Ohoka Subdivision Fast Track Assessment – Expert Report

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1. Context

This document summarises the findings of my review of technical documents relating to the Ohoka Fast Track application. My role is to provide advice to the EPA on stormwater management aspects of the application, including stormwater quality and quantity (flood risk). My review has focussed on the PDP reports relating to stormwater management and flood risk, but I have also reviewed evidence prepared by experts for Environment Canterbury and Waimakariri District Council, as well as public submissions relating to stormwater quality or flood risk.

Documents reviewed included:

- Appendix 43 – Proposed District Council Consent Conditions
- Appendix 41a – Proposed Plan: Evidence of Chris Jones
- Appendix 37 – Development Constraint Maps
- Appendix 27 – Civil Engineering Plans
- Appendix 20 – Hydrology Assessment – Pattle Delamore Partners
- Appendix 14 – Infrastructure Assessment – Inovo Projects
- Appendix 4 – Consultation Documents and Records with Waimakariri District Council
- Appendix 3 – Record of Consultation with Canterbury Regional Council
- Appendix 47 – Updated Waterways and Wetlands Changes Plan – Inovo
- Appendix 31 – Updated Stormwater Management Report – PDP
- Appendix 26 – Updated Scheme Plans – Inovo
- Appendix 22 – Updated Flood Effects Report – PDP
- FTAA-2606-1253 – Memorandum of Counsel for Carter Group Limited, 10 September 2026
- Ōhoka Residential Subdivision – AEE

2. Relevant Experience

I have been working in engineering since 1998 (28 years), with most of that time (26 years) spent specialising in hydraulic modelling, hydrology, stormwater design and flood risk management. Twenty of those years have been spent based in Christchurch, so I am familiar with local standards, the region and the complexities of hydrology on these alluvial plains.

I have an ONC and HNC in Civil Engineering. I am a Chartered Engineer (CPEng) and a Chartered Member of Engineering New Zealand (CMEngNZ). Outside my role at WSP, I am also actively involved in hydrological research. I recently submitted a manuscript to the Journal of Hydrology New Zealand on a nationally calibrated saturation-excess simulation model for flood estimation, and I have lectured master's students at the University of Canterbury on urban flood risk management.

I was involved in the peer review of the Silverstream flood modelling referenced by one of the submitters and have previously peer reviewed developments in the region on behalf of Environment Canterbury and Waimakariri District Council.

3. High Level Assessment

The technical reports prepared by PDP provide a sound basis for assessing the proposed development in terms of stormwater management and flood risk. Positive aspects of the assessment include consideration of the interaction between stormwater and groundwater, development of a catchment model supported by some calibration and validation work, and assessment of a range of rainfall event durations for detention design.

The development is located on an alluvial plain near the coast. In this setting, the groundwater recharge catchment may extend beyond the topographic catchment, and groundwater may rise to the surface. These interactions complicate the assessment of flood risk and hydrology and may extend the critical rainfall duration. This is consistent with the historic flood events described in my review, which have tended to be associated with rainfall extending over multiple days. Designing for prolonged rainfall events can materially influence detention storage requirements and the resulting land area required.

3.1 Matters of agreement

I consider that the potential stormwater and flood risk effects of development in this area can be managed through preservation of natural overland flow paths and provision of appropriately sized detention storage.

The proposed approach to stormwater treatment is generally aligned with industry practice. Swales, rain gardens and ponds are proposed to reduce contaminant concentrations in runoff from the developed site. Their suitability and performance will depend on the detailed design, contributing land uses and site conditions.

I consider grassed swales to be an effective stormwater management device where ground conditions allow appreciable infiltration through the swale invert, particularly during smaller, more frequent rainfall events and drier periods. Although their treatment efficiency may be lower than that of some other practices, assessment of contaminant removal alone may not fully capture the benefit of reductions in runoff volume through infiltration. Their overall effectiveness is strongly dependent on the ratio of swale area to contributing catchment area and the in-situ ground conditions.

Representing observed flows entirely as surface runoff, when those flows include subsurface contributions, may introduce conservatism in some aspects of the modelling. However, this does not, by itself, establish that the predicted flood response or detention storage requirements are conservative. This remains a matter to be demonstrated.

I consider the development feasible from a stormwater management perspective, provided the detailed assessment and design demonstrate that it can be managed in accordance with good practice without worsening downstream flooding across an appropriate range of scenarios.

3.2 Matters of disagreement

My principal disagreement concerns the apparent inclusion of a climate change allowance in the permissible discharge used to size the detention systems. As I understand the documentation, the allowance is based on a low-probability climate scenario and would permit discharge at a rate greater than the existing discharge under current climatic conditions.

I do not consider that demonstrating compliance with this discharge limit alone would establish hydraulic neutrality. In my view, the proposed detention scheme needs to demonstrate that downstream flooding is not worsened under both current and future climatic conditions, with pre-development and post-development effects compared under equivalent climate assumptions. The assessment should include a suitable range of climate scenarios rather than relying solely on the selected low-probability scenario.

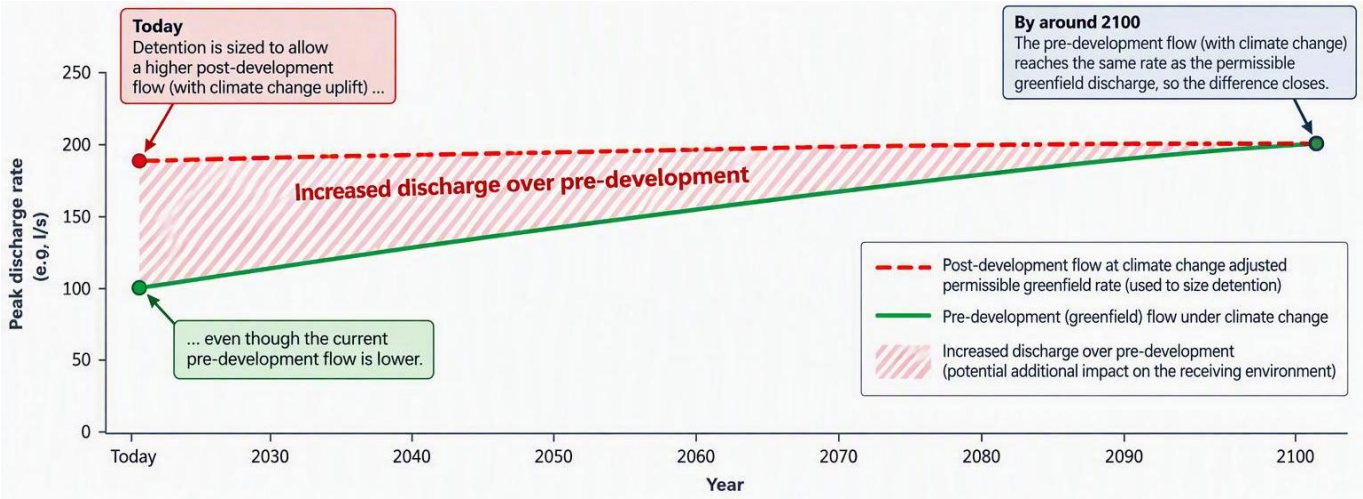

Figure 1 – An indicative visual representation of how including projected climate change in the permissible discharge increases immediate flood risk at the developments point of discharge.

3.3 Matters requiring clarification or further information

My remaining findings primarily concern incomplete documentation, limited sensitivity assessment and insufficient demonstration that longer-duration rainfall events have been adequately assessed. These are not necessarily disagreements with the proposed approach. Rather, further information is needed to confirm that the detention storage is appropriately sized and to understand its sensitivity to the design assumptions.

These matters could influence the required detention footprint and, consequently, the achievable development yield. If the storage requirements are underestimated, downstream flood risk could be worsened.

I have also identified inconsistencies in the documentation that require clarification or correction.

The following sections identify actions to:

- Clarify design assumptions where documentation is incomplete.

- Resolve discrepancies between reports.
- Provide additional assessment demonstrating the robustness of the proposed detention scheme and its sensitivity to key assumptions.

4. Stormwater Management

4.1 Summary

The documentation describes an appropriate overall approach to stormwater management. Further detail is required to confirm the design assumptions, reproduce the sizing calculations and assess the proposed system's performance. This is particularly relevant to detention design, where storage requirements are sensitive to the assumptions adopted.

The clarification and additional assessment requested below are intended to establish whether the proposed flood detention scheme provides the required mitigation of downstream effects. These requests do not, in themselves, establish that the scheme has been designed incorrectly. They identify matters that cannot yet be confirmed from the documentation reviewed.

4.2 Detention Design

The assessment needs to demonstrate that the proposed stormwater management system can manage development runoff without worsening downstream flooding. The design assumptions and supporting calculations are relevant both to this assessment and to confirming the detention footprint and associated development yield.

PDP has adopted a design storm approach. My requests below focus on documenting that approach and demonstrating its performance across an appropriate range of rainfall events and antecedent conditions. Continuous simulation is discussed separately in Section 1.2.1 as an additional verification option.

The stormwater management plan does not currently provide all the information needed to independently review the detention sizing and confirm hydraulic neutrality. Further documentation of the methodology, assumptions and system operation would allow these matters to be assessed.

The following matters require documentation, clarification or additional assessment:

1. **Rainfall patterns.** Identify the design rainfall temporal patterns and any historical rainfall ensembles assessed. Explain how these informed the permissible discharge rates and detention storage requirements. Include consideration of patterns with concentrated high-intensity bursts and more prolonged, lower-intensity rainfall, so that sensitivity to the distribution of rainfall through each event can be assessed.
2. **Hydrological methodology.** Document the hydrological approach, the assumptions adopted and the representation of rainfall losses over pervious areas in the detention sizing calculations.
3. **Storage routing and tailwater.** Explain how detention storage and outlet operation have been represented, including the treatment of tailwater effects. The report refers to both the NRCS curve number method in HEC-HMS and fixed runoff coefficients. Clarify the respective roles of these methods. Where outlet discharge may be affected by downstream water levels, demonstrate that the adopted modelling approach represents this interaction adequately.
4. **Equivalent pre- and post-development comparisons.** Compare pre- and post-development discharges for matching rainfall durations, temporal patterns and climate scenarios at each downstream discharge point. Where the maximum pre-development discharge across all durations

has been adopted as a common discharge limit, supplement this with event-specific comparisons. This would establish whether discharge increases occur in events other than the event producing the maximum pre-development flow.

5. **Climate change basis.** Clarify whether a climate change allowance has been included in the permissible discharge used for detention sizing. If so, explain how performance under current climatic conditions has also been assessed. Provide comparisons that distinguish development effects from climate change effects, using equivalent climate assumptions for pre- and post-development conditions and a consistent basis across the stormwater and flood assessments.
6. **Runoff coefficients.** Clarify whether the adopted runoff coefficients have been used to calculate peak flows, runoff volumes, or both. Where they have been used volumetrically, provide the basis for their selection and demonstrate their suitability for that purpose.
7. **Combined system operation.** Demonstrate the combined operation of the first-flush basins, wetlands, detention areas and receiving waterways. Address time-varying tailwater, outlet submergence, backflow, spillways and bypasses, where relevant. Report maximum water levels and storage utilisation, including the influence of restricted discharge on overflow timing. Distinguish permanent water storage, treatment storage or extended detention, and temporary flood storage.
8. **Antecedent conditions.** Assess representative wet and dry antecedent conditions. Include events in which pre-development runoff from pervious areas would be relatively low, to establish whether downstream flooding is affected under those conditions.
9. **Drain-down and successive events.** Provide calculated drain-down times and assess plausible storm sequences in which storage has not fully recovered between events. This would establish sensitivity to the volume of water held in detention storage at the start of an event.
10. **Rainfall on stormwater management areas.** Confirm whether rainfall falling directly onto the stormwater management areas (SMAs) has been included in the sizing calculations. Clarify whether the areas used to calculate permissible discharge and development runoff include or exclude the SMA footprints.
11. **Long-duration rainfall.** Assess 48-hour and 72-hour rainfall events and explain how the selected durations address the applicable WDC guidance. Include consideration of the prolonged rainfall associated with the 2014, 2022 and 2023 historical events identified in this review. Demonstrate the available storage and system performance through the critical downstream flood peak.
12. **Groundwater interaction.** Address the potential for groundwater levels to exceed basin invert levels following antecedent rainfall or during prolonged rainfall events, including events longer than 24 hours. Assess sensitivity to plausible groundwater conditions and explain the implications for available storage and system operation.
13. **Downstream flood effects.** The assessment reviewed reports peak discharges at the downstream site boundary. Provide an assessment of how the timing, volume and rate of those discharges interact with flows in downstream areas subject to flooding. Represent the proposed basins within the TUFLOW assessment, or provide an equivalent linked assessment, to demonstrate their combined effect on downstream flood conditions.

4.2.1 Additional Verification

Continuous simulation could provide additional verification of the design storm assessment by testing the detention system across a wider range of rainfall sequences and antecedent conditions.

If undertaken, this could use the available record from a suitable rainfall gauge to compare pre- and post-development performance, with appropriate representation of rainfall losses, groundwater influences and storage recovery.

I am not identifying continuous simulation as essential to completing the assessment. It is an additional option for strengthening confidence in the proposed scheme. Its value would depend on the suitability of the rainfall record and the representation of the relevant hydrological processes. The clarification and sensitivity assessments requested above remain relevant to the adopted design storm approach.

4.3 Imperviousness

The design is based on specified impervious coverage. Clarification is required on how those assumptions will be maintained through detailed design, construction and subsequent development. This includes potential additions such as minor residential units, sleepouts, patios, sheds and garages.

The application would benefit from the following:

14. **Imperviousness sensitivity**. Assess detention performance with higher impervious coverage than assumed in the design. This would quantify sensitivity to potential increases over time, commonly referred to as “impervious creep”.
15. **Implementation and ongoing management.** Explain the proposed mechanism for maintaining impervious coverage within the design assumptions, including how these limits would be addressed through relevant approval processes and subsequent property alterations. Where exceedances are possible, explain how any additional runoff would be managed.

4.4 Stormwater Treatment – Additional Information suggested

The following information would assist in confirming the suitability and operation of the proposed treatment systems:

16. **Treatment selection.** Document the basis for selecting the proposed treatment systems, including their respective benefits, limitations and suitability for the site.
17. **Pond water quality.** Document the design basis for maintaining appropriate pond water quality during prolonged dry and hot periods, including consideration of elevated water temperatures and low dissolved oxygen concentrations.
18. **High-groundwater operation.** Explain how the proposed rain gardens and biofiltration systems would operate under high-groundwater conditions, including rainfall occurring after prolonged antecedent rainfall has elevated groundwater levels across the site.

5. Flood Modelling

5.1 Summary

The flood modelling provides a basis for assessing flood behaviour. Further clarification and sensitivity assessment are required to establish how the adopted hydrological representation and range of simulated events influence the assessment of development effects.

Some modelling assumptions may be conservative for particular outputs or events. However, the overall direction and magnitude of any conservatism have not yet been established, particularly for longer-duration events and the comparison of pre- and post-development conditions.

The requests below are intended to strengthen confidence in the assessment and clarify its alignment with applicable WDC design requirements.

5.2 Modelling Scope

The documentation indicates that calibration was primarily based on the 2022 historical flood event, with two additional events used to check model performance. Clarification is required on the relationship between the gauged catchment and the development catchment, and the basis for transferring the calibrated parameters to the development site.

The model represents the flow response through surface runoff processes. Given the site's alluvial setting, the potential contribution of groundwater and other subsurface flows warrants consideration when interpreting the calibration and applying it to design events.

My preliminary analysis of Gauge 66417 indicates a baseflow index of approximately 0.82. Application of a Lyne–Hollick filter to the 2023 event attributes approximately 67% of the flood peak to the filter's quick flow component. These are filter-based estimates, rather than direct measurements of surface and subsurface contributions, and should not be interpreted as a definitive separation of physical flow pathways. They nevertheless provide a basis for examining how the adopted hydrological representation influences the model results.

Representing the observed response entirely through surface runoff may affect the fitted rainfall-loss and routing parameters. The available information does not establish the direction or magnitude of those effects at the development site. In particular, further assessment would help establish whether the model adequately represents runoff volumes, hydrograph timing and critical durations during prolonged rainfall.

The documentation notes a poorer fit for the two additional events and identifies spatial rainfall variability as a possible explanation. The relative influence of rainfall uncertainty, parameter transferability and the adopted hydrological representation remains to be established. Sensitivity assessment would assist in understanding whether these uncertainties materially affect the conclusions about development effects.

Where subsurface contributions are represented through surface runoff, the suitability of the calibrated parameters for assessing changes in impervious coverage and setting permissible development

discharges also requires explanation. A fit to the observed total hydrograph does not, by itself, confirm that the model represents the change in runoff associated with development.

Clarification is also required on how the adopted Horton loss representation accounts for antecedent conditions, available soil storage and groundwater influences. The relevant question is whether the assumed losses remain appropriate throughout prolonged rainfall events, rather than whether a particular model formulation is inherently unsuitable.

These matters do not, in themselves, establish that the flood predictions are incorrect. They identify uncertainties whose significance should be assessed through documentation, comparison with observations and targeted sensitivity testing.

The following work would assist:

19. **Impervious-area runoff.** Clarify how runoff from impervious surfaces has been represented for existing and proposed urban areas, including the SMA footprints. The documentation reviewed does not make this representation clear. Provide the adopted impervious fractions, rainfall-loss assumptions and runoff-routing approach.
20. **Current and future climate.** Report current-climate and future-climate results separately, with matching pre- and post-development comparisons for each. This would allow development effects and climate change effects to be distinguished.
21. **Comparison with flood-frequency estimates.** Report the peak flows predicted at the Cust River gauge for the design storms and compare them with the available flood-frequency estimates. For example, compare the flow generated by the 1% AEP design rainfall with the estimated 1% AEP flood peak. Use this as a consistency check, recognising uncertainty in both estimates, rather than as definitive proof of rainfall–flow AEP equality. Explain material differences and their implications for the assessment.
22. **Integrated detention and flood assessment.** Represent the detention systems within the flood assessment, either directly or through linked pre- and post-development hydrographs that account for storage and outlet operation. The documentation reviewed does not yet demonstrate their combined performance with the downstream flood system. This assessment would allow the effects of discharge timing and volume, as well as peak flow, to be considered beyond the site boundary. It can be undertaken at the current design stage using the proposed system configuration, with subsequent refinement during detailed design.
23. **Event range and rainfall profiles**. Assess a broader range of rainfall durations and event magnitudes and explain how the selection aligns with applicable WDC design requirements. Include prolonged and multi-peaked rainfall patterns, and patterns with the highest intensities late in the event, to assess sensitivity to groundwater conditions, depression storage and antecedent wetness. Consider the 2014, 2022 and 2023 historical rainfall profiles alongside the synthetic design storms. Where historical profiles are scaled to design rainfall depths, document the scaling method and distinguish these sensitivity tests from simulations of the historical events themselves. Include more frequent events, such as the 2-year and 10-year ARI events, to assess detention operation and downstream effects across a range of magnitudes. Where downstream erosion is relevant, consider the resulting discharge rates, durations and receiving-channel conditions. Compare simulated peak flows at the Cust River gauge with the available flood-frequency estimates, as described in Item 21, to assist interpretation of the design-event results.

6. Other Matters

Through the review the following discrepancies were identified which should be corrected / resolved:

24. Some discrepancies were noted between the flood modelling and stormwater reports, with differing culvert dimensions reported. These should be resolved for consistency, and the flood modelling amended if required.
25. Different climate-change horizons also appear to have been used for the flood modelling and stormwater detention design.