Before the Independent Commissioners appointed by the Waimakariri District Council

In the matter of	the Resource Management Act 1991 (**the Act**)
and	
In the matter of	Proposed Waimakariri District Plan: Ohoka Rezonings (Hearing Stream 12D)
and	
In the matter of	Further submission by the Oxford Ohoka Community Board [submitter 62] to the Rolleston Industrial Developments Limited [submitter 160] and Carter Group Property Ltd [submitter 237] submission to Rezone land at Ohoka

Brief of evidence of Nick Keenan on behalf of Ohoka Community Board (as Further Submitter) – Stormwater Management.

Dated: 13 June 2024

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Andrew Schulte (andrew.schulte@cavell.co.nz)
Counsel for further submitter

CavellLeitch LIMITED

Level 3, BNZ Centre
111 Cashel Mall
PO Box 799, Christchurch
T: +64 3 379 9940 F: +64 3 379 2408

Evidence of Nick Keenan:

Introduction

1. My full name is Nicholas John Keenan. I am a Chartered Professional Engineer, a Chartered Member of Engineering New Zealand. I hold a Bachelor of Engineering (Civil) degree from the University of Canterbury. I am also a Registered Professional Engineer Queensland (RPEQ).

2. I have twenty-eight years' experience, with twenty years' employment with Stantec in Wellington, Perth, Auckland and Dunedin. I specialise in stormwater infrastructure implementation, hydraulic modelling and flood risk, and rivers engineering. I generally work within a project team providing drainage and stormwater technical design for roading, land development and infrastructure projects. I have been involved with Waka Kotahi NZ Transport Agency state highway safety improvement and upgrade projects on the Kapiti Coast, Wellington, Wairarapa, Whanganui, Rotorua, Canterbury and Otago since 2006, and subdivisions work in Central Otago since 2017.

3. The purpose of this summary evidence is to provide technical advice on the Applicant's submission in support of the evidences of Shane Bishop and Waimakariri District Council with regards to stormwater management only.

4. In preparing my evidence, I have reviewed:

    4.1. Mr Eoghan O'Neill, statement of evidence, sections 9 -41 (stormwater), 5 March 2024

    4.2. Mr Dave Compton-Moen (landscape), 5 March 2024

    4.3. Joint witness statement 18 August 2023

    4.4. Mr Eoghan O'Neill, PDP, memo, responses to WDC comments, 17/08/2023

    4.5. Mr Shane Bishop, Summary brief of evidence, 8 August 2023

    4.6. WDC memo, 3 Waters Advice, Attachment B, 14 May 2023 (Mr Colin Roxburgh, stormwater, sections 21-45)

5. I have performed a desktop assessment of the available subdivision information – in particular, with respect to stormwater flood management and treatment in the context of a shallow groundwater

table. I have not been to the Project Area – relying on Google Earth and the landscape evidence for context.

Code of conduct

6. In preparing my evidence I have reviewed and agree to comply with the Code of Conduct for Expert Witnesses contained in Part 9 of the Environment Court Practice Note 2023. This evidence has been prepared in compliance with the Practice note. I confirm that the issues addressed in this statement of evidence are within my area of expertise, except where relying on the opinion or evidence of other witnesses, which I will specify. I have not omitted to consider any material facts known to me that might alter or detract from the opinions expressed.

Scope of evidence

7. My evidence covers a review of stormwater related evidence and concerns and providing my technical opinion.

8. I have discussed aspects of the applicant evidence with Mr Shane Bishop and another development engineer within Stantec to increase my understanding of the context of the project.

Summary of Evidence

9. My approach is to base the order of my evidence on the comments from Mr Colin Roxburgh (Servicing, Evidence, sections 21-45, 16 May 2024) and the evidence is organised under the same three general headings. Additional comments are added after that as needed.

<u>Above Ground Basins and Assessment of Changes to Downstream Flows</u>

<u>Groundwater Information</u>

10. [24] I understand that the groundwater table is at a shallow depth below existing ground level across the site. Ideally, a series of groundwater piezometer sites would be installed on the site with data captured in the future, or references made to nearby recorded data (if this exists) to understand the seasonal fluctuation of the groundwater table to inform design.

Flood Storage Attenuation Volumes

11. The proposed stormwater management design includes flood attenuation storage volumes to offset (compensate for) the land intensification effects that are implied by increasing the runoff factor from 0.35 to (0.5-0.78) and reducing the time of concentration from (40 to 85) minutes to (10 to 33) minutes. Also, a strategy of over-attenuating the majority area to allow non-attenuation in the minority area to result in a net neutrality is supported, in principle, to eliminate peak discharge from the site boundary.

12. However, I still see the time-dynamic effect of increased runoff volume (even if attenuated to a discharge-neutrality at the site boundary) will affect existing downstream stormwater systems that rely on local storage ponding and timing of peaks to function. That is, the discharge hydrograph peak may be reduced but the peak starts earlier and lasts longer as storages empty.

13. A subdivision land development like the proposed site will affect downstream storages and dynamic timings that can only be calculated through 2D hydraulic modelling. These adverse effects diminish with the increasing distance downstream from the site, but a model is needed to show this.

2D Hydraulic Modelling

14. In my opinion, a more-detailed, 2D hydraulic flood model would be needed to assess downstream adverse effects due to increased runoff volume from a proposed site this large and intensive, and in a position that is upstream of existing low intensity (or rural lifestyle areas). Existing downstream low-density areas are likely to rely on localised storage ponding volumes during flood events and this would change if increased runoff volumes came from the site. The model duration would be at least 24 hours rainfall and longer if needed and would compare pre- and post-development scenarios.

15. In my opinion, a demonstration of both peak discharge and total volume attenuation is required for this site. This can only be provided with a 2D hydraulic model that can run scenarios that iterate dynamic timing and storage and show a sensitivity assessment to design-out the downstream effects of the proposed stormwater management approach.

Engineering Design and Construction Control

16. The attenuation storage volumes are proposed to be constructed on the surface by 1m high bunding. The natural ground slope appears to be approximately 1:200 - meaning that the storage areas would need lengths of 200m up-gradient of the bunds, and this is shown in the two example catchment pages C1 and C2.

17. In my opinion, this approach to develop the attenuation storage is feasible but would require a higher-than-normal level of design and construction control over final road and corridor earthworks. The lot and road layout would need to be sympathetically designed with final development topography and flood management constraints in mind. The issues around hydraulic head, freeboard to floor levels, head loss through treatment, shallow groundwater table and surface attenuation storage volumes could be solved with earthworks (likely imported) and that may pose questions of commercial practicality.

18. The plans submitted in the evidence of Mr Compton-Moen do not fully represent the size, extent and location of stormwater attenuation systems and treatment solutions within the site. To be effective the attenuation basins would need to be largely unplanted, open spaces designed with their principal function in mind. These stormwater devices are not clearly reflected in the plans submitted.

19. Given lower tolerances for error in levels within the site and higher likelihood of downstream effects beyond the site boundary, more engineering detail and a more fulsome description of the stormwater management strategy is needed. This would demonstrate how flood flows from large residential sub-catchment areas are gathered and discharged into the storage areas for attenuation and then release into the downstream receiving waters. The engineering and stormwater management system needs to work within the constraints of the shallow groundwater table below and freeboard to house floor levels above the stormwater level.

Suitability of Site for Raingardens

20. Proprietary raingardens (Filterra) and Bioscape biofilters are considered to be similar in how they operate in that stormwater floods a surface area which soaks vertically through artificial media that filters out contaminants, then clean stormwater is drained away. Filterra treats a smaller area per unit.

21. In my recent interaction with Stormwater360 regarding Bioscape biofilters in a State Highway environment, a key requirement from the supplier was that the engineering media not be flooded with attenuation volume floodwater and that a head loss through the filter of about 1m be allowed in the hydraulic design of the drainage system.

22. Additionally, a gross pollutant trap (GPT) device will be recommended upstream of the filter to capture heavier contaminants and save the Bioscape engineering media for finer filtering. The GPT has a head loss through it of 200-400mm. If this does not happen, the Bioscape engineered media fouls too quickly and will need more frequent replacement.

23. In a shallow gradient topography, the head losses through biofilter and GPT devices would need careful design so that drainage systems can deliver 5mm/hr rainfall through the filters, and bypass larger events to storage volumes as needed without flooding the Bioscape device.

24. I support the concerns noted in Mr Roxburgh's evidence [sections 38-40].

25. In my opinion, the stormwater treatment strategy may need to consider other approaches that minimise head losses such as grass filters and wetland treatment swales. My expectation is that Bioscapes may not be appropriate if the groundwater table is matched to the levels of the Bioscape depth – but this would need further design advice from the supplier as impermeable lining to isolate groundwater from contaminants in the engineered media may present a risk.

26. Aside from pipeline hydraulics and head losses, pipelines from rain gardens, Bioscape devices and GPTs will certainly intersect the water table if the water table rises to 0.5m or less from the final ground surface. The road structure will likely include subsoil drainage that could assist with ground water table management near the surface.

27. In terms of ground water intersecting with pipeline levels, modern pipelines and connections are reliably watertight initially and would offer long service and welded pipe joint connections could be considered. This would leave pipeline capacity for stormwater flows in most cases over the design life. Otherwise, if groundwater inflows into stormwater pipelines occur, then flows will drain to the stream outlets and this is not a concern.

Suitability of Outline Development Plan

28. In general, I support the comments noted in Mr Roxburgh's evidence [sections 41-45] and I expect that a more detailed description of the overall stormwater management strategy and some typical engineering detail proving the drainage aspects is required in order for Council to accept and approve the ODP. Some of that detail I describe above with the 2D hydraulic model, pre- and post-development scenarios which will necessitate detailing.

29. I support the concept of drainage easements along key flow paths so that drainage channels can be maintained and free of private development encroachments. These channels will contribute to returning ground water table levels back to normal levels post flood events.

Additional Comments and Discussion

30. With reference to Mr O'Neill, (PDP, memo, responses to WDC comments, 17 August 2023) the WDC District Model was used to test the volume difference at the outflow from the site. I am not clear if this model and its inputs could be adopted for downstream effects assessment and design sensitivity. With careful attention to catchments, inflows, rainfall patterns, downstream conditions and details over the site, this is the sort of 2D model that could prove the appropriateness of the site.

31. Overall, the application description does not clearly describe how stormwater flows can drain from the road to the treatment system with its pipeline and back to the surface attenuation volumes. This requires a hydraulic grade line and profile that reflects the head differences needed for filtering to occur.

32. A separate hydraulic profile would be needed for the 50 year ARI flood case to prove that flood management using above-ground storage is feasible. Without this level of detail, I cannot assess the feasibility of the stormwater management system overall.

33. I am not clear as to the extent that earthworks are proposed to solve hydraulic difference issues, but note that the site does have a 1:200 general gradient to work with.

Conclusions

34. Seasonal groundwater level data on the site would be useful in understanding the groundwater regime on the site.

35. The principle of flood storage attenuation volumes to offset land development intensification is supported to provide a net discharge-neutral drainage.

36. The principle of over-attenuation in parts of the development to offset non-attenuated areas is supported.

37. The increased runoff volumes from the site may produce adverse downstream effects in areas (properties) that rely on localised storage volumes to manage flooding. Depending on timing of runoff hydrographs from the site and durations of critical events, this cannot be calculated or assessed without a 2D hydraulic flood model and a range (sensitivity) of rainfall scenarios.

38. The level of complexity and level tolerances of engineering design and construction for this site would be higher than normal subdivision development due to the constraints of high groundwater table and freeboard to floor levels. This may impact on the commercial practicality of the site.

39. More engineering and drainage detail, and a description of the stormwater management strategy, is likely needed to allow Council to assess the development risks and downstream effects.

40. Given the shallow surface gradient across the site, a stormwater treatment approach that requires approximately 1.2m head loss to work, and relies on an impermeable lining as a barrier to high groundwater table levels, may not be appropriate. Other stormwater treatment approaches could be considered that are shallow or less affected by ground water. [but may have other issues? - Or why wouldn't they have included them.

Date: 13 June 2024

Nick Keenan