AN APPRAISAL OF RECENT REPORTING OF SOUTH DUNEDIN HAZARDS

1. Introduction

There is some irony that DCC and ORC should be planning "drop in" sessions for residents in respect of South Dunedin hazard issues during September 2016, some 15 months after the major flood. The prime cause of flooding in June 2015 was DCC's failure to maintain its infrastructure (not just mudtanks), and its failure to operate its pump stations to their intended capacities. The subsequent spread of misconceptions (i.e. groundwater levels, rainfall significance etc) surrounding the flood causes was at least partly due to inaccurate ORC analyses and reporting.

Repetitive and new doubtful information emanating from ORC via its latest report has been noted. Presentations and an over-simplistic video production have been observed. A footnote covering these observations is included at the end of this appraisal.

Long-delayed DCC reports on causes of the South Dunedin flooding have already been strongly criticised by the author. Specifically discredited are misrepresentations of sea level, groundwater and rainfall ranking. Accepted now by DCC as factors (somewhat grudgingly, and depending on the audience) are mudtank blockage and Portobello Road pump station failures (plural); still to be fully acknowledged are the failures at Musselburgh Pumping Station.

Attention is now turned to significant parts of hazard reports produced by the Otago Regional Council and utilised by DCC.

2. Coastal Otago Flood Event 3 June 2015 (ORC, published October 2015)

This report deals with a wider area than South Dunedin. It is apparent that ORC staff never visited the flooding areas of South Dunedin on 3 June, but took advantage of fine weather to take some water level readings the following day. The opportunity for useful progressive surface water level recording was thus lost. Levels were collected at some 150 points on 4 June. ORC's main conclusion was that "*localised variations in topography were probably the main driver of flood depth*". Or, put another way, water depth was deepest where the ground was lowest. This seems hardly surprising, and even trivial. No attempt was made to explain the photographic images presented of extensive ponding remaining well after the rains had ceased. The phenomena of blocked mudtanks and unutilised pumping capacity went seemingly unnoticed.

The report does usefully reference ORC's four borehole recorders of groundwater, but makes the somewhat misleading assessment that groundwater levels were "*elevated*" prior to the rainstorm. This misinformation was seized upon by agencies such as DCC and the Office of the Parliamentary Commissioner for the Environment to highlight climate change impacts.

Having obtained the actual groundwater level data from ORC via the LGOIMA process, the author was able to reveal this "groundwater fallacy" in reviews from February 2016, but it was not until the publication of NZ Listener's article (June 11-17, 2016) entitled FLOOD FIASCO that ORC admitted that pre-flood groundwater levels were in fact "*just a little bit above average*". ORC now seems intent on resurrecting this fallacy.

The ORC report fails to address the real and key issues of pumping station failures (Portobello Road and Musselburgh), or comparisons with much lesser flood impacts in the larger rainfall event of March 8/9 1968.

The report states that the 2015 24-hour rainfall was the largest since 1923. This was patently incorrect, but again was utilised by DCC to divert blame from their role in the disaster.

3. The Natural Hazards of South Dunedin (ORC, published July 2016)

The report states unambiguously in its Opening Summary that the major flooding of June 2015 was "*a result of heavy rainfall, surface runoff, and a corresponding rise in groundwater*". By now, most people are aware that the causes of the flooding's disastrous impact were failure to optimally operate pumping stations, failure to clear mudtanks, and failure to deploy staff to key areas during the event. Again, none of these factors is addressed in ORC's report.

The report presents a table on its second page entitled "*Factors Which Can Influence Flood Hazard*". Examples of exaggerated negativity include:

1. ***Heavy Rainfall*** *: Many recorded instances of rainfall leading to surface flooding.*
   : Heavy rainfall events have occurred frequently over the last decade.

Comment: These conclusions do not appear to be supported by the report's text, and are vague, factually challengeable and alarmist. Prior to 2015, no major flooding had occurred in South Dunedin since 1968, and even that was minor by comparison.

2. ***Sea Level****: Groundwater level fluctuates (by up to 0.5m near the coast) on a twice-daily cycle in response to normal ocean tides.*

Comment: All of South Dunedin is near the coast; most of the area does not experience such large fluctuations. This should have been made clear by the inclusion of groundwater data from all 4 ORC sites across the plain, not just from Kennedy Street.

3. ***Seismic**: Large earthquakes could result in increased flood hazard on the South Dunedin plain, due to liquefaction-related land subsidence or direct, sudden, changes in land elevation relative to sea level.*

Comment: All areas of NZ have some susceptibility to earthquake damage. Dunedin is amongst the areas at lowest risk; no incidences of even minor liquefaction have ever been reported in South Dunedin, and little or no clearly liquefiable materials have been identified (Refer GNS, 2014*).

In respect of groundwater levels, the report (p.22) makes the finding *if median groundwater level at Culling Park was similar to that at the other ORC bores, then surface ponding could occur much more regularly.*

Comment: The key data, overlooked by ORC is that by 8am on 3 June 2015 groundwater levels at Culling Park were already slightly higher than at two of ORC's three other bores (Kennedy Street and Bathgate Park). Pre-existing groundwater levels were already largely irrelevant after just 23mm (less than an inch) of rainfall. Low pre-existing groundwater levels provided little benefit.

On p.23 it is reported that Fordyce (a post-grad student, apparently) "found" that areas of silt (or is it sand?) can *impede infiltration of rainfall causing a greater risk of flooding due to the rapid groundwater response observed at those sites.*

Comment: If infiltration were impeded, would not groundwater response be slowed?

On pp.26-27 it is postulated that increases in groundwater level (brought about by the June 2015 rainfall) caused *a rapid increase in infiltration into the wastewater network.*

Comment: Careful analysis of data across the entire event actually demonstrates that wastewater flow increases were predominantly caused by surface water entering the wastewater system, most probably via illegal connections, gully traps etc. The condition of "aged" wastewater pipes is therefore unlikely to prove a major issue in respect of flood water management.

On p.38 it is stated that *the 2010 Darfield earthquake resulted in some minor damage to property in the Dunedin area.*

Comment: Is this even relevant to South Dunedin? In any case, no detail is provided on what and where damage occurred. The expert GNS report states that little if any

damage was caused in the Dunedin area. Why does the ORC report provide the more negative slant?

On p.39 the report states that *were the 2011 Christchurch earthquake to be centred directly under Dunedin, then similar damage could be anticipated.*

Comment: Given Christchurch's considerable earthquake history and Waimakariri influence, the conclusion seems irresponsible. To my knowledge, no such dramatic conclusion is drawn in the expert GNS report.

The report (pp.49-52, figs 40ff) maps areas of South Dunedin that its models predict would be inundated in the event of sea level rise. This has caused considerable local alarm following publication in ODT.

Comment: Four sea level rise scenarios ranging from 0.11m to 0.60m are mapped. The unusual choice of 0.11m starting point for assumed initial sea level rise appears to hark back to previous (international) predictions of sea level rise. Mapped ponding depths projected into the 0.10-0.20m range, rather than in the less alarming 0-0.10m range, may be an unfortunate pessimistic outcome.

There appear to be fundamental problems with the areas and depths of groundwater inundation plotted. These discrepancies are treated in some detail below. But even if the plots are accurate, the following should be noted:

I. The majority of areas inundated in lesser sea level rise scenarios are the playing field areas of Tonga and Bathgate Parks.
II. In all sea level rise scenarios plotted, there is virtually no inundation evident across extensive areas to the "east" of a line through Burns, Bradshaw and Kirkaldy Streets. This seems questionable.
III. Potential ponding, as described in the report, can easily be eliminated should it threaten. Solutions are not offered in the report.
IV. Most importantly, the inundation maps appear identical with those presented in the original ORC modelling report The South Dunedin Coastal Aquifer & Effect of Sea Level Fluctuations 2012, author Jens Rekker. Interestingly, however, the original report also predicts the existence of significant areas of permanent inundation in a <u>zero</u> sea level rise scenario. These inundated areas are only about 30% smaller than for the 0.11m scenario, and therefore cover a considerable area (refer fig 2 of Rekker's report). Problematically for ORC, this finding is totally at odds with reality; there is obviously no current (i.e. zero sea level rise) ponding evident at the locations identified. The modelling outputs are therefore pessimistically wrong in some areas at least, don't reflect reality, and cannot therefore be trusted. Mr Rekker, to his credit, acknowledges the inaccuracy of his model's predictions by confirming that the model should show no saturation in the "zero sea level rise" scenario. Unfortunately, the authors of

the 2016 hazard report have reproduced maps that they should have known likely to be wrong. Unfortunately, the zero sea level rise inundation maps are not reproduced in the latter report; that would have immediately demonstrated the anomalies. (Note: this is not to say that ponding can not occur should sea levels rise; areas should not have been presented as wet or dry as defined by clearly imperfect modelling).

Conclusion

1.The ORC reporting seems biased towards "catastrophism", lacks objectivity, accuracy and balance, and promotes negativity. Few solutions are offered, despite their obvious availability. Residents of South Dunedin should preferably read the BECA 2014 Report *Assessment of Options for Protecting Harbourside and South City From Direct Impacts of Sea Level Rise* (for DCC) if they want an expert perspective of sea level rise impacts and solutions for South Dunedin, and the GNS Report *2014/068 Assessment of Liquefaction Hazards in the Dunedin City District* (for ORC) should they seek expert appraisal of seismic issues for the area.

II. If South Dunedin residents wish to better understand why parts of their area were flooded in June 2015, they should read the attached summary, based on the author's investigations carried out over the intervening period since the flood event.

Footnote

At both a presentation delivered by ORC and on its recent video production, the questionable information promoted in its Hazards Report was compounded by a succession of challengeable findings and statements from its hazards writers. These included:

i. Parts of South Dunedin (in addition to Forbury Park) are permanently ponded during the winter months; +
ii. The 1923 and 2015 rainfalls were similar; +
iii. South Dunedin has comparable earthquake risk to Christchurch's (based on possible unknown faults etc); +
iv. Pre-existing groundwater levels were a significant factor in the 2015 flood; +
v. An admission was made that ORC modelling predicted that significant groundwater should be ponding under current sea level conditions. This was accompanied by a reluctance to concede that the modelling must therefore be unreliable;
vi. Areas reclaimed by the Otago Harbour were built upon soon after the sand was pumped in, and not well compacted; +
vii. Groundwater levels are higher in winter because of higher rainfalls then; +
viii. South Dunedin collects all the water from the surrounding hill catchments; +

+ These findings are strongly disputed.

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