Melbourne.

- Importation of topsoil for all earthworks projects within the PSP also needs to be justified. There is no explanation offered in the report. In nearly all drainage projects topsoil removed during the construction of the water asset is returned following excavation. Sometimes topsoil removed from adjacent roads is also used. The estimates allow a base cost of $10M just for the importation of topsoil. If there is a geotechnical reason for such a massive extra cost then this needs to be clearly stated.

- The total supervision costs of 12.25% comprising 3.25% council fees and 9.0% supervision and project management appears excessive and should be reviewed.

Other Design Suggestions to Reduce Costs

(a) Wetland NWL

One factor that will significantly affect final costs is the NWL chosen for wetland design.

Currently Engeny and Alluvium both have NWL at 13.6 m for WLRB1. We believe this is way too low given natural surface levels of about 16 m and downstream inverts about 13.1 (after construction of the outfall).

It is recommended that macrophyte zone NWL be raised to 14.2 m in WLRB1. That equates to excavation saving of about 60,000 m3 for the Alluvium WLRB1a+b design. At their base rate of $38/m3 that is a saving of $2.3M.

The higher NWL also increases clearance over inevitable vegetation growth in the MOP outfall over time and enhances hydraulic grade for culvert/pipe outfall design.

In turn this change in NWL raises the invert levels of the lower portions of the E-WW and W-WW waterways so that further significant savings in excavation can be made on those assets. Such invert raising should not significantly impact on calculated flood levels or finished surface levels.

Grades averaging 1 in 750 are achievable in the lower reaches of both waterways with the raised NWL which are still within normal guidelines. Inclusion of online pools for habitat and aesthetic values can also increase effective bed grades.

We have not had time to check the other wetlands but similar comments and potential savings may apply.

(b) SB4/SB6 Locations

These basins are currently shown as offline to W-WW and E-WW occupying large areas of otherwise developable land.

It is our view that these basins should be integrated online to reduce land take, earthworks, plantings and to improve aesthetics.

Design would need to satisfy velocity and maintenance criteria but we expect no real problems. We see significant cost savings and greatly improved waterway corridor aesthetics accruing through this change.

(c) WLRB1 Low flow outlet

The current Alluvium low flow outlet design for WLRB1a+b reflects the Engeny proposal. It provides for 10*300 mm pipes (length ~100 m), to get under/over the gas main and the water mains. Figure 1 refers.

There will be inevitable operation and maintenance problems with this design. There are more practical and less costly arrangements available which should be considered in future design.

A quick check on the capacity of the designed outlet system at headwater level of 14.5 m (crest of the high flow outlet culverts under Wonthaggi Korumburra Road) shows that no more than 650 l/s can be discharged to the MOP outfall.

Figure 2 shows a suggested alternative that matches this capacity with a simple box culvert arrangement. A small pool should be added at the outlet end to the MOP outfall regardless of whatever design solution is adopted.

(d) Asset Locations and alignments

Although not part of our brief we would like to suggest that flexibility be retained in the PSP DCP wording to allow future subdivisional and drainage asset design to be varied from the adopted functional layouts, subject to still meeting the best practice performance requirements for drainage.

Our experience convinces us that unless the wording is flexible it will prove to be difficult to adjust drainage asset location/alignment/shape in future design.

One example is the functional design report mentions that roads should be constructed alongside the W-WW and E-WW waterways. We believe there is a need to create more interest in the layout of the subdivision and variety in the lots to assist in long term success of waterway design and ongoing maintenance.

This could be achieved by having a number of sections along the waterways where lots face directly onto the waterway with only a pedestrian/maintenance track between the lots and the waterway. A small lane could run along the rear of these lots to give access to their garages. The owners of these lots have “ownership” of the waterway that they are overlooking. The main road would have to dogleg around these areas which would help restrict high speeds along these roads. We understand this arrangement was shown in a number of PSP’s in northern Melbourne. It is ideally suited to pockets of medium density development as well.

(e) Contributions

The drainage costs for this PSP were always going to be high because of the large areas outside the PSP that have to drain through the PSP.

Page 12 of Alluviums’ report states that 720 ha of agriculture and existing/proposed urban catchments external to the PSP drain to WLRB1a and WLRB1b.

A drainage contribution from the external existing and proposed urban areas should be considered in a similar manner to the way they are treated in the Melbourne Water area. No contributions are sought from rural areas as they have not increased the runoff ie., no increase in impervious areas.

Graham Daff and Neil Craigie
24 December 2021

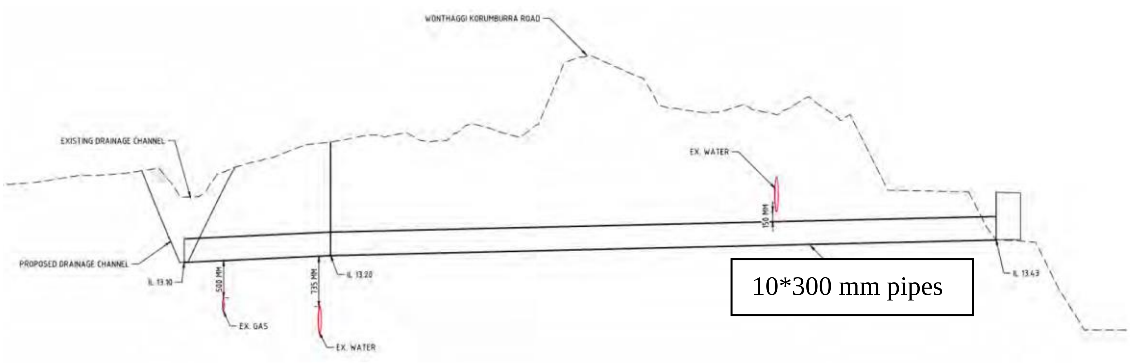

Figure 1 **Engeny/Alluvium Proposal for WLRB1 lowflow outlet**

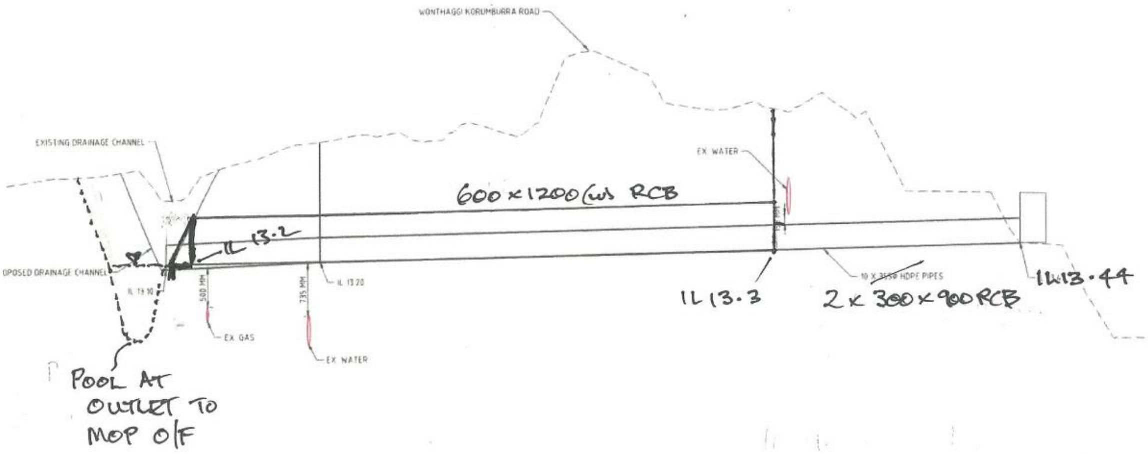

Figure 2 **Suggested Alternative for WLRB1 lowflow outlet**