BEFORE	the Hearings Panel
IN THE MATTER	of the Resource Management Act 1991
AND	
IN THE MATTER	Rotorua District Plan Change Two – Pukehāngi Heights

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STATEMENT OF PLANNING EVIDENCE OF DAVID JEFFERY MARSHALL ON BEHALF OF TE ARAWA LAKES TRUST

20 September 2020

INTRODUCTION

1. My full name is David Jeffery Marshall. I am a self-employed consulting planner.

2. This statement of evidence has been prepared for Te Arawa Lakes Trust (**the Trust**) in relation to Rotorua District Plan Change 2 - Pukehāngi Heights (**the Plan Change**).

PROFESSIONAL QUALIFICATIONS AND EXPERIENCE

3. I have a Bachelor of Planning Degree from Auckland University (conferred in 1998) and over twenty years' experience as a planner. I have worked in a variety of planning roles for local government, central government, the private sector and tangata whenua. I have been involved in developing district plans, regional policies and plans, and national policies and legislation. These roles have included extensive engagement with tangata whenua. For the past five years I have worked as a planner for tangata whenua, first for the Raukawa Charitable Trust from 2015 to 2019, and from October 2019 for the Te Arawa Lakes Trust. This role has involved assessing the effects of a range of plans and policies on tangata whenua values and recommending means to recognise and provide for those values. I am a certified commissioner under the Minister for the Environment's Making Good Decisions programme.

4. In preparing this evidence I confirm that I have read the Expert Witness Code of Conduct set out in the Environment Court's Practice Note 2014. I have complied with the Code of Conduct in preparing this evidence. My qualifications as an expert are set out above. Except where I state that I am relying on the evidence of another person this written evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed in this evidence.

SCOPE OF EVIDENCE

5. My evidence addresses the following topics:

   (a) Particular relevant statutory considerations;

(b) Cultural sites and associations;

(c) Stormwater and water quality;

(d) Stormwater and flooding; and

(e) Lake Rotorua nutrient management.

6. In preparing this evidence I have read:

(a) The cultural impact assessment of proposed development at Pukehangi Heights prepared by Ngāti Kearoa Ngāti Tuarā for Rotorua Lakes Council (**the Council**);

(b) The Section 32 report prepared for notification of the Plan Change;

(c) The submissions of Ngāti Kearoa Ngāti Tuarā, Ngāti Whakaue and the Trust;

(d) The Section 42A Planning Report (**the S42A Report**) and the subsequent correction to the S42A Report;

(e) The joint witness statement on stormwater;

(f) The memorandum "Plan Change 2 – Stormwater Review" prepared by Sean Finnigan for Te Arawa Lakes Trust (attached as **Appendix One**); and

(g) The statements of evidence prepared by:

(i) Robyn Bargh;

(ii) Lani Kereopa; and

(iii) Nicki Douglas.

7. I participated in pre-notification consultation on the Plan Change on behalf of the Trust from October 2019 on and assisted in the drafting of the Trust submission on the Plan Change. I participated in post submission negotiations between the Council, the Trust and iwi submitters. I visited the Te Arawa Group Holdings portion of the plan change area with Robyn Bargh on 10 September 2020 and was also able to view other portions of the area from the road with Ms Bargh.

8. In this evidence I have adopted the submission point numbering used by Council but note that these are incomplete with regard to the Ngāti Kearoa Ngāti Tuarā submission which, in addition to its own points, also adopts the relief sought in the Trust submissions. The relief sought in the Trust submission is also sought in the Ngāti Whakaue submission. I therefore address the common points in the Ngāti Kearoa Ngāti Tuarā, Ngāti Whakaue and the Trust submissions collectively, where appropriate.

STATUTORY CONSIDERATIONS

Resource Management Act 1991

9. The Plan Change seeks to contribute to the overarching sustainable management purpose the Resource Management Act 1991 (**the RMA**). In doing so it must recognise and provide for the relationship of Māori and their culture and traditions with their ancestral lands, water, sites, waahi tapu, and other taonga under section 6(e) of the RMA. Particular regard must be had to kaitiakitanga under section 7(a) and the principles of the Treaty of Waitangi must be taken into account under section 8.

10. In my view the effects of the Plan Change identified in submissions of Ngāti Kearoa Ngāti Tuarā, Ngāti Whakaue and the Trust and described in the evidence of Lani Kereopa and Robyn Bargh are significant effects on the relationship of Māori with their ancestral taonga and should be evaluated in terms of section 6(e) of the RMA. I also consider the submissions made and evidence presented to be active exercises in kaitiakitanga, seeking to maintain that relationship, and the role of Te Arawa as hunga tiaki (which I am advised is the Te Arawa term for kaitiaki).

11. In terms of the principles of the Treaty of Waitangi I consider that the principle of partnership must be taken into account. The Te Arawa Settlement Deed and Act establishes a partnership between the Trust and local authorities for the purpose of contributing to the sustainable management of the lakes, for the use and enjoyment of future

generations while recognising and providing for the traditional relationship of Te Arawa with their ancestral lakes[1].

National Policy Statement on Freshwater Management 2020

12. The Plan Change provisions that relate to freshwater must give effect to the relevant provisions of the National Policy Statement on Freshwater Management 2020 (**NPS-FM**)[2]. The NPS-FM establishes Te Mana o te Wai as a fundamental concept for freshwater management[3]. It requires that local authorities actively involve tangata whenua in identifying the local approach to Te Mana o te Wai and in changing district plan provisions that relate to freshwater management[4].

13. In my view the submissions and evidence of Ngāti Kearoa Ngāti Tuarā, Ngāti Whakaue and the Trust with regard to stormwater quality, stormwater quantity and lakes water quality should be considered to be contributing the ongoing identification of the local approach to Te Mana o te Wai.

Te Tūāpapa o ngā Wai o Te Arawa and He Mahere Taiao mō ngā Wai o Te Arawa

14. Nicola Douglas identifies Te Tūāpapa o ngā Wai o te Arawa (**Te Tūāpapa**) as the guiding framework for management of the Te Arawa Rotorua Lakes and the key provisions that must be taken into account.[5] The Trust has also developed and approved He Mahere Taiao mō ngā Wai o Te Arawa (**He Mahere Taiao**) to describe and provide further guidance to decision makers on Te Arawa values and views. Both documents must be taken into account in changing a District Plan[6].

15. In my view the provisions of He Mahere Taiao to be taken into account include objective 5.1A which restates the second strategic goal of Te Tūāpapa and objective 5.1B which sets out the aims of land and freshwater planning, including affording greater priority to the natural

[1] Nicola Douglas Evidence paragraph 7.
[2] RMA s75 (3) (a).
[3] Clause 1.3 (1) and (2).
[4] NPS-FM Clause 3.4 (1) (a) and (b).
[5] Nicola Douglas Evidence paragraphs 10 and 11.
[6] RMA s74 (2A).

limits of the lakes and freshwater. The section 5.1 policies to achieve these objectives must also be taken into account. This includes recognising the local and cumulative effects of land use and development on the health and wellbeing of Te Arawa Lakes[7].

CULTURAL SITES AND ASSOCIATIONS

16. The Ngāti Kearoa Ngāti Tuarā, Ngāti Whakaue and Trust submissions (22.0, 10.4, 42.0 and 10.0–10.3) seek a number of amendments to the introduction, policies and performance standards of the Plan Change to include recognition of relevant Te Arawa iwi and hapū and the wider cultural landscape. It is also sought that policy 2.9 be expanded to include discovered as well as known culturally significant sites. The submissions seek that the provisions of the Plan Change identify tangata whenua as affected parties in the consideration of resource consent applications.

17. The evidence of Robyn Bargh clearly identifies the adverse effects of the alienation and further development of the Plan Change area on tangata whenua and their relationship with the land[8]. The evidence of Robyn Bargh and Lani Kereopa also identifies the potential adverse effects of decreased water quality and increased water quantity on downstream sites and values. Nicola Douglas identifies the importance of the Te Arawa relationship with Te Rotorua-nui-a-Kahumatamomoe (Lake Rotorua) and the need to restore its water quality[9].

18. In my view the actual and potential adverse effects, and relationships, identified are significant and it is appropriate to recognise these through the amendments sought to the introduction, policies and performance standards. In particular I consider it appropriate to identify Ngāti Kearoa Ngāti Tuarā, Ngāti Whakaue and the Trust as affected parties in regard to potential effects on culturally significant sites, downstream water quantity, downstream water quality and Lake Rotorua water quality in order to comply with 6(e) of the RMA.

[7] He Mahere Taiao Policy 5.1.1
[8] For example Robyn Bargh Evidence paragraphs 22-24.
[9] Nicola Douglas Evidence paragraphs 8 and 9.

19. I consider that the S42A Report adequately evaluates these submission points and I support the recommended amendments at paragraphs 8.141 through to 8.149 of the report.

STORMWATER AND WATER QUALITY

20. The Ngāti Kearoa Ngāti Tuarā, Ngāti Whakaue and Trust submissions (22.3,10.4 and 42.4 and) seek that any decrease in downstream water quality from development within the Pukehāngi Structure Plan be avoided. The evidence of Lani Kereopa and Robyn Bargh clearly identifies the adverse effects of the further degradation of downstream water quality on tangata whenua and their relationship with the Utuhina[10] and the desire to avoid degradation through further contamination[11].

21. The Plan Change addresses water quality issues through objective 2 and policy 2.3. Objective 2 directs that overall environmental quality within the structure plan area be developed then maintained and enhanced. Policy 2.3 directs that land use and stormwater management be integrated through the use of low impact stormwater management principles. The Ngāti Kearoa Ngāti Tuarā, Ngāti Whakaue and Trust submissions seek that this policy be retained and that objective 2 be expanded to provide direction on environmental quality in surrounding and downstream areas. The s42A Report recommends rejecting these submissions on the basis that there is already sufficient direction under the Operative Regional and District Plans to ensure that offsite effects are addressed.

22. I note that there are already Regional and District Plan provisions relating to stormwater quality. In particular District Plan objective 13.3.2 and policy 13.3.2.1 as referred to in the s42A Report[12]. However I note that those provisions refer to subdivision design only contributing to water quality improvements and avoiding, remedying or mitigating adverse effects. I do not consider these general district plan provisions to be specific enough to the potential adverse effects of development in the Plan Change area. In my view the provisions should direct land use change to protect downstream water quality in order to avoid the adverse

[10] For example Lani Kereopa Evidence paragraphs 60 and 61.
[11] Robyn Bargh Evidence paragraphs 35-37.
[12] Section 42A report paragraph 7.25

effects of decreases in water quality as identified in submissions and evidence.

23. Therefore I do not consider that the existing plan change provisions address the concerns of tangata whenua. I also note that the direction to use low impact stormwater design principles in policy 2.3 clearly has intended downstream water quality benefits although the policy sits under an objective that only refers to environmental quality within the structure plan area. I consider that the lack of an objective relating to downstream water quality is inconsistent with the addition in the Plan Change of a specific objective on downsteam water quantity (objective 3).

24. I therefore consider that objective 2 should be amended as follows:

The environmental quality, character, amenity and cultural values of the Pukehangi Heights Development Area are developed and then maintained and enhanced through appropriate urban planning and design <u>including stormwater treatment design which protects downstream water quality</u>.

STORMWATER AND FLOODING

25. The Ngāti Kearoa Ngāti Tuarā, Ngāti Whakaue and the Trust submissions (22.2, 42.6 and 10.4) seek that any increase in downstream flooding be avoided. The submissions seek that a strong policy direction be added to the Plan Change stating that applications which do not demonstrate that they will avoid an increase in downstream flood risk will be refused consent. The evidence of Lani Kereopa and Robyn Bargh clearly identifies the adverse effects of existing flooding and the adverse effects of any increase in flood risk[13].

26. Evaluation of the potential downstream flooding effects of the change to urban land use and the development of appropriate provisions has proved problematic during the Plan Change process due to incomplete modelling and differences of expert opinion. In order to assist in

[13] Robyn Bargh Evidence paragraphs 33-34 and Lani Kereopa paragraphs 69-73

evaluating the Plan Change the Trust has engaged an independent stormwater engineer (Sean Finnigan - Director, Environmental Engineering, Fraser Thomas Ltd) to advise on the differences of opinion and participate in expert caucusing. I understand from the joint witness statement now provided and Mr Finnigan's advisory memo (attached to my evidence as **Appendix One**) that progress has been made in resolving these issues but that Mr Finnigan does have some outstanding concerns.

27. I note that developments in the stormwater modeling undertaken have led to a substantial increase in the number and area of indicative stormwater ponds shown in the Proposed Structure Plan since notification. This includes the identification of potential lower catchment stormwater attenuation in downstream Council reserves. However I do not consider that this resolves the uncertainty arising from the stormwater modeling and the sequential nature of this process (that is the Plan Change, if approved, will be followed by subdivision and stormwater discharge applications).

28. I therefore consider it necessary for the Plan Change to contain a clear policy direction on increased downstream flood risk. However I recognise that it is problematic for policies to direct that resource consent applications be refused. Consequently I support the recommendations in the S42a Report[14] amending tables A5.2.3.1.a and A5.2.4.1.a so that applications which cannot demonstrate no increase in flood risk are non-complying activities. This will enable such applications to be tested against objective 3 of the Plan Change and the scale of potential adverse effects to be assessed.

LAKE ROTORUA NUTRIENT MANAGEMENT

29. The Ngāti Kearoa Ngāti Tuarā, Ngāti Whakaue and Trust submissions (22.3, 42.5,10.3 and 10.5) seek to protect Lake Rotorua water quality. It is sought that the Plan Change not proceed without robust modelling that demonstrates nutrient flows within the catchment will be reduced. The evidence of Nicki Douglas reinforces that for the Trust reductions in

[14] Section 42A report paragraphs 8.265 and 8.266

nutrient flows are fundamental to the sustainable management of Lake Rotorua, recognising and providing for the relationship of Te Arawa with the lake and achieving the outcomes sought in the Trust policy documents[15].

30. I note that management of nutrient flows in the Lake Rotorua catchment occurs within the context of an integrated framework of operational actions and policy instruments developed as part of the Rotorua Te Arawa Lakes Programme to protect and improve water quality in the lakes. The overarching policy instrument is the Bay of Plenty Regional Policy Statement (**RPS**) which directs that the total amount of nitrogen that enters Lake Rotorua shall not exceed 435 tonnes per annum (policy WL 3B). I note that Regional Plan Change 10 has been developed to give effect to the RPS provisions for rural land and is currently going through a staged Environment Court decision making process.

31. In my view given the established importance of reducing nutrient flows to Lake Rotorua and the provisions of the NPS-FM it is necessary for the District Plan to address the issue of nutrient, and in particular nitrogen, flows arising from the expansion of urban land use in the Lake Rotorua catchment. In this case the Plan Change can seek to address the changes in nitrogen flows in the catchment arising from the Pukehangi Structure Plan.

32. I therefore generally support the introduction of new principles, objectives policies and methods to address this issue as recommended in the S42A report[16]. However I consider that to be consistent with existing provisions in the District Plan, which seek substantial reductions in nutrient flows from subdivision[17], and the RPS provisions, which require managed reductions in nitrogen flows, these new provisions should also direct that nutrient flows be reduced to achieve the RPS targets. I do not consider that an objective of no net increase in nitrogen flows can be stated to contribute to water quality improvements. Furthermore I do not consider

[15] Nicola Douglas Evidence paragraph 12.
[16] S42A report paragraphs 7.30, 7.31, 8.181 and 8.182.
[17] Policy 13.3.1.1

that these necessary limits on nutrients should be subject to a practicability qualifier as recommended for new policy 5.1.

33. I therefore recommend that the new provisions be amended as follows:

New General Principle
Development that is designed within nutrient management limits and contributes to the ~~no net increase~~ reduction in nitrogen entering Lake Rotorua.

New Objective 5 Pukehāngi Heights Development Area – Nutrient Management
Development within the Pukehāngi Heights Development Area results in ~~no net increase in~~ decreases in nutrient losses thereby contributing to water quality improvements in Lake Rotorua.

New Policy 5.1 Subdivision and land use shall~~, where practicable,~~ be designed to achieve nutrient losses within the nutrient limits of the land.

34. I support the intent expressed in the s42A Report that these provisions and the subsequent policies and methods be considered interim measures until district wide provisions are developed which are integrated with the final form of regional plan controls.

David Jeffery Marshall

20 September 2020

APPENDIX ONE

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MEMORANDUM

Date: 17 September 2020 Job No 32864
To: Te Arawa Lakes Trust
Subject: Plan Change 2 – Stormwater Review
From: Sean Finnigan

This Memorandum reports on my review of the revised WSP Stormwater report (September 2020) and evidence of associated Rotorua Lakes Council (RLC) stormwater/flood modelling experts.

This follows my initial review of the following documentation and attendance at the Stormwater Expert Caucusing held on 25 August 2020 by "Zoom" video platform:

- WSP (19 August 2020): PC2 - Pukehangi Heights Stormwater Report, Rev 02
- WSP – Powerpoint presentation entitled "PC2 – Pukehangi Heights Stormwater Caucus – Key Information (as of 21 August 2020)"
- BOPRC Modelling Maps showing different catchment locations and model coverage.

Part 1 of this Memorandum addresses:
1. The main concerns with the RLC model (August 2020).
2. Whether the RLC model accounts adequately for climate change?

1.1 INITIAL REVIEW AND OUTCOMES OF CAUCUSING

1.1.1 Over Conservatism of Model

In relation to flood modelling the use of the "72 hour nested storm" as used in the GUCM (Greater Utuhina catchment model) was agreed by all experts as not "overly conservative", but rather "appropriately conservative".

WSP had advised in their August 2020 report that the 72hr nested storm approach is a good method for determining peak flows (which determine the maximum water levels in streams) but overestimates storm volumes (which determine how much water pours out of a stream if it overtops), and that use of this storm duration has resulted in the detention ponds being bigger than originally modelled (i.e. a change from around 6ha to 14ha of total pond area.

Bay of Plenty Regional Council's (BOPRC) position as I understand (and agree with) is that use of the 72hr nested storm is appropriate as it allows for some rain occurring on the day before and after a major storm event and hence provides a robust and defensible methodology for representing antecedent ground conditions (i.e. allowing for the ground already being wet or streams having elevated water levels in them before the main storm hits). Alternative modelling approaches include modelling "heavy ended" storms or "ensemble storms".

For clarity:
- A "nested storm" is where for a given storm frequency (e.g. 100 year event (1% AEP event), storms of different durations are combined or "nested" together to produce a nested hydrograph or graph of rainfall versus time over the period of interest – 72 hours in this case.

- A "heavy ended" storm is one where the heaviest rainfall occurs in the last part of the storm, when ground conditions are already saturated and water levels raised. This phenomenon is reflected in the Fletcher Challenge Marathon storm (1999), Matata storm (2005), Wanganui River flood (2015) and Edgecumbe River flood (2017).
- An "ensemble storm" approach requires modelling multiple rainfall storms with different rainfall patterns and durations and has been adopted in Australia based on experience from actual floods which behaved differently and caused more damage than expected based on existing models.

1.1.2 Flood Frequency Analysis

As recorded in the Joint Witness Statement – Stormwater dated 1 September 2020 (**JWS**), an issue was raised about shortcomings in WSP's flood frequency analysis which was based on data from around 2005-present (15 year record), and which gave an estimated 100 year peak flow of 36m^3/s at the Utuhina Stream Depot Rd rainfall gauge. The data used by WSP in their analysis is from the right hand side of the graph in Figure 1.

In contrast, BOPRC consider (and I agree) that use of only the last 15 years of data gives an under-estimate of peak flows, as it misses multiple more severe flood flows from earlier years (see left hand side of Figure 1). If the earlier data is included, BOPRC obtained a 100 year peak flow of around 55m^3/s.

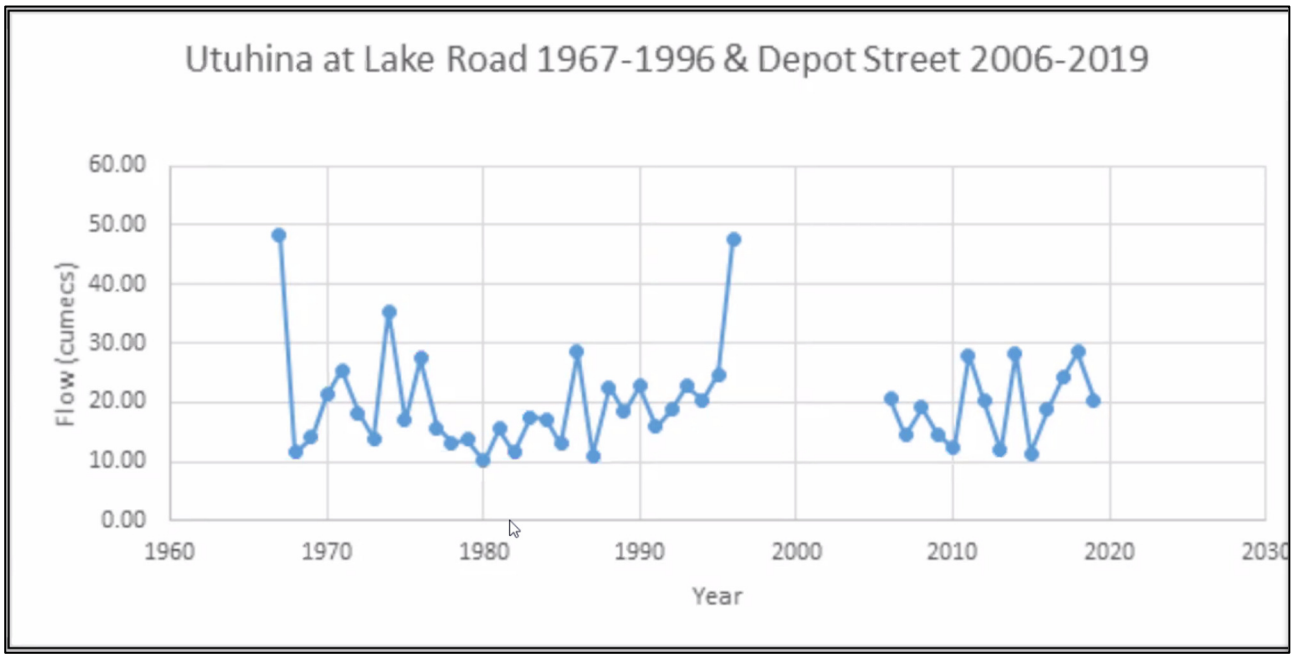

Figure 1: Utuhina Flow Data

1.1.3 Pond Draw-Down Time

As recorded in the JWS, an issue was raised about the drawdown time necessary in the system of ponds proposed by WSP for effects mitigation.

The WSP August 2020 report referred to initial testing showing that adoption of the 72hr nested storm approach meant that the detention ponds showed an adverse effect downstream as a result of the additional volume generated from using this approach.

This rasied questions about whether the ponds are already being partially filled during the first 24 hours of the storm, when rainfall intensities are typically of the order of 1-3mm/h and it would be expected that the resulting runoff would pass through the ponds without any water being stored over this period. The period of time some ponds may be taking to drain following a storm event is also an issue.

This is a significant point, as the downstream effects are sensitive to pond discharges. If the ponds take too long to drain, they could be subject to additional storms before being fully empty, while downstream water levels would also still be elevated, when a second storm hits. Furthermore, grass in the ponds may die if under water for too long.

BOPRC requested additional information on the pond layout and connectivity.

I shared the view of BOPRC that the current modelling results can not be relied on, without further proof being provided that the pond design is adequate, and if not, that the ponds need to be redesigned and the system remodelled.

It was agreed that the ponds ought to be sized so that "50% of volume stored within detention ponds that can only drain via the lowest outlet, shall drain within 24 hours."

As recorded in the JWS, all experts agreed that further assessment was required to advance discussions and to reach agreement on the effects assessment. Time has not however allowed for the experts to reconvene to have those discussions following the further modelling.

1.2 INCORPORATION OF CLIMATE CHANGE

In accordance with BOPRC advice (2019), climate change has been modelled for the future condition, as of 2130, allowing for a 3.68°C temperature increase, which is equivalent to climate change model RCP8.5 (RCP = relative concentration pathway). This is discussed more fully in the WSP August 2020 report in section 3.1.4.

Peter West (Blue Duck Consulting, on behalf of BOPRC) has advised that climate change has been applied as per Table 6 of NIWA's HIRDS V4 report (August 2018), reproduced below. For a nested storm, the percentage increase per degree is worked out for each duration component before nesting, so this means appropriate rainfall increases are applied to different storm durations within the nested storm. This means for a 3.68°C temperature rise, for the 100 year storm, the 1 hour duration rainfall is increased by 50% (3.68 x 13.6%), while the 72 hour duration rainfall is increased by 25.4% (3.68 x 6.9%).

Table 6: Percentage change factors to project rainfall depths derived from the current climate to a future climate that is 1 degree warmer.

DURATION/ARI	2 YR	5 YR	10 YR	20 YR	30 YR	40 YR	50 YR	60 YR	80 YR	100 YR
1 HOUR	12.2	12.8	13.1	13.3	13.4	13.4	13.5	13.5	13.6	13.6
2 HOURS	11.7	12.3	12.6	12.8	12.9	12.9	13.0	13.0	13.1	13.1
6 HOURS	9.8	10.5	10.8	11.1	11.2	11.3	11.3	11.4	11.4	11.5
12 HOURS	8.5	9.2	9.5	9.7	9.8	9.9	9.9	10.0	10.0	10.1
24 HOURS	7.2	7.8	8.1	8.2	8.3	8.4	8.4	8.5	8.5	8.6
48 HOURS	6.1	6.7	7.0	7.2	7.3	7.3	7.4	7.4	7.5	7.5
72 HOURS	5.5	6.2	6.5	6.6	6.7	6.8	6.8	6.9	6.9	6.9
96 HOURS	5.1	5.7	6.0	6.2	6.3	6.3	6.4	6.4	6.4	6.5
120 HOURS	4.8	5.4	5.7	5.8	5.9	6.0	6.0	6.0	6.1	6.1

The adoption of this scenario is based on the reality that current emissions are tracking towards this temperature increase and a desire to design infrastructure to be resilient. However, this scenario does not allow for any reduction in emissions over the next 110 years. WSP considers that this pathway has a low probability of eventuating and could potentially result in over conservative design. They advise that a more pragmatic approach might be to allow additional space for expansion of the attenuation areas in the future, once the likely outcome is better understood. They consider that the RCP 6.0 scenario is a "middle of the road" prediction of climate change and has been adopted by several territorial authorities for similar

catchment wide and effects based studies. The RCP 6.0 scenario allows for a 2.2^{0}C temperature rise by 2130, which would reduce the percentage increases in rainfall referred to above for the 1-72 hr duration events to 15.2-29.9% (i.e. approximately 60% of RCP8.5 scenario).

It should be noted that the flood modelling done compares the post-development situation (i.e. PC2 area developed) with the pre-development (existing) situation with or without climate change rainfall applied to both cases. Hence, the ponds provide for mitigation of the effects of the PC2 development but not for mitigation of the effects of climate change. This is common practice in my experience – any new development will aim to address climate change effects within the development area itself, so as to avoid adverse downstream effects from its development. Addressing downstream climate change effects as well is not normal, unless specifically required under a planning instrument or similar (e.g. District or Regional Plans, Stormwater network discharge consents, Catchment Management Plans), or driven by Council who may then contribute towards any associated increased stormwater system costs over and above what is required to serve the development alone.

2 SUBSEQUENT REVIEW OF REVISED STORMWATER REPORT AND ASSOCIATED RLC EVIDENCE

This part of the memorandum provides feedback following review of the following documents:

- Statement of Evidence of Liam Foster (Technical Principal Water, WSP)
- Statement of Evidence of Mark Pennington (Senior Water Resources Engineer and Technical Director, T&T)
- WSP (14 September 2020) "PC2 – Pukehangi Heights Stormwater Report" report prepared for Rotorua Lakes Council – version 3 – post caucus and additional modelling work reporting

This review provides an update to the main concerns raised with the RLC model at the Stormwater caucusing, based on the more recent information provided referred to above and then provides a brief summary and discussion of the revised modelling results.

2.1 MAIN CONCERNS

I note that Liam Foster's evidence clearly explains the main changes made to the modelling and report post-caucus in paragraphs 13-14 of his evidence.

2.1.1 Over Conservatism of Model

WSP has edited their report to refer to the model findings being conservative. However, there are still some inferences throughout the report to the 72h storm not being the most appropriate for sizing detention basins. For example:

- Section 3.1.2.2 states "*Further design phases may need to be undertaken using a different frequency based approach*".
- Sections 3.1.3 and 3.1.4 states "*gaining agreement with regulatory authorities prior to consent on alternative approaches for rainfall assumptions for subsequent design stages should be sought*", while there is a similar statement in section 3.1.6.
- Section 3.1.7 states "*subsequent stages after rezoning will work to test the approach utilised to support a precautionary assessment for Plan Change and work with regulatory authorities on a overall approach to the catchment through to future consent application phases*".

In my opinion, the design storm of 72 hours appears to be appropriate, based on catchment specific data analysis presented by BOPRC and my limited involvement to date. Furthermore, the detention ponds (or basins) are designed to drain 50% within 24 hours, but will take longer time periods to drain completely. The Stormwater report (page 39) refers to Basin 10 taking the longest to drain, but being empty within 3 days (72 hours) of the peak volume being passed. Additional information in Tables A1-A3 of Appendix A includes pond emptying times, showing they range from 48-63h for the 10% AEP to 1%+CC AEP storm events for Scenario 15, while corresponding times for Scenario 16 are 57-68h, supporting this. This further reinforces the 72 hour design storm being appropriate.

2.1.2 Detention Pond Design

As noted, it was agreed by all experts that the detention ponds should be sized so that "50% of volume stored within detention ponds that can only drain via the lowest outlet, shall drain within 24 hours."

The revised stormwater modelling was based on changing the pond outlet configurations to achieve this objective (essentially rearranging and resizing the orifices on the pond outlets). This was done for two scenarios 15 and 16, with the orifice details reported in Table 2-1 of the WSP September 2020 report.

For scenario 15, the pond orifices were reassessed to achieve the "50% drain down in 24 hr" objective, while higher soakage rates were applied than in earlier scenarios – 10mm/hr for the top terrace and 15mm/hr for the bottom terrace, compared with 5mm/hr in the August 2020 modelling work. Section 3.1.7 of the report explains that the adopted soakage rates are at least three times less than actual soakage rates measured at eight locations across the site from limited field investigations and hence are considered to be conservative.

For scenario 16, the lowest pond orifices were replaced with smaller diameter outlets, with a secondary larger diameter outlet placed between 0.5-0.6m above the pond base, corresponding approximately to the 10% AEP design event. This was done to further enhance the "plan change outcomes away from pure flood management for the modelled scenarios so that more frequent events than the 10% AEP are not made worse as a direct result of the plan change proposals" (refer section 4.1 of Stormwater report). This is discussed further in Section 2.2 of this memo.

The updated modelling results for the ponds are presented in Tables 4-2 and 4-3 of the WSP Stormwater report. These tables show that pond drain down times for the 10% AEP event up to and including the 0.2% AEP event with climate change are a maximum of 1280min for Scenario 15 and 1360min for Scenario 16, all of which comply with the 50% 24hr (1440min) drain down criteria.

It is noted that the drain down times reported for Scenario 15 are highest for the 1% AEP storm event and decrease for the 1% +CC (climate change) AEP event and decrease further for the 0.2% + CC AEP event. My understanding, from an email discussion with Liam Foster is that this is a consequence of the relative heights and sizes of different orifices and when they are activated for different storm events.

Hence, the detention basin design objective is achieved for both scenarios.

2.2 MAIN FINDINGS OF UPDATED MODEL

Liam Foster in his evidence advises that their investigation has targeted determining whether a solution can be found that can avoid increased flood risk downstream, with adverse effects being measured in terms of increased downstream flood levels. Their revised modelling has found that the adopted stormwater management approach can have a neutral or positive effect on peak flood water levels and peak velocities downstream. Of the two scenarios run, Scenario 16 enables greater certainty for similar outcomes for more frequent events than those currently modelled.

Their modelling covered 10% AEP (10 year), 2% AEP (50 year), 1% AEP (100 year) and 0.2% AEP (500 year) events, with the 1% and 0.2% events also allowing for climate change. They produced difference maps which are included in Appendices B and C of the WSP Stormwater report. These difference maps show the change in flood level and velocity relative to the existing situation. They generally show a decrease in flood level of 10-100mm for all scenarios. Three typical maps are shown below. The first shows the existing predicted flooding for the 1% + climate change storm. The second and third are difference maps for depth and velocity respectively, where the different colours show the modelled changes in flood level and velocity. All green colours represent decreases in flood level.

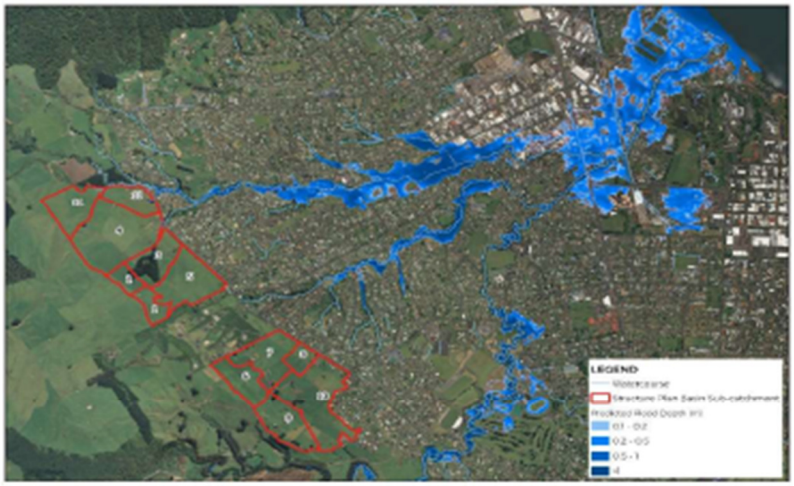

Figure B- 7 – GUCM – 1% + CC - Flood Map – Depth - Existing State

Figure B- 8 – GUCM – 1% + CC - Depth Difference map – Scenario 15

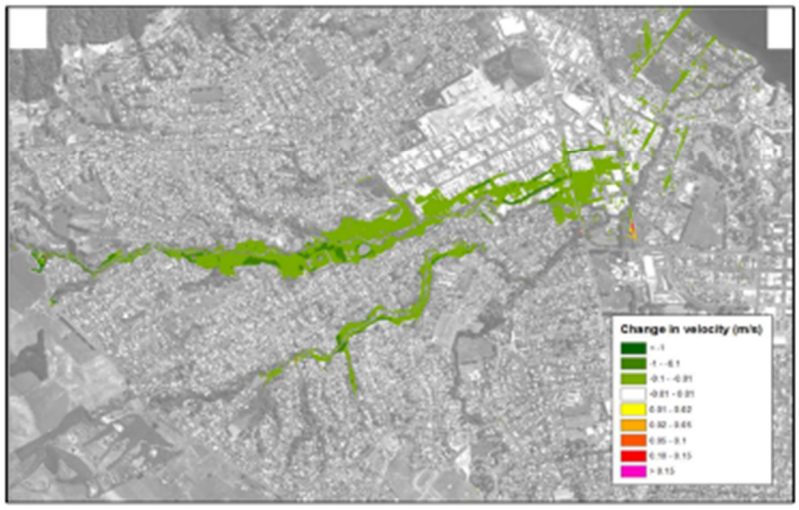

Figure B- 9 – GUCM – 1% + CC - Velocity Difference map – Scenario 15

Figure 2: WSP Flood Modelling Results (September 2020)

The revised modelling also included checking a number of other issues, including the following:

- Risk of basins spilling – this was found to be low, but it was acknowledged that no formal design of the overland flowpaths from the ponds has been undertaken at this stage.
- Storage availability post-event, checking what additional rainfall events the basins could accommodate following a design event. Their analysis found that the ponds have enough capacity to accommodate an additional 90-100mm of rain within 24h of the design storm, or over 160mm of rain after 48 hours.

As discussed briefly in section 2.1 of this Memo, Scenario 16 aims to address more frequent storm events than the 10% AEP storm. More reference to this is made on page 61 of the WSP Stormwater report including "it is recognised that the more frequent events are the events that 'form' the channels with the larger events acting as a flush to the system" and on page 64 that Scenario 16 will help to achieve the requirements identified within BOPRC-01 (2012). Liam Foster has advised by email correspondence (17/9/20) that Scenario 16 was run as it was considered that the larger lower orifices of Scenario 15 were likely to be showing an increase in post-development flow for events less than the 10% AEP event modelled.

BOPRC-01 (2012) (updated as at December 2015) provides Stormwater Management Guidelines for the Bay of Plenty region. The channel erosion issue is briefly described in Section 2 (see extract in Figure 3) of these guidelines and in more detail in part 7 under "stream channel erosion mitigation criteria".

Channel erosion

As bankfull flows increase in frequency with development, the channel erodes to become stable for the increased flow and velocity. As shown, this often results in a wider, "U" shaped channel, the most efficient shape for transporting the flow. During this process, aquatic habitat is lost.

Figure 3: BOPRC-01 (2012) Description of Channel Erosion Effects from Development

In my opinion, with both Scenarios 15 and Scenario 16, further consideration needs to be given to the effect of detention basin discharges resulting in prolonged elevated flows in the downstream network, compared with the pre-development situation, this being a consequence of the greater volume of post-development runoff. The main potential effects of prolonged elevated flows are:

- Reduction in the capacity of stormwater pipe systems discharging directly to watercourses, due to elevated water levels in the stream slowing down the rate of discharge (tailwater effect).
- Increased stream channel erosion, as it is these more common storm events that tend to shape the stream channel.

Whilst the WSP Stormwater report does refer to these issues, they are not discussed in detail. In my opinion, these are important issues, that should be considered as part of an overall holistic approach to catchment management, rather than simply focusing on flooding.

WSP refer to there potentially being a lot more soakage available than allowed for (even with the increase made to their infiltration parameters compared with the previous WSP Stormwater report) which will help to reduce runoff volumes, and other "water sensitive design" measures that can be taken to reduce runoff volumes.

2.3 FURTHER WORK RECOMMENDED IN MODELLING REPORT

There are multiple references in the stormwater report to doing further work later, with the implications of some statements being this could result in significant changes to the stormwater system, including possible changes to the 72 hour nested design storm (see section 2.1.1) of this memo.

Mark Pennington's evidence also alludes to this, advising that while the modelling has identified at least one solution to the stormwater and flood management considerations, this may not be the optimal solution able to be achieved, and an optimal solution may emerge through subsequent stormwater master planning work

currently being undertaken. Hence, he advocates flexibility be allowed for in the approach to delivery of the stormwater and flood management system.

The proposed basins will take up about 14ha (refer SMP, Table 2-1) of the approximately 150ha PC2 area, or 9.3% of the total area which is significant. Table 2-1 of the SMP refers to this 14ha area representing the maximum top water level. It is not known whether this is based on the ponds being "boxes with vertical sides" or whether side and base slopes have been allowed for, which would increase the area required. Additional area would be required for freeboard, access and a perimeter buffer. This is likely to increase the total area by several hectares. It is not clear if the pond areas shown on the Structure Plan allow for this additional area. It is important, in my opinion, that the pond area on the Structure Plan should be appropriate at the Plan Change stage.

There are also a large number of ponds, which are understood to be spread out across an "escarpment" or terraced typology. There will be an ongoing operation and maintenance responsibility and associated cost to RLC. It is not clear whether much thought has been given to how these ponds might become community assets, by for example being sportsfields with sand carpets (or similar) that drain well and function as flood storage areas. Based on an indicative sportsfield area of 1.3ha, five ponds may be large enough for this use. Some of the larger ponds are reasonably close to each other and could potentially be combined to form a larger multi-field park.

It appears that there may be a desire to reduce the area taken up by the ponds as part of future work, through possibly adopting a different design storm or other measures, such as adopting increased soakage rates, so as to increase the area available for residential development.

It is unclear how much flexibility the PC2 process allows for changes in stormwater system design at a later stage and to what extent. It may not be easy to relocate or resize a stormwater pond as water only flows downhill and hence the ponds must be at or near the bottom of their respective catchments and their sizing is interrelated – i.e. if one pond is resized, its location changed, and/or its discharge point changed, this will affect the entire system, and should be checked by rerunning the entire model. Hence, in my opinion, it is preferable that the stormwater management system be designed, modelled and approved in an integrated fashion (with the associated ponds being shown on the approved Structure Plan) as part of the Plan Change approval process, rather than left to be revised/refined later, other than possible minor changes.

In addition, a mechanism should be put in place for any significant changes to this system to be remodelled as part of Plan Change implementation. The RLC Planner, Craig Batchelar, advised that they would have liked to have had more certainty on the stormwater modelling before the Plan Change was notified. However, he noted there are other "hold points" in place which mean development can't go ahead until the stormwater issues are resolved. These include the subdivision resource consent process and the BOPRC stormwater discharge consent process. The latter may be addressed as part of a comprehensive stormwater discharge consent application being prepared by RLC for a wider area, or separately by a stormwater discharge consent for the Utuhina catchment.

3 OTHER COMMENTS

3.1 Report Inconsistency or Confusing Statements

There are some inconsistent or confusing statements – some examples include:

Section 1.3 refers to runoff from site and upgradient rural catchments being captured and drained to the 12 detention basins, which differs from the statement at the bottom of page 16, while Table 2-1 shows that only a total of 9.9ha of upgradient rural catchment is drained to the ponds. This has been discussed with Liam Foster (WSP) who has advised by email (17/9/20) that "*paragraph 1 under Figure 1-6 should include a link to Figure 2-5 to show which areas of upstream catchment are routed to the ponds (as well as the current reference to the figure above showing the approximate basin locations). In Figure 2-5, the three larger sub-catchments above the development are captured and conveyed through (or around) the plan*

change area (see Figures 2-4 for one way to do this). The areas (blue on Figure 2-5) that are more proximal to the plan change area, the 9.9ha, have at this stage been captured and routed through the basins. The existing flowpaths for the larger areas that interact or flow through the area are to be maintained and protected with 10 or 15 m buffers to pass this flow through the plan change area. Section 1.3 on p4 presents these two alternatives but I suspect the following text doesn't clarify it enough as to what have done".

Section 4.1.2 refers to the second orifice for scenario 16 being placed at the ~10yr storm event level (which is consistent with Figure A-1, but section 4.1.2 (last paragraph) refers to the scenario 16 basins being configured to effectively prevent increased flow for events down to the 50% AEP event post-development, while Section A-1 refers to the primary orifice being sized for the 50% AEP event.

In response, Liam Foster has advised by email (17/9/20) that the "*lowest orifice is sized to pass forward the 50% AEP flow (based on calculations seeking to not increase peak flow post development, undertaken outside the model software, using discrete rainfall distributions (as noted in Section 2.2.1.1)). The second outlet is located to only start to be used at about the 10% AEP event. These were then tested in the spreadsheet model referenced in Section 2.2 to check that the peak flows were not increased across a range of AEP and durations.*"

Page 48 states "plan change configurations for both scenarios 15 and 16 are not resulting in negligible effects downstream". Liam Foster has clarified that the word not should be deleted from this statement, so that it reads "are ~~not~~ resulting in negligible effects downstream". This makes sense.

These issues are minor and not considered to change the report findings.

4 SUMMARY AND CONCLUSIONS

Overall, I consider that the concerns raised by BOPRC have been adequately addressed, in relation to the basin drain down time and assessment of downstream effects, in relation to flooding. I have discussed this briefly (email and telephone) with Peter West and Peter Blackwood of BOPRC but have not had the opportunity to view the evidence of these BOPRC experts before submitting this Memo to the Trust.

I do have some ongoing concerns about the effects of prolonged increased peak flows on stream channel scour/erosion and downstream pipe capacity effects, but the WSP Stormwater report does refer to these issues and Scenario 16 goes some way to addressing them, while the WSP Stormwater report suggests these issues would be looked at further as part of future work. I support these issues being further addressed as part of further design and modelling work.

I also have some concerns about the flexibility of the PC process in allowing for further stormwater system design changes and remodelling and consider that the stormwater system should be reasonably certain (say 90% finalised in terms of location and land area required) at the PC approval stage. However, I acknowledge that there are other opportunities, or hold points, to address a lack of certainty, as raised by Craig Batchelar, RLC Planner.