Memo

<table>
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<tr>
<th>Date</th>
<th>26 August 2019</th>
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<tr>
<td>To</td>
<td>Hannah Goslin, Consultant.</td>
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<tr>
<td>From</td>
<td>David Just, Team Leader Consents Planning.</td>
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Annual Volume for Resource Consent CRC182422 and CRC192414

Introduction

Fulton Hogan Limited (the applicant) holds resource consent CRC182422 which is a water permit authorising the take and use of water for irrigation at Jones Road, Templeton. The property where the irrigation is authorised to occur is located within the proposed Roydon Quarry site.

The applicant proposes that water taken under resource consent CRC183422 will be used for quarrying purposes such as aggregate washing and dust suppression. They do not propose to take any additional water (which would be a prohibited activity in this zone), rather they propose to use the water in accordance with the scope of the existing consent.

The existing consent does not include a limit on the annual volume of water that can be taken. Therefore, in order to determine how much water is available to use for quarrying purposes, an appropriate annual volume first needs to be determined for the existing water permit. This is in accordance with Policy 4.63 of the Canterbury Land and Water Regional Plan (LWRP) which requires that all groundwater abstractions are subject to a maximum seasonal volume based on reasonable use in accordance with Schedule 10 (attached).

The purpose of this Memo is to summarise the Schedule 10 reasonable use test as applied to resource consent CRC182422.

Schedule 10 of the LWRP

Schedule 10 contains three methods for determining seasonal irrigation demand, and only applies to water used for irrigation purposes. These methods are appropriate to use given that the annual volume of water available is determined by the scope of the existing water permit, which is for irrigation of 32 ha (hectares) of pasture as outlined in the original application for that consent (applied for as CRC010516).

The Schedule 10 methods for determining the seasonal irrigation demand provide the annual volume for a water permit for irrigation. The use of any of the three methods in the schedule is equally valid in determining the annual volume required for irrigation.

In their second response to the request for further information (dated August 2019) the applicant has determined an annual volume of 351,622 m³ (cubic metres). From the demand table provided (Table 2: Schedule 10 annual volume assessment for current consent) I can...
establish that the applicant has used method 3 of Schedule 10. They then note that this is more than could have been taken under the consent over a calendar year, and propose limiting this to 274,642 m³ (being the average daily volume of 752.44 m³ pumped every day of the calendar year).

The applicant has in my view made two key errors in determining the volume for irrigation for the abstraction authorised by CRC182422.

1. **Area to be irrigated:**

   The area authorised to be irrigated is limited by the original application – this is 32 ha, as discussed in the legal opinion by Wynn Williams, attached to Ms Goslin’s report. The irrigation demand calculated by the applicant assumes that 66 ha can be irrigated – this is not the case. As volume is calculated on a per hectare basis, the volume calculated for 32 ha is just short of half the volume calculated for 66 ha.

2. **Provisions in Schedule 10**

   Schedule 10 method 3 has been used by the applicant. As the applicant has used this, my advice is based on an audit of their application of this method. In determining the total seasonal demand, provision is made for the following in Schedule 10:

   1. An irrigation application efficiency of 80%
   2. A system capacity to meet peak demand
   3. A nominal irrigation season from 1 September to 30 April
   4. Demand conditions that occur nine out of ten years;
   5. A land use of intensive pasture production

   The methodology used by the applicant has not taken into account two of these provisions, being 2, and 3 above.

   **A system capacity to meet peak demand (provision 2.)**

   Irrigation is undertaken to replenish soil moisture lost (in millimetres per day (mm/d)) via evapotranspiration which occurs as a result of evaporation and transpiration. The system capacity is the ability of the irrigation system to deliver water needed to replenish water lost from the soil via evapotranspiration.

   Peak demand in Canterbury can be very high, and the applicant has not taken into account the peak demand for the site, which needs to be considered in order for the assumptions of the model, and therefore the volume determined, to be met.

   The approach taken by Environment Canterbury when auditing annual volumes is to apply a minimum system capacity threshold of 4.32 mm/d – irrigation at rates lower than this are described as being of limited system capacity. The applicant has assumed that a system capacity of 1.14 mm/d (752.44 m³/66 ha – same calculation method as footnote 2) is sufficient

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1. 6,772 m³ / 9 days = 752.44 m³ per day
to meet peak demand – this is not the case in my opinion, furthermore the applicant has not considered the peak demand specific to the site.

In order to understand the effect of limited system capacity on the annual volume, the approach I have taken is to establish the area that can be irrigated to a system capacity of 4.32 mm/d with the consented volume of 6,772 m³ per 9 days.

In this case 6,772 m³ per 9 days equates to 4.32 mm/d over an area of 17.42 ha 2.

This means that the applicant cannot effectively irrigate more than 17.42 ha at periods of peak demand.

The applicant has correctly calculated the volume demand for 66 ha:

- if this was both the area able to be irrigated; and
- the system capacity could meet peak demand,

neither of which is the case.

An appropriate method of taking the limited system capacity into account is to reduce the annual volume calculated for the 66 ha to that required for 17.42 ha – this results in a volume of 96,489 m³ being calculated3.

A volume of 96,489 m³ is equivalent to 128 days of irrigation at the maximum daily volumes authorised by the CRC182422.4

A nominal irrigation season from 1 September to 30 April (provision 3.)

The nominal irrigation season in Schedule 10 is listed as 242 days – this is the period over which demand conditions mean that irrigation is required in order to replenish soil moisture lost via evapotranspiration to allow plant growth. As evapotranspiration is affected by a number of factors, e.g. low soil temperatures, plant canopy area, overcast weather, still days, relative humidity, wind) irrigation is not required every day of any season. Soil moisture or growth conditions outside the irrigation season are such that irrigation is not required.

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2 6,772 m³ / 9 days = 752.44 m³ per day

4.32 mm/1000 (1000 mm = 1 m) = 0.00432 m irrigation depth

752.44 m³ / 0.00432 m = 174,177 m² = 17.42 ha (1 ha = 10,000 m²) - to a depth of 4.32 mm

3 17.42 ha (irrigable area) / 66 ha (annual volume calculation) = 0.26 (i.e. 26% of the volume calculated for 66 ha is what is needed irrigate 17.42 ha).

0.26 x 365,622 m³ = 96,489 m³ is the volume required for 17.42 ha.

4 96,489 m³ (annual volume)/ 752.44 m³ (daily volume) = 128 days.
The volume determined above of 96,489 m³ means that the irrigation volume (equivalent to 128 days pumping at the maximum rates and volumes) can be delivered entirely within the nominal irrigation season of 242 days.

The applicant has proposed an annual volume equivalent to 365 days pumping – this is a fanciful volume when considered against Schedule 10 and the purpose of irrigation for which the current consent is held.

**Recommended Annual Volume**

In summary, I am of the view that applying method 3 of Schedule 10 of the LWRP determines that an annual volume of 96,489 m³ is appropriate for the irrigation authorised under CRC182422. If an additional use consent is to be granted for quarrying purposes, this annual volume limit should apply to ensure that no additional water is taken from that currently authorised.

**File reference:** CRC192414 and CRC182422.

**Attachments:** LWRP Schedule 10
Schedule 10 Reasonable Use Test

This Schedule only applies to the activity of using water for irrigation purposes, and does not apply to wastes that are discharged to land under an authorised discharge permit. Such discharges will be subject to the relevant policy provisions and rules set out in Section 5.

This schedule provides three methods for determining the seasonal irrigation demand.

1. Records of past use, moderated to ensure the annual volume is sufficient to meet demand conditions that occur in nine out of ten years for a system with an irrigation application efficiency of 80%; or
2. Use of a model that has been field validated and shown to reliably predict annual irrigation volume within an accuracy of 15%. The annual volume calculated using the model shall be compliant with the following criteria:
   (a) an irrigation application efficiency of 80%;
   (b) a system capacity to meet peak demand;
   (c) a nominal irrigation season from 1 September to 30 April; and
   (d) demand conditions that occur in nine out of ten years.
3. Using the methodology set out below and the figures set out in Table S10.1.

To determine the applicable seasonal irrigation demand standard and derive an annual volume:

1. find the total seasonal demand from Table S10.1 for the particular soil PAW class. Where the soil PAW class is between 100 - 200 mm, insert the appropriate PAW for the soil to be irrigated into the formula to determine the total seasonal demand;
2. determine effective irrigation season rainfall for the location using Figures S10.1 and S10.2:
   Map of effective irrigation season rainfall;
3. deduct this rainfall amount from the total seasonal demand amount to give the irrigation requirement in millimetres – this provides the seasonal irrigation demand standard;
4. adjust this seasonal irrigation demand standard by multiplying by 10 to find the volume of water (cubic metres) per hectare per season; and
5. multiply this amount by the area that is to be irrigated to give the annual volume.

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<th>Example</th>
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<tr>
<td>Consent details: 110 L/s</td>
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<tr>
<td>Maximum instantaneous pump rate 110 L/s</td>
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<td>Volume per DRP: 9,108 m³</td>
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<td>Design Return Period (DRP): 1 day</td>
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<td>Area to be irrigated: 200 ha</td>
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<td>Profile Available Water (PAW) at location: 69 mm</td>
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<tr>
<td>Total Seasonal Demand: 910 mm (taken from Table 10.1)</td>
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<tr>
<td>Effective rainfall (exceeded 60% of time) 230 mm (determined from Figure 10.1)</td>
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<tr>
<td>Annual irrigation allocation (910 mm – 230 mm) X 10 X 200 ha = 1,360,000 m³</td>
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### Table S10.1: Total seasonal demand to meet plant water requirements

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<tr>
<th>Soil PAW Class</th>
<th>Total Seasonal Demand</th>
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<tr>
<td>&lt;100 mm</td>
<td>910 mm</td>
</tr>
<tr>
<td>100-200 mm</td>
<td>910 – 1.6 (PAW – 100) mm</td>
</tr>
<tr>
<td>&gt;200 mm</td>
<td>750 mm</td>
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**Soil PAW Class** represents the upper and lower limits of the soils that are generally irrigated in Canterbury in terms of the profile available water (PAW) of the soils. Between the upper and lower limits set out in Table 10.1, a sliding scale is used to determine the relevant total seasonal demand.

**Total seasonal demand** is the total amount of water required to satisfy plant water needs during the main growing period. This demand can be satisfied by rainfall and irrigation. In determining the irrigation component, provision has been made for:

1. an irrigation application efficiency of 80%;
2. a system capacity to meet peak demand;
3. a nominal irrigation season from 1 September to 30 April;
4. demand conditions that occur in nine out of ten years; and
5. a land use of intensive pasture production.

**Effective irrigation season rainfall** is the amount of rain that will contribute to crop growth over the nominal irrigation season. In determining this amount, provision has been made for:

1. rainfall that occurs on average in six out of ten years (which, together with a complementary seasonal irrigation allowance, is estimated to meet total water demand with a reliability of nine out of ten years based on analysis of long-term climate data); and
2. excluding daily rainfall amounts of less than 5 mm, or cumulative rainfall amounts in consecutive days in excess of 50 mm.

**Seasonal irrigation demand standard** for a given soil PAW the depth of water (measured in millimetres) per hectare per year required to be supplied by irrigation to satisfy plant water demand after allowing for effective irrigation season rainfall.
Canterbury Land and Water Regional Plan

Figure S10.1: Map of effective irrigation season rainfall (millimetres) (northern and central Canterbury)

Figure S10.2: Map of effective irrigation season rainfall (millimetres) (mid and southern Canterbury)