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Kapiti Coast District Council
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12 August 2016

Attention: Sarah Stevenson

Dear Sarah

Kapiti Proposed District Plan - Flood Hazard submissions

Further to your request, and my attendance at the hearing, I have reviewed the evidence of Mr Klimenko, Mr Brittliff, and Mr Manning. I have summarised key points of evidence related to my expertise and the scope of the previous work by CH2M Beca, and have commented on the evidence as presented. In doing so, I have not spoken any further with any of the parties.

My findings are given in three tables attached to this letter.

If you have any further questions, or need further comment or clarification, please do not hesitate to contact me.

Yours faithfully

Graham Levy
Senior Technical Director - Water Resources

on behalf of
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Copy
Rebecca Lloyd

Submission 86 – Klimenko and Couchman

Item	Submission issue	Response
1	Accuracy of modelling – desktop analysis not a substitute for site specific analysis. LiDAR only accurate to 500 mm.	Catchment-wide modelling as undertaken here is common practice for defining flood hazard in urban catchments. It does involve some approximations and can result in local inaccuracies at a detailed site basis. However, as outlined in the CH2M Beca report relating to this submission, the approach taken for Kāpiti is in line with industry practice. The accuracy of LiDAR on paved and open grassed areas (which are what is relevant here), is considerably greater than Mr Klimenko claims (refer Jacobs response), and it is suitable for purpose. Precise calculation of pipe and street flow can be misleading in a real world situation, because in storms of 100 year ARI magnitude there is likely to be at least partial blockage of street and driveway sumps, and impediments in the street channel (debris or parked cars) will significantly change the flow depth locally and can result in spill even when calculations of an assumed fully functioning drainage system might suggest otherwise. Looking at this specific site, the model is unlikely to have accurately calculated the capacity of the Tasman Road and Health Camp Road secondary flow paths. However, based on review of the topography, a second visit to this site and some additional calculations and assessment, I conclude that on the balance of probabilities there would be overflow from the road and consequently some degree of ponding in these properties in a 1% AEP storm event.
2	Source of ponding at 7 and 11 Health Camp Road – submission suggests the model states that this is from the Waitohu Stream	The submission goes to some length to demonstrate that there would not be back-flooding from the Waitohu Stream. From my observation and interpretation of the modelling and the KCDC drainage system, this is probably correct. However, the source of ponding on these properties, as shown in the modelling, and as stated in section 2 of the CH2M Beca report, is secondary flow from the street. Therefore the discussion about Waitohu Stream back-flooding is not relevant.
3	Operation of Council stormwater system	The CH2M Beca report, at section 7, makes it clear that the Council system has approximately a 2 year capacity, which is not surprising in a development of this age, and well short of the 10 year primary system capacity now expected in new developments. There is no statutory obligation on Council to retrospectively upgrade stormwater systems to current design standards. Secondary flow (in storms exceeding the primary system capacity) normally flows in the street, or in identified secondary flow paths. This is the case here. In very large storms (such as the 100 year storm with climate

		change) there will be substantial flow in the streets, and potential for it to overflow kerbs and into lower-lying property. This occurs widely in older subdivisions in New Zealand. The situation on these properties is not unusual, and Council is not obliged to remedy it. However, it is appropriate for Council to identify these secondary flow paths and ponding areas on hazard maps, again a widespread practice in New Zealand. For reference, the approved method for soakage design under the Building Regulations only addresses the 10 year ARI, 60 minute duration storm, well short of the design 100 year flood standard. It therefore implicitly envisages the possibility of ponding in extreme storms.
4	Depth and duration needed to trigger ponding classification	I am not aware of any standard approach to setting a threshold for duration and depth of flooding for urban contexts. There are provisions in many rural drainage schemes, but these relate to a duration of several days that would then affect pasture survival, and they often apply to more frequent storms that the 100 year. In the urban flood hazard context, the most appropriate precedent is the Building Regulations, which state that "*Surface water*, resulting from an event having a 2% probability of occurring annually, shall not enter *buildings*." There is no duration or depth threshold in this case. It is common practice to apply a freeboard to calculated flood levels to address uncertainty and site factors, and thereby ensure that water does not enter buildings. The use of the 100 year rather than the 50 year ARI of the Buildings Regulations is widespread practice throughout New Zealand.
5	Definition of ponding	The proposed Council definition of ponding includes the statement "Ponding can be associated with rivers and streams as well as the piped stormwater network." Arguing that the reference to rivers and streams means that must be the source is spurious. Secondary flow and ponding associated with the stormwater drainage system is covered by the definition, and is applicable to this site. It constitutes a potential hazard to buildings and is therefore properly recognised as such.
6	High intensity rainfall has been experienced in this area and not resulted in ponding for more than a few minutes.	We have analysed historical rainfall for Otaki (Regional Council Works Depot) as a guide to the severity of historical events at Otaki Beach (recognising that the actual depths at Otaki Beach in the modelling would be lower than at Otaki, but storm return period cold be similar). In section 9.2 of the CH2M Beca report, the results are presented, and conclude that at relevant durations for this site taking into account wetting of the soil (1 to 2 hours) the 1992 event would have been about a 30 to 60 year event (depending on duration) under future climate change. At shorter and longer durations it was less severe. Other events were less than 10 year, including shorter events that would be critical for the street runoff and drainage. Therefore there have not been any events even close to the design event in recent decades.

		My reading of the submission on page 3 suggests that there has been ponding on the driveways of these properties in recent events that soaks away in 25 to 30 minutes. If correct, this would support the mapping of a ponding hazard on these properties.
7	Groundwater levels are low	There is reference in the submission to groundwater levels of 600 mm below ground level in wet periods. I would regard a groundwater level of only 600 mm below surface as high groundwater that could inhibit soakage, particularly when considering the ability of the ground to absorb a 100 year storm event. There was verbal submission in the hearing that the groundwater is not connected to the sea because it is not saline. It is highly likely, given the dune sands, that the groundwater is directly connected to the sea, but that rainfall and soakage provide a positive gradient keeping salinity out from under these properties. Because of this connection there will inevitably be some increase in groundwater levels as a result of sea level rise, further reducing the ability of the ground to absorb extreme storm runoff.
8	Soil classification	There was reference in the submission to soakage rates of about 600 mm/hr from a soakage test. The rates were actually higher than this, but a safety factor of 3 was applied for design purposes. Such rates are consistent with this type of sandy soil, but interpretation and application need careful consideration. The test was done in February, so would be with dry soils and low water table. The test bore was 80 mm diameter, and the test appears to have only taken 2 hours. Therefore the soil would not have been saturated during the test. Further, it was conducted at depth, so is not representative of what might infiltrate through the surface where effects of surface compaction, collection of organic material, finer sands and detritus might be expected. It is therefore suitable for soak pit design (the purpose for which it was done), but not for understanding surface infiltration, for which it is more common to use a double ring infiltrometer test taken at the surface. The curve number method has its origins with the US Soil Conservation Service, but is widely used internationally, and has been adopted (and calibrated) in parts of NZ. The curve number used (65) is generally representative of urban lawns in average condition on class B soil, or poor condition on class A soil. I have considered whether the use of a lower curve number for Class A in average condition (49) would make a substantive difference to the outcome of the modelling, and my conclusion is that it is unlikely.

Conclusion – Klimenko and Couchman

There is nothing in the evidence to the hearing that causes me to alter my conclusion that these properties are appropriately identified as subject to ponding in the 1% AEP climate change flood event, as set out in the proposed District Plan. This is consistent with the findings in the CH2M Beca report.

Submission 176 – Dalton

Item	Submission issue	Response
1	Depth of overland flow – 80 mm versus kerb height of 100 mm	Mr Brittliff has calculated flow depths that are marginally below kerb level (by 20 mm). He does not appear to have accounted for the possibility of partial pipe inlet blockage, or partial blockages in the street channel (debris, parked car), both of which can lead to local increases in surface flow and depth. My estimate is that the flow velocity in the street would be about 1 m/s and the velocity energy at that velocity is a further 50 to 60 mm, enough to raise the water level at an obstacle to over kerb level. Further, as he notes, there is a low point in Tangahoe Street adjacent to 117 The Parade, with the overflow from that low point directly into that property and into 115 The Parade, across the road. If sufficient ponding were to occur it would pond back into 5, 4, 6 and 8 Tangahoe Street (which are all at the same low level). Either of these mechanisms would likely result in water reaching 8 Tangahoe Street and ponding there.
2	Council standards and the need for Council to manage the flow, including evidence paragraph 11.4.2	While the current KCDC design standard is for 10 year primary system capacity, there is no statutory obligation on Council to retrospectively upgrade older stormwater systems to current design standards. The primary system is likely to have less capacity than 10 year, given the age, as acknowledged by Mr Brittliff at paragraph 15. Secondary flow (in storms exceeding the primary system capacity) normally flows in the street, or in identified secondary flow paths. This is the case here. In very large storms (such as the 100 year storm with climate change) there will be substantial flow in Tangahoe Street, and potential for it to overflow kerbs and into lower-lying property. This occurs widely in older subdivisions in New Zealand. The situation on these properties is not unusual, and Council is not obliged to remedy it. However, it is appropriate for Council to identify these secondary flow paths and ponding areas on hazard maps, again a widespread practice in New Zealand.
3	Definition of flood plain, including comments at 11.14.1	Mr Brittliff disputes the definition of flood plain, particularly suggesting that since a flood plain is along a waterway that is naturally subject to flooding, it is not appropriate for this site. However, the KCDC definition of ponding also includes ponding associated with the piped stormwater network (and by implication the secondary flow path), and that is an appropriate definition for ponding on these properties. Therefore the identification of ponding on this site is consistent with the District Plan definition of ponding.

4	Depth and volume of ponding, application of freeboard	Mr Brittliff goes into some detail on the volume and therefore depth of ponding. However, his simplified approach of calculating volume over the ponded area then redistributing it over a larger area at a shallower depth is less accurate that the gridded digital terrain data used in the model, and misses the point of the modelling and mapping. The model shows there will be ponding on this property, and if so then even if it is shallow, it is a potential hazard for which mapping is appropriate and a minimum floor level should be set.
5	Proposed street-side bund as a remedy	Council is under no obligation to contain all secondary flow within the street. Even if Council were to install a bund in the future, that does not change the current susceptibility of the property to ponding, and therefore does not change the current District Plan mapping. The effectiveness of such a bund would not be assured. The drop-off from the street back into the properties (other than at driveways) is steep and starts immediately behind the kerb in places, and would be challenging to bund effectively. Any water thus contained would still finish up at the low point in Tangahoe Street, and would need to pond there at some depth, if it were not to spill into 115 and 117 The Parade.

Conclusion - Dalton

The nature of this site, with an upstream catchment including two roads and a number of other properties, and with the group of properties in including 8 Tangahoe Street forming the lowest point in the catchment, without any secondary flow path away from them, is an obvious context in which a ponding hazard would occur in extreme events exceeding the primary drainage system capacity.

- I therefore remain of the opinion that the mapping of ponding is appropriate, as set out in the CH2M Beca report.
- I also remain of the opinion that 4 Tangahoe Street and 117 The Parade have a similar risk of ponding, as stated in the CH2M Beca report.

Submission 453 – Manning

Item	Submission issue	Response
1	Section 5 Hydraulic neutrality	There is nothing new in the evidence that would alter my conclusions on the subject of requiring flood peak attenuation, as set out in the CH2M Beca report. My comments related to attenuation particularly of large flood events.
2	Section 6 Flood hazard at Manning property	There appears to be reference to previous information that predates and is not relevant to the Proposed District Plan maps (e.g. the stream being 20 m from its correct alignment). I have no comment on these matters. The relief sought - resurvey and remodelling of the stream through Mr Manning's property, is already being actioned by Council. If the new survey and modelling allows the hazard maps to be locally refined, that would be appropriate. As outlined in the CH2M Beca report, I would not expect substantive changes. The area covered in bush (where LiDAR data is less accurate) is a narrow confined gully, and flood extents are unlikely to change much, even if flood levels do change locally within the bush area. At one point Mr Manning references my comment on possible 1 m discrepancies between model invert levels and survey / contours. While this is a significant level difference locally, it is also affected by the shape of the channel and the flood level effect is likely to be less. Further, as outlined in the paragraph above it appears to be localised to the confined bush gully reach and would have little effect outside this reach. The gradient of the stream means any effect would disappear in about 60 m distance upstream.
3	Section 7 The Flood hazard maps Coastlands weir flood record	The matter of data from the Coastlands weir has been debated by Mr Manning for many years. I have seen the data, and have spoken to Mr Marks of GWRC (an experienced hydrologist) about the record. I am satisfied from this and my own assessment of the data and the hydraulics of the stream in this general reach (from the Manning property to the weir) that there is not a datum error of the form that Mr Manning claims, but also that the weir record at high flows cannot be relied on. There are three principal reasons for this: There are no confirmatory flow gaugings at even moderate flood flows; the channel form means that theoretical calculation of higher flow rating through this site is difficult (Mr Manning and GWRC have both attempted this and their results differ); and in high flows it is not unusual for there to be blockage at the Epiha Street culvert (as acknowledged by Mr Manning), resulting in flow bypassing the weir. Mr Manning suggests that the weir flood data should be used as the basis for estimating the design flood event

		as real data is more reliable. As outlined in the CH2M Beca report, I have examined the flood records, and was not able to fit any of the standard extreme value distributions to the data, making prediction of larger floods by this method tenuous and unreliable.
4	Incorporation of freeboard in flood levels	Mr Manning suggests that freeboard should not be included in the flow depth plotted on hazard maps. It is appropriate, and common practice, for hazard maps to identify the level and the spatial extent of the freeboard that is applied. There are different approaches to how this is done, and KCDC has adopted the approach recommended by GWRC. Some other jurisdictions plot a separate "flood sensitive" margin, and quote flood levels with a clear statement of the freeboard that needs to be added. Both approaches are valid, and the principle of identifying the spatial extent of the freeboard "zone" within the flood maps, as done by KCDC, is an acceptable approach.
5	Design flood flows	There is nothing new in the evidence from Mr Manning that would cause me to change my views on the design flood flows. As noted in the CH2M Beca report, the design flows selected are at the conservative (high end) of the range that would be expected. The method used by Jacobs is industry standard, and some effort was put into calibrating the hydrological parameters in the model to the more reliable smaller flood record from the Coastlands weir. Contrary to Mr Manning's statements, other methods for validating the flows have been considered, including the regional methods published by NIWA. This is addressed in the CH2M Beca report at section 8.2
6	Rainfall isohyets	Mr Manning suggests that the CH2M Beca report is wrong is stating that the rainfall in the upper catchment was about 20% higher. The specific figures, from the map for the 10 year ARI, current climate, 24 hour storm, is about 138 mm at the Paraparaumu raingauge (marked on the map) and about 165 mm in the upper Valley Road area, making it almost exactly 20% higher. My other comparisons of the SKM isohyets against our own analysis of the Paraparaumu record, and comparison with HIRDS for the gauge site and the upper catchment, are set out in the CH2M Beca report. There is nothing in Mr Manning's evidence that would cause me to change my opinion that the isohyet maps are generally appropriate for use in the flood modelling.

Conclusion - Manning

There is nothing new in Mr Manning's evidence that would cause me to change any of the recommendations in the CH2M Beca report. In particular:

- The design flows used for the mapping are appropriate if at the conservative end of the expected range;
- There is justification for local resurvey, remodelling and updating the maps locally within Mr Manning's property.