



Memorandum

TO: Amanda Loeffen

FROM: Bas Veendrick and Andrew Brough

DATE: 4 April 2011

RE: Memorandum describing the differences in supply and demand modelling between PDP and Aqualinc

1.0 Introduction

The aim of this memo is to clarify the differences in model assumptions and model results between the modelling that has been done for Hurunui Water Project (HWP)/Ngai Tahu Properties (NTP) and the Hurunui-Waiiau Zonal Committee. The modelling for HWP/NTP was undertaken by PDP while Aqualinc Research Ltd (Aqualinc) has modelled several different options for the Hurunui-Waiiau Zonal Committee.

In order to compare the potential irrigable areas for a number of storage options in the Hurunui- Waiiau Water Management Zone, Aqualinc prepared a report describing the model assumptions and resulting estimated irrigable areas for each storage options. This report is labelled: Hurunui-Waiiau Storage Options – Modelling Assumptions and Results (Aqualinc, Report No C1009204/1, February 2011).

Some of these storage options have been modelled previously by PDP and this memo intends to clarify the differences in modelling approach and results for these options. Therefore this memo only relates to a comparison of the following scenarios in the Hurunui-Waiiau Storage Options report:

- ✦ Lake Sumner Option HWP
- ✦ Lake Sumner Option NTP
- ✦ Hurunui South Branch Dam
- ✦ South Branch & Lake Sumner
- ✦ Waitohi HWP
- ✦ Waitohi DPML

As mentioned before the intention of this memo is to clarify the differences in model assumptions and model results and does not aim to make a judgement on the appropriateness of the model assumptions and estimated irrigable areas. As PDP and Aqualinc have had different briefs for their modelling and therefore model assumptions and model results inherently differ.

PDP staff met with Aqualinc staff on Thursday 24 March 2011 to discuss the differences in results. This assisted the PDP staff in understanding the scope and nature of the work Aqualinc staff were engaged to carry out and also to understand the reasons for a number of the model assumptions made by Aqualinc. It is our understanding that Aqualinc has updated their original report (Report No C10092204/1, February 2011), however PDP has not received a copy of this updated report. The comments in this memorandum therefore only relate to report C10092204/1, February 2011.

For clarity purposes this memo follows the report structure of the Aqualinc report with:

- ✦ Section 2 providing an overview of the results
- ✦ Section 3 covering the general modelling assumptions
- ✦ Section 4 discussing the option specific assumptions

2.0 Overview of Results

Table 1 provides the irrigable areas as estimated by PDP and Aqualinc. In general the PDP modelling results show smaller irrigable areas than the Aqualinc modelling for all options. The main reasons for these differences are the general and option specific assumptions behind the modelling. These differences will be explained in more detail in sections 3.0 and 4.0 of this memorandum.

Table 1: Comparison Between Aqualinc Modelling Results and PDP Results													
Scenario		Lake Sumner				Hurunui South Branch Dam		South Branch & Lake Sumner		Waitohi			
		Hurunui Water Project		Ngai Tahu Properties Ltd						HWP		DPML	
		Aqualinc	PDP	Aqualinc	PDP	Aqualinc	PDP	Aqualinc	PDP	Aqualinc	PDP	Aqualinc	PDP
Irrigated Areas (ha)	Hurunui A-Block	13,760	9,000	13,760	9,000	13,760	9,000	13,760	9,000	13,760		13,760	
	New B-Block	9,500	6,000	20,000	16,000	34,000	26,000	45,000	35,000	31,000	27,000	32,500	28,000
Total		23,260	15,000	33,760	25,000	47,760	35,000	58,760	44,000	44,760	27,000	46,260	28,000
Reservoir Volume (Mm ³)		27.5	27.0	31	30.5	111	111	27.5	27.0	104	104	104	104
On-farm storage total volume (Mm ³)				20	15								
Total Storage (Mm ³)		27.5	27.0	51	45.5	111	111	139.5	139	104	104	104	104
* The PDP estimates for irrigable areas assume that the entire irrigable area is spray irrigated. Therefore the estimates may differ slightly from the estimates in the HWP AEE which assume that a small proportion of the area is borderdyke.													

3.0 General Assumptions

3.1 Potentially Irrigable Areas

The potential irrigable area for HWP/NTP differs from the potential irrigable area for the Hurunui-Waiiau Zone. HWP/NTP only intends to irrigate new and/or existing irrigable land in the Culverden Basin south of the Pahau, Scargill and Omihi (total area of approximately 42,000 ha) whereas the Zonal Committee seeks to find a solution to irrigate a much larger area in North Canterbury (total area of approximately 100,000 ha). This will inherently result in different model assumptions as explained below.

The Hurunui-Waiiau storage option report assumes that: *'it is practical to deliver water from storage to anywhere in the potentially irrigable areas'*. Although this is a reasonable assumption to get a broad overview of irrigable areas for each of the different options it has to be noted that a more detailed look into some of the storage options may exclude some areas from being supplied with water from a certain storage reservoir. An example of this is detailed in section 4.4 of this memo.

3.2 Irrigation Demand

PDP and Aqualinc use similar methods to calculate irrigation demand. Both methods are based on a soil-moisture balance and assume that the entire area is pasture. It is however unclear from the Aqualinc report what irrigation application rates were used and what is assumed for losses in the irrigation system. Following the meeting with Aqualinc it became clear that an irrigation application rate of 5 mm /day (i.e. 0.58 L/s/ha) was used which includes losses in the distribution system. PDP has assumed an irrigation application rate of 0.6 L/s/ha (i.e. 5.2 mm/day) and an additional 20% loss to allow for losses in the distribution channels and losses between the farm gate and the actual water that reaches the soil. The small difference in irrigation application rates is unlikely to impact significantly on the estimates for irrigable areas, however when allowing for losses in the system the estimates for irrigated areas will decrease (see Table 1).

3.3 Supply Reliability

PDP and Aqualinc have used similar criteria for supply reliability. Aqualinc's reliability criteria is equivalent to supply not meeting demand once every 10 years whereas the PDP criterion is equivalent to supply not meeting demand once every 7 years.

3.4 Existing Irrigated Areas

In order to be clear about the numbers stated in Table 1 of the Aqualinc report it has to be noted that the irrigable area in the Hurunui A-Block includes areas that are currently already irrigated (i.e. existing Balmoral Irrigation Scheme) and therefore the total irrigated area under the Hurunui A-block and the total irrigated areas in Table 1 are not the total new irrigable land. It is unclear how Hurunui A-Block water can irrigate a total area of 13,760 ha. The size of the Hurunui A-Block water is 6.7 m³/s (Amuri reach) and with the assumed (Aqualinc) irrigation application rate of 0.58 L/s/ha this can irrigate an area of approximately 11,500 ha. During the meeting it was mentioned that the A-block water from the Domett Plains Reach may have been included in the Hurunui A-block water. Since PDP did not receive the updated Aqualinc report it is unclear whether this is the case.

3.5 Water Allocation

Both the Aqualinc and PDP modelling is based on Variation 8 of the NRRP. Even though Variation 8 is now withdrawn it is considered the most appropriate allocation regime to use and it is our understanding that Environment Canterbury (ECan) specified this flow regime for the Hurunui-Waiiau Storage Options Report.

4.0 Option Specific Assumptions

4.1 Lake Sumner Options

PDP and Aqualinc have modelled the HWP and NTP Lake Sumner Options based on the same option specific assumptions. The difference in irrigable areas as quoted in Table 1 originates from the different (general) assumptions for irrigation demand (see section 3.2) and the Hurunui A-block water (see section 3.4).

The modelling brief from Ngai Tahu Properties Ltd for the Lake Sumner NTP option specified 12 days of on-farm storage. With a larger irrigable area for the Hurunui A-block (as assumed by Aqualinc) the size of the on-farm storage requirement will also increase (from 15 Mm³ to 20 Mm³). Therefore the size of the on-farm storage is different (15 Mm³ compared to 20 Mm³) resulting in an even larger irrigable area as estimated by Aqualinc (see Table 1).

4.2 Hurunui South Branch Dam

The Aqualinc report states that: '*Details have been derived from HWP's Resource Consent application*'. Although this is correct for the option specific assumptions for reservoir active storage and reservoir operating range a different assumption was used for the minimum outlet flow. The HWP Resource Consent application sets a minimum flow of 4.5 m³/s directly downstream of the dam whereas Aqualinc has modelled this option with a minimum flow of 4.5 m³/s downstream of the North Esk confluence. The minimum flow at the outlet of the South Branch Dam was set by the ecologist working for HWP and was considered appropriate to protect in-stream values.

Setting a minimum flow of 4.5 m³/s downstream of the North Esk confluence will result in a larger irrigable area compared to setting this minimum flow directly downstream of the Dam. The 'Aqualinc' minimum flow effectively means a lower minimum flow for the stretch of the river directly downstream of the dam.

4.3 South Branch and Lake Sumner

The same comments apply as in section 4.1 and 4.2 resulting in a smaller irrigable area than estimated by Aqualinc.

4.4 Waitohi River Options

As mentioned before HWP has only modelled Waitohi option HWP and DPML (described in section 4.4.1 and 4.4.2 of the Hurunui – Waiiau Storage Options report). Aqualinc and PDP have assumed the same option specific assumptions for active reservoir storage size, reservoir operating range and minimum outlet flow. PDP however considers that for these options it is more realistic to assume that the Waitohi Reservoir is only supplying the irrigable areas on the south side of the Hurunui River. The

Waitohi Reservoir is ideally situated to supply this area and it is considered unrealistic that water will be transferred across the Hurunui River to supply the North Bank of the river. Hence the summer A-Block water (which is already allocated) is not available as run of river water to either directly irrigate the land and/or to fill up the Waitohi Storage Reservoir. This will obviously affect the irrigable areas and using these assumptions the estimated new irrigable area for the Waitohi HWP and Waitohi DPML will be 27,000 ha and 28,000 ha. The DPML option has a slightly larger irrigable area due to the assumption that this option diverts a maximum of 21.7 m³/s compared to a maximum diversion of 8m³/s for the HWP option.

5.0 Summary and Conclusion

This memorandum highlights the differences in model assumptions and model results between the modelling that has been done by PDP and Aqualinc. It is our understanding that the modelling that has been done for the Hurunui-Waiiau Zonal Committee aims to provide an indication of irrigable areas for each of the options based on a set of general and option specific assumptions.

This memo provides a table with irrigable areas based on the PDP and Aqualinc modelling and aims to explain the differences in the modelling assumptions and resulting irrigable areas. The irrigable areas presented in the Hurunui – Waiiau Storage Options report may be appropriate for comparative purposes, however it needs to be clear that when modelling some of the options in more detail, and when taking into account site specific constraints, the areas that can be reliably irrigated may change.

For the purpose of clarity and to summarise this memo the main differences between the PDP and Aqualinc modelling are:

- ∴ Aqualinc has assumed an irrigation application rate of 0.58 L/s/ha which includes (on farm and distribution system) losses whereas PDP has assumed an irrigation application rate of 0.6 l/s/ha and an additional 20% losses (to represent on farm and distribution system efficiencies).
- ∴ Aqualinc calculates that Hurunui A-Block water can irrigate a total area of 13,760 ha whereas PDP calculates an area of approximately 9,000 ha.
- ∴ Some option specific assumptions differ based on site specific knowledge which has not been taken into account in the Aqualinc modelling.