

Appendix 5: s53(2)(a) Fast-track Approvals Act 2024 (FTAA) Technical Advice

Date	12/10/2026
To	Consents – Fast-track
Expert Name and Job Title	Philippa Aitchison-Earl, Senior Scientist – Groundwater Resources Science, Canterbury Regional Council
Project advice provided for	Carter Group Limited - Ōhoka Residential Subdivision
Documents referred to	Hydrology Assessment (Bas Veendrick, PDP) Groundwater Assessment of Environmental Effects (AEE) Report (Carl Steffens, PDP) Dewatering and Dust Suppression AEE (Nic Love, PDP)
Qualifications	I hold BSc (Hons) degree in Geology, with a groundwater focused post-graduate dissertation. I am employed at Environment Canterbury as a Senior Scientist – Groundwater and have over 25 years' experience with Canterbury groundwater. I am a member of the NZ Hydrogeological Society. I have published papers in peer-reviewed Scientific Journals, as well as numerous Council reports. My work includes investigating, monitoring, and reporting on groundwater resource quantity and groundwater quality of the region. This role involves assessing and providing advice on potential groundwater impacts of activities seeking consent.
Code of Conduct	I confirm that I have read and agree to comply with the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2023. This technical report has been prepared in accordance with that Code. In particular, unless I state otherwise, the opinions I express are within my area of expertise, and I have not omitted to consider material facts that might alter or detract from the opinions that I express.

Introduction

- Specific questions in Appendix 4 of Minute 1 of the Expert Panel (14/9/2026) that are relevant to my expertise in Groundwater Resources are:
 - 3. Potable water supply
 - 4. Dewatering and stream depletion.
 - 5. Waterways, wetlands and ecology
 - 6. Stormwater and flooding
- In this advice, I first comment on the new information provided by the applicant, then address the questions from the panel. My response to panel questions is only for matters that I am an expert in: Groundwater Resources.

I have reviewed the following updated or new documents from the applicant:

- Water Supply Memo, 10/9/2026 (Nic Love and Carl Steffens, PDP)
- Change in Water Balance Assessment, 31/8/2026 (Emma Rhodes, Bas Veendrick and Carl Steffens, PDP)

- Construction and Earthworks Spring and Groundwater Monitoring Plan, 31/8/2026 (Caitlin Frazer and Emma Rhodes, PDP)
- Stormwater Management, 10/9/2026 (Oliver Saunders and Alex White, PDP)

I also refer to my previous s46 Technical Advice 'Groundwater Resources', 30/6/2026.

2. The 'Water Supply Memo' includes indicative bore locations for the potable water supply and Community Drinking Water Protection Zones (CDWPZ). It includes bore installation and aquifer testing requirements that can be used to update assessments of sustainable yield, well interference and stream deletion (included in Groundwater AEE dated 25/5/26).
 - The 'Change in Water Balance assessment' provides
 - an estimate of the change in land surface recharge that may occur with the introduction of 40% area hardstand surfaces; and
 - an assessment of the change in effects on streamflow because of moving abstraction for potable water to deeper aquifers, updating the assessment previously provided in the original Groundwater AEE dated 25/5/26.
 - The 'Construction Earthworks Spring and Groundwater Monitoring Plan' outlines the pre-development measurements of surface flow and groundwater levels and proposed ongoing monitoring of these.
3. The 'Stormwater Management Plan' includes designs for wet basins, which rely on assessments of the maximum groundwater level on the proposed sites.

Discussions with the applicant

4. I have been involved in a meeting with the applicant (and their experts) as recorded in Appendix 1.

Outstanding areas of contention and significance

Change in water balance assessment

5. The 'Change in Water Balance Assessment' report is an outcome of the meeting between Canterbury Regional Council Scientists Philippa Aitchison-Earl (Groundwater Resources) and Lucy Just (Hydrologist) and the applicant's water experts from PDP on 11 August 2026. It addresses two outstanding matters of contention I raised in the meeting: the change in land surface recharge and the change in effects on streams.

Change in land surface recharge

6. Land surface recharge refers to any rainfall and irrigation water that infiltrates through the soil to groundwater. I compared the PDP estimates to more recent model results

(detailed in Etheridge and Hanson (2019¹) and Etheridge and Wong (2018²)). The estimates are similar to the PDP ones for dryland recharge, but there is more uncertainty with irrigated recharge. I agree that a reduction of 6 L/s (or slightly higher) in land surface recharge can be used as a potential reduction in the groundwater balance and hence in spring flow to the Ohoka Stream. Therefore, this is no longer an outstanding matter of contention.

Change in stream depletion because of moving abstraction to deeper aquifers

7. Stream depletion from existing shallow wells is estimated in the PDP report as 22.96 L/s, 90% of the 150-day irrigation season pumping (25.4 L/s).
8. The stream depletion effect of moving to deeper wells for the potable water supply is assessed using the Ward and Lough (2011) solution for a leaky aquifer system, including stream bed conductance/logging. Aquifer parameters are taken from an aquifer test on WDC well BW24/0262. Stream bed conductance values for the Ohoka Stream are taken from testing in the late 1990s (Sanders and Lovell, 1999³). The pumping rate over 365-days is 1,043 m³/day, which is the equivalent of 12.04 L/s. Stream depletion is reported to be 5.2 L/s, presumably over a 365-day period (this is not specified).
9. The PDP assessment does not include calculations or graphs of the stream depletion response. My response is therefore limited to the description provided in the report.
10. In my experience, solutions for stream depletion from leaky aquifers are extremely sensitive to the value of stream bed conductance. The test on BW24/0262 did not provide a stream bed conductance value, because water level data obtained from a shallow piezometer during the aquifer test was unusable due to interference from neighbouring pumping wells. This means that any conductance values assessed for the stream bed are less certain. The PDP assessment does not include any consideration of parameter sensitivity or an uncertainty analysis. I tested, for example increasing the stream bed conductance from 1.04 m/day to 2.5 m/day (within the range measured in the late 1990s stream bed surveys) increased the 365-day depletion from 54% to 71% of the pump rate.
11. Presumably a 365-day pumping period is used in the PDP assessment. Over longer pumping periods, stream depletion will approach 100% of the pumping rate, with abstraction effects likely spread widely across the area, rather than concentrated on the closest stream. For example, increasing the length of the stream depletion assessment to 2, 5 and 10 years using the PDP parameters increases the amount of depletion from 54% to 65%, 76% and 83% of the pumping rate. Effects will be felt most during dry periods when streamflow is low.

¹ Etheridge, Z. and Hanson, M. 2019 'Waimakariri Land and Water Solutions Programme: Options and Solutions Assessment: Numerical Groundwater Model: Model conceptualisation, design and development' Environment Canterbury Report R19/77.

² Etheridge, Z. and Wong, R. 2018 'The current state of groundwater quantity in the Waimakariri CWMS Zone' Environment Canterbury Report R18/81.

³ Sanders, R. and Lovell, M. 1999. 'Observations of the Ohoka Stream System in a Drought' Environment Canterbury Report U99/32.

12. In summary, the parameters used in the provided assessments are uncertain and the have not been tested for sensitivity. There is little benefit in debating precise aquifer or stream depletion values when wells have not been drilled and tested yet. Even when wells are drilled, there will still be uncertainty involved in analysing aquifer test results, particularly streambed conductivity and the related effects on streamflows.
13. Stream depletion assessments indicate the level of risk that a well is connected to a stream, and if there is benefit in management with minimum flows. In this example, with abstraction from a deeper aquifer, effects are smoothed across time and not best managed by minimum flows. But they become a steady, long-term effect in the groundwater-surface water system that cannot be managed in the short-term by stopping pumping.

Construction Earthworks - Spring and Groundwater Monitoring Plan

14. The PDP report 'Construction Earthworks Spring and Groundwater Monitoring Plan' outlines the past and proposed monitoring of surface flows and groundwater levels. In general, I agree with the monitoring methodology. Good baseline monitoring has been undertaken to allow comparison of change.
15. The monitoring plan proposes to monitor for 1-year after any staged development. There is a risk that the 1-year post monitoring does not capture extremes (very high or low levels), making comparison to the baseline more tenuous. Choosing an appropriate period of ongoing monitoring is difficult as we cannot predict extremes, especially with future climate change. I would recommend that a monitoring plan require piezometers remain installed for future monitoring requests.
16. The monitoring plan notes a review three times a year to identify indicators of adverse effects. It is unclear what an 'adverse effect' is within the monitoring plan that would trigger reporting, as no triggers or indicators have been identified or proposed.
17. Therefore, the adequacy of the proposed monitoring plan is still an area of contention.

Water Supply Memo

18. The 'Water Supply Memo' (and the previous Groundwater AEE) assesses potential drawdown effects on other water supply bores, specifically the WDC well BW24/0262, using parameters from the aquifer test on BW24/0262.
19. With actual bore and aquifer testing of the new bores, as proposed as consent conditions (which I agree with), the assessment of effects will likely change, making this an outstanding area of contention.

Questions from the Expert Panel

(3) Potable water supply: *The feasibility, capacity, resilience and long-term ownership of the proposed staged water-supply solution; effects of the proposed bores on existing groundwater users, springs, wetlands and surface water.*

20. Effects of proposed bores on existing well users is assessed as 'well interference' and is detailed in my s46 Technical Advice 'Groundwater Resources', 30/6/2026, paragraph 51-57, and effects on surface waters is included in paragraph 58.
21. The PDP 'Water Supply Memo' updates part of the previous assessments (within the Groundwater AEE of 25/5/2026), with more accurate locations (Figure 1 of memo). Aquifer parameters used are from the existing WDC well BW24/0262. The memo does not include cumulative drawdown assessed under LWRP Schedule 12 for all existing and the five proposed new sites., I recommend this is requested to allow easier comparison of effects.
22. The PDP Water Supply memo proposes consent conditions for step and aquifer testing with observation bores, and that test results can be used to update assessments. I agree that testing should be required, but there is a risk that the new test results are different from the modelled results based on which the consent is granted.
23. Effects on surface waters from the proposed water supply wells are modelled assuming a two-layer leaky aquifer system where the stream and shallow water table is separated from a semi-confined aquifer by lower permeability layers. This is a conceptually appropriate model, but applying the Ward and Lough (2011) solution for stream depletion requires estimates of several aquifer parameters, which introduces more uncertainty. As noted in Paragraphs 4-9 of this evidence, the uncertainty in parameters can have significant effects on prediction of stream depletion. The most conservative estimate would be that the maximum depletion will eventually equal the total pumping rate over the longer term, so around 12 L/s spread across the various Ohoka tributaries.

(4) Dewatering and stream depletion: *the conceptual hydrogeological model used; whether cumulative depletion effects on the Ōhoka Stream, its tributaries, springs and wetlands have been adequately assessed, including from any long-term subsoil drainage required.*

24. Dewatering effects on stream depletion are covered in Paragraph 61-66 of my s46 Technical Advice 'Groundwater Resources' 30/6/2026. I agree with a conceptual model of a shallow water table aquifer. However, applying a stream bed conductance/clogging layer in the assessment may not be justified, as the property is in an area of groundwater emergence and there is a close connection between springs, stream channels and shallow groundwater. The most conservative assessment would assume full connection between the dewatering takes and surface water. Table 1 in my technical advice of 30/6/2026 provides depletion effects.
25. Long-term subsoil drainage is assessed in the PDP Hydrology Assessment Report of 2/6/2026, and in my advice of 30/6/2026 in Paragraphs 42-50, and 59-60.

26. PDP provided an updated Land Surface Recharge assessment as part of the 'Change of Water Balance' dated 31/8/2026, which I reviewed in paragraph 3, with a potential reduction to groundwater recharge (and potentially to spring flow) from hardstand areas of around 6 L/s.
27. The change in groundwater recharge has not been assessed compared to spring and streamflow.
28. Actual effects of dewatering could be monitored as part of the 'Construction Earthworks Spring and Groundwater Monitoring Plan'. As detailed in paragraph 10-12 of this advice, what an 'adverse' effect is not identified in the monitoring plan.
29. Subsoil drainage via stormwater infrastructure may intercept groundwater and locally divert groundwater flow paths. My advice of 30/6/2026 in paragraph 60 was *'It is impossible to predict this before construction. If granted, monitoring of stream and spring flow before and after construction should occur, but it is likely there will be unavoidable localised changes to the hydrology, even if the overall discharge from groundwater to Ohoka Stream remains similar'*

(5) Waterways, wetlands and ecology: *Whether all affected waterways, springs and natural inland wetlands have been correctly identified and effects quantified accurately; whether avoidance of loss and modification has been adequately considered.*

30. The effect of abstraction for water supply, dust suppression or dewatering on spring and streamflow, and of a reduction in groundwater recharge due to hardstand areas has been assessed, but as detailed throughout this advice note, using estimated aquifer parameters creates a less accurate assessment of potential effects. If consent is granted, updated assessments may improve predictions, and monitoring measures effects, however this is not mitigation.

(6) Stormwater and flooding: *Whether the modelling adequately represents groundwater, drainage, climate-change and flood conditions; whether filling, earthworks and urbanisation could increase flooding or drainage effects on adjacent or downstream land.*

31. I am not expert in stormwater infrastructure, but I address the depth to groundwater adopted in design in paragraph 67-68 of my advice on 30/6/2026.

Benefits of the project

32. There are no specific benefits with respect to my area of expertise.

Appendix 1: Record of consultation

Expert and date of discussion	Subject	Summary	Matter resolved? Y/N
CRC Scientists Philippa Aitchison-Earl and Lucy Just 11 August 2026	Groundwater and surface water hydrology	<i>A meeting was held with the Applicant to discuss groundwater and surface water matters associated with the proposal, including the site water balance and how changes to existing flow paths and volumes would be managed. As a result of the discussions, the Applicant agreed to provide a change in water balance assessment and a draft construction earthworks spring and groundwater monitoring plan to further address these matters.</i>	CRC considers further refinement of the content of the management plan is required

Fast Track Approvals Act 2024 (FTAA) Technical Advice

Ōhoka Residential Development – Groundwater Resources

Date	3/7/2026
To	Joanne Mitten, Principal Consents Planner, Environment Canterbury, cc Samuel Prystupa, Consents Planner, Environment Canterbury
From	Philippa Aitchison-Earl, Senior Scientist – Groundwater Resources Science, Environment Canterbury
Project advice provided for	Carter Group Limited - Ōhoka Residential Subdivision
Documents referred to	Hydrology Assessment (Bas Veendrick, PDP) Groundwater Assessment of Environmental Effects (AEE) Report (Carl Steffens, PDP) Dewatering and Dust Suppression AEE (Nic Love, PDP)
Qualifications	I hold BSc (Hons) degree in Geology, with a groundwater focused post-graduate dissertation. I am employed at Environment Canterbury as a Senior Scientist – Groundwater and have over 25 years' experience with Canterbury groundwater. I am a member of the NZ Hydrogeological Society. I have published papers in peer-reviewed Scientific Journals, as well as numerous Council reports. My work includes investigating, monitoring, and reporting on groundwater resource quantity and groundwater quality of the region. This role involves assessing and providing advice on potential groundwater impacts of activities seeking consent.
Code of Conduct	I confirm that I have read and agree to comply with the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2023. This technical report has been prepared in accordance with that Code. In particular, unless I state otherwise, the opinions I express are within my area of expertise, and I have not omitted to consider material facts that might alter or detract from the opinions that I express.

Overview

- I have reviewed the following documents
 - Hydrology Assessment Report Final 2/6/2026 (Tom Garden, PDP)
 - Groundwater Assessment of Environmental Effects (AEE) Report Final 25/5/2026 (Nic Love, PDP)
 - Dewatering and Dust Suppression AEE Report Final 25/5/2026 (Nic Love, PDP)
 - Ohok0061 Development – Regional Consents. Proposed conditions
 - Stormwater Management Final 18/6/2026 (Philip Claassens, PDP).
- The Hydrology report sets out the hydrogeological assessment used to provide technical support for the applications made by Ohoka Residential Development under the Fast-track Approvals Act 2024 (FTAA).
- The Hydrology report presents the environmental setting of the subdivision including geological setting, groundwater flow paths, springs and wetlands and depth to water.

4. The Hydrology report assesses potential effects on ground and surface water due to construction of the subdivision including:
 - changes in recharge to groundwater due to an increase in impervious area
 - potential redirection of groundwater flow through excavations and fill
 - downstream/downgradient changes in stream flow and groundwater level
5. The Groundwater AEE report identifies and assesses the potential effect of the take, use and discharge of groundwater from proposed bores for community supply, and proposes a Community Drinking Water Protection Zone. It also considers subsoil drainage of groundwater to drains and stormwater management areas (SMAs)
6. The Dewatering and Dust Suppression report assesses effects of dewatering groundwater with rates up to 75 L/s, and the use of groundwater for dust suppression at the same rates as current irrigation takes. Dewatering is required for construction of SMAs, pipeworks, roading and stream realignments.
7. The following addresses the sections of these reports that pertain to groundwater level, flow, and quality. This is an update of advice provided on 21/4/2026 on the draft consultation and pre-application documents

Substantive Application Documents

Overall Review of the report: Hydrology

8. In general, I agree with the Applicant on the regional and site specific hydrogeologic setting as presented in the report.
9. In general, I consider the site investigations undertaken to assess groundwater levels, flows, and quality to be extensive and comprehensive for the intended purpose.
10. In general, I consider the conceptual hydrogeologic model is based on results of the investigations and available data and accurately reflects the known hydrogeology of the region and areas specific to the project.
11. I note an additional source of information is available in Sanders and Lovell (1999), a report on the Ohoka Stream during the 1997-1999 drought when the stream was partially dry. This report includes a local piezometric survey to show local groundwater flow direction, which is approximately West to East, broadly similar to regional contours presented in the PDP report. The Sanders and Lovell report also includes additional very low, drought, water levels in well M35/0596 on the site which were added to the ECan Wells Database in August 2025 but are not included in the Hydrology Report (the low water levels are included in Figure 2 in 'Outstanding areas'). These levels are lower than the current well depth, indicating that the well has silted up or partially collapsed.
12. I agree that the springs are likely to be sourced from the water table, where channels are incised into groundwater and through the fine-grained overlying layer. The geotechnical information on the variable thickness of silts overlying the gravel aquifer at the site matches the model from Sanders and Lovell (1999) shown in Figure 1, with springs feeding the Ohoka Stream within a patchy surface confining layer. The mapped springs in Environment Canterbury's database were located in 1996. As

noted in Sanders and Lovell (1999), the original swampy landscape has been modified since European settlement so that drains intercept water that would have been 'natural' springs. Table 1 of the PDP report shows gaining flow in tributary channels which indicates that the existing spring locations are not the only source of influent groundwater, groundwater will seep along the length of the channels.

13. Spring M35/7485, noted as 'artesian' in the ECan database from a field visit in 1996. I agree it is likely the spring is water table/depression type based on measured water levels and have edited our database.
14. I agree there is unlikely to be an upward gradient from deeper to shallower layers, and that spring flow is likely sourced from the underlying gravel aquifers, and less from the finer-grained overlying sediments. I agree that the groundwater sourcing the spring flow will include upgradient sources, however an assessment of change in local land-surface recharge has not been made (see Outstanding areas) I note local groundwater pumping can also impact on spring flow.
15. I agree that the wetlands are likely connected to groundwater given the high water table.

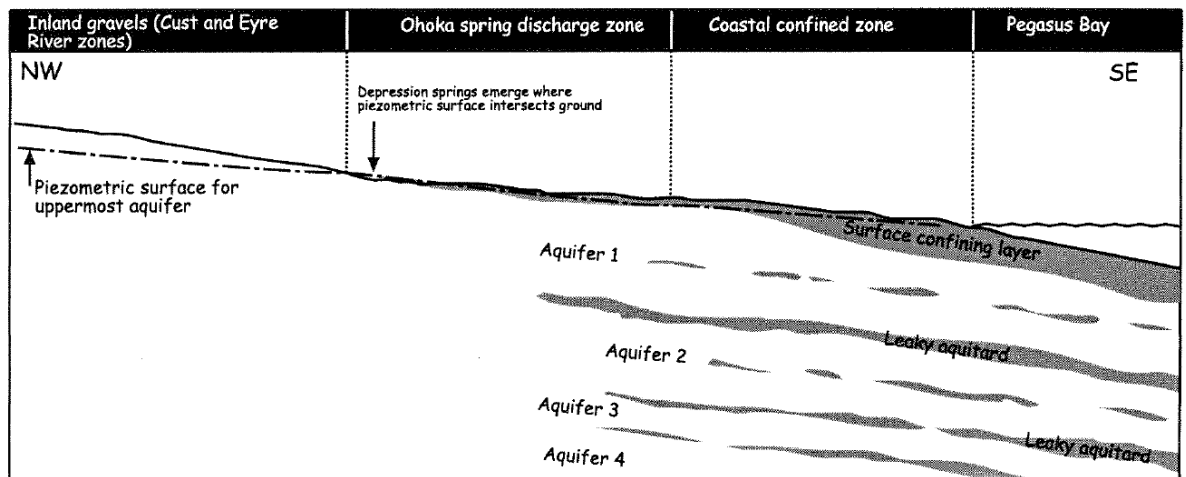


Figure 1: Schematic hydrogeological cross-section through the Ohoka area (from Sanders and Lovell, 1999)

Overall review of the report: Groundwater AEE

16. In general, I agree with the description of the hydrogeological environment, which is also largely contained in the Hydrology Report. I note that without the new wells being drilled, the assessment relies on assumptions.
17. In general, I agree with the description of groundwater levels, and influences on them.
18. In general, I agree with the drawdown/interference assessment methodology, however I do not agree that results can be assessed for neighbouring wells until the applicant's wells are drilled and aquifer tested. Refer to 'Outstanding areas'.
19. In general, I agree that cumulative effects on the wider groundwater system, with a potential positive benefit from reduction in pumping from the shallow aquifer (see Paragraph 34). I note that in the Executive Summary, shallow bores are said to be

more sensitive to drawdown interference than deeper bores which is incorrect but later clarified in Section 6.2.3 that this refers to shallow bores causing the greatest interference on other shallow bores, and deeper bores on other deeper bores.

20. In general, I agree with the methodology for assessing the impact of groundwater pumping on streams. As for the drawdown assessment, I note that this should be updated when the wells are drilled and aquifer tested.
21. In general, I agree that the Community Drinking Water Protection Zone should be assessed once wells are drilled. Any zone should be drawn under operative planning rules at the time.
22. In general, I agree that subsoil drainage to drains and SMA's will occur when groundwater elevations are higher than the drains/SMA's. I agree with the methodology to predict drainage rates but note this is constrained by two hydraulic conductivity values and not shown geographically. I do not comment on the non-consumptive nature of take as this is a planning matter.

Overall review of the report: Dewatering and Dust Suppression

23. In general, I agree with the description of the hydrogeological environment, which is also largely contained in the Hydrology Report and Groundwater AEE.
24. The dewatering methodology is unknown, as no contractor has been appointed. Discharges are proposed to be to surface waters, or to land where waters have elevated metal concentration, perhaps through temporary excavations. Dewatering proposes to avoid high groundwater levels and wet onsite conditions
25. In general, I agree with the approach to estimate dewatering rates for a basin (as part of the SAM construction) based on lowering groundwater levels to 2 m below ground and using a relatively high hydraulic conductivity. The rates are estimated at around 17 L/s over 30 days, or 45 L/s initially, with 50 L/s chosen as an upper limit. If groundwater levels exceed 0.5 m, then rates may increase.
26. In general, I also agree with the dewatering assessment for trenches, with upper rates estimated as 25 L/s for trenches and 20 L/s for manholes.
27. In general, I agree that the rates and volumes proposed for dust suppression are lower than used for existing irrigation consents.
28. In general, I agree that the discharge of same quality groundwater to land, providing samples are collected, will meet LWRP Rule 5.119 conditions.
29. In general, I agree that subsidence of land due to dewatering is low risk due to the extensive gravel deposits.
30. In general, I agree that dewatering water is hydraulically connected to surface waters, and the proposed discharge location condition. I note that where the discharge is to land, it cannot be guaranteed that the water will flow towards the impacted stream, but it will likely flow towards Ohoka Stream tributaries.

Overall review of the report: Stormwater

- 31. In general, I agree with the description of the hydrogeological environment, which is also largely contained in the Hydrology Report and Groundwater AEE.
- 32. In general I agree with the depths to groundwater presented in Table 6

Benefits of the project

- 33. The transfer and reduction of total rate/volume of groundwater takes from the existing shallow aquifer irrigation takes to deeper potentially less connected to surface water aquifers could create a positive impact on stream flows, reduce groundwater allocation, and reduce drawdown effects to shallow water table bores. This assumes that the existing takes are actively used and are part of the measured environment.

Outstanding areas

- 34. Within the Hydrology report, there are numerous statements that effects are '*expected to be negligible*', but it is unclear how these expectations have been defined.
- 35. I note that the reports refer to the existing irrigation consents that will be transferred and/or reduced in volume, often as a mitigation/offset for the new activity. This assumes that the existing consents are currently utilised and hence part of the existing environment. No information such as metering is provided to support this.
- 36. The 'Groundwater and Spring Flow Monitoring Plan' in condition 9 of proposed Excavation/Earthworks consent conditions sets out expectations of what a plan will include. As monitoring is already occurring at the site, and excavated areas are outlined on plans, I would recommend that a completed monitoring plan is attached as consent condition, not just requiring one be prepared.

Hydrology Report: Groundwater Levels

- 37. Depth to water at the site is measured with an array of piezometers. Data from piezometers typically shows highs in May 2025. The long-term data at ECan monitoring well M36/0596 on the site indicates that levels were high between May and August 2025 (as they were regionally). Readings were not reported from all piezometers in June 2025. As this was a wet period it is possible high groundwater may have made access may have been difficult to some sites. If readings were available, they may have shown higher groundwater levels than measured in May.
- 38. Groundwater levels have changed in the area since the Waimakariri Irrigation Scheme began operation from late 1999 and have not reached the very low levels measured in the past. Longer-term groundwater levels in M35/0596, and two local ECan monitoring shallow wells (Figure 2) have not since been as low as measured in and prior to the 1997-99 drought.

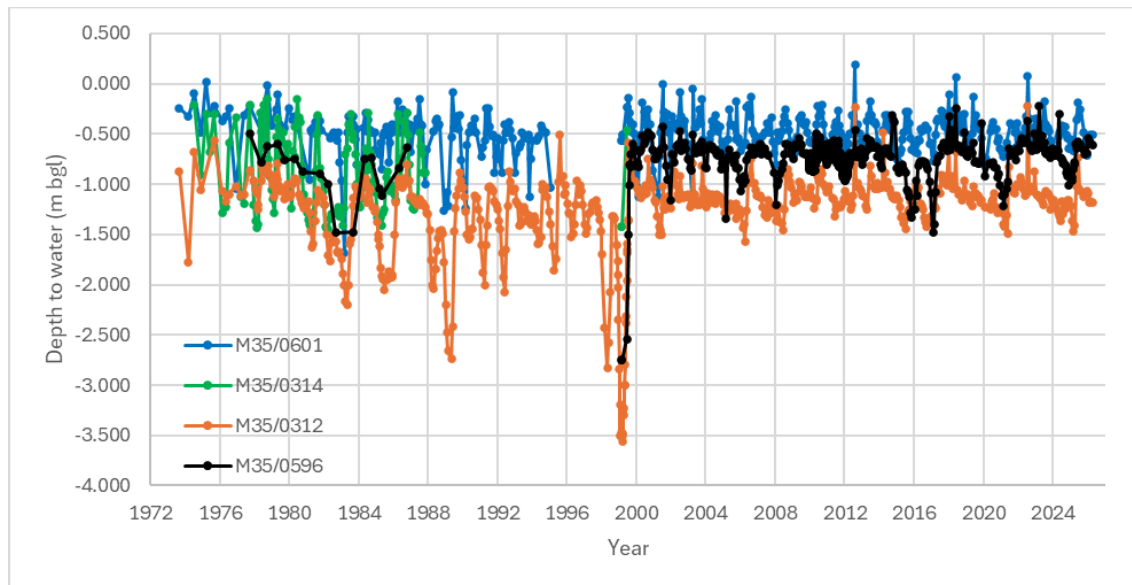


Figure 2: Updated groundwater levels in M35/0596 compared to two other local shallow wells (M35/0601 2.6 km east, M35/0312, 3.5 km north-west and M35/0314 1.9 km north-west). Note less variation in groundwater level post 1999-2000 as Waimakariri Irrigation Scheme starts operation.

Hydrology Report: Change in land surface recharge contributing to spring flow due to the increase in impervious land area

39. A reduction in land surface recharge by channelling water to stormwater and then to surface water flow rather than infiltrating to the underlying aquifer is assessed in the Hydrology Report as not having a significant effect on spring flow. This is based on generalised comments that the spring water source is from a larger catchment upgradient, and that local soils are poorly drained.
40. The hydrogeological model for the site shows patchy soil and surficial fine sediments. Recharge to groundwater can still occur through these sediments, particularly when the water table is lower. During periods when the water table is high, soils are at full capacity (saturated) and land surface recharge is more likely to run off. The report does not include an assessment of how much recharge currently occurs at the site and how much this will reduce with site development. This is a relatively simple assessment to complete with rainfall, evapotranspiration and soil data. Springs rising on the site may still have a component of local recharge. Work on spring water chemistry in other parts of Canterbury has shown springs often 'skim' off local recharge with short flow path (e.g. Scott and Aitchison-Earl, 2020¹).
41. The report notes that any impact on spring flows from reduced land-surface recharge will be partially offset by reduction in pumping for irrigation from existing shallow

¹ Scott, M and Aitchison-Earl, P (2020) *Investigating flows and nutrient pathways near Waikāhiki Stream*, Environment Canterbury Report R20/61

groundwater, to be replaced by a deeper bore for community supply. The irrigation takes are seasonal, with effects mostly within the summer irrigation season. This is different timing to a reduction in land surface recharge which occurs mostly in the winter-spring. How this impacts on overall flow to springs and the stream is not assessed, excepting comments around offsetting of impact by surrendering shallow groundwater abstraction. I refer to the evidence of Lucy Just Paragraph 34.

Hydrology Report: Potential for re-directing groundwater flow paths

Service Trenches and Hardfill areas

42. I agree that there is likely to be interception of shallow groundwater associated with excavation trenches and other earthworks. I agree that the most sensitive areas will be around springs and in areas where the underlying gravel aquifer is closer to the surface. It will be very difficult to avoid some localised diversion of groundwater when undertaking earthworks, and it is a pragmatic approach to focus on the more sensitive areas. These areas are not specifically identified in the application, just that they will be 'established prior to construction'. These could be identified in the proposed 'Groundwater and Spring Flow Monitoring Plan'.
43. I agree that continued monitoring of groundwater levels and stream flows will assist in adaptive responses, but I note that monitoring is not mitigation.

Potential Effects from Areas of Fill

44. This assessment looks at the impact on the overall surface/groundwater system of infilling existing drains that do not permanently flow. It concludes that there will be localised changes in groundwater levels, but that the overall '*total combined groundwater contribution to surface water, and hence surface water flows, from the site are not expected to change significantly*'.
45. It is impossible to agree or disagree with this expectation without assessing monitoring data before, during and after the activity.

Hydrology Report: Potential effects on hydrological function of wetlands

46. Changes in local land surface recharge and in the potential diversion of groundwater flow paths through excavation are identified as potentially lowering groundwater levels and impacting on wetlands.
47. The report states a reduction in local land surface recharge is '*not expected to significantly affect groundwater levels or wetland hydrology*' given that '*that the current contribution of land surface recharge within the development area is small compared to groundwater through-flow*'.
48. No assessment has been given of the magnitude of local land surface versus regional catchment zone of the springs to support this statement.

Hydrology Report: Potential effects downstream/downgradient of the site

49. Potential risks to downstream/gradient properties due to changes in groundwater level or spring flow are *'expected to be negligible'*.
50. Without monitoring data to assess changes over time, or any modelled effects, it is difficult to assess if the effects would be negligible. It is acknowledged that any groundwater modelling will also come with uncertainty which may not assist with decision making. The proposed 'Groundwater and Spring Flow Monitoring Plan' should be created before any construction and should contain monitoring thresholds for stream flows and groundwater levels based on downgradient impacts – no metrics or suggestions for appropriate metrics are included in the AEE.

Groundwater AEE Report: Well interference assessment

51. A well interference assessment where the pumping wells have not yet been installed requires assumptions around pumping rates and aquifer parameters. Environment Canterbury typically requires that wells are installed and aquifer tested before consenting, to reduce uncertainty with assessments.
52. An adequate depth of penetration of 14.3 m depth is used to assess shallow bores based on Schedule 12 of the Land and Water Regional Plan. My understanding is that this method is only applied by ECan Consent Planning staff for non-fast track consents where a consent is notified so that neighbouring owners are informed of potential effects.
53. Aquifer parameters are based on those reported for nearby WDC well BW24/0262 screened 78-84m below ground. These are used to apply a Hunt and Scott (2007) drawdown assessment which assumes pumping from a semi-confined aquifer, with some leakage downwards from an overlying water table shallow aquifer. I agree that the parameters will give a starting indication of potential drawdown effects, but these should be reassessed if/when the wells are constructed and test pumped.
54. The interference assessment assumes a shallow water table aquifer extending to 30.6 m depth, with a semi-confined aquifer below. This assessment is tentative as there are few deeper wells in the vicinity. It is based on depth ranges of wells within 2 km. As with the aquifer parameters, this depth parameter is an appropriate screening tool that should be reassessed if/when wells are constructed and tested.
55. Without actual well construction and parameters, it is not appropriate to assess exact drawdown potential effects on neighbouring wells.
56. I agree with the approach (when wells are constructed) of comparing changes in drawdown effects of the existing irrigation bores to the new deeper water supply bores.
57. I would recommend that if consent is granted, aquifer tests with observation wells to determine aquifer parameters and sustainable yield be a requirement along with an updated interference assessment.

Groundwater AEE Report: Effects on surface water (stream depletion)

58. While I agree with the methodology for determining stream depletion, I note that the stream depletion assessment will be very sensitive to the assumed values for stream bed conductance (detailed further in Paragraph 66). The shifting of abstraction from the shallow water table to deeper aquifers will change the timing of any depletion from seasonal related to irrigation pumping to a more built-in smoothed effect over time.

Groundwater AEE Report: Subsoil drainage

59. Drain/SMA inflow represents interception of groundwater that may otherwise have flowed toward existing springs/drains. It will vary across the site with changing thicknesses of surficial finer grained deposits. The drain flow will be more significant at times of high groundwater level and may lead to more quickflow component to surface waters. The impact of this interception on existing water courses is not assessed.
60. The AEE notes that only local effects such as on individual springs are anticipated and based on expected drainage rates of 0.00036 L/s per m (10 L/s over 28 km drainage system) effects are 'anticipated' to be minor. I note that local changes in sub-surface permeability such as preferential flow channels mean that drainage will not be evenly spread out across the drainage ditches, but more likely concentrated in some areas (such as the existing springs which are likely fed by such preferential flow). It is impossible to predict this before construction. If granted, monitoring of stream and spring flow before and after construction should occur, but it is likely there will be unavoidable localised changes to the hydrology, even if the overall discharge from groundwater to Ohoka Stream remains similar.

Dewatering and dust suppression report

61. The characterisation of groundwater chemistry and nutrients from sampling of shallow wells is from one sample on 27/7/25 from piezometers, a period of higher groundwater levels which may have diluted contaminants.
62. Dewatering occurs at different times and locations to the existing irrigation consents, so effects on neighbouring wells and streams will also vary and occur at different times. I do agree that lowered rates, and less abstraction during the summer may be a positive effect to groundwater levels compared to the existing irrigation abstraction.
63. Application of 'adequate penetration of the aquifer' of 14.3 m under LWRP Schedule 12 may identify less affected neighbouring bores than the reality (see Paragraph 53).
64. The approach for identifying at risk neighbouring drinking water wells for further assessment, then assessing effects is complex, and relies on estimated aquifer properties. Site-specific conditions could lead to higher drawdown than predicted. In my opinion, drawdown effects from dewatering on neighbouring wells may be better managed by measuring actual drawdowns during dewatering within piezometers on site between the dewatering location and the nearest drinking water wells as part of

consent conditions. ECan typically uses 0.1 m drawdown as a cut-off for interference effects. This could be included within the 'Groundwater and Spring Flow Monitoring Plan'.

65. The stream depletion assessment uses a method that accounts for finer-grained sediments in stream beds impeding the flow of water between the stream and groundwater (Hunt, 2003), using a parameter called 'stream bed conductance'. This value is taken from average values for the whole Ohoka catchment measured by PDP in 1999 as detailed in the AEE report.
66. Because springs arise on the property, and stream flow has been shown to gain (and potentially lose) as detailed in the PDP Hydrology report, there is close connection between groundwater and the stream, we cannot assume the stream is uniformly separated from the aquifer by a consistent less permeable layer. Table 1 below presents the depletion assuming a direct connection (Jenkins/Theis method) using the same aquifer parameters and distances to replicate Table 1 of the PDP report (with the PDP values included as the initial shaded lines). This increases stream depletion to 85-92% of the pump rate of 1.9 L/s. The reality will lie somewhere between these two assessments, with some parts of the stream more connected (hence springs and gaining/losing reaches) than others. Further background outlining risks in using stream bed conductance values is outlined in Smith (2009²).

Stream	Pumping rate (L/s)	Distance to Stream (m)	Stream Depletion Solution	150 day Depletion Effect		
				(L/s)	(% of abstraction)	Stream Depletion Category
Ōhoka Stream (to the north)	1.9	330	Hunt (2003 ³)	0.8	36.1	Low
Ōhoka Stream Tributary (to the south)	1.9	190	Hunt (2003)	0.88	39.8	Low
Ōhoka Stream (to the north)	1.9	330	Jenkins/Theis (1968 ⁴ /1935)	1.6	85	High
Ōhoka Stream Tributary (to the south)	1.9	190	Jenkins/Theis (1968/1935)	1.7	92	Direct

Table 1: Updated Stream Depletion Assessment Results

² Smith. M. (2009), Techniques for Evaluating Stream Depletion Effects. A Supplement to the Guidelines for the Assessment Of Groundwater Abstraction Effects On Stream Flow (2000), Environment Canterbury Report R09/53

³ Hunt, B. (2003) Unsteady Stream Depletion when Pumping from Semiconfined Aquifer, ASCE Journal of Hydrologic Engineering Vol. 8, No 1. pp 12-19

⁴ Jenkins, C.T. (1968), Techniques for Computing Rate and Volume of Stream Depletion by Wells. Groundwater, 6: 37-46.

Stormwater Management

67. There is not an assessment of infiltration losses to groundwater under stormwater management areas, through liners, when the water table is beneath the basin. I agree that when groundwater discharges into the basin, it will be contained within the basin if the outfall is located above the highest groundwater level.
68. Regarding the adopted depth to groundwater in Table 6 of the AEE evidence. I refer to Paragraph 38. noting that the existing monitoring may not have measured the highest possible groundwater level.