



memorandum



TO	Pukerua Property Group	FROM	Katy Grant
		DATE	2 October 2026
RE	Mount Welcome – Wetland Hydrology Model for Alternative Stormwater Design		

1.0 Introduction

Pukerua Property Group LP (the Applicant) are seeking to obtain fast-track consent for the development of a residential subdivision near Pukerua Bay in an area known as Mount Welcome. The Mount Welcome site is located at 422 State Highway 59, near Pukerua Bay.

The original application included what the Applicant still considers to be the preferable stormwater design, which included ecological offsetting within stormwater detention devices, where existing natural wetlands already occur. The hydrology assessment included in the application was based on that design. During the fast-track consenting process it has become clear that the various regulators would prefer that the stormwater and ecological functions remain separate, so the Applicant has developed an alternative stormwater solution where ecological offsetting occurs elsewhere (Option 2 scenario). This memorandum updates the hydrology assessment for the site based on this alternative stormwater design. Reference should be made to the original Hydrological Assessment Report (PDP, 2025) and the response to reviewer comments (PDP, 2026) for details of the original scenario and assessment.

2.0 Changes to stormwater design

Envelope Engineering Limited have updated their original stormwater design as follows:

- ✧ Inclusion of 3,000 L tanks on all residential lots, with 2,000 L retained for outdoor use and 1,000 L on lot detention;
- ✧ No changes to raingarden sizing or configuration;
- ✧ Retention wetlands changed to stormwater detention ponds, with a reduction in permanent water volume to the values presented in Table 1, but with no changes to the previously proposed culvert and spillway levels; and
- ✧ Wetland areas lost to stormwater ponds to be included in new offset wetlands in the Kakaho East catchment (separate from stormwater design and not part of this assessment).

3.0 Hydrology Modelling

The existing water balance models for the Taupo and Kakaho West catchments were updated to include the revised tank sizes and detention function, as well as the alteration of the retention wetlands into stormwater detention ponds. The following assumptions were included in the model update:

- ✧ Catchments are unchanged from original model,

- ✧ Pond volumes were updated to the values presented in Table 1,
- ✧ Spillway and culvert levels are unchanged from original model,
- ✧ 1,000 L detention within tanks on all lots, discharging into the stormwater network at a rate of 0.9 L/s,
- ✧ 2,000 L retention tanks for outdoor use, with 100 L/day removed for garden use when the 10-day average rainfall is less than 0.1 mm/day,
- ✧ Lots size assumed to be 350 m² on average with no differentiation made between lot and tank sizes across the development for modelling purposes,
- ✧ Roof area assumed to be 50% of lot area, so 175 m² on average,
- ✧ 75% of roof runoff directed to the tank, with the remainder going directly to the stormwater network; and
- ✧ Full tank volume assumed to be available for use (i.e. no dead storage).

Table 1: Updated Permanent Pond Volumes

Stormwater Pond	Permanent Water Volume (m ³)
A	100
B	115
C	85
D (not included in model)	20
E	180

There are two versions of each catchment water balance model:

- ✧ A 25-year duration model with a daily timestep for wetland hydrology assessment and discharge variations, and
- ✧ A 1-year duration model with a 5-minute timestep for flow calibration, using rainfall data from a year with average rainfall.

The 25-year model is the focus of this assessment, but the 5-minute models have been used to compare the change in discharge rates in specific catchments discharging into the stormwater detention ponds to provide some context for the potential change in flows. However, it is acknowledged that this is not what the model was designed to assess, so the results should be considered as an indication of change rather than in terms of their specific values. Furthermore, the catchments are tied to the on-site wetlands and stormwater detention ponds, rather than the discharge locations from the stormwater network, so will include areas that will sheet flow into the wetland as well as flow along the drainages.

The following scenarios were considered as part of this assessment:

- ✧ Baseline – predevelopment conditions
- ✧ Post-development Option 1 – Applicant’s preferred stormwater design
- ✧ Post-development Option 2 – Applicant’s alternative stormwater design
- ✧ Post-development Option 2a – Option 2 with the inclusion of plumbed in greywater reuse.

Tiaki Wai raised the potential for greywater reuse as a requirement, so Option 2a was included to determine if this would have a beneficial effect on the on-site streams and wetlands and discharge from the site.

4.0 Results - Taupo Catchment

4.1 Wetlands

The alternative stormwater design (Option 2 scenario) results in the same effects on the onsite wetlands in the Taupo Catchment as the preferred option. The wetlands will be the same or wetter than under the baseline scenario, with the wetter period concentrated into the drier summer months. There is little risk of prolonged inundation due to the gradients of most of the wetlands (excluding the wetlands lost to the stormwater detention ponds under this scenario). The same is true for Option 2a.

4.2 Stream flow

It is noted that there was an error in the flow rates in L/s presented Figure 8 in the response to reviewers' comments¹ so the following Table 2 and Figure 1 show the correct values and the previous numbers presented should be disregarded.

As noted in the original assessment, there is an increase in total discharge from the site into the Taupo Catchment in all post-development scenarios due to the changes to catchment boundaries and the increase in impervious surfaces (see Figure 1). The alternative stormwater design does not significantly change the outflows from the site and the results indicate that including greywater reuse would have no significant effect (see Table 1). The differences between the modelled average, median and 95 percentile flows are negligible for all three of the post development scenarios. There are more differences in the maximum modelled flows, but some of this is a relic of the modelling and the daily timestep.

Table 2: Summary of Taupo Catchment Discharge Data for Stormwater Options

Flow Magnitude (L/s)	Baseline	Post-Development		
		Option 1	Option 2	Option 2a
Minimum	0	0	0	0
Average	8	26	25	25
Median	1	9	8	8
95 %ile	29	118	119	117
Maximum	689	950	950	866
Notes: 1. Based on model using 25 years of real rainfall data. Does not include theoretical design rainfall events.				

¹ PDP (2026). Mount Welcome Fast Track – Response to reviewer comments dated 6 August 2026. W027550005M001.

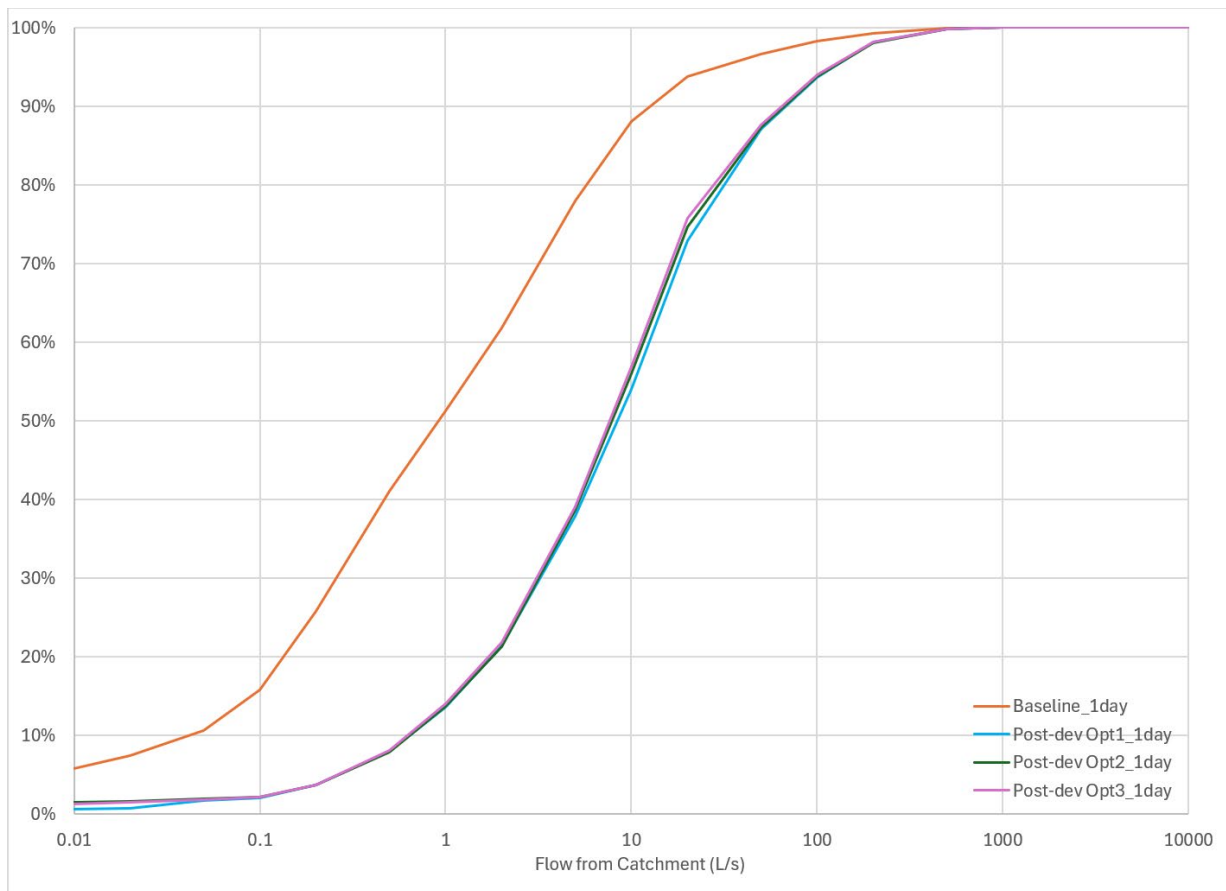


Figure 1: Flow frequency from Taupo Catchment

One of the concerns raised under the original stormwater design was the potential for scour to erode gullies due to the increased discharges. The model was not designed to assess these effects, but to provide some context, the 5-min model for a year with average rainfall has been used to summarise the flow results for one of the steepest catchments with longer potential flow paths (T3W6 in Figure 2). This catchment includes:

- ✧ Discharge from three small raingardens (circled in yellow in Figure 2) which are included in sub-catchments C2, C4 and C5;
- ✧ Sheet flow from grassed slopes in sub-catchments C1 and C3 (noting that the effects of planting or natural vegetation regeneration have not been included in the model),
- ✧ Flow of these discharges into wetland T3W6, located on the gully floor,
- ✧ Discharge from this wetland via stream into wetland T3W5 and subsequently into detention pond C (at wetland T3W4).

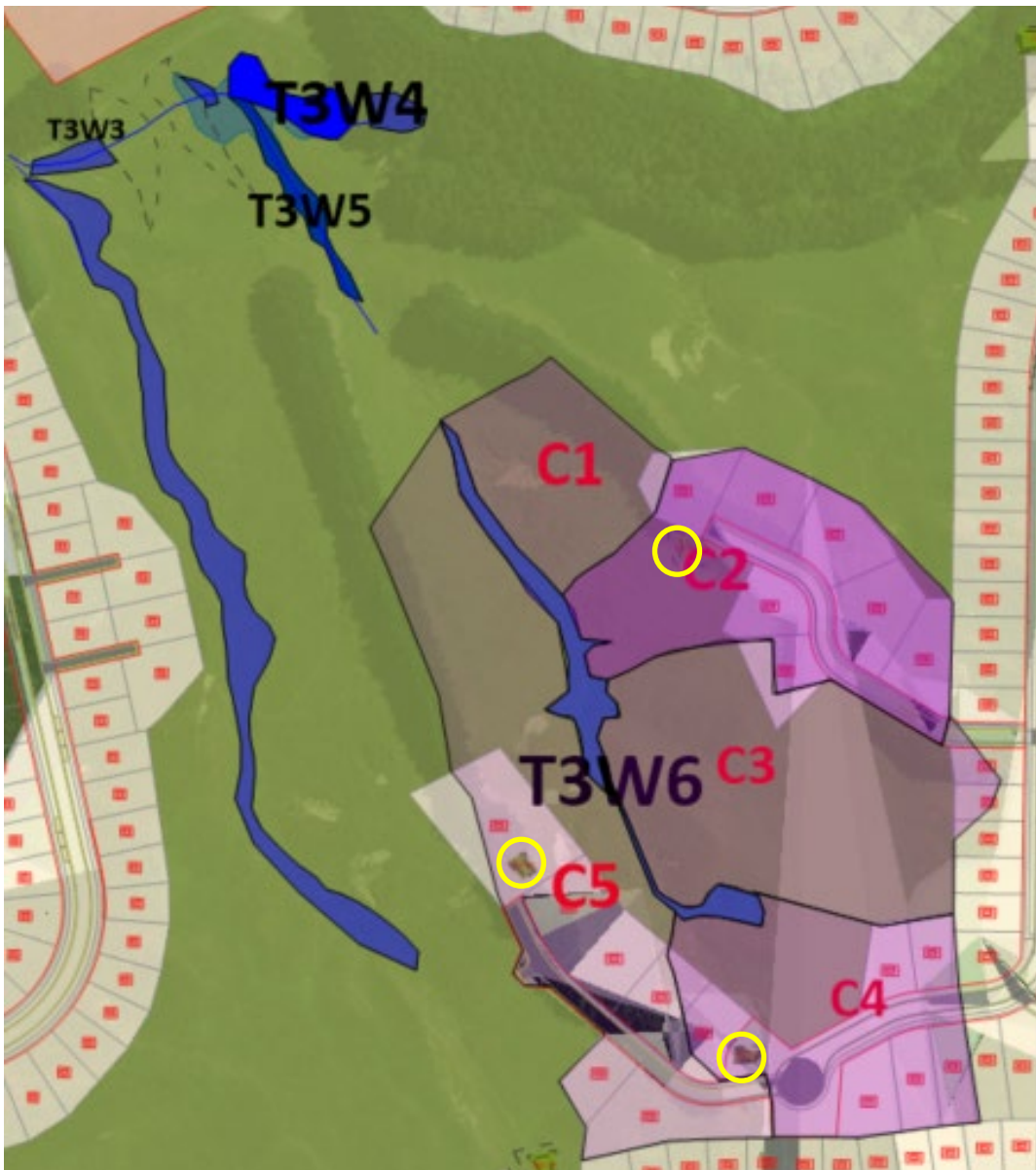


Figure 2: T3W6 Sub-catchments

The results for the different post development options are presented in Table 3 and indicate that the introduction of tanks with both retention and detention volumes has very little effect on the discharges into the catchment. In fact, the only value that is measurably different is the 95th percentile which shows a slight reduction under Option 2a, although the magnitude of this difference would be immeasurable. However, this variation is unlikely to be sufficient to have a significant impact on the risks associated with scour and sediment mobilisation. Similar results are seen for each sub-catchment with only minor changes in flow.

Table 3: T3W6 Flow Variations under Post-Development Options

Total Flow into T3W6 (L/s)	Option 1	Option 2	Option 2a
Minimum	0	0	0
Average	1.1	1.1	1.1
Median	0.03	0.03	0.03
95 %ile	6.4	6.4	6.1
Maximum	89	89	89

4.3 Summary

In summary the change from the Applicant's preferred option to the alternative (Option 2) does not represent a significant change to the retained onsite wetlands, overall discharge and flow rates within the catchment. Whilst there are some minor variations, the inclusion of greywater reuse in the model does not result in a significant reduction in the discharge flow rates in the Taupo Catchment on a local or catchment wide scale and is therefore not preferred. This is in accordance with the previous assessment for this part of the site.

5.0 Results – Kakaho West Catchment

5.1 Wetlands

The inclusion of on-lot retention/detention tanks under the Option 2 scenario does not result in any significant effects on the downstream wetlands in the Kakaho West catchment. Whilst there are minor increases in the number of drier days compared to baseline, the increase is negligible and within the error margins of the assessment. Under both the preferred stormwater design and the alternative option, the majority of the wetlands are the same or wetter, particularly during the summer months.

5.2 Stream flow

It is noted that there was an error in the flow rates in L/s presented Figure 9 in the response to reviewers' comments¹ so the following Table and Figure show the correct values and the previous numbers presented should be disregarded. The results presented here in Table 4 and Figure 3 are for the same four model scenarios detailed in Section 3.

The post-development flows in the Kakaho West catchment are slightly lower than the pre-development flows, primarily due to catchment being diverted west into the Taupo Catchment post-development. The inclusion of tanks under Option 2 slightly reduces the flows further, although the change is very minor. If greywater reuse is included this further reduces the flows. Whilst the changes are minor, given that the flows in this catchment will be reduced post-development under all the stormwater options, it is considered that Options 1 or 2 would be preferable to stop the average flow decreasing any further.

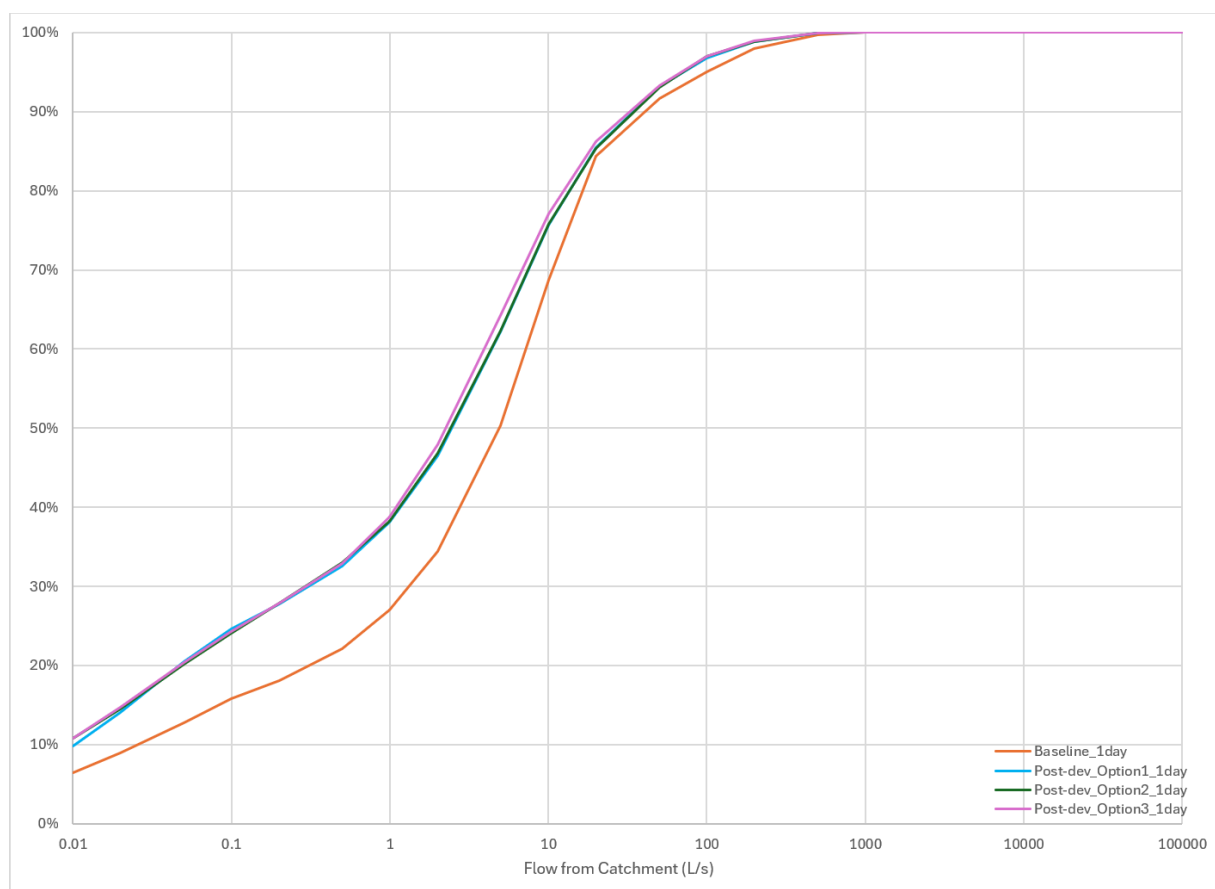


Figure 3: Flow frequency from Kakaho West Catchment

Table 4: Summary of Discharge Data for Kakaho West Catchment for Stormwater Options

Flow Magnitude (L/s)	Baseline	Post-Development		
		Option 1	Option 2	Option 3
Minimum	0	0	0	0
Average	20.0	14.4	14.2	13.6
Median	4.9	2.5	2.4	2.3
95 %ile	99.8	69.3	68.0	66.5
Maximum	1005	810	810	809
Notes:				
1. Based on model using 25 years of real rainfall data. Does not include theoretical design rainfall events.				

There has been considerable discussion during the consenting process around the potential for sediment discharge into Retention Wetland E in the Kakaho West catchment. In the water balance model, this wetland area is referred to as K1W4. The regulators raised two key concerns, discharge from the catchment upstream of the site causing sediment mobilisation and deposition in the retention wetland and the erosion and scour from the increased discharge in local catchments into this area. The existing upstream pond near the northern boundary of the site will continue to act as a natural sediment retention device for the upstream catchment, so that concern is not considered further here.

The inclusion of on-lot tanks for retention and detention was discussed as a possible option for reducing the risks of scour and erosion, in conjunction with forebays for sediment removal. The conversion of the retention wetland into a stormwater detention pond under Option 2 removes the requirement for forebays. The 5-minute one-year average rainfall model has been used to assess whether the inclusion of on-lot tanks will have a significant impact on discharge flow rates from the neighbouring catchments into wetland K1W4 (Stormwater Detention Pond E, under the alternative stormwater design).

As noted previously, this model was not built or designed for this purpose, so the numbers presented below are to provide context to the likely changes rather than an indication of actual flow rates within channels. The modelled catchments assessed here are presented in Figure 4 and include the key catchments discharging directly into K1W4 with no buffering from other wetlands or streams. These catchments do not represent the total discharge into this location, but include the following catchments:

- ✧ C1 containing 8 lots and a small treatment device discharging to a large sloped area of grass (no additional planting planned or assumed in the model),
- ✧ C2 is the same as C1, but with only 6 lots,
- ✧ C3 includes a large development area with 111 lots discharging via a raingarden into a broad shallow ephemeral drainage system, with a relatively low gradient,
- ✧ C4 contains 23 lots discharging via raingarden down a slope towards the wetland, and
- ✧ SC6 includes a large development area along the ridge with 102 lots which discharge via raingarden into a short gully which flows into the top of K1W4.

These catchments represent the key types of sub-catchment in the Kakaho West part of the development and include significant development area. The yellow circles highlight the treatment devices (raingardens) in these catchments.



Figure 4: Sub-catchments for K1W4 assessed here

The results are summarised in Table 4 and indicate that there is little difference between the flows predicted by the model under Options 1 and 2, suggesting that the inclusion of retention and detention tanks on each lot may result in little change to the flow rates in the catchments. The inclusion of greywater use does result in slight reduction in the modelled rates, although it is considered unlikely that the reduction is sufficient to make a significant difference to erosion. However, the risks associated with a further reduction in flow in this catchment are considered to outweigh any benefits associated with a small reduction in erosion, so Options 1 or 2 are considered to be preferable from a stream flow perspective.

Table 5: K1W4 Flow Variations under Post-Development Options

Total Flow into K1W4 (L/s)	Option 1	Option 2	Option 2a
Minimum	0	0	0
Average	4.2	4.2	3.7
Median	0.1	0.1	0.1
95 %ile	24	24	20
Maximum	302	301	292

Notes:

1. Based on model using 25 years of real rainfall data. Does not include theoretical design rainfall events.
2. Not total catchment inflows, total for sub-catchments presented in Figure 4.

5.3 Summary

In summary, the updated modelling indicates that the use of an alternative stormwater design does not result in significant changes to the effects on the on-site retained wetlands, overall discharge and flow rates within the catchment, when compared to the Applicant's preferred stormwater design. The inclusion of greywater re-use from on-lot rainwater tanks may result in reduced flow rates in some sub-catchments but also reduces the total discharge. The changes to catchment boundaries as a result of the development are likely to cause some reduction in flow rates within the Kakaho Stream, but this should be minimised where possible. It is therefore considered that Options 1 or 2 represent a lower overall risk to the stream hydrology than Option 2a, which is therefore not preferred.

6.0 Conclusions

In conclusion, the existing water balance models have been updated to assess alternative stormwater designs with the conversion of the proposed retention wetlands into stormwater detention ponds and the inclusion of tanks on all residential lots with:

- ✧ 2,000 L retention function for garden use, and
- ✧ 1,000 L detention with a 0.9 L/s discharge rate to the stormwater network.

These updated models have been used to assess the effects on the hydrology of the wetlands and streams on and leaving the site under the alternative stormwater options. Results have been compared to baseline conditions and the Applicant's preferred stormwater design option. The inclusion of greywater re-use has also been assessed.

The results indicate that there is little material difference between the current and alternative stormwater designs from a wetland hydrology and stream flow perspective. The inclusion of greywater reuse has a negligible effect on flows in the Taupo catchment and potentially a small, negative impact in the Kakaho West catchment and is therefore not preferred for that catchment from stream flow perspective.

7.0 Limitations

This memorandum has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Pukerua Property Group LP and others (not directly contracted by PDP for the work), including Envelope Engineering, BlueGreen Ecology and GWRC. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the memorandum. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

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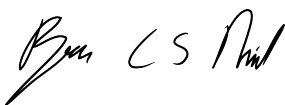
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