BEFORE THE HEARING PANEL

IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of Proposed Plan Change 37 - Nukuhau (private) by AN Rajasingham LPT Trustees No 124 Limited anors to the Taupo District Council to rezone c.78ha of land in the Nukuhau area from Rural Environment to a mix of General Residential and Mixed Density Residential with a Neighbourhood Shopping Centre overlay.

STATEMENT OF EVIDENCE OF WARREN STANLEY BIRD (STORMWATER)

Dated 20 October 2021

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INTRODUCTION

1. My full name is Warren Stanley Bird.

2. I hold a Bachelor of Engineering (Civil) from the University of Canterbury. I am a Chartered Member of Engineering New Zealand and a Chartered Professional Engineer in the practice area: Design of 3-waters.

3. I am employed as a Technical Principal - Stormwater in the Earth, Environment and Water business of WSP (NZ) Limited (**WSP**), based in Auckland. In this capacity I am responsible for providing consultancy services, predominantly in the field of stormwater management, as well as supporting other professionals engaged in these activities.

4. My professional experience spans a total of 38 years. The first third of my career was spent principally with an urban/rural local authority, working in the fields of water supply, wastewater, and stormwater disposal, urban flood protection, roading and traffic management, building and subdivision control and refuse landfill management. I have spent the last 24 years working for two different Auckland consultancies predominantly in the field of stormwater management in its many forms (e.g. preparation of catchment management plans, erosion and sediment control planning, urban flood protection projects, reticulation upgrading and the treatment and disposal of stormwater in conjunction with commercial, institutional and highway projects). For the development of individual sites (e.g. schools, prisons, commercial developments) I frequently provide design services for water, wastewater and stormwater.

5. My experience relevant to Proposed Plan Change 37 – Nukuhau (**PC37**) is as follows:

    a) Design and consenting of the East Taupo Arterial.

b) Review of upgrading options following a 2012 flood event in the Brentwood gully.

c) Design of the Wharewaka subdivision.

6. Two of these projects involved construction on erosion-prone pumice land. The other was in response to a major flooding and erosion event.

7. I have been engaged by the Applicants to provide evidence in relation to stormwater matters in relation to PC37.

8. I have been following the Nukuhau development since late 2017, when I was originally nominated for involvement. By the time the project eventuated, other personnel within WSP undertook the 3-waters design role, and my role was restricted to discrete design advice. The engineer primarily responsible for the stormwater concept design to date has since left WSP and is unavailable for this hearing. However, he has comprehensively briefed me on all relevant matters. I confirm I have read and adopt the findings in the following reports in all material respects:

a) *Nukuhau Structure Plan Development: Desktop Study – Water and Wastewater* dated 8 July 2020 - Appendix D to the Plan Change Request; and

b) *Nukuhau Plan Change – Stormwater Management* dated October 2020 – Appendix F to the Plan Change Request.

ENVIRONMENT COURT CODE OF CONDUCT

9. I confirm that I have read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2014 and have complied with it in preparing this evidence. I confirm that the issues addressed in this evidence are within my area of expertise and I have not omitted to consider

material facts known to me that might alter or detract from the opinions expressed in my evidence.

SCOPE OF EVIDENCE

10. My evidence will cover the following matters:

    a) A brief outline of the 3-waters approach proposed for the Nukuhau growth area;

    b) Comments on specific 3-waters issues raised by submitters;

    c) Comments on 3-waters issues raised via the s42A report; and

    d) My conclusions.

SUMMARY OF EVIDENCE

11. My evidence covers the fields of potable water, wastewater and stormwater.

12. Potable water can be obtained from the Taupo township supply, but a pump station and pipes will need to be upgraded to ensure sufficient pressure is maintained.

13. Wastewater from the Nukuhau development can be discharged by gravity into the Taupo township reticulation once capacity limitations in the existing system are addressed. The required work is already on Taupo District Council's (**TDC**) work programme. Until that time, no Nukuhau discharge should occur unless other arrangements have been made.

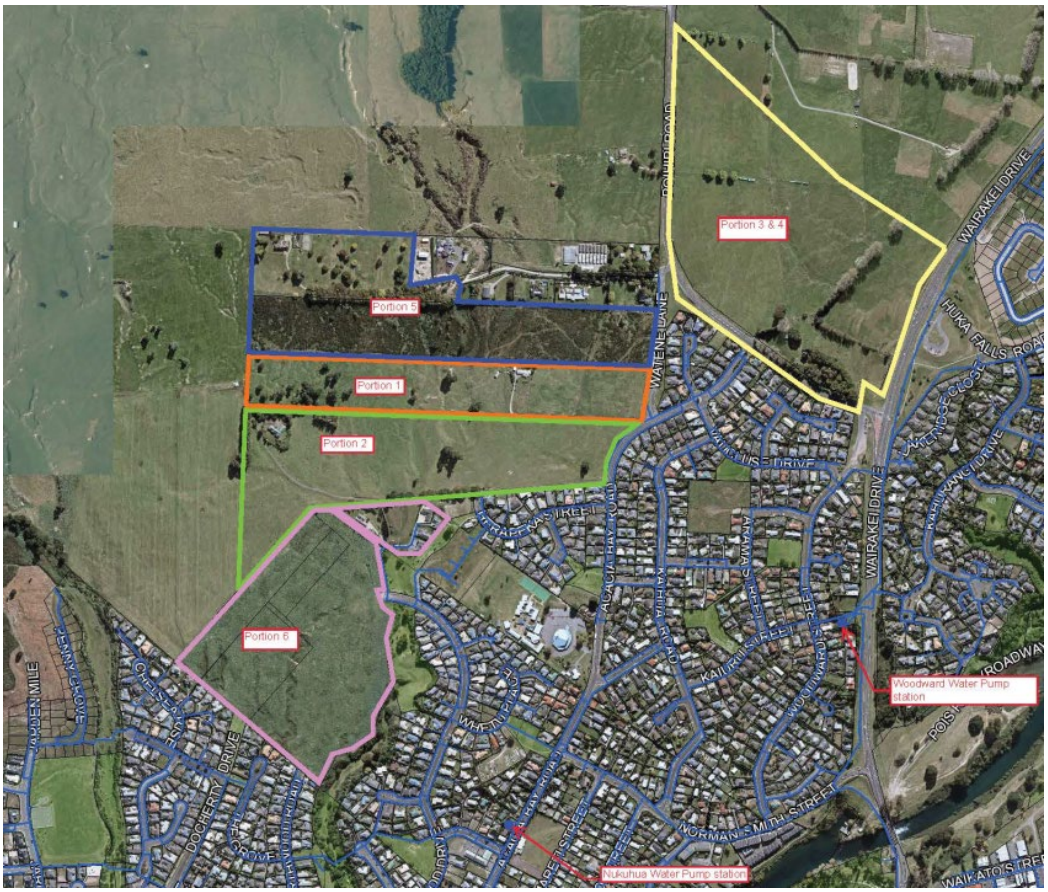
14. Stormwater disposal will be primarily to ground soakage (after first being treated where it arises from roads). Excess flow in large storms (greater than 10% Annual Exceedance Probability (**AEP**)) will flow as overland flow to existing natural gullies, which will be retained and enhanced to convey flow without erosion.

PC37

15. A full outline of the proposed Nukuhau Structure Plan is included in the Private Plan Change Request.[1] The water and wastewater assessment is based on an ultimate development of 780 residential lots in 78 ha of rural Nukuhau. A portion of the development area has been earmarked for a local centre zone. For simplicity of calculation at this plan change stage, water demand and wastewater yield from this commercial land-use have been assumed to be the same as standard residential development. A detailed analysis will be carried out in conjunction with detailed design.

16. In my evidence I refer to "portions" of the PC37 area. These portions are as per Figure 2 of the *Desktop Study- Water and Wastewater*. A part of Figure 2 from that study is reproduced below for convenience.

[1] Nukuhau: Private Plan Change Request to the Taupo District Plan, v4, WSP, 20 January 2021.



DESIGN CONCEPT – POTABLE WATER

17. Water supply to the Nukuhau area is addressed in depth in the report *Nukuhau Structure Plan Development: Desktop Study – Water and Wastewater*[2] which is Appendix D to the Private Plan Change Request. The water supply analysis was updated in June 2020 and included as Appendix B1 of that report[3].

18. Anticipated flows were calculated for the Nukuhau Structure Plan area in accordance with Section 6.5.11 of TDC's *Code of Practice for Development of Land* (2009), yielding the figures tabled.[4] Note that the tabled areas are now overstated as they relate to an earlier version of the plan change

[2] WSP Consultants, v4, 8 July 2020.
[3] Appendix B1: Water Modelling Report – June 2020.
[4] Reproduced from Table 1-1, Appendix B1, *Nukuhau Structure Plan Development, Desktop Study – Water and Wastewater.* Issue 4, WSP, 8 July 2020.

documentation. The flows are therefore overstated similarly and may be considered conservative.

Table 1-1 : Nukuhau development demand summaries

			A	B = 2/3B	C	D = B + C
Portion	Size (m2)	Estimated Lots (no.)	Qpeak (L/s)	Domestic Demand (L/s)	Fire Flow (L/s)	Total Demand (L/s)
1	90,936	93	10.46	6.97	12.5	19.47
2	145,540	149	14.08	9.39	12.5	21.89
3 & 4	336,049	239	18.98	13.7	12.5	26.1
5	211,074	151	14.20	9.47	12.5	21.97
6	149,845	168	15.19	10.13	12.5	22.63
TOTALS	933,444	800	72.91	48.62		

Table 1-1 above tabulates the demand calculations used for the modelling work from ref: (WSP-Opus, 2019).

19. The relevant design flows are the greater of those in column A or column D. The internal reticulation in each Structure Plan area will be designed and sized to provide these flows.

20. The wider water supply network analysis was based on the InfoWorks water network computer model developed by WSP for TDC in 2019. Features of that model included:

    a) Inclusion of a future trunk water main linking Acacia Bay to the Taupo water supply system.

    b) Consideration of a number of future development areas, including Nukuhau.

21. Further model runs were then carried out to assess the effect of the Nukuhau development in isolation.

22. The Nukuhau development area lies adjacent to two TDC District Metering Areas (**DMA**): Woodward DMA and Nukuhau DMA. Nukuhau Portions 1-5 are located alongside the Woodward DMA, served by the Woodward pump station and Portion 6 is located alongside the Nukuhau DMA, served by the Nukuhau pump station. Both these pressure zones comprise pump-

boosted reticulation. That is, there are no storage reservoirs or header tanks within either of these zones; pressure is maintained solely by the operation of the pump stations.

23. The water network model found that the Nukuhau pump station and DMA reticulation are sufficient for Portion 6 to be connected and will provide sufficient supply and pressure to the development area without causing excessive pressure-drop in the existing system.

24. However, this is not the case for the Woodward DMA, where the existing network and pump station will require upgrading before Portions 1-5 can be connected. Upgrading will involve approximately 1.2 km of new 150 and 200 mm diameter pipe outside the Structure Plan area as well as new pump-sets at the station.

25. Further upgrading will be required upstream of the two pump stations, but this upgrading will be required regardless of whether the Nukuhau development proceeds.

26. In the medium to long term, TDC plans to construct several new reservoirs, including one at Poihipi Road, on high ground above the Structure Plan area. This will serve as a header tank to maintain pressure, as well as providing additional water security in the event of pump or power supply failure, or extraordinary demand. However, the PC37 development is not contingent on this reservoir.

DESIGN CONCEPT – WASTEWATER

27. Nitrogen is a key pollutant of Lake Taupo. Sources of nitrogen in groundwater (which feeds the lake) include livestock and domestic septic tanks. Urban development of the Nukuhau area will deliver a net reduction in nitrogen to groundwater, as the developed area will be fully reticulated to the Taupo wastewater treatment facility, and livestock will be eliminated. I recommend that septic tanks are not permitted.

28. Wastewater disposal is covered in the report *Nukuhau Structure Plan – Desktop Study – Water and Wastewater*[5].. The study included computer modelling using TDC's own InfoWorks CS sewer model of the north-Taupo wastewater reticulation, with and without the Nukuhau development. Moreover, the model includes pipe system survey at critical locations, and has been calibrated against several rainfall events.

29. Wastewater flow from the Nukuhau Structure Plan area has been estimated as follows:[6]

Table 3: Development Wastewater Design Flows

Development Portion	Estimated HUE	Wastewater Design Flows (Code of Practice TDC)	5 x ADWF
Portion 1	93	5.8 l/s	3.6 l/s
Portion 2	149	9.4 l/s	5.8 l/s
Portion 3 & 4	239	15.0 l/s	9.3 l/s
Portion 5	151	9.5 l/s	5.9 l/s
Portion 6	168	10.6 l/s	6.6 l/s

30. Flows have been estimated using both the TDC Code of Practice which rather conservatively requires 8 times Average Dry Weather Flow (**ADWF**)and 5 times ADWF. The 5 times figure is commonly applied around New Zealand (for example NZS4404 – *Land Development and Subdivision Infrastructure*). The wastewater system analysis underpinning this plan change application has been based on the TDC methodology, which means that the real impacts on the downstream receiving system are likely to be even less than indicated by the modelling.

[5] WSP Consultants, Issue 4, July 2020.
[6] Reproduced from Table 3, *Nukuhau Structure Plan Development, Desktop Study – Water and Wastewater.* Issue 4, WSP, 8 July 2020.

31. The existing Nukuhau/Brentwood urban area wastewater drains by gravity to and across the Control Gate Bridge to the Taupo Wastewater Treatment Plant.

32. The Nukuhau Structure Plan area is higher again than the existing Nukuhau/Brentwood area, so the new wastewater reticulation will be able to drain by gravity to existing connection points at its lower boundary, and from there to the treatment plant. There are some complexities regarding available capacities downstream of the respective connection points that will need to be worked out in detail. Simply put, some upgrading of the downstream system will be required, with the precise extent and location dependent on final development patterns and staging.

33. Most significant of all is that the wastewater pipe across the Waikato River at the Control Gates Bridge is under-sized. Pipe upgrading is in TDC's Long-Term Plan for 2021-23, but until that happens the system is unable to receive Structure Plan area flows at peak times without risk of overflowing.

34. Options available to the Nukuhau developers in the interim include the following:

    a) Defer development until sewer upgrading is completed;

    b) Provide wastewater storage tanks for retention and off-peak release of wastewater flow; or

    c) Provide a separate community wastewater treatment facility.

35. Option c) is likely to be unattractive in light of capital and whole-of-life costs, nitrogen constraints, consenting complexities and community perception. However, options a) and b) are feasible, and I suggest specific details can be considered during the future subdivisional consenting phase. In the meantime, it is sufficient to conclude that there are both interim and

long-term options available for wastewater servicing of the Nukuhau Structure Plan area.

DESIGN CONCEPT – STORMWATER

36. The Nukuhau Structure Plan area is part of the Nukuhau catchment. The PC37 area lies adjacent to approximately 20% of the length of the 6km Nukuhau main gully and is located roughly a quarter of the way up the catchment. The PC37 area rises from RL400m at its southern extent (Portion 6/Rangatira 8A17) to RL 450m in the north (Portion 5/59 Watene Lane).[7] Upstream of the Structure Plan area lies a further 306 ha of rural and forestry catchment, rising to an elevation of approximately 600 m.

37. Stormwater servicing of the Nukuhau Structure Plan area is addressed in the report *Nukuhau Plan Change – Stormwater Management* which is Appendix F to the Plan Change Request (**Stormwater Management Report**).[8]. The report incorporates the results of catchment computer modelling carried out specifically to inform the plan change proposal.

38. Fundamentally, the report recognises the importance of preserving Lake Taupo water quality and proposes adopting BPO measures in line with the Waikato Regional Council (**WRC**) stormwater guideline[9] to ensure this.

39. The Stormwater Management report includes a table summarising its recommended strategy (refer Table 8-1 of report). For roads, strategies include: treatment prior to soakage disposal for flows up to 10% AEP, with excess flowing away via overland flow paths and gullies. For private properties, strategies include: rainwater harvesting/storage and soakage disposal for flows up to 10% AEP, with excess flows to overland flow paths and gullies. Table 8.1 should be considered more of a menu of options

[7] For context, Lake Taupo has a normal water level of 357m asl.
[8] WSP Consultants, Rev 2, October 2020.
[9] *Waikato Stormwater Management Guideline*, Waikato Regional Council technical report 2020/07.

rather than a comprehensive prescription. That is, detention could be achieved by any of the options listed.

40. Further detention in the gullies will restrict the 1% AEP flows to no more than their pre-development levels (noting that for some developments a portion of this extra detention could be provided on-site instead, and conversely, for some discrete areas some of the 10% AEP soakage may need to occur in the gullies).

41. The Nukuhau area comprises deep pumice soils, which routinely provide exceptionally good soakage, to a groundwater table 10 or more metres[10] down. These soils are also exceptionally erosion-prone and can become hydrophobic (i.e. resist water penetration) in certain conditions. That is, very dry pumice soils (e.g. late-summer) initially repel water until "wetted-up". During very heavy rainfall, infiltration is often negligible at the start of the storm, leading to surface flow, but after wetting-up the infiltration rate increases substantially.

42. Our strategy is therefore to provide soakage as close to source as possible, hence the individual property soakage devices. This will avoid the concentration of water into a few large devices that could be prone to failure or tomo formation. (This is consistent with TDC advice that multi-lot soakage devices have been unsatisfactory in the past.) Private soakholes will be designed in accordance with TDC's Code of Practice, which prescribes a porous concrete manhole sized to manage the 10 year ARI, 1 hour rainfall, through 25% soakage and 75% storage. The cooler, more humid, sub-surface conditions of the soakhole are expected to be less prone to hydrophobic conditions than an equivalent surface device. The 75% storage component also allows for capture and retention of water during the initial wetting phase, after which soakage is much increased.

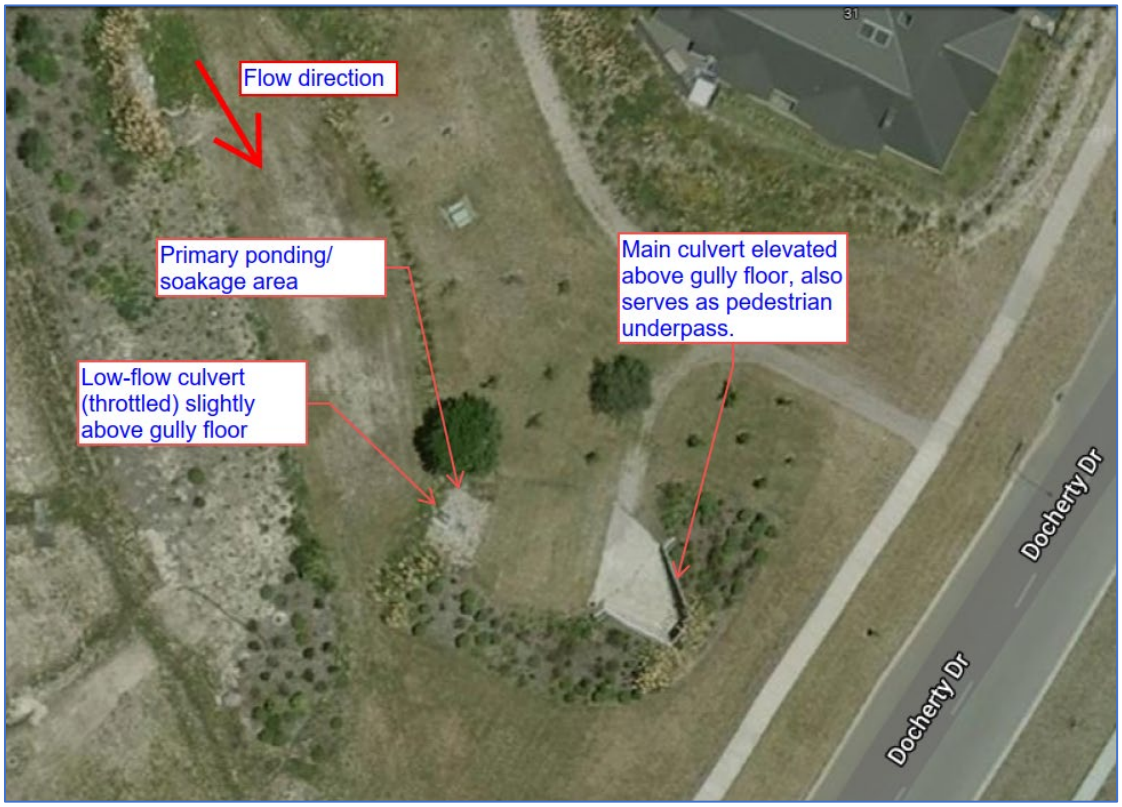
[10] Testing in winter 2000 identified groundwater 12-15m deep, with some localised (probably perched) zones at 4.5m depth.

43. Our strategy for drainage of roads is broadly similar. Council's Code of Practice requires treatment through a gross pollutant trap (or something better) prior to discharge to a soakhole. In the case of Nukuhau, treatment is expected to be provided via swales. Minor rainfalls will percolate through a bioretention base where contaminants will be trapped allowing treated rainwater to soak away into the sub-strata. Higher flows will flow lengthways along the swale, being treated by the vegetation along the way before arriving at an end-of-swale soakage area. Vegetation will be carefully selected to withstand arid conditions and topsoil will be formulated to provide an effective mulch to limit hydrophobic conditions in the pumice below. Disposal will be to soakage up to the 10% AEP event, primarily in the road reserve, but where the steepness of the gradient prevents full storage, flow will be led to combined detention/soakage devices in the gully floors. (One example of where it may not be possible to achieve full 10% AEP soakage within the road corridor is roads running straight up and down the contour, because the "wedge" of water stored behind each check dam is insufficient.) The Stormwater Management Report suggests oversized pipes and underground tanks could be used, however I note TDC's strong preference for "open" systems over "closed" systems, as outlined in its Code of Practice.

44. Full achievement of the treatment and disposal objectives may require more space than is normally available in a conventional road reserve. However, specific design of streetscapes and stormwater management devices will be the responsibility of the developer/s and occur in the future. Some stormwater treatment and soakage functions may be able to occur in parts of the gullies, as I will outline below.

45. Peak flow attenuation will be implemented to ensure 10% AEP storm flow from the developed catchment in the receiving gullies is no greater than that from the pre-development catchment. As indicated above, the post development 10% AEP runoff will be zero in normal circumstances.

46. The development will also aim to achieve no increase in 1% AEP runoff due to development. That is, the increase in flow due to development will be attenuated back to pre-development levels by a combination of detention storage and soakage. I anticipate this detention will take the form of ponds in the main gullies upstream of each road crossing, thus encouraging infiltration and also slowing flow velocity, which will reduce erosion. Below is a photograph of a similar concept in the next catchment over. A large culvert (also used as a pedestrian underpass) is provided above gully floor level, effectively forcing a detention pond to form in large storms in the gully upstream of the road crossing. A smaller, lower culvert is throttled to encourage infiltration. Extensive gully planting has been undertaken, which has grown substantially since the date of this photo.



47. Using the larger gullies for stormwater detention is fundamental to achieving the stated stormwater management goals. The gullies provide not only the space for detention ponding, but they provide a land form that is amenable to ponding without needing excessive earthworks. I will go one step further and say that achieving the 1% AEP hydrologic neutrality

objective will be very difficult without using the gullies. WRC personnel have indicated informally that they are comfortable with careful use of the gullies for stormwater management – a view with which I concur. Therefore, any rules around gully protection need to be cast in a manner that allows gully use for stormwater management in a manner that is sensitive to the morphological and habitat values sought to be preserved.

48. Scenario modelling using TuFlow hydraulic modelling software was carried out and reported in the Stormwater Management report. Modelling primarily focused on the 1% AEP storm, under future development and climate change to 2090. The report showed that if runoff from impervious surfaces is kept at pre-development levels up to the 1% AEP event (by soakage, detention, or a combination of both), downstream flood increases will be largely mitigated. Water level increases are kept less than 10mm, which is less than the model's margin of error.

49. From this, I conclude that with the proposed management measure, flooding will be no worse following development than it is currently. While 1% AEP velocities don't change significantly, they are already high enough to cause erosion, so it will be vital to ensure gullies remain well vegetated.

GULLY MANAGEMENT

50. One related issue that deserves some attention is the treatment of the multiple dry gullies that braid the PC37 area. These gullies are characteristic of the wider Taupo area, reflecting the drainage paths surface water will follow in extreme flow events. In some cases, they are caused by collapsed underground tomos. In their natural state they often have steep sides due to the highly erodible nature of the pumice soils (there is some evidence of this in older aerial photos of the site). However, in general the gullies at Nukuhau are more gently contoured, probably the result of decades of farming where they have been deliberately smoothed to create more even pasture.

51. The Nukuhau gullies range from 10m wide to 85m wide but are typically 40-50m wide. In portions 1 and 2/Rajashingham and Lexus Trustees blocks one gully system reaches 110 m wide where two adjacent gullies meet. The gullies are typically 1-6 m deep, reaching up to 10m deep in some locations.

52. Pumice soils are sensitive to land-cover and land-use changes. Pumice soakage is adversely affected by soil compaction through stock trampling, vehicle tracking or earthworks. Similarly, vegetation changes from forest to scrub to grass cover can have big impacts on soakage. Even rank grass vs close-cropped grass has been shown to affect soakage. Without proper control, these can lead to increased surface runoff and erosion.

53. As noted, the Nukuhau gullies are already modified by previous farming practices. They have been re-contoured, natural scrub cover has been removed and replaced by (in most cases) close-cropped grass. The land has already experienced the effects of trampling, vehicle tracking and earthworks,[11] and soakage is likely to be less favourable than when the land was in its completely natural state.

54. It will be necessary to construct a number of access road embankments across the gullies at specific locations. In these locations the gullies will be culverted, with culverts sized to convey the 1% AEP flow. As noted above, this provides opportunities to create headwater detention ponds by forming low walls at the culvert inlet. The ponds will provide detention storage and encourage additional soakage. Road embankments provide a particular opportunity for this sort of treatment as their greater mass reduces the hydraulic gradient and the associated risk of tomo formation.

[11] Refer Waikato Regional Council Technical Report 2015/41, *Soil Quality Monitoring in the Waikato Region 2013,* Sec 8.2, which states, "All arable/pastoral land uses monitored were impacted by surface compaction; only forestry showed no compaction at all sites." Note: The study covered a range of soil types including pumice.

55. Additionally, detention storage could be formed in the outer zones of wider gullies, although this is a less optimal approach, requiring more earthworks. Care would need to be taken during design to ensure the hydraulic head of the retained water does not lead to piping failure in the retention bund or in the pumice soil underneath it.

56. Like WRC, I consider that a Gully Management Plan would be a suitable mechanism for establishing which Nukuhau gullies warrant protection and for those that do, which activities are permissible, and which activities are inadvisable. I consider the stormwater management measures I have described are compatible with the natural function of the gullies, – the conveyance of periodic storm flows – as well as re-vegetation for erosion protection, re-vegetation as an ecological corridor, and passive recreation.

3-WATERS ISSUES RAISED BY SUBMITTERS

57. WRC (submission 43) seek protection of natural gullies. Any gully protection must be accompanied by a robust definition of which gullies and which gully values are to be protected, so that acceptable stormwater management functions are not inadvertently prohibited. Mr Kusabs (submission 50) seeks a similar outcome through insertion of the word "significant" in the matters for assessment. I consider this is not appropriate as, even in the significant gullies there may be certain activities that are acceptable (such as stormwater detention or soakage) and certain other activities that are not. WRC has requested that a Gully Management Plan be prepared. I agree that this could be a sensible way of defining which gullies and which gully values require protection, and also which activities are acceptable and consistent with those values.

58. Mr Hendricks (submission 18) proposes a novel technology for winning "spare" energy from water mains, however he overlooks the fact that the Nukuhau area is already a pumped supply.

59. The Rangitira E Trust (submission 49) express concern that available infrastructure, including wastewater capacity, will be "used up" without consideration of their needs. I have outlined in my evidence that wastewater pipe capacity is already inadequate. The PC37 Applicants are working with TDC to ensure sufficient capacity is provided in their planned upgrading programme.

60. Todd Land Development Consultancy (**Todd Land**) (submission 52) made several comments relating to stormwater that I would like to address. Firstly, that the stormwater modelling does not extend to Lake Taupo. Hydraulic modellers commonly apply "boundary conditions", which are the water levels and flows at the extremities of the modelled zone. These are set far enough up and downstream that they do not unduly skew the results within the area of interest. The focus of modelling was to determine effects in the Structure Plan area and existing residential area immediately downstream. Less emphasis was applied to the gully reach below Acacia Bay Road as there are other factors that will have a much greater effect on stormwater behaviour in this area. For example, there is currently no culvert under Acacia Bay Road, and this is reflected in the model.

61. Todd Land also takes exception to the flooding indicated below Acacia Bay Road by the WSP modelling and notes that the land has not been seen to flood previously. In response I point out that the model reflects an event that is only expected to happen on average once in every hundred years. Moreover, it includes a climate change allowance for factors that have not happened yet. Because it has not been possible to calibrate the model against real storms, the modellers have in places adopted (in my view appropriately) conservative assumptions. This uncertainty does not detract from the primary usefulness of the model as a comparative tool. We are less interested in deriving accurate flood levels or flows than we are in gauging the *changes* that will come about as a result of development. For this purpose, the model is suitable.

62. Mr Meadowcroft, in his evidence supporting TDC's s42A report, notes that TDC's own modelling does not show flooding at 179 Acacia Bay Road. TDC's modelling is based on a rain-on-grid approach, which is a more basic – and usually more conservative – approach. Losses to ground soakage are one example of a significant unknown where modellers could have a significant diversity of opinion; due to hydrophobic conditions, the usually high soakage characteristics of the soil can become relatively poor. So, I am not perturbed by differences in model indications. Hydraulic models generally – and especially those involving ephemeral gullies in pumice catchments – should be considered less a statement of the "truth" and more an indication.

63. I concur with Todd Land that the typical road and swale cross section illustrated in the stormwater report may not be suitable everywhere, and more particularly that it may not fit into a standard road reserve width. I expect the concept to be adapted as required by individual developers. In some cases this will require a wider-than-standard road reserve.

64. I have already addressed one of Todd Land's other concerns in my evidence, that that primary soakage from all private properties will be sized for the 10% AEP runoff. Soakage from roads will also target the 10% AEP event wherever possible.

65. Todd Land raises several questions relating to the wider catchment and to the proposed Acacia Bay Road culvert, which are mostly outside the domain of this hearing. Nevertheless, I provide comment as follows:

    a) No mitigation outside the PC37 area is currently proposed. The flood modelling assumes that land upstream of the PC37 area will remain undeveloped (this is not unreasonable, as any future development of that land can be expected to attenuate flows in a manner similar to PC37).

b) I have acknowledged that the flood model is uncalibrated; it is notoriously difficult to record flood flows and levels in these essentially ephemeral gullies. However, I reiterate that the absolute flow and level data is less useful than the comparative data.

c) WSP's modelling shows that there would be a noticeable effect if PC37 development proceeded without stormwater mitigation, but these effects will be negligible with the proposed mitigation.

66. Lakes and Waterways Action Group Trust (submission 53) expresses concern about the possible realignment of gullies. The Applicants have requested that this matter is more appropriately dealt with via the regional consent process for the future developments.

67. Mr McCarthy (submission 55) has observed the stormwater system in his area overflowing and expresses general concern about the additional strain on infrastructure that he perceives the PC37 development will create. Taupo stormwater pipes today are designed to convey the 10% AEP storm flow. Older pipes may be to a lower standard, and the designer may have assumed more or less runoff lost to soakage than actually exists. Pipe blockage, debris build-up, root intrusion can all play a part, so I am not surprised Mr McCarthy has observed pipes surcharging. The PC37 stormwater design strategy is intended to generate zero runoff up to a 10% AEP storm, so the area should not worsen stormwater overflows in those storms.

68. The Rauhoto Land Rights RMA Committee (submission 20) raise concerns about wastewater crossing the Waikato River. This is a wider issue being addressed by TDC for the benefit of the wider community and is outside the scope of this hearing.

3-WATERS ISSUES RAISED BY S42A REPORT

69. I have reviewed the s42A report and am comfortable with its conclusions with respect to water and wastewater. I have the following comments to add to the findings of the stormwater section.

70. In response to Todd Land's submission (submission 52) that modelling does not extend to the lake, TDC's stormwater specialist Mr Meadowcroft states extension ". . . will assist in confirming post-development flows do not exceed pre-development flows." I believe, in the absence of other significant downstream tributaries that could cause flood timing and coincidence effects, that it is sufficient to demonstrate neutrality at the downstream boundary of the PC37 area, and to Acacia Bay Road, as presently.

71. Similarly, I consider there is little benefit in further modelling possible future upstream development (Todd/Meadowcroft). It is safe to assume that any development that does occur will require flows mitigated to pre-development levels (as with PC37), and therefore the area's current modelling as an undeveloped catchment is sufficient.

72. I am however comfortable that the hydraulic analysis will progressively improve as more information becomes available (e.g. peer review input, validation against any flood flow data that is able to be captured, incorporation of any further soakage research). In this way, the hydraulic model represents a progressively-improving tool that can be used to assess the flood neutrality of discrete areas as development proceeds.

CONCLUSION

73. Before granting PC37, the Panel will want to be confident that the development it precipitates can be served in terms of water, wastewater and stormwater. In my opinion, sufficient 3-waters infrastructure is either available, will become available or can be provided by the developers. A large number of specific details remain to be worked out during subsequent consent applications; however, I consider these processes provide enough compulsion to ensure development will proceed in a manner and timeframe appropriate to the supply of 3-waters services.

Warren Stanley Bird

20 October 2021