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Wednesday, February 22, 2023

Ref: 10484

Kaipara District Council
42 Hokianga Road
Dargaville
0340
Attention: David Usmar

**RESPONSE TO INITIAL REVIEW OF STORMWATER MANAGEMENT FOR PRIVATE PLAN CHANGE – DARGAVILLE RACING CLUB INCORPORATED.**

Dear David,

An initial review of the stormwater management for the proposed development (Dargaville Racecourse Development), for which a private plan change is being sought, was undertaken by Awa Environmental Limited, on behalf of the Kaipara District Council. The findings and recommendations of this initial review was published in a memorandum addressed to yourself, which was dated 18 November 2022, with reference J000663. The memorandum was shared with the applicant, who was offered the opportunity to provide a response.

The memorandum concluded with a statement saying that "*whilst the applicant has shown that it may be possible to mitigate some of the adverse impacts of their development, there is missing information that will need to be provided to demonstrate that the development can be adequately serviced in terms of stormwater drainage and flood hazard.*"

We thank you for the opportunity to provide a response to the review, including further information to address the key findings of the report.

The response below, should be read in conjunction with the latest version of the Civil Engineering Assessment Report included in the application, prepared by Lands and Survey Engineering.

**1. Query:**

*"Given the low-lying nature of the site, it is unclear how future stormwater networks and ponds will drain into the existing downstream drains without extensive fill earthworks."*

**1. Response / Clarification:**

Although the site is relatively flat, it must be noted that there is a generous fall across the site towards Awakino North Road, which will facilitate good surface drainage. Obviously, the site will undergo surface terrain modifications and recontouring at the development stage, to direct runoff to the points of treatment, attenuation and discharge.

The elevations of development areas across the terrain ranges between 8.0 NZVD and 4.5 NZVD, with the invert level of the roadside drainage at the lowest point of discharge being at 3.3 NZVD. The details of how the terrain will be modified through a cut and fill operation and how the surface and subsurface drainage will function is

details that are expected to be developed during the design stage, when subdivision resource consents are being sought.

It is anticipated that runoff from the developed site will be conveyed to a series of treatment and attenuation devices via the on-site stormwater pipe network, roads and surface drains.

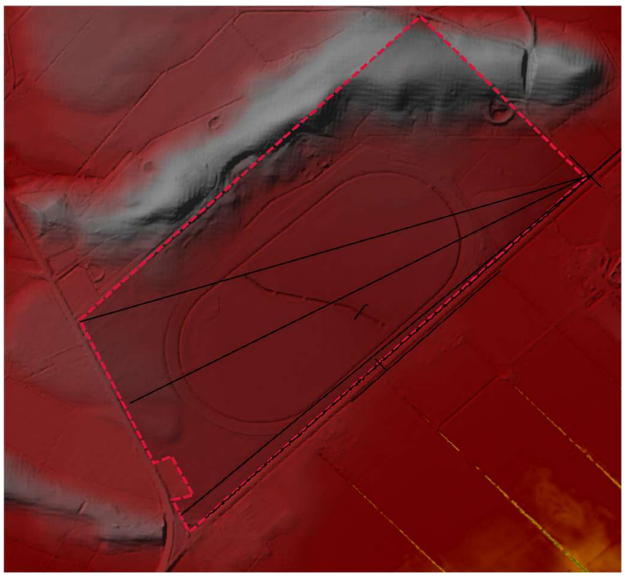

*Figure 1 - Lidar Terrain Surface (Source: LINZ)*

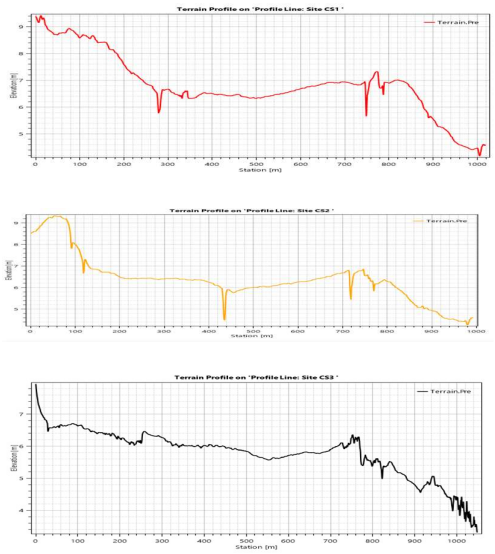


*Figure 2 - Surface profiles across the subject site*

Figures 1 and 2 above shows the slopes of 3 sections taken across the site towards the lowest point of discharge in the north-east corner. The average slopes are measured as being 4.0 to 4.5%, which is considered adequate to drain into the existing downstream networks.

The existing downstream network consist of a series of open drains, generally with slopes in an eastern to north easter direction. There are various discharge and distribution options to direct flows from Awakino roadside drains, to ensure an adequate level of service is achieved. Again, the arrangement, upgrades and drainage improvements to establish the discharge distribution can be designed and developed when subdivision resource consents are being contemplated.

We conclude that although the assessment is not explicit on how the future stormwater network and management devices will drain into the existing downstream network, the information provided above demonstrates that drainage of the site is possible, subject to further investigation and design.

**2. Query:**

*"It is not clear whether the stormwater infrastructure in the area will have capacity to cater to the requirements of design periods for commercial land use i.e. 5% AEP. An upgrade of infrastructure may be required to provide a suitable level of service to the development."*

**2. Response / Clarification:**

It is expected that minor upgrades and maintenance will be required to enhance conveyance capacity and functionality of downstream drainage infrastructure, however detailed assessment and design of these upgrade requirements can be addressed and developed during the resource consent stage. Having said that, the focus of

the proposed concept stormwater management included in our engineering assessment report, is to maintain hydraulic equilibrium to that of the predevelopment stage. The internal infrastructure will be designed to provide the level of service for that of a 5% AEP event and provide further mitigation for events exceeding the level of service, however the management controls will be done at a subdivision catchment level, where the discharge from the site is limited to that of the predeveloped state.

The NRC River Flood Hazard maps indicates that the surrounding and downstream area is subject to flooding in 1%, 2% and 10%AEP events. A simulation with the aid of 2D hydraulic modelling software was undertaken to understand the overland and surface drainage from the site towards the flood susceptible areas and discharge points and test the capacity of the existing roadside table drains and downstream drainage network for the various events, up to and including the 1% AEP rainfall event.

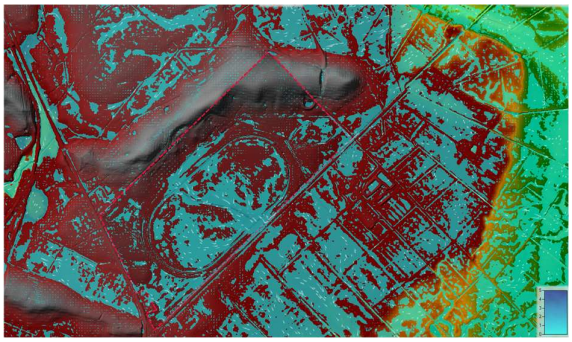

*Figure 3 - 2D Surface drainage - 1% AEP Event*

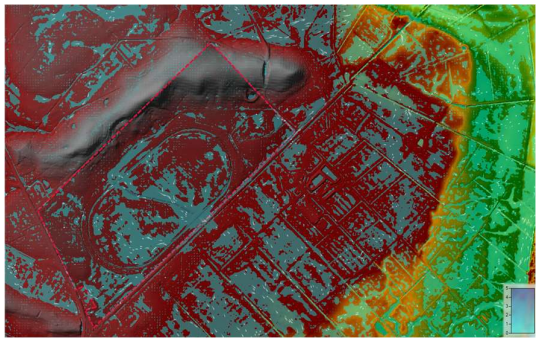

*Figure 4 - 2D Surface drainage - 5% AEP Event*

Figure 4 above clearly depicts that the surface flows from the site for the 5% AEP event is mostly contained within the roadside drain, which discharges towards the northeast, whereas the larger 1% AEP event depicted in figure 3 is expected to flood across Awakino North Road.

Observation note: Large parts of the areas that suggests “flooding”, is limited to sheet flow or shallow runoff during rainfall events. Figure 5 below depicts a depth analysis for surface runoff for the 1% AEP rainfall event.

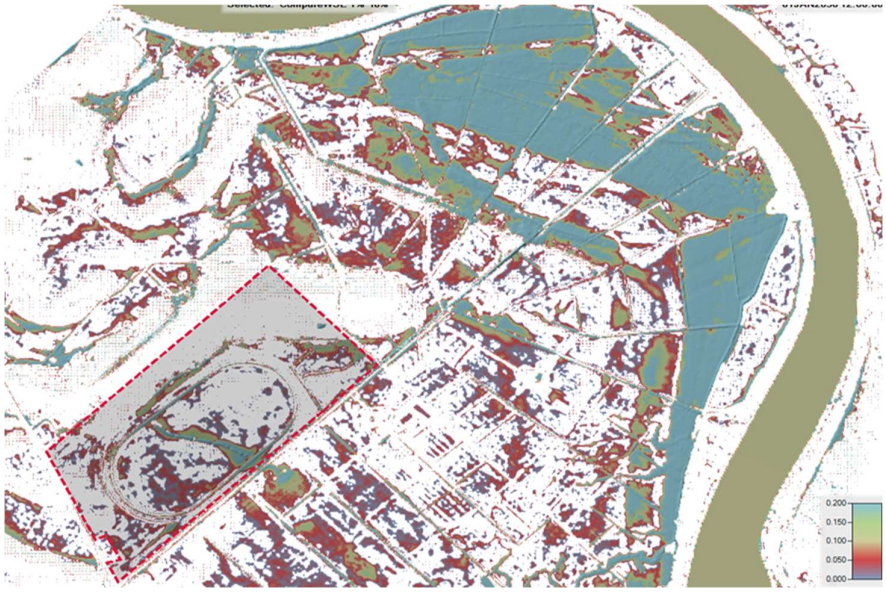


*Figure 5 - Surface runoff maximum water depth for 1% AEP event*

Although the works and anticipated stormwater infrastructure upgrades associated with the proposed development will not result in specific mitigation and relief to existing downstream flooding issues, it will be able to ensure that the effect from the development provides a nett improvement by way of more controlled discharge and more even discharge distribution from the site, with specific improvements on critical downstream reaches to service the development.

It must be noted that the main risk of downstream flooding is driven by the river flood hazard of the Wairoa River, which has a very different hydrological response to large rainfall events, compared to that of the subject site.

The recent flooding events caused by the Cyclone Gabrielle, is testimony to this, where it was observed that during the peak of the flooding experienced in and around Dargaville township, the runoff from the site and downstream receiving environment was nearly non-existent, with little to no major flow in the existing drainage network near the site. This is discussed further in our response to query number 4 below.

Our assessment provides an indication that the downstream infrastructure may lack capacity, however this can be mitigated by way of minor upgrades and maintenance, supplemented by a on-site catchment management scheme to reduce peak discharge from the development during rainfall events up to and including the 5% AEP event, to ensure an appropriate level of service is maintained.

**3. Query:**

*"The assessment does not appear to have considered the upstream catchment draining into the site which could both be impacted by the proposed development, and could impact the development."*

**3. Response / Clarification:**

A detailed catchment delineation was undertaken to understand the wider catchment area contributing to flow in the downstream infrastructure ("catchment if influence") and the potential effect the development may have on runoff from an upstream contributing catchment area. The catchment delineation shown in Figure 6 below, clearly depicts that the "catchment if influence" is mostly contained within the boundaries of the site. The delineated "catchment of influence" is measured as 50.6ha, compared to the overall surveyed site area included in the assessment in section 4.2.5 of our report of 45.06ha. The variation on the catchment area is attributed to road surfaces downstream of the site (drains within Awakino North Road and lower parts of Part Lot 35 DP 11124) and a part of Part Lot 36 DP 11719 draining into the site. The additional predevelopment flows from Part Lot 36 DP 11719 can easily be managed through the proposed drainage infrastructure and conveyed through the site.

There is not expected to be any effect on the ability to drain Part Lot 36 DP 11719 through the subject site, where the inflows are from the upper parts of the catchment, some 7 meters higher than the highest development area within the subject site. Therefore, we conclude that the effects from the upstream catchment draining into the site are less than minor.

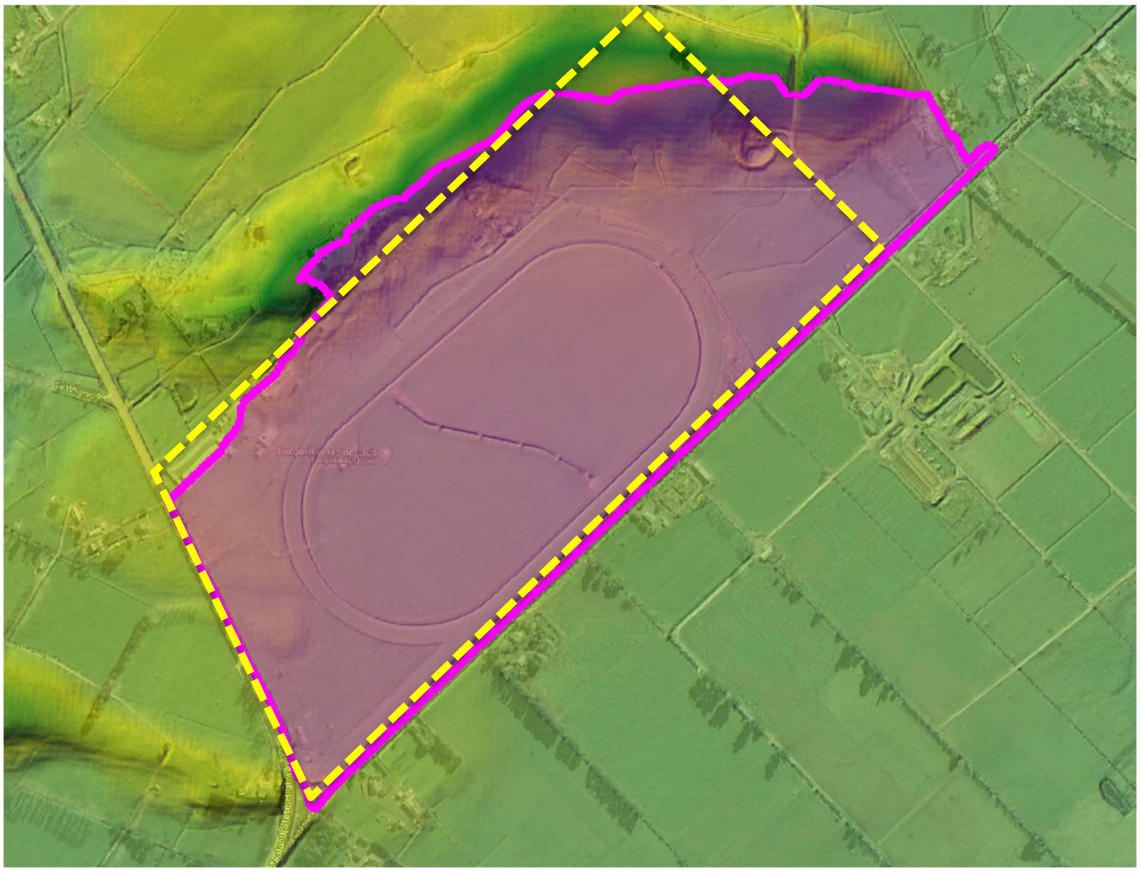

*Figure 6 - Subject site catchment of influence.*

**4. Query:**

*"Whilst the applicant has proposed stormwater attenuation devices to mitigate the effects of increased impervious area, they have not assessed what the potential impact the development will have on downstream flooding, in terms of the displaced ponding on the site."*

**4. Response / Clarification:**

On site depressions will be filled in, and the site will be recontoured to provide more affective drainage of rainfall from the site, as soon as excess rainfall is converted to runoff. Considering the typical shape of a conventional runoff hydrograph, and the fact that the subject site is situated at the bottom end of the Wairoa River catchment, we envisage that the displacement of on-site depressions is negligible.

To understand this, and put the statement above in context, we investigated the potential impact on the downstream river flooding and compared the concentration times of the respective contributing catchments.

Catchment and flood statistic and data was sourced from NIWA website for New Zealand River Flood Statistics.

The Wairoa River has a catchment area of 2827km$^2$, with the longest flow path being approximately 127km. The time of concentration for the river reach near the subject sites point of discharge where flooding may be of concern is estimated as 25.5 hours using Ramser Kirpich formula.

The simulations included in our engineering assessment report, suggests the time of concentration for peak discharge to reach the discharge points of concern is approximately 45minutes. Therefore, any additional runoff

volume from the subject site, that is conveyed off the site and discharged, prior to the peak rainfall intensity that is expected to drive the peak discharge, will have little effect of the conveyance capacity of downstream infrastructure, and almost certainly no impact on downstream flooding due to the substantial variation and extreme unlikely circumstances where the additional volume being discharge will influence or coincide with the peak river flood.

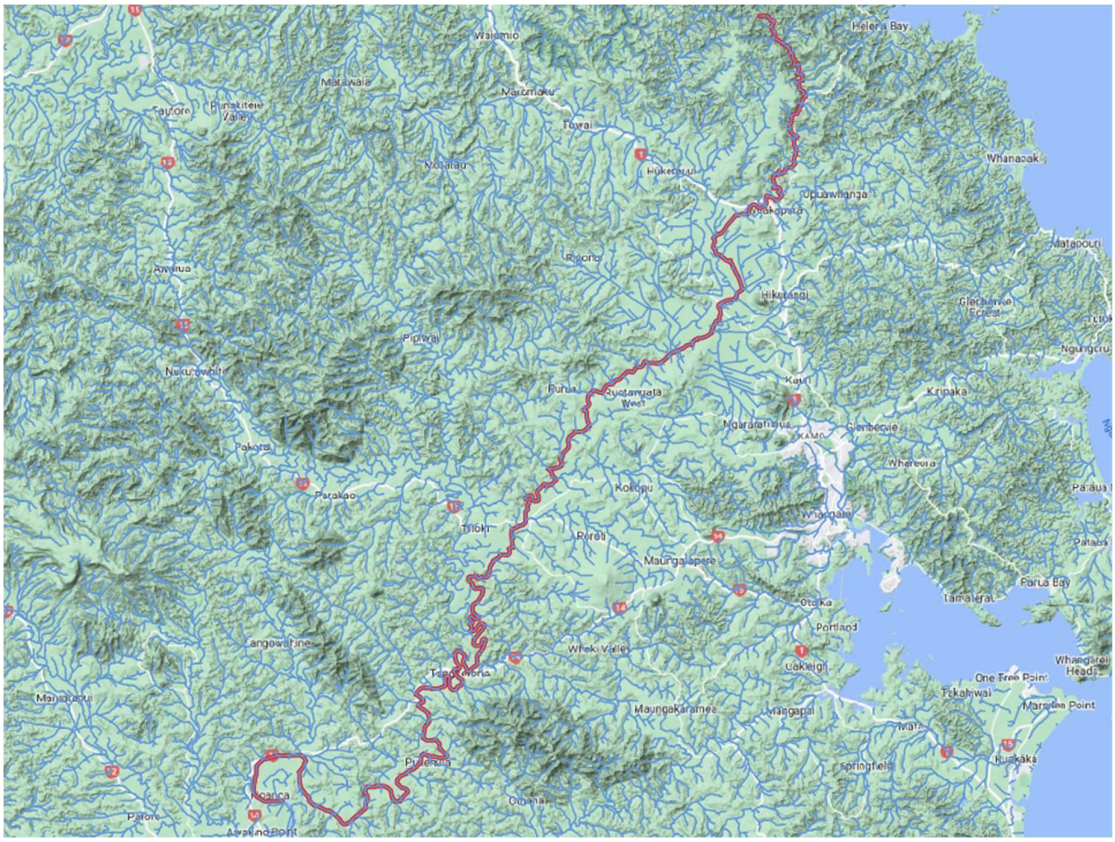


*Figure 7 - Wairoa River Reach for station near site (127km long)*

*Table 1 – Time of Concentration Calculation for Wairoa River Reach*

| | | | | |
|---|---|---|---|---|
| L | 127166.8 | m | | |
| Sa (Equal Area Method) | 0.00386 | m/m | | |
| Acatch | 2827.3 | km2 | | |
| dH | 268.2 | m | | |
| Tc (Ramser Kirpich) | 1411.5 | mins | 23.5 | hrs |
| Tc (Bransby-Williams) | 47.2 | hrs | 47.2 | hrs |
| Tc (US Soil Conservation Service) | 29.7 | hrs | 29.7 | hrs |



APPENDIX B

TIME OF CONCENTRATION FORMULAE

1. RAMSER-KIRPICH

$$T_c = 0.0195\ L^{0.77}\ S_a^{-0.385}$$

where $T_c$ = time of concentration, in minutes
$S_a$ = average channel slope, in m/m
L = flow length from the farthest point on the catchment to the outlet, in m.

2. BRANSBY-WILLIAMS

$$T_c = \frac{0.953L^{1.2}}{A^{0.1}H^{0.2}}$$

where $T_c$ = time of concentration, in hours
L = maximum flow length, in km
A = catchment area, in $km^2$
H = the difference in elevation between the highest and lowest points on the main channel, in m.

3. U.S. SOIL CONSERVATION SERVICE

$$T_c = \left(\frac{0.87L^3}{H}\right)^{0.385}$$

where $T_c$ = time of concentration, in hours
L = maximum flow length, in km
H = the difference in elevation between the highest and lowest points on the main channel, in m.

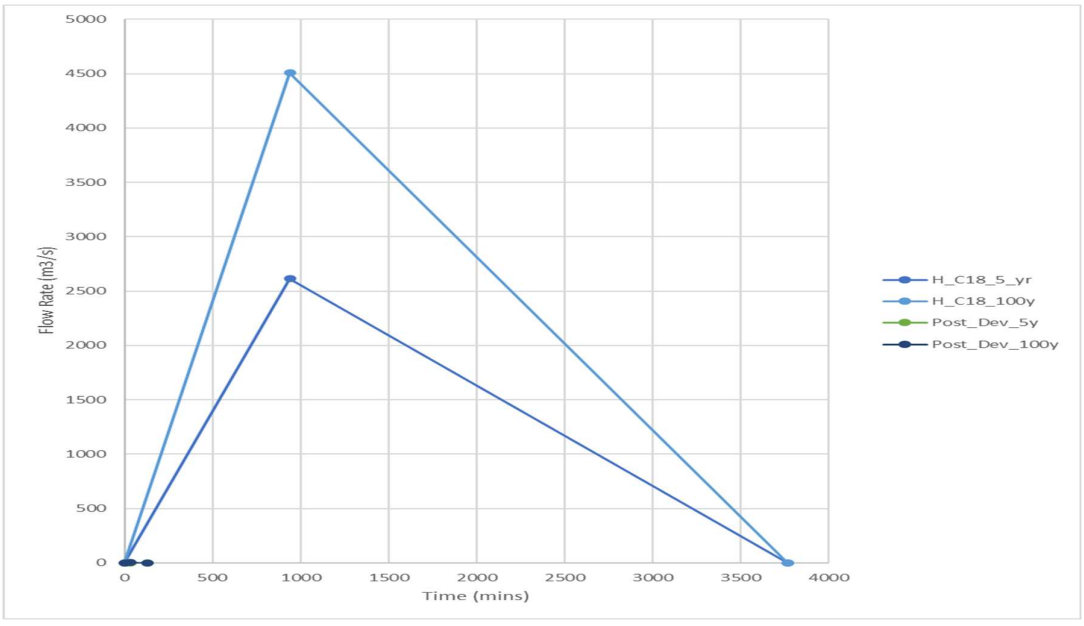


*Figure 8 - Simple hydrograph comparison depicting TC variation.*

**5. Query:**

*"There are a large number of unknown culverts in place that the development will need to rely on in terms of stormwater servicing, for which no capacity assessment has been carried out. It is therefore currently unclear whether the site can be designed to meet the required level of service in terms of drainage and flood hazard.*
*It is noted that the permeability rate of the underlain soil is considered very low to negligible and that the site appears to be generally waterlogged. It is unclear how this matter will be managed, especially in the areas where*

*detention ponds are proposed. The water table may impact on the ability of detention ponds to provide the necessary storage without substantial engineering/earthworks."*

**5. Response / Clarification:**

The response to this query is provided in two parts:

Part 1 – Unknown culverts and capacity assessment…
As discussed throughout this response, it is acknowledged that there are several issues that remains unclear and unknown, which includes current capacity of downstream infrastructure, however our 2d hydraulic model suggests that for the most part that there is adequate capacity to convey runoff for the 5% AEP event. Again, this is a matter which can be further investigated and resolved during resource consent stage, where lack of capacity of infrastructure is not an objective impossibility in respect to level of service. There are multiple drainage routes and options that can be explored during a more detailed assessment at resource consent stage.

Part 2 – High ground water levels, permeability of soils and in- ground stormwater management devices…
The excavated stormwater management devices will naturally draw down the ground water and constantly drain to maintain a maximum permanent water depth within the device. (Devices being contemplated being constructed wetlands.) Downstream infrastructure will be assessed, upgraded and modified as required to ensure continuous drainage is maintained, where it has been demonstrated in our response to query 1 above, that there is no lack in hydraulic head to achieve good drainage. It is noted that continuous drawdown of ground water may influence ground stability. Therefore, it is envisaged that this will be considered when more detailed geotechnical investigation and analysis is undertaken during the resource consent stage.

Should you have any queries regarding the above, please do not hesitate to contact me on 021 024 99917 or via email at henk@landsandsurvey.co.nz.

Kind regards,

**Henk de Wet** CPEng, CMEngNZ, IntPE(NZ) / APAC Engineer
Technical Director
Lands and Survey Engineering LTD