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Dear Louise,

Part B: Influence of Pomanda Island Weir on the potential for Riverbank Collapse

To assist SA Water and DWLBC to understand and manage any potential impacts from the variations of water levels in the river at critical sites between Swan Reach and Wellington identified in previous investigations, SKM has been engaged by DWLBC to undertake an assessment of possible effects of river water level change due to construction of a weir at Pomanda Island. It is understood the weir may be constructed to a nominal crest level of RL+0.10m AHD.

In addition to the long term water levels driven by weir level, short term wind induced water level changes are expected at each site. These water level changes are considered to be less than +/-0.5m over typically 6-12 hours.

This letter is structure to address SA Water's questions, with regard to the following sites:

- Caloote;
- East Front Road;
- Riverfront Road;
- Walker Flat; and
- Woodlane.

Q 1. What are the risks of slumping being brought forward if the water level rises after the construction of a weir at Pomanda Island?

We have used our existing slope stability models, with an allowance for the higher long term water level at around +0.15m AHD, and slightly higher depending on rive flow rates, to arrive at the following conclusions:

- The Factors of Safety and Reliability Indices, at four of the five sites have been increased by the proposed water level rise (the exception being Woodlane Reserve);
- At Woodlane Reserve, sandy layers provide a significant proportion of the forces resisting slope stability failure. Unfortunately, in this situation, an increase in water level leads to a reduction in the resisting forces. However, the Reliability Index and Probability of Failure at this location do not change significantly;
- The proposed increase in water level is unlikely to result in new tension cracks. It should be noted, however, that local climatic conditions could initiate new shrinkage cracks, which although not caused by the same mechanism as tension cracks, could still potentially have adverse effects on stability;
- The existing cracks do not influence the calculated Factor of Safety, for the proposed increase in water level;
- The wind-induced rapid drawdown (0.5m over ~12hrs) does not affect the global stability significantly. The drawdown may increase local scouring or bank erosion processes, especially at existing slip sites where near vertical raw soil banks are exposed.

It should be noted that this study is limited to the selected locations and the given water level changes.

Q 2. What is the level of confidence that current cracks will fail irrespective of the water level increasing?

No assessment of risk has been performed at this time. However, although the proposed increase in water level has generally resulted in increases in the calculated Factors of Safety (except a slight decrease at Woodlane Reserve) the FoS at all sites is still below what we would consider to be acceptable, i.e. below a FoS of 1.5.

Q 3. Can the above risk be reduced by limiting the rate of water level rise? If so, what is the maximum recommended rate?

The rate of water level rise will not affect the risk of failure in the riverbank slope.

Q 4. Will lifting the water level prevent any of the current cracks from failing (slumping)?

Although the proposed increase in water level has generally resulted in increases in the calculated Factors of Safety (except a slight decrease at Woodlane Reserve) the FoS at all sites is still below, what we would consider to be acceptable.

Q 5. Is it possible to quantify the extent of further cracking if the river level continues to drop?

Lowering of water level (which is expected to continue if the weir is not built and river flows remain at the 1,000-1,500Ml/day rate of the last year) will increase surcharge loads on the riverbank and cause existing cracks to propagate and new cracks to initiate at existing sites as well as new cracking at new sites. New sites cannot be indicatively predicted until a systematic hazard assessment has been done along the river.

In simple terms, then, we consider the extent of further cracking with lowering water level cannot be reliably quantified as it will be affected by several different mechanisms, including:

- Shrinkage cracks can form in cubic blocks or hexagonal blocks and the cracks will become wider as the level of desiccation increases with drought conditions. This can cause additional settlement of the ground due to the 3D shrinkage of the desiccated blocks;
- Shrinkage cracks in areas adjacent to the river increasing to the depth of the water table due to drying of the reactive clays being exposed to surface temperatures and evaporation to a greater depth. The seasonal moisture zone in Murray River area is approximately 4m deep so, as the groundwater table drops, so the shrinkage cracks follow;
- Shrinkage cracks may become tension cracks that fill with surface water and initiate failure from the crest when it rains. Tilting increases the width of shrinkage cracks in the direction of the tilting;
- Subsidence due to the lowering of the groundwater level has led to surface settlement over the last 4 years and will continue in coming years due to time-delay effects – however, the magnitude of change in coming years is difficult to quantify.
- Differential settlement, due to variation in the thickness of clay layers, can lead to tilting and crack formation along the river bank.
- Tree roots exaggerate shrinkage effects in reactive soils, so a row of trees may cause instability at the edge of the river.

Q 6. What length of time does the river need to be at a lower level before further cracks are expected?

As noted in our response to Q5, there are a series of mechanisms for crack formation and the rate of propagation, which are difficult to quantify. As a consequence, we do not consider that we can make a reliable estimate of the time-frame for crack propagation. However, based on the water levels and timing associated with the Long Island bank collapses, cracking is likely to occur within as little as a few days to a few weeks after water level has reached a critical low point for instability at any particular site, particularly if the water level continues to fall.

Please do not hesitate to contact me should you require more information.

Yours sincerely,

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