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JARDINE LANDFILL: PEER REVIEW STORMWATER CALCULATIONS

1. INTRODUCTION

Flood Sense Ltd has been engaged by Clark Fortune McDonald to carry out a peer review of a stormwater report pertaining to a landfill proposal as outlined on CFM Plans 12471. The report and plans were produced in CFM's Queenstown office by Craig Woodcock, BSurv, MNZIS.

The approach taken by Flood Sense in this review has essentially been to view the proposal "from scratch", and to compare our assessments with those produced by CFM. This required a site visit, carried out on Saturday 1 October.

The inspection confirmed that the CFM report accurately described the location and purpose of the proposed works. The site exists at the head of a minor gully that drains an area of relatively gently rolling pasture between SH6 and the south arm of Lake Wakatipu. Historically, the gully would also have drained a small catchment located above SH6 on the considerably steeper slopes of the Remarkables. This subcatchment has long since been cut off from the lower catchment with the construction of SH6. The water table running parallel to the highway is intended to be adequate to prevent flows encroaching across the road, with a large culvert collecting the runoff from a wider area of the Remarkables and conveying the flow via a large and continuous gully to the lake.

The CFM report appears to assume that runoff from the upper subcatchment will be substantially or entirely cut off by the highway drainage system, and will not therefore contribute to the cleanfill area. The assumption, while appearing not unreasonable, is not well justified in the report. This review looks at the matter in rather more detail.

It is confirmed therefore that a lower flat and well vegetated catchment contributes to the cleanfill area, but that the potential contribution of runoff from above the highway should be more fully investigated.

2. DESIGN RAINFALLS

The report assumes a 100-year design return period, and a10 minute design rainfall intensity. The design rainfall is stated as being derived from NIWA's High Intensity Rainfall Distribution tabulations. We have confirmed that the assessed design rainfall intensity of 54mm/hr is of the right order (our calculations produced 57mm/hr), but we consider that the selection of a 10 minute design storm may be unrealistically short, leading to an overestimate of design rainfall intensities.

We have therefore produced an alternative series of runoff assessments. Our summary of findings is as follows:

Scenario 1: The lower catchment

We have estimated the area of the lower (i.e. below SH6) catchment to be of the order of 20 hectares. This is significantly greater than the 13 hectares assumed by CFM. It is conceded that the actual catchment is difficult to accurately determine, as the catchment boundaries are indistinct, even with the reasonably good contour information provided. Our estimate is conservative, in keeping with our approach to ensure that any error is on the side of safety.

Using standard BIA E1/VM1 methods, we have calculated a length of overland flow of approximately 660m, and an average surface slope of approximately 0.04, leading to a time of concentration of 35 minutes. Reducing the ToC to 30 minutes (also conservative) and using the projected HIRD's intensities for a 2 degree temperature increase (again conservative), we have produced a design rainfall intensity of 26mm/hr for a 10-year rainfall, leading to a design flow of 289 l/s. This compares with the 585 l/s derived by CFM for a 100-year flow.

It is considered that a 10 year flow is the more appropriate design parameter for swale design. Purely for purposes of comparison, our calculation for a 100myear flow is 522 l/s, approximately 10% lower than the CFM derivation. The similarity is essentially a consequence of what we would consider to be compensating challengeable assumptions in the CFM report.

Scenario 2: The upper catchment. The upper catchment (above SH6) is obviously steeper and, in its higher elevations, comparatively devoid of vegetation. We assumed a higher runoff coefficient of 0.60 for the upper reaches, and 0.35 overall. The overall slope is of the order of 14%, giving a ToC of 12 minutes. Allowing for a climate change adjustment of plus 2 degrees, we have assessed that the upper subcatchment will deliver a peak flow of approximately 545 l/s to the roadside water table.

We would routinely expect the highway authorities would ensure that the adjacent water table would be designed to ensure that such cross country flows can be accommodated without road

damaging overflow occurring. The roadside water table is of uniform cross section, typically having a bottom width of at least 300mm and batters of around 1.5:1 on average. The channel slope was determined from the provided contours to be approximately 3%. The channel was observed to be in stable condition and lightly vegetated. Using a Mannings value of 0.04 (again, a conservative estimate), we derived a channel capacity of at least 1.5 m^3/s (1,500 l/s). This is a full 3 times the assessed 100-year contribution from the above-road catchment of interest in this case.

3. THE GRAVEL FAN

A succession of gravel fans have formed above the State Highway as narrow gorges in the uooer levels of the Remarkables disgorge on to much wider expanses a few hundred meters above the road. These fans appear stable and well-vegetated. The State Highway appears to have generally been built below the lower extent of the fans. The fans could conceivably become active in the event of prolonged intense rainfall, but the proposed swale is located a further 600 meters below, across gently sloping pasture. No direct impact of gravels originating upstream of the State Highway is therefore envisaged.

More worthy of consideration is the possibility of fan-based gravels washing into the water table adjacent to the State Highway. The resultant blockage (or partial blockage) could direct limited flows from the upper catchment towards the proposed swale, but such blockage would be expected to be expeditiously cleared by the roading authorities to ensure that the road remained open. Flows would then return to the main drainage path through the 1500mm culvert that drains towards Lake Wakatipu well to the south of the proposed swale. This scenario may have been considered in the CFM report (its paragraph 3) that refers to issues developing and being remediated as necessary. The report might have been more specific, in our opinion.

4. FLOW CAPACITY OF THE PROPOSED SWALE

The CFM report describes the swale as being grassed, having a 800mm base width, and 2:1 batters. A Mannings n value of 0.35 was assumed. This value is confirmed a appropriate for mid-length vegetation. Our calculations demonstrate that such a swale at the advised slope of 1% will convey 713 l/s at a depth of 400mm. This compares well with the 720 l/s derived by CFM and, quite significantly, allows a freeboard of a further 400mm. If the swale were to flow at bankfull level, we have calculated that the swale capacity would increase to in excess of 3,000 l/s.

This demonstrates to us that the swale capacity as designed is more than adequate, even in the most extreme of super-design situations conceivable.

5. CONCLUSIONS

1. The CFM report underestimates the catchment area contributing to the proposed swale.

2. The report adopts a 10-minute design rainfall period. This is considered too short, leading to a significant overestimate of design rainfall intensities.

3. The variances summarised in conclusions 1 and 2 are to a considerable degree mutually compensating.

4. The report also fails to consider any possible impacts of runoff from above the State Highway.

5. Notwithstanding the above, we have independently concluded that the swale as designed is adequate to accommodate a 100 year, 30 minute storm runoff with in excess of 400mm freeboard (this incorporating an allowance for climate change impacts).

6. At bankfull, the swale will accommodate in excess of 4 times the 100 year design flow.

7. *Direct* impacts on the proposed swale of gravel flows in the event of fan instability are not considered possible.

8. *Indirect* impacts on the swale of any flow re-direction caused by gravel flows are possible, although extremely unlikely, but are likely to be short-term. The bankfull capacity of the swale appears adequate to ensure that any resulting temporary flow increase should be dealt with without difficulty.

9. To summarise, it is considered that the proposed swale as described in the CFM report is easily adequate to accommodate any foreseeable contributing flows, even allowing for climate change impacts and gravel fan instability. Ongoing maintenance of the swale is assumed.

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Director
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