Before an Independent Hearings Panel
Appointed by Waimakariri District Council

under: the Resource Management Act 1991

in the matter of: Submissions and further submissions on the Proposed Waimakariri District Plan

and: Hearing Stream 12D: Ōhoka rezoning request

and: **Carter Group Property Limited**
(Submitter 237)

and: **Rolleston Industrial Developments Limited**
(Submitter 160)

Reconvened hearing statement of evidence of Eoghan O'Neill (Stormwater)

Dated: 17 October 2024

Reference: J M Appleyard (jo.appleyard@chapmantripp.com)
LMN Forrester (lucy.forrester@chapmantripp.com)

chapmantripp.com
T +64 3 353 4130
F +64 4 472 7111

PO Box 2510
Christchurch 8140
New Zealand

Auckland
Wellington
Christchurch

chapman tripp

RECONVENED HEARING STATEMENT OF EVIDENCE OF EOGHAN O'NEILL

INTRODUCTION

1 My full name is Eoghan Michael O'Neill.

2 My area of expertise, experience, and qualifications are set out in my statement of evidence dated 5 March 2024 for this hearing stream.

3 I also provided evidence in my supplementary statement of evidence dated 13 June 2024 and further supplementary statement of evidence dated 25 June 2024.

4 The purpose of this evidence is to respond to matters listed in paragraphs 7 and 8 of the Panel's Minute 40.

CODE OF CONDUCT

5 Although this is not an Environment Court hearing, I note that in preparing my evidence I have reviewed the Code of Conduct for Expert Witnesses contained in Part 9 of the Environment Court Practice Note 2023. I have complied with it in preparing my evidence. 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. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

EXPERT CONFERENCING

6 I attended both the stormwater and wastewater streams of the 12C/12D expert conferencing on matters identified in Minute 33. I also attended the stormwater conferencing for hearing stream 12C.

7 This evidence will address the questions, set out for conferencing, related to stormwater and wastewater servicing of the Ohoka block. It will also provide relevant supplementary information with respect to any relevant disagreement statements contained within the relevant Joint Witness Statements (*JWS*).

JOINT STREAM 12D CONFERENCING ON STORMWATER INFRASTRUCTURE

8 Four questions related to stormwater infrastructure at the Ohoka block were posed to the 12D expert conferencing, these were as follows:

(a) Is the proposed stormwater solution feasible?

(b) Does detailed design of stormwater treatment for residential developments typically occur at the subdivision resource consent stage when the detailed subdivision design has been established?

(c) Is the use of raingardens (constructed as proposed in Mr O'Neill's evidence) appropriate for the treatment of stormwater at this site?

(d) If Environment Canterbury's interpretation of its Canterbury Land and Water Regional Plan (relating to the interception of groundwater from stormwater devices requiring a consent to take) changed prior to development, would more conventional stormwater conveyancing and treatment options also be feasible for the site?

9 All experts agreed that proposed stormwater system solution can feasibly manage stormwater runoff from the site in terms of water quality and attenuation of peak flows and that immediate downstream impacts associated with peak flows can be adequately managed. It was also agreed that the subdivision stage is appropriate for developing a detailed development plan for the site with associated stormwater management solutions.

10 All experts agreed that the proposed raingarden system, if constructed properly, will provide appropriate treatment of stormwater. It was agreed that there is potential for some groundwater seepage into the raingarden drainage layer and stormwater network over the lifetime of the system. It was agreed by all experts that this base flow should be managed via detailed design, so it does not result in a continuous flow through the downstream attenuation basins and result in a maintenance issue within the basin.

11 It was also agreed by all experts that if the Environment Canterbury interpretation with respect to interception and consumptive use of groundwater by stormwater treatment wetlands and wet ponds was changed, then the use of other types of stormwater management infrastructure such as treatment wetlands and wet ponds would then be feasible for the site.

GROUNDWATER SEEPAGE INTO STORMWATER PIPES

12 The potential for seepage of groundwater into stormwater pipework (including that associated with the proposed raingardens) was also discussed at Plan Change 31 (*PC31*) expert conferencing during the PC31 process for the 12D block. At that conferencing, all experts (including Messrs Roxburgh and Bacon of Waimakariri DC (*WDC*) and Mr. Callum Margetts and Mr Ben Wilkins of Environment Canterbury) agreed that infiltration of groundwater into wastewater and stormwater pipe networks is endemic to all such networks and

is not something that is managed by ECan as a water take requiring consent under the Land and Water Regional Plan (*LWRP*). That relevant JWS statement is also attached to this evidence as **Appendix 1**.

13 I note that the issue of interception of groundwater by stormwater pipes has also been raised by Mr Andrew Willis in his S42A Report Addendum dated 9 October 2024. In Paragraph 32 of this Addendum, related to the JWS for Engineering, Mr Willis states *"I also note it is agreed that there is potential for some groundwater seepage into the raingarden drainage layer and stormwater network over the lifetime of the system. I am unclear if this would contravene the LWRP and be prohibited. If this is the case, I remain of the opinion that it has not been adequately demonstrated that the proposal can be serviced for stormwater and that therefore the proposal does not demonstrate that it provides significant development".*

14 In response to the above, I would again point to the agreed statement from the PC31 conferencing JWS in which all experts agreed that this type of groundwater infiltration is endemic to all stormwater and wastewater networks and is not interpreted by Environment Canterbury to require a specific water take consent. The focus of Environment Canterbury has been on the "consumptive use" of ground water by constructed stormwater treatment wetlands or open stormwater ponds. The consumptive use being interpreted as the evaporative loss of water from the surface of a wetland or permanent pond. This approach is very much viewed by all stakeholders, including the affected District Councils and Environment Canterbury, as an unintended consequence of the wording of the LWRP. Environment Canterbury have recently prepared proposed Plan Change 8 (PC8), which includes provisions for development of constructed wetlands to become a Permitted Activity under the LWRP. PC8 is currently undergoing invited consultation with key stakeholders.

15 Furthermore, as per Paragraph 18.2 of my Supplementary Evidence dated 13 June 2024, the stormwater pipes to be constructed at Ohoka will be tested at construction to prove their seals are intact and watertight, this is standard practice. Any leakage of groundwater into the pipes that may eventually occur will be some years into the future and would be a very small seep, the total volume of which would be unlikely to exceed the current permitted water take provision for the site, allowed currently within the LWRP.

JOINT STREAM 12C/12D CONFERENCING ON STORMWATER INFRASTRUCTURE

16 The 12C/12D expert conferencing on stormwater dealt predominantly with potential issues associated with groundwater resurgence and its potential cumulative effects. All experts agreed that there is potential for effects to occur immediately downstream

of a development site, if resurgent groundwater is not adequately managed on site. There was also agreement among all experts that such effects can be managed through the following methods:

a) Avoid reliance on discharge to ground via rapid infiltration or similar;

b) Maintaining historic flow patterns across the site;

c) Use of storage to attenuate flows;

d) Design to include conservative assumptions regarding groundwater and avoid intercepting permeable gravels (and maintain the low permeability silt cap where present).

17 Review of the information collected by WDC with respect to ponding issues arising as a result of previous groundwater resurgence events suggests that such issues have typically been seen in the Mandeville area. This would be consistent with how stormwater is managed throughout much of Mandeville which predominantly use soakage systems to dispose of stormwater to the ground. These soakage systems are typically located at the lowest point of a contributing catchment and all stormwater conveyance is designed to convey stormwater to that soakpit. During a resurgence event, the ability for these soakage systems to operate becomes severely compromised, or in some circumstances they can operate in reverse and provide an outlet for groundwater to emerge. The result of this is significant localised ponding in the area of the soakage infrastructure.

18 In contrast, there is no evidence available to suggest groundwater resurgence has occurred in Ohoka generally or, particularly, in the proposed development site at 535 Mill Road (*12D Site*). As noted in Paragraphs 20 and 21 of the Reconvened Hearing Statement of Mr Bas Veendrick, groundwater resurgence, via surface expression of flow on the land surface within the 12D site, is unlikely to be significant, due to the nature of the overlying silts and clays at the site. The resurgence issues identified in Mandeville have arisen because the soakage to ground based stormwater systems are ineffective when groundwater levels are high, resulting in extended durations of ponding in channels and low areas. The concept design for stormwater management and disposal for the 12D site utilises open channels for drainage of the site to downstream surface water systems. The internal stormwater drainage network will consist of a network of swales or pipes that ultimately drain to a surface water outlet at their lowest point. Therefore, in the unlikely event that groundwater resurgence did occur, effects will be adequately mitigated through the proposed stormwater design for the site which discharges to surface water rather than to ground.

JOINT 12C/12D CONFERENCING ON WASTEWATER INFRASTRUCTURE

19 At the joint 12C/12D expert conferencing on wastewater infrastructure it was agreed that there are significant wastewater capacity constraints on the existing Ohoka/Mandeville wastewater system serviced by the Bradleys Rd pump station. During times associated with groundwater resurgence, following significant prolonged rainfall events, the wastewater system can be overwhelmed for up to two weeks at a time. All experts agreed that during such times there was very little available capacity in the existing wastewater network.

20 The WDC experts (Mr Roxburgh and Mr Aramowicz) agreed that, given the rate of subdivision that has occurred historically in the Mandeville area, and the extent of existing development, there is currently a small amount of un-utilised capacity in the Mandeville/Ohoka wastewater system. Both agreed it would be a reasonable compromise to allow the unused capacity to be used in the short term to facilitate growth by allowing a temporary connection for the 12D Site (i.e. the Carter Group development), providing of course that capacity to service the Mandeville area is reinstated before it becomes capacity constrained.

21 The short-term spare capacity is within the Bradleys Rd-Rangiora wastewater rising main (well-downstream of the Bradleys Rd pump station) where Council estimate there is short-term capacity for approximately 219 – 250 lots (as was identified in Stream 12D JWS). The reason the short-term discharge from 12D can be accommodated by the existing rising main is that the pressure caused by the pumped wastewater reduces as it flows along the pipe. At some point the pressure caused by the Bradleys Rd pump station will have reduced sufficiently, allowing additional wastewater from the 219 - 250 lots of 12D to be accommodated by the pressure rating of the existing pipe. The proposed permanent wastewater solution for 12D will require a dedicated trunk main to Rangiora wastewater treatment plant be built in due course to achieve the capacity needed for the 12D Site, thereby reinstating full capacity to the Bradleys Rd-Rangiora rising main.

22 I agree with the WDC experts that this is a practical proposal to facilitate development of the 12D area. There is some potential, subject to an appropriate funding agreement being agreed between the 12D developer and WDC, for this new wastewater system to also provide an outlet to other 12C development blocks.

CONCLUSIONS

23 In summary I conclude that:

a) The proposed stormwater system for the 12D Site can feasibly manage offsite effects during peak flows, this has been agreed by all experts in the JWS for hearing stream 12D.

b) Infiltration of groundwater into wastewater and stormwater pipe networks, including pipes associated with the raingardens at the 12D site, is endemic to all such networks and is not something that is managed by ECan as a water take requiring consent under the LWRP. This principle was agreed by all relevant experts, including the WDC experts, in the JWS for PC31.

c) There is no evidence available to suggest groundwater resurgence has occurred in Ohoka or on the proposed 12D Site at 535 Mill Road.

d) In the unlikely event groundwater resurgence did occur, effects will be adequately mitigated through the proposed stormwater design for the 12D Site which discharges to surface water rather than to ground.

e) There is an agreed wastewater solution for the 12D Site. Subject to agreement between the developer and WDC, this solution could also provide an outfall for some or all of the 12C sites.

Dated: 17 October 2024

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Eoghan O'Neill

APPENDIX 1

BEFORE THE HEARINGS PANEL
FOR PROPOSED PRIVATE PLAN CHANGE 31 TO THE WAIMAKARIRI DISTRICT PLAN

UNDER the Resource Management Act 1991 (RMA)

AND

IN THE MATTER of an Application by Rolleston Industrial Developments Limited for a private plan change to the Waimakariri District Plan pursuant to Part 2 of Schedule 1 of the Resource Management Act 1991

JOINT WITNESS STATEMENT

18 August 2023

Joint Witness Statement of Experts – Plan Change 31 to the Waimakariri District Plan

Topic: Groundwater and surface water issues and implications for stormwater management

Conferencing Dates: 10 August 2023 and 17 August 2023

Location: Waimakariri District Council, except Shane Bishop by remote video link

Scribe: Eoghan O'Neill of PDP Ltd.

Introduction

1. The following witnesses attended conferencing:
    a. Ben Wilkins (on behalf of Canterbury Regional Council).
    b. Callum Margetts (on behalf of Canterbury Regional Council).
    c. Ben Throssell (on behalf of Rolleston Industrial Developments Limited).
    d. Eoghan O'Neill (on behalf of Rolleston Industrial Developments Limited).
    e. Tim McLeod (on behalf of Rolleston Industrial Developments Limited).
    f. Carl Steffens (on behalf of Rolleston Industrial Developments Limited).
    g. Bas Veendrick (on behalf of Rolleston Industrial Developments Limited).
    h. Colin Roxburgh (on behalf of the Waimakariri District Council).
    i. Christopher Bacon (on behalf of the Waimakariri District Council).
    j. Shane Bishop (on behalf of the Waimakariri District Council).

Note that Mr Bishop attended the initial conferencing session on the 10th August via video conference on MS Teams but was unable to participate in the final conferencing session of the 17th August where the statement was drafted.

Environment Court Practice Note

2. It is confirmed that the signatories to this Joint Witness Statement (JWS) have read the Environment Court Practice Note 2023 Code of Conduct for expert witnesses and in particular Section 9 (Code of Conduct, Duty to the Court and Evidence of an expert witness) agreed to abide by them in the production of this Statement.

Experts' qualifications and experience

3. The qualifications of the experts are set out in their respective statements of evidence.

Key information sources relied on

4. The key information sources informing this JWS are:

    a. Evidence prepared by the experts who attended this conferenced with respect to the Plan Change 31 application.

    b. Appendix 1 - Supplementary Stormwater Information for Conferencing (provided to the expert panel on 17th August 2023).

    c. Appendix 2 - Additional modelling outputs provided to the expert panel on 17th August 2023

    d. Appendix 3 – Supplementary Water Supply Information for Conferencing.

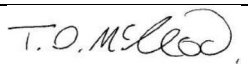
Questions for consideration

Agreed Statements of Conferencing Experts.			
Issues	**Key facts and Assumptions**	**Agreed Position**	**Disagreements**
Wastewater	Capacity existing for PC31 at Rangiora WWTP Site can be serviced with conventional gravity reticulation or pressure sewer reticulation, to be agreed with Council at subdivision stage. There is some temporary capacity available in the existing wastewater pressure main to service initial development stages of PC31. This number of lots is approximately 219 to 250 lots.	All experts agree that viable wastewater options are available for the site. There is some short-term capacity in the wastewater rising main from Bradleys Road to Rangiora WWTP. It is agreed that the plan change area could utilise this spare capacity for the initial stage(s), subject to agreement on the exact number of lots and timing of when the new rising main would need to be built. There would need to be a mechanism to ensure that the new rising main still gets built by the developer at an agreed time even if the full development area is never built out. This mechanism to be agreed by the Planners for Council and Applicant.	
Tidal Effect	The potential issue of tidal effects on flooding in Ohoka was raised by a number of submitters.	All experts agree that there is no tidal effect at the PC31 site	
Interception of Groundwater by Infrastructure and potential effects	Proposed infrastructure e.g. wastewater and stormwater pipe trenches, swales, raingardens/bioscapes, road subbase, have the potential to intercept seasonal high groundwater levels in parts of the site. This has the potential to divert groundwater via the trenches which could cause localised wet areas or ponding in low areas and divert water away from springs. There are mitigations, as described in evidence e.g. detailed groundwater investigation, low permeability trench material, water stops, buffer distance to springs etc, which will reduce the risk associated with interception of groundwater. In parts of the site swales may have the potential to intercept high groundwater, this could result in the base of the swale being wet which could create maintenance difficulties. In parts of the site the roading subbase may intercept the high groundwater table, which could affect the structural performance of the road. However, pavement construction methodologies are available such as stabilised pavements that can mitigate the effect of high groundwater. There is the potential for the raingardens and associated pipework to leak over the course of its operational life given installation is likely to be within the water table in parts of the development. Pipes are tested for water tightness at the time of construction however over years of operational life the seals can deteriorate and begin to leak. If this creates a baseflow to the detention basins there is the potential for them to become wet and boggy leading to maintenance issues. There are design solutions available which will be investigated and detailed at subdivision consent stage, e.g. linking basins bubble up inlet structure to the basin outlet structure, which are designed to manage flows associated with infiltration. Such flows, if they eventuate, would be extremely small relative to the design flows of the system.	All relevant experts (BW, BV) agree that the potential decrease in groundwater recharge contributing flow to springs due to an increase in impervious area is unlikely to be an issue. All relevant experts agree that the mitigation proposed in the ODP will reduce the risk for re-directing shallow groundwater. This includes the proposed detailed groundwater investigation, alternative design options of kerb and channel versus swale as appropriate, construction methodologies, buffer distances for springs and the groundwater seep, groundwater level monitoring and monitoring of spring flow and spring water levels. See disagreements column for clarification of expert's position on level of risk reduction. All relevant experts agree that the potential for re-directing shallow groundwater flow away from springs can be mitigated through appropriate design and construction of underground services trenches and roads where they may intercept shallow groundwater. See disagreements column for clarification of expert's position on level of risk reduction. All relevant experts agree that infiltration of groundwater into wastewater and stormwater pipe networks is endemic to all such networks and is not something that is managed by ECan as a water take requiring consent. .	In the view of some relevant experts (BV, TM) appropriate mitigation measures are available to ensure spring flows and water levels are not adversely affected. Measures can be further detailed when comprehensive groundwater level monitoring information across the site becomes available at subdivision consent stage. Other relevant experts (CR, CB) do not believe there is sufficient certainty that all risks are adequately mitigated and that the success of the mitigations will not be verified until after construction after which time negative impacts may be difficult to address or reverse. This applies to the concerns raised in the Summary Evidence of Mr. Roxburgh with respect to the rain gardens and downstream stormwater basins, the roadside swales, the road subbase, and infrastructure trenches intercepting shallow groundwater, with the original concerns remaining unchanged in the view of Mr. Roxburgh. Despite the disagreement above, all four relevant experts agree that, if a consenting pathway provides for the installation and operation of subsoil drainage at the site prior to subdivision consent approval and development, this would provide greater certainty as to the effectiveness of the mitigations. Mr Roxburgh notes that subsoil drainage is not part of the current proposal due to the potential consenting barrier associated with systems designed to intercept shallow groundwater.

Stormwater Attenuation and ensure no increase in downstream stormwater flows.	Stormwater detention can be provided at the site with basins being constructed at existing ground level to ensure no interception of groundwater. It is likely that, in parts of the site, basins could be excavated 200mm or more below existing ground level. There is a portion of the PC31 site that cannot flow into attenuation ponds, the developable area which cannot drain to a pond is approximately 26 Ha. Assuming this area is developed and not attenuated, in order to achieve hydraulic neutrality across the site the outflow from the other basins is proposed to be managed/reduced to compensate for the increased runoff from the unattenuated area. The total detention volume required to facilitate this has been calculated at 26,464 m^3 but would be considered to be generally within a range of approximately 15,000 to 30,000 m^3 of storage.	All experts agree that 126 Ha of the PC31 site can be managed for stormwater with treatment and detention able to be achieved. All experts agree the approximately 26 Ha of the site, generally along the Whites Rd boundary, can be adequately treated but cannot drain to an attenuation basin, subject to fall being achieved from treatment outlets into the Whites Road drain. All experts, except for Mr Roxburgh, agree that the outflow from the attenuated area basins can be managed to ensure hydraulic neutrality is achieved across the site. All experts agree that the total detention volumes estimated for the site are with a reasonable range of certainty that would be expected at Plan Change Stage. All experts agree that subdivision stage is appropriate for demonstrating a detailed development plan for the site with associated stormwater management solutions. If some areas of the site cannot be demonstrated to be able to be appropriately mitigated to ensure hydraulic neutrality up to the 50-year event, they will not get approval to process at subdivision stage, and development in these unattenuated areas would need to be reduced until it can be demonstrated that neutrality can be achieved.	Mr. Roxburgh maintained the position stated in summary evidence that the concept of unattenuated areas of the development discharging into a receiving environment that is vulnerable to any increase in flood risk introduces an unacceptable level of risk , and would only find the above ground basin concept acceptable if there was assurance that if it cannot be adequately demonstrated at a later stage that there is no increase in flood risk as a result of the unattenuated areas for all scenarios, the unattenuated areas either wouldn't be developed, or that the level of development would be reduced to a point that neutrality can be demonstrated to the satisfaction of Council. Mr Roxburgh is not satisfied at this point that all runoff from the unattenuated area would be able to be adequately treated by rain gardens, as further work is required to show that there is sufficient fall from the design level of the rain garden outlet into the Whites Road drain for the 26 Ha at the bottom end of the site, and similar to the above would only be satisfied from a treatment perspective if there were similar assurances that if at subdivision stage there are some areas of the site where treatment cannot be achieved, that the level of development would be reduced such that all areas could receive treatment. Some experts (EON, TM, BT) disagree with Mr Roxburgh that the concept of having a small area of the site being unattenuated (26.4 Ha) presents an unacceptable level of risk. The proposed unattenuated area is relatively small, approximately 17% of the overall site, the stormwater design will seek to achieve hydraulic neutrality through management of the outflow from the other basins to compensate for the increased runoff from the unattenuated area At subdivision stage, the stormwater concept will be developed and tested in detail to ensure the risk of increasing downstream flows in minor events is adequately mitigated. If the effects of development of some smaller portions of the unattenuated area cannot be appropriately mitigated, these can be developed to a lower density, or not at all, so that overall hydraulic neutrality is ensured.
Water Supply	The preferred source of water for the PC31 site is an onsite deep supply. Additional modelling has demonstrated that this is likely to be a viable option with a reasonable spaced well field. The proposed supply may provide additional redundancy for the existing Ohoka township supply.	All relevant experts agree that there is an adequate solution available to supply the PC31 site with potable water from deep onsite groundwater.	Mr Roxburgh believes there has been insufficient analysis of the shallow groundwater or offsite deep groundwater options for these options to be accepted by WDC without further analysis.
Flooding	Proposed residential dwellings and detention basin locations have the potential to influence flow of flood water across the site and affect flood levels off site.	All relevant experts agree that it is possible to develop PC31 to limit offsite effects from the 0.5% AEP flood event to increases in flooding of less than 20 mm for habitable dwellings. Waimakariri District Council staff consider this increase to be less than minor.	CM Considers that there is some residual uncertainty regarding offsite effects for smaller, more frequent flood events, however there is an

	The proposed detention basins and residential areas have been modelled to capture any changes in off-site effects.		appropriate level of confidence that the Plan Chage can proceed and that there are controls available through subdivision consenting phase to address these uncertainties.
Groundwater Flow (called groundwater resurgence by submitters)	Concerns have been raised that groundwater changes as a result of PC31 development could influence groundwater levels locally or could increase spring flows and impact on flooding.	All relevant experts agree that the baseflow component (groundwater component) of flow to streams is a very small percentage of flow during flood events and therefore won't have a significant impact on flooding. Groundwater emerges in stream channels and local springs but there are natural limits on the extent to which groundwater will rise because of natural discharges to these features. All relevant experts (CS, TM, BT, BW, CM, BV) agree that if the mitigations proposed for management of intercepted groundwater by infrastructure are successful then it is unlikely there will be offsite effects due to changes in groundwater flows. All relevant experts agree that in a 200-year flood event ground water flows are unlikely to have a significant impact on the difference of flood levels pre and post development.	CM and BW consider there is still some residual uncertainty regarding the offsite effects, however there is an appropriate level of confidence that the Plan Chage can proceed and that there are controls available through the subdivision consenting phase to address these uncertainties.

Signed

Witness	**Signature**	**Date**
Ben Throssell		**18/Aug/2023**
Callum Margetts		**18/Aug/2023**
Eoghan O'Neill		**18/08/2023**
Christopher Bacon		**18/08/2023**
Tim McLeod		**18/08/2023**
Ben Wilkins		**18/08/2023**
Shane Bishop		**18/08/2023**
Carl Steffens		**18/08/2023**
Colin Roxburgh		**18/08/2023**
Bas Veendrick		**18/08/2023**

Appendices

Appendix 1 - Supplementary Stormwater Information for Conferencing (provided to the expert panel on 17th August 2023).

Appendix 2 - Additional modelling outputs provided to the expert panel on 17th August 2023

Appendix 3 – Supplementary Water Supply Information for Conferencing.

PATTLE DELAMORE PARTNERS LTD
Level 2, 134 Oxford Terrace
Christchurch Central, Christchurch 8011
PO Box 389, Christchurch 8140, New Zealand

Office +64 3 345 7100
Web **www.pdp.co.nz**
Auckland Tauranga Hamilton Wellington
Christchurch Invercargill

memorandum

TO	PC31 Conferencing Experts	FROM	Eoghan O'Neill
		DATE	17/08/2023
RE	Proposed Private Land Plan Change Request 31 – Responses to WDC Comments		

The purpose of this memo is to document initial responses to the *Summary Statement on Water, Wastewater, and Stormwater Relating to Private Plan Change Request PPCR31 – 535 Mill Road, Ohoka Plan Change Application (08 August 2023*) as received from Waimakiriri District Council (WDC). This memo only addresses concerns and queries raised by WDC for the stormwater component.

Paragraph 46,47 & 48 – concern raised about difference in attenuation calculated and the areas needed. The second part of the concern raised regarding the attenuation volume required for longer events and if PDP considered a range of duration (i.e., the 18hr duration).

Response:

The attenuation volume of 55,950 m^3 as reported in the Stormwater Management Report has been updated and the 2% AEP attenuation volume of 21,990 m^3 quoted in the evidence is correct. The change is as a result of:

- The 21,990 m^3 is the combined attenuation required for the individual catchment (4 off) for their respective catchment peak event (2% EAP rainfall event).
- The 55,980 m^3 was determined using the rational method for a time of concentration of 6 hrs for the pre-development catchment which was used to represent the total contributing catchment critical duration which is 6hrs. The post-development catchment time of concentration was much quicker (approx. 1.5hrs) for the catchment. This resulted in a very low pre-development flow to be attenuated for resulting in the overly conservative attenuation volume of 55,980 m^3.The critical duration for attenuation using this approach would be approx. 12 hrs.

The method used to calculate the 55,980 m^3 is further not applicable in this instance as the infiltration rate within the catchment changes (i.e., the initial abstraction rate reduces from 6 mm/hr to 1 mm/hr during long events) and results in larger pre-development flows during long duration storms (i.e., 6 hrs event). The rational method does not account for this as the runoff coefficient is assumed to remain constant (i.e., the run-off coefficient did not increase due to a reduction in soil infiltration rates).

The WDC District Model was used to test what the 2% AEP volume difference at the outflow from the site would be during a 6-hr event. The estimated change in volume was approximately 10,000 m^3. This is less than the 21,900 m^3 calculated at when the concept was revised and therefor the basins were sized based on the 21,990 m^3 attenuation volume requirement which is still considered to be conservative.

Paragraph 41, 42 & 43 – concerns were raised about areas of the development that will not be serviced by proposed basins and whether the basins are appropriately sized and located.

Response:

Approach to answer this was to consider the existing site contours, the proposed site (road) layout, and where flows would be reasonably expected to be able to divert towards the proposed basins. See **Attachment 1 and Attachment 2** which provide proof of concept long sections for the lower basins in Catchments C1 and C2.

The total area that can drain to basins is approx. 126.4 ha and the area which cannot drain to a basin is approx. 26.4 ha. The area that cannot feasibly drain towards the proposed basins is along Whites Road and the corridor width ranges from 150 m in the south to 220 m towards the north (Ohoka end). It should be noted that a significant proportion, approx. 10 Ha, of this 26.4 Ha will not be subject to increased impervious development due to the protection of key flow paths, the allowance for a large riparian strip along Whites Rd and the presence of stormwater detention basins. For the sake of conservatism, the full 26.4 Ha has been used as unattenuated area in this assessment.

The second part of the concern raised was the potential impact of the unattenuated flows on the downstream catchment. Based on the areas identified above which cannot drain to the basins, the expected post-development peak runoff has been calculated using the rational method. See Table 2 below. These flows have been subtracted from the pre-development flows (Table 1) to provide an allowable attenuated outflow for each catchment. Based on this outflow, revised basin attenuation volumes have been calculated Table 3. Based on topographic information, this volume has been distributed across a number of basins, See **Attachment 3**. These basin locations have been run through the flood model and the outputs are within the parameters discussed in the evidence of Ben Throssell.

Table 1: Pre-Development Catchment Flows

Catchment	C-Coeff	Area (Ha)	Tc (min)	2% AEP Flows (m^3/s)
1	0.35	30.68	85	0.88
2	0.35	54.16	43	2.27
3	0.35	51.1925	36	2.41
4	0.35	16.7678	40	0.74
Total		**152.8**		**6.29**

Table 2: Post-Development Catchment Flows					
Catchment	**C-Coeff**	**Total Catchment Area (Ha)**	**Unattenuated Area (Ha)**	**Catchment Tc (min)**	**Unattenuated 2% AEP Flows (m^3/s)**
1	0.69	40.9	4.4	33	0.44
2	0.70	43.6	4.9	30	0.50
3	0.50	61.7	16.2	26	1.16
4	0.78	6.6	0.9	10	0.19
Total		**152.8**	**26.4**		**2.29**

Table 3: Attenuation Volumes				
Catchment	**C-Coeff**	**Attenuated Area (Ha)**	**Max Outflow (m^3/s)**	**Catchment Attenuation Volume (m^3)**
1	0.69	36.52	0.44	16,547
2	0.70	38.75	1.78	4,527
3	0.50	45.43	1.24	4,861
4	0.78	5.70	0.55	530
Total		**126.4**	**4.0**	**26,464**

Prepared by

Eoghan O'Neill
Technical Director – Water Infrastructure

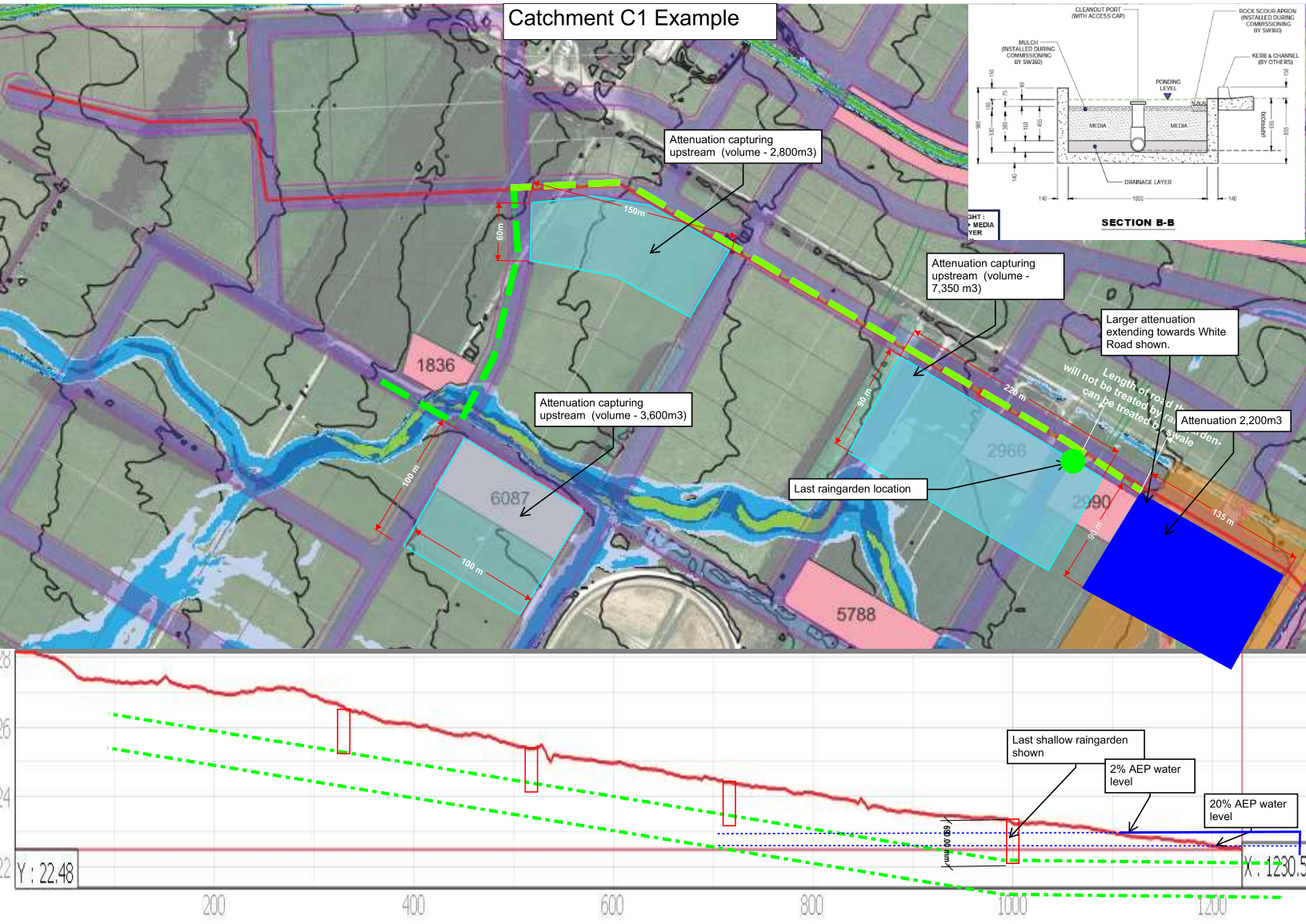
Attachments

Attachment 1 - Long section_Example 1

Attachment 2 - Long section_Example 2

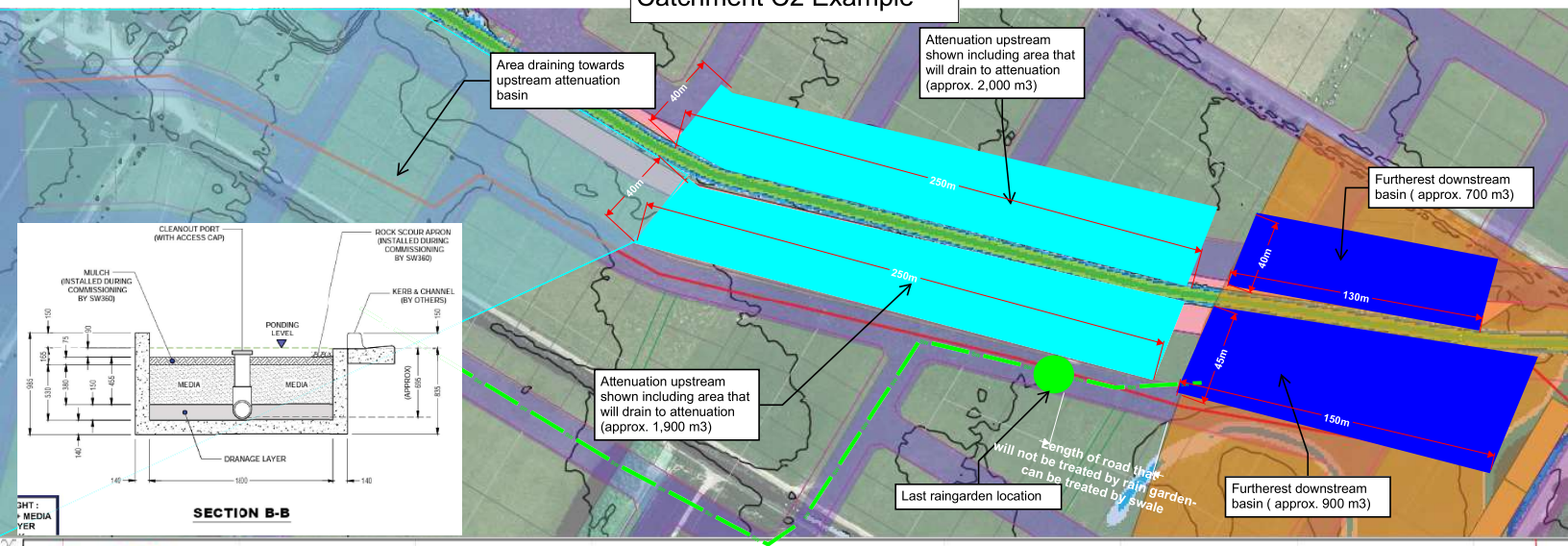
Attachment 3 - Catchment & Basin Layout

Catchment Attenuation Volume Calculations


Catchment C1 Example
Attenuation capturing upstream (volume - 2,800m3)
Attenuation capturing upstream (volume - 7,350 m3)
Larger attenuation extending towards White Road shown.
Attenuation capturing upstream (volume - 3,600m3)
Attenuation 2,200m3
Last raingarden location
1836
6087
2966
2990
5788
150m
60m
100 m
100 m
90 m
220 m
90 m
135 m
CLEANOUT PORT (WITH ACCESS CAP)
ROCK SCOUR APRON (INSTALLED DURING COMMISSIONING BY SW360)
MULCH (INSTALLED DURING COMMISSIONING BY SW360)
KERB & CHANNEL (BY OTHERS)
PONDING LEVEL
MEDIA
MEDIA
DRAINAGE LAYER
SECTION B-B

Last shallow raingarden shown
2% AEP water level
20% AEP water level
Y : 22.48
X : 1230.5
200
400
600
800
1000
1200

Catchment C2 Example



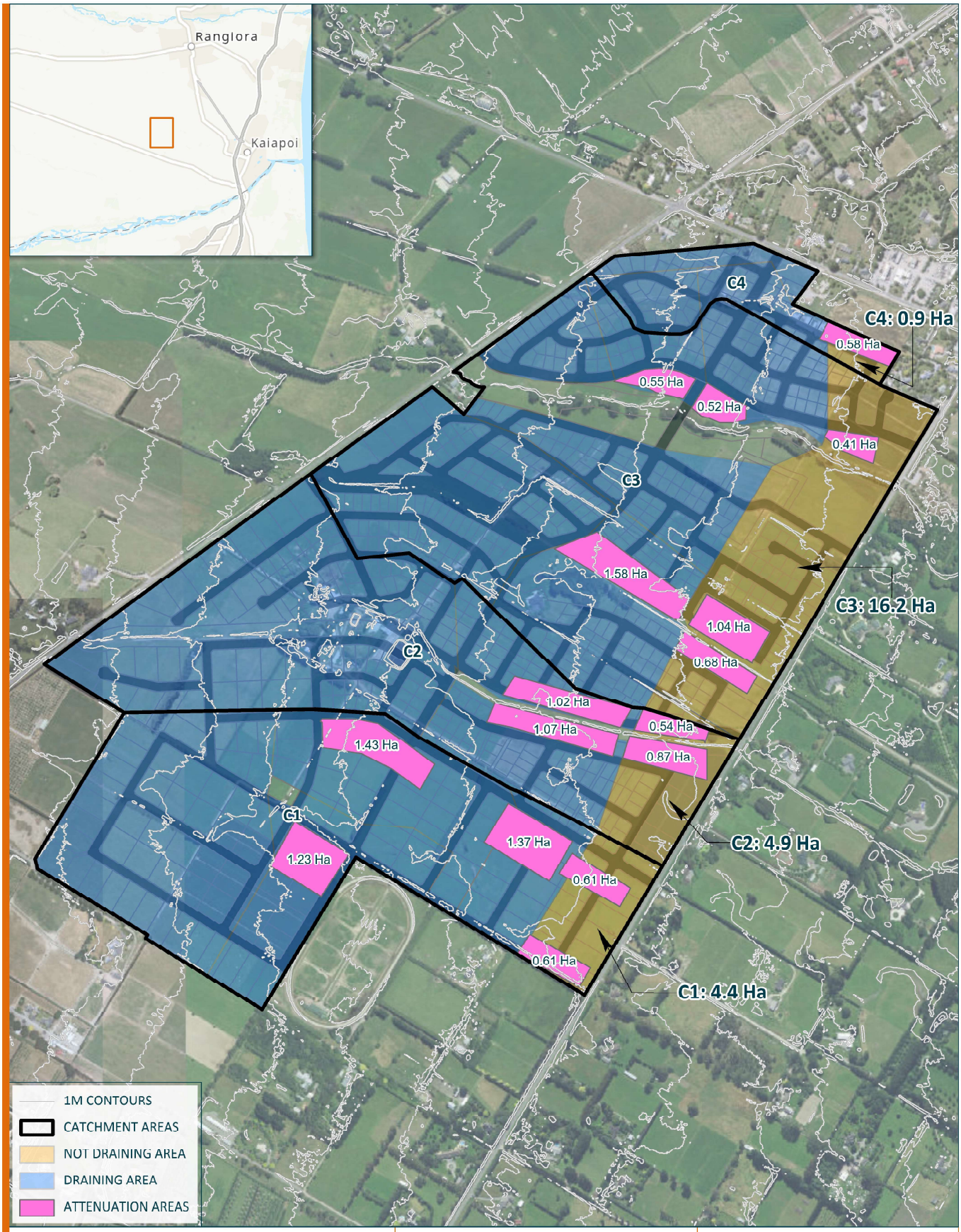


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FIGURE 1: ATTENUATION AREAS AND BASIN LOCATIONS

OHOKA STORMWATER INVESTIGATION

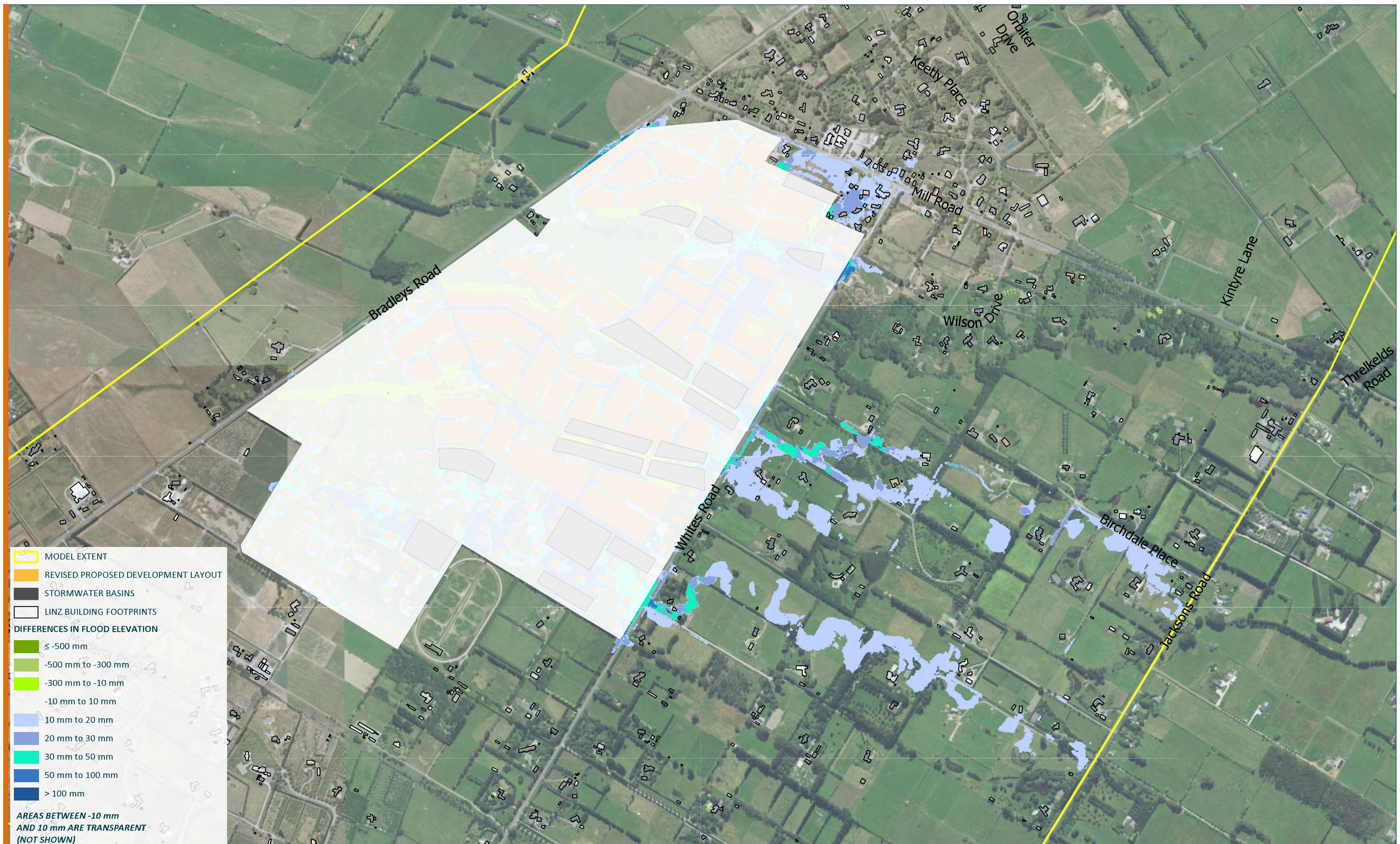
SOURCE:
1. AERIAL IMAGERY: EAGLE TECHNOLOGY, LINZ, STATSNZ, NIWA, NATURAL EARTH, © OPENSTREETMAP CONTRIBUTORS., EAGLE TECHNOLOGY, LAND INFORMATION NEW ZEALAND, EAGLE TECHNOLOGY, LAND INFORMATION NEW ZEALAND, GEBCO, COMMUNITY MAPS CONTRIBUTORS.

0 150 300
METRES
SCALE : 1:10,000 (A4)

N

REVISION: 001 | DATE: AUG 23 | BY:CB
CLIENT: ROLLESTON INDUSTRIAL DEVELOPMENTS LTD

Figure 1



pdp

FIGURE 1: DIFFERENCES IN FLOOD ELEVATION FOR THE 200YR EVENT

OHOKA PLAN CHANGE

SOURCE:
1. AERIAL IMAGERY: EAGLE TECHNOLOGY, LAND INFORMATION NEW ZEALAND, GEBCO, COMMUNITY MAPS CONTRIBUTORS.
2. ROAD INFORMATION DERIVED FROM LINZ.
3. BUILDING FOOTPRINTS DERIVED FROM LINZ.

0 250 500
Meters
SCALE : 1:10,000 (A3)

N

REVISION: 01 | DATE: AUG 23 | BY: JR
CLIENT: ROLLESTON INDUSTRIAL DEVELOPMENTS LIMITED

C04518300_GIS006

PATTLE DELAMORE PARTNERS LTD
Level 2, 134 Oxford Terrace
Christchurch Central, Christchurch 8011
PO Box 389, Christchurch 8140, New Zealand

Office +64 3 345 7100
Web **www.pdp.co.nz**
Auckland Tauranga Hamilton Wellington
Christchurch Invercargill

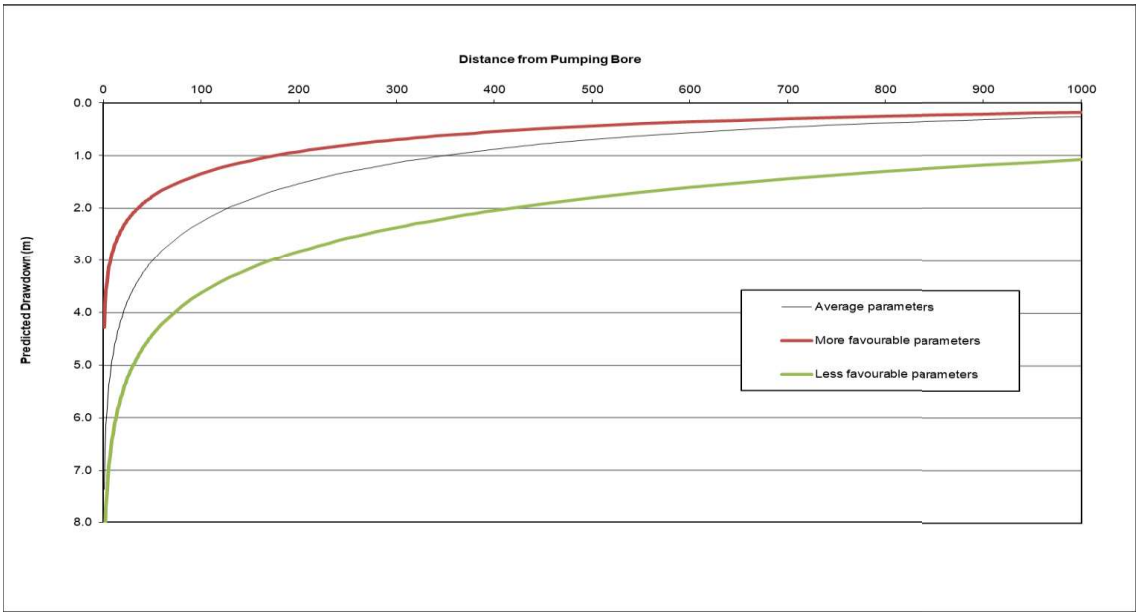
memorandum

TO	PC31 Conferencing Experts	FROM	Carl Steffens
	Client Company Name	DATE	18/08/2023
RE	Proposed Private Plan Change Request 31 – Response to WDC		

The purpose of this memo is to address potential Water Supply issues raised by Mr Colin Roxburgh (WDC) at the PC31 expert conferencing session held at WDC on 10 August 2023.

With regard to the preferred deep onsite water supply option, Mr Roxburgh had potential concerns regarding uncertainty in the number of bores that may be required, and how spaced out they may need to be if aquifer parameters proved be different (larger predicted drawdown effects) than the parameters used by PDP for preliminary well interference modelling. The specific concern of Mr Roxburgh is that if there is an excessive number of bores required, or they were excessively far apart, the supply may be uneconomic for the council to take over and operate.

Based on Mr Roxburgh's concerns, Mr Steffens has carried out further work to clarify these issues. The drawdown interference modelling described in Mr Steffens evidence was based on adopting the average aquifer parameters from previous constant rate pump testing (December 2015) in existing Ohoka deep supply bore BW24/0262. Based on those adopted values (in addition to more favourable and less favourable aquifer parameter scenarios), Mr Steffens has carried out further assessment to show the potential drawdown profile in the deep aquifer with distance from a single individual proposed pumping bore. The resulting figure is shown below and was presented at the meeting of the experts on 17/08/2023.



The drawdown profiles presented are based on abstraction from a single bore continuously at 9.3 L/s for a 150 day period. This rate represents a third of the proposed daily volume limit (2,412 m^3/day, equivalent to continuous pumping for 24 hours at 27.9 L/s). Therefore, the full daily volume limit under this scenario would be provided by 3 bores as per the evidence previously presented by Mr Steffens at the hearing (with an additional bore required to be drilled for redundancy).

To estimate the total potential drawdown effect in an individual neighbouring bore based on this assessment firstly requires determination of the distance between the neighbouring bore and each of the three proposed pumping bores, secondly, reading off the calculated drawdown based on the distance between the neighbouring bore and each individual proposed supply bore, and thirdly, summing of the three separate predicted drawdown values.

For example, if one proposed supply bore was located 400 m from existing supply bore **B**X24/0262, one supply bore was 500 m from BX24/0262 and the remaining bore was 600 m distant, the drawdown interference in BX24/0262 based on the average pump test parameters (black profile line in the figure) would be the sum of 0.88 m (400 m distant), 0.7 m (500 m distant) and 0.56 (600 m distant). That results in a total drawdown effect in BX24/0262 of 2.14 m. Based on that spacing from BX24/0262, it should be possible to position all three proposed bores north of the Ohoka River within the proposed PC31 area, while also maintaining similar spacing between all three of the proposed bores.

The analysis of the step-drawdown testing previously carried out in BX24/0262 (June 2015) predicts self-induced drawdown of 61.4 m in the bore based on 150 days of continuous operation at 12.8 L/s. Under summer groundwater level conditions previously predicted by PDP, this leaves around 10 m of available drawdown in the bore which is more than sufficient to accommodate the 2.14 m drawdown interference effect predicted from the operation of three proposed supply bores. This assessment is conservative in terms of pumping rates because in reality it is not expected that the proposed supply will use the required daily volume limit continuously for 150 days, or that the existing bore will operate at it's consented maximum rate for the same period.

Therefore, if the average aquifer parameters adopted from the previous constant rate testing prove to be applicable, a potential average bore spacing of around 500 m is considered appropriate for a total of three supply bores, while ensuring no adverse operational drawdown interference effects in BX24/0262 (or the new supply bores).

If more favourable parameters (such as those indicated by the red profile shown in the figure) were to be derived during testing of the proposed bores, the effects would be less and therefore three supply bores would still be viable with similar or less spacing between bores.

The green profile line shown in the figure shows less favourable aquifer parameters. This level of effect is based on the most conservative representation of the results from the previous constant rate pump testing in BX24/0262. The total drawdown interference in BX24/0262 from three proposed bores operating under the same conditions as the previous assessment (same separation distances, rates and pumping duration) would be 5.4 m. This is a considerable amount of drawdown interference, however there would still be around 4 m of available drawdown remaining in BX24/0262 under this scenario during predicted summer groundwater level conditions (even considering the overly conservative pumping rates and duration adopted for the assessment). If testing of new bores showed this scale of interference, then consideration could be given to additional supply bores and/or spacing to manage the potential effects.

If four or more supply bores ended up being required (+ 1 for redundancy), then a larger area would be required, although it should be feasible that all supply bores could be sited within less than half of the total subdivision area.

In summary, at this stage it can't be confirmed how many bores will be required, however the initial and additional assessments carried out by PDP confirm that a deep supply option is viable. If a greater number of bores were required than anticipated it is important to note that the applicant will be covering all costs related to the drilling and infrastructure construction relating to the proposed water supply.

Prepared by

Carl Steffens
Technical Director – Water Resources