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Manuherikia Catchment Water Strategy Group
C/o Kate Scott
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P O Box 302
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WATER SUPPLY OPTIONS FOR THE MOUTERE DISPUTED SPUR ROAD AREA – PRELIMINARY ASSESSMENT

Dear Kate

1.0 SUMMARY

This letter[1] documents Golder Associates (NZ) Limited's (Golder) preliminary assessment of water supply options for the Moutere Disputed Spur Road area. The key findings are as follows:

- Given its location, using water stored in Falls Dam to irrigate the Moutere Disputed Spur Road area, will always be difficult and expensive given the extensive distribution network required. Unless more water can be stored at Falls Dam than is currently expected under the proposed 27 m raise it is anticipated that local solutions will be required in order to increase irrigation in the Moutere Disputed Spur Road area.
- Given the expected high cost of irrigation water, land uses and crop types that maximise the benefit per unit of water are likely to be necessary. Low water demand crops such as lucerne and irrigation practices that minimise water use (efficient spray irrigation, piped supply, water harvesting and buffer storage) are likely to be required.
- It is anticipated that a combined approach which uses a variety of water sources (existing schemes, private takes, possibly groundwater, increased on-farm storage etc.) and which optimises water management on-farm and at a sub-catchment level via a water users group will be the most beneficial.

Recommendations for the focus of a Stage 2 – pre-feasibility assessment are provided in Section 6.0 of this letter.

2.0 INTRODUCTION

The Manuherikia Catchment Water Strategy Group (MCWSG) is currently undertaking a feasibility level study of the Manuherikia River catchment to provide water storage and distribution for irrigation. In October 2013 a group led by Golder Associates (NZ) Limited (Golder) was commissioned to undertake the following four components of the feasibility study:

[1] This Letter Report is subject to the Report Limitations outlined in Attachment A.

1) Geotechnical and engineering;

2) Environmental investigations;

3) Land tenure, water allocation, planning and resource management act (RMA) issues;

4) Economic and commercial investigations, scheme ownership and management models.

Aqualinc Research Limited (Aqualinc) who led the earlier pre-feasibility assessments was commissioned to undertake the hydrological component of the feasibility study.

The pre-feasibility assessments proposed a high race which extended to the Matakanui Station boundary. Landowners south of Matakanui Station and in the Moutere Disputed Spur Road area have indicated that they wish to expand their existing irrigation activities and are seeking guidance on water supply options.

The current MCWSG feasibility assessments are looking at five irrigation development options (raising Falls Dam by 5 m, 15 m and 27 m, the proposed Mt Ida Dam and improved irrigation efficiency in the lower Manuherikia Valley. Of the five options only the 27 m raise of Falls Dam and possibly the 15 m raise would provide sufficient water to potentially allow irrigation water to be supplied to the Moutere Disputed Spur Road area. The other three options will not service the Moutere Disputed Spur Road area.

3.0 SCOPE

As part of the feasibility study MCWSG requested that Golder assess the potential for extending the proposed high race past Matakanui Station and providing irrigation water to landowners in the Moutere Disputed Spur Road area. It was agreed that the assessment would to be undertaken in the following three stages:

Stage 1: Preliminary Assessment. To include the following: a meeting with relevant landowners, a brief site visit, a desktop review of existing information to assess irrigation options.

Stage 2: Pre-feasibility Assessment. To include the following: assessment of potential irrigable areas, water requirements, development of a primary distribution network including alignment of the high race. High level cost estimates to be prepared and a meeting held with potential irrigators to discuss options and determine if the assessment should proceed to feasibility level.

Stage 3: Feasibility Assessment: To include the following: geotechnical field mapping to confirm the alignment of the extension to the high race. Feasibility level design and costing to be completed and documented.

This letter documents Golder's Stage 1 preliminary assessment findings.

4.0 METHODOLOGY AND INFORMATION SOURCES

In completing this preliminary assessment and providing our recommendations we undertook the following three steps:

1) A meeting with landowners in the Moutere Disputed Spur Road area on 19 November 2013 to discuss their water supply needs. Following the meeting the end of the proposed high race and a potential buffer storage site on Matakanui Station was visited. Subsequently the general area was viewed from the Moutere Disputed Spur Road.

2) Brief review of the relevant background material, particularly Aqualinc (2013a, 2013b and 2013c), MWD 1984 and OPUS 2010.

3) Documentation of the assessment process and its key findings in this letter.

In completing this preliminary assessment Golder considered numerous documents, a list of which is provided in Attachment B.

5.0 DISCUSSION POINTS AND KEY OBSERVATIONS

5.1 Landowner Meeting

A meeting with landowners in the Moutere Disputed Spur Road area on 19 November 2013 discussed their water supply needs. Representatives from three properties attended who are understood to be the key stakeholders interested in this preliminary assessment. Table 1 below summaries both their current irrigation activities and their potential future irrigation activities if a reliable water source is secured.

Table 1: Moutere Disputed Spur Road landowner irrigation information.

	Andrew Paterson	**Hamish and Tony Yopp**	**Murray Ashton and Charlie McNally**
Current irrigation	305 ha	Two irrigated blocks: 1) 80 ha (60 ha reliable) and 2) 300 ha (some not reliable)	Approximately 200 ha during a good year, (some not reliable)
Irrigation type	120 ha Spray, 60 ha Border Dyke, Remainder contour (some not reliable)	Mostly spray (combination of K-Line, guns and pivot). 100 ha contour (unreliable)	All contour
Water source	Combination of County Races, and private water rights from Neds Creek and Middle Creek	Private water rights from Laheys Creek and Centre Creek	Private water rights from Laheys Creek plus a storage dam
Crops irrigated	Combination of grass, lucerne and green feed crops	Combination of grass and green feed crops	Grass
Future	Expand current irrigation to up to 900 ha of spray with existing land use (fine wool) and similar irrigated crops.	Expand current Block 1 irrigation to up to 200 ha of spray with existing land use (sheep and beef) and similar irrigated crops. Difficult to expand Block 2 due to contour.	Improved supply reliability to fully irrigate the 200 ha. Land use expected to remain sheep. Stock water an issue.

Most of the area is irrigated from private water rights from various relatively small tributaries of Chatto Creek. Reliability of water supply is a key issue and the landowners have already invested in on-farm buffer storage. Without reliable water supply it is difficult to justify the cost of moving to efficient spray based systems

A total of 800-900 ha is currently irrigated of which approximately 400 ha is spray irrigated. Some of the irrigated area (particularly the non-spray irrigated areas) has poor water supply reliability and production will be reduced due to soil moisture deficits. If a reliable water supply can be found there is a desire to fully irrigate approximately 1,600 ha.

5.2 Water Requirements

Aqualinc 2012a assessed irrigation water requirements for the whole of the Manuherikia Catchment. The Moutere Disputed Spur Road area was classified as having a mean annual rainfall of 450-550 mm. The soils in the area are variable and while the majority are light with a profile available water (PAW) of 30-90 mm there are areas of medium (PAW of 91-140 mm) and heavy (PAW of 91-140 mm) soils. There are considerable areas of flat to rolling land which are suitable for irrigation. Soil moisture modelling indicated that irrigation demand for 80% efficient spray irrigation during an average year is likely to range from approximately 500 mm for the heavy soils up to approximately 600 mm for the lighter soils. During a 1 in 10 year drought irrigation demand is expected to increase to approximately 650 mm for the heavy soils and to over 700 mm for the lighter soils (Aqualinc 2012a). System capacities during the peak of the season ranging from 3.5 mm/day for the heavy soils to 4.5 mm/day for the light soils are suggested (Aqualinc 2012a).

Assuming a seasonal irrigation requirement of 600mm/year and a system capacity of 4 mm/day, irrigation of the 1,600 ha identified by the landowners would require approximately 9-10 M m^3/year at a maximum flow rate of approximately 740 L/s. Assuming that the current water sources and on-farm buffer storages can reliably supply irrigation water to approximately 500 ha, the current shortfall is approximately 6-7 M m^3/year at a maximum flow rate of approximately 500 L/s (18 head). A flow of 500 L/s can be accommodated in a relatively small race or in a 500-800 mm diameter pipe (depending on the pressure loss that is acceptable). It is noted that more than half of this extra water is expected to be used on Matakanui Station itself and the high race associated with a 27 m raise of Falls Dam is already proposed to supply Matakanui Station (Aqualinc 2012a).

5.3 Previous Studies

5.3.1 MWD 1984

The concept of a high race running along the western side of the Manuherikia Valley and supplying irrigation water to large areas is not new and was first suggested in the early 1900's and was investigated by the Ministry of Works and Development (MWD) in the 1970's and 1980's. MWD (1984) investigated a race that extended from an intake on the Manuherikia River near Loop Road to Golden Road and provided irrigation water to the Moutere Disputed Spur Road area. The scheme was abandoned due to expected excessive costs.

The MWD spent time investigating the alignment of the race and developed a preferred alignment that ran under the Devonshire Diggings and intersected the Moutere Disputed Spur Road near Moutere. The MWD used a low grade for the race which allowed the race to traverse at a higher elevation but would have resulted in lower water velocities and a corresponding larger race.

5.3.2 MCWSG Pre-feasibility Assessments

The MCWSG pre-feasibility investigations revisited the concept of a high race and proposed a race starting at a similar location to that proposed by MWD 1984, but ending at the boundary to Matakanui Station (Aqualinc 2012b). Aqualinc (2012b) proposed a steeper grade to the race to both utilise existing infrastructure (the Dunstan Main Race) and to align the race through generally flatter topography. An added advantage of the steeper race would have been higher velocities and a smaller race. Aqualinc (2012b) assessed five potential termination points for the high race (Dunstan Creek, Hamilton Road, Muddy Creek, Matakanui and Matakanui Station boundary). The principal reason for the termination points was related to potential command area and the irrigated area that could be supplied by various sized increases to the storage in Falls Dam. Muddy Creek was found to be the optimal termination point for maximising command area while minimising race length (Aqualinc 2012b). Past Muddy Creek the extra command area per unit increase in race length decreases substantially.

Aqualinc (2012b) indicates that the reason for terminating the race at the boundary of Matakanui Station was *"land owner interest, and 800-1000 ha of irrigable land on the property that could be supplied*." The location of the proposed termination point is near Coal Creek.

The MCWSG pre-feasibility investigations have indicated that a 27 m raise of Falls Dam will provide a live storage volume of 90Mm^3 which, in combination with run of river abstractions, will provide sufficient water to reliably spray irrigate 21,000 ha in the Manuherikia Valley above Ophir, while maintaining existing irrigation below Ophir. A high race extending to the boundary of Matakanui Station, in association with upgrading a number of the existing races, would provide a command area which is expected to be sufficient to cater for the 21,000 ha of spray irrigation.

5.3.3 OPUS 2010

OPUS 2010 investigated the option of supplying some of the land in the Moutere Disputed Spur Road area with water from Lake Dunstan. The scheme was essentially an extension of the proposed Dairy Flat scheme and involved considerable pumping. The scheme was not progressed due to expected excessive costs.

5.4 Water Supply Options

5.4.1 Extension of High Race

MWD 1984 indicates that a high race could be extended through the Moutere Disputed Spur Road area. A brief review of contour information and visual inspection from Moutere Disputed Spur Road indicates that, while the terrain is difficult and will result in higher construction costs through an increased need for piping and syphons, a suitable alignment is expected to be possible, particularly given the relatively small flow rates that are required. It is anticipated that the race would need to be extended through to approximately Moutere requiring approximately 15 km of new race.

Feasibility of extending the proposed high race is highly dependent on both the volume of water that can be stored at Falls Dam and uptake of irrigation water closer to the storage. Water supplied to the end of a race network is always the most expensive as it requires all the upstream infrastructure to be constructed. For storage based irrigation schemes it is cheaper to focus the irrigation activities on the areas closest to the storage, and it is difficult to justify supplying water to land which is far away when there is unirrigated land that is closer. Supplying water to the Moutere Disputed Spur Road area would require either more water to be stored at Falls Dam than is currently expected under the proposed 27 m raise or for potentially irrigable land closer to the storage to be left unirrigated.

As part of the feasibility investigations Falls Dam and the reservoir are currently being surveyed to confirm the potential storage volume, which will allow the hydrological model (Aqualinc 2013) to be refined and used to confirm how much land can be supplied with reliable irrigation water. Should this process result in an increase in the 21,000 ha that the hydrological model has predicted can be reliably spray irrigated (Aqualinc 2013) then it would be logical to look at extending the high race.

5.4.2 Omakau Main Race

The Omakau Main Race can supply water into the Chatto Creek catchment albeit at an elevation approximately 20-30 m lower than the proposed high race. Both the 15m and the 27 m raise of Falls Dam could potentially provide extra water that could be abstracted via the Omakau Main Race. Upgrading and increasing the capacity of the Omakau Main Race is expected to be simpler and significantly cheaper than developing the proposed high race. Supplying the Moutere Disputed Spur Road area from an enlarged and slightly extended Omakau Main Race will require some pumping but Golder suggests that the relative cost of the high race versus a pumped supply from the Omakau Main Race should be assessed once the high race costs are finalised.

Golder notes that there is a considerable command area under the Omakau Main Race, a significant proportion of which is not fully irrigated. Demand for extra water associated with an increased capacity of the Omakau Main Race is likely to be high and much of the demand is expected to come from existing Omakau Main Race irrigators. Golder expects that it would be difficult for landowners in the Moutere Disputed Spur Road area to gain access to water from the Omakau Main Race unless substantial upgrades were proposed.

5.4.3 Groundwater and MAR

Golder 2014a indicated that while the groundwater resources of the Manuherikia Catchment as a whole are relatively limited, there is an area of potential groundwater in the Thompsons Creek / Matakanui area. There may be potential to use the groundwater for irrigation particularly if aquifer recharge and storage can be enhanced and through a managed aquifer recharge (MAR) scheme. The relevant section from Golder 2014a is reproduced below.

Potential for Managed Aquifer Recharge

Managed Aquifer Recharge (MAR) is a system of artificially enhancing the rate and volume of recharge accruing to an aquifer, often combined with an aquifer extraction scheme. The implementation of MAR may include the following recharge enhancement approaches:

- Diversion of surface water into infiltration basins where recharge occurs at elevated rates.
- Diversion of water into water courses with a high bed conductance under conditions where elevated rates of stream bed recharge occur.

- Spreading of water onto land in a manner where the natural recharge rate(s) are exceeded.

The last approach is the unintended consequence of contour and border dyke irrigation or water race losses, as outlined above in Groundwater Recharge. There is a concern that with modernisation of the Manuherikia irrigation networks that higher efficiency methods of irrigation would predominate with the consequence of reduced net recharge rates for groundwater. Despite the relative lower importance of groundwater as a water resource in the Manuherikia River Catchment, sub-surface flows are still very important in sustaining base-flow for streams, wetlands and rivers.

The availability of groundwater is adversely affected by the following inherent factors in the Manuherikia River Catchment:

- Low hydraulic conductivity / transmissivity of the aquifer leading to low bore yield.
- Rudimentary levels of drilling and well construction technology leading to lower bore yields than would otherwise be possible with measures such as mud-drilling and sand-pack well development (ORC 2012b).
- Thin layers of saturated gravel or sand between the water table and aquifer base.
- Fluctuation of the water table in unconfined aquifers, causing variance in the saturated thickness and therefore transmissivity, affecting bore yield when the water table drops.
- The absence of year-round groundwater recharge or aquifer storage leading to the water table fluctuation set out in the point above.

Little can be done to improve an aquifer's hydraulic conductivity. However enhancing the recharge of the aquifer would ordinarily maintain the transmissivity and aquifer storage, with the benefit of allowing more consistently high bore yield. Accordingly, the main opportunity for enhancing the groundwater resource in a part of the Manuherikia River Catchment is by locating a zone with adequate aquifer hydraulic conductivity and high bore yield under high water table conditions as inherent features. Undertaking MAR on such a zone would have the positive effect of increasing the perennial groundwater resource reducing the likelihood that groundwater extraction will lead to generalised groundwater level decline. An examination of the information available for the Manuherikia River Catchment highlighted the Thompsons Creek and associated deposits where the creek exits Thompsons Gorge at Matakanui. This part of the Thompsons Creek catchment was also the subject of alluvial gold exploration, from which the review gained most its sub-surface information.

The gold exploration near Matakanui included several dozen exploration drill holes between the end of the gorge and Glassford Road (Jacobs et al. 1995, Becker 2004). The profiling of the drilling results allowed the delineation of an alluvial fan and a set of paleo-channels comprising sandy, cobbly gravel beneath the Thompsons Creek flood plain. The paleo-channels extend to depths ranging between 20 m and 25 m, which are remarkably deep for an area of average Quaternary alluvium depth being 6 m (Becker 2004). The water table lies approximately 5 m below the ground surface suggesting the ability of Thompsons Creek to lose water into the aquifer by infiltration.

Observations of Thompsons Creek losses to the underlying aquifer were made during ORC field work on 11 – 12 January 2011 (pers. comm. Matthew Hickey, ORC Science Manager, 3 April 2014). A water intake straddles Thompsons Creek in Thompsons Gorge in the hill country to the west of Drybread. The race has spillway and by-wash discharges from which the flow into the downstream creek was gauged at 236 L/s. On 11 January 2011 and during dry weather, the flow of creek water has been observed to diminish downstream, especially over the deepened zone of alluvium outlined above. The creek was observed to diminish by 120 L/s at the Glassford Road crossing. Downstream of Glassford Road to Mawhinnery Road the creek exhibited further losses to the aquifer, but the pattern was complicated by further irrigation intakes, siphons and by-washes.

The interpretation of these observations is that Thompsons Creek loses all or a portion of its flow to the alluvium as it crosses into the deepened, higher transmissivity alluvial materials. The elevated hydraulic conductivity of the creek bed and the deeper water table provide the conditions for the loss of creek flow and recharge of the aquifer. The flow of groundwater is laterally constrained by the past deposits of Thompsons Creek (the aforementioned paleo-channels) so the creek receives water back from the aquifer downstream once the water table begins to intersect the base of the creek. This downstream seepage zone is probably the result of thinning of the aquifer downstream of Glassford Road and down-cutting of the creek to the alluvium. Such infiltration - seepage couplets are found in a number of Clutha Catchment tributaries where the river concerned crosses from the basement rock to a porous alluvial or outwash terrace, e.g., Cardrona, Lindis or Fraser Rivers.

Such settings are also potentially workable as MAR reservoirs. The pumping of groundwater from the aquifer and flows in the creek could be manipulated to optimise the storage of water for release when required. In addition, the better water quality and microbiological security of an aquifer can be utilised to provide water more suitable for drinking water than surface water. For example, were CODC to establish intake bores in the Thompsons Creek alluvium, but found water table fluctuations impaired the quantity that could be obtained, MAR could alleviate that vulnerability. Through strategic releases of irrigation race water to offset low creek flow from the natural headwaters, the alluvial aquifer might be managed to maintain a more consistent water table height for optimal bore field operation.

5.4.4 On-Farm Storage and Water Transfers

While on-farm storage is generally more expensive than scheme storage, for properties that have creeks with good winter flow and suitable dam sites the development of on-farm storage can be a cost effective alternative to the development of large scheme distribution networks to access distant scheme storage. The fact that all three properties already have on-farm storage indicates that such storage is a viable option for the area. Information of creek surface flows in the areas and the potential to harvest winter runoff is required to confirm if further water harvesting and on-farm storage is a viable source of irrigation water for the area.

To limit by-washing the proposed high race will require buffer storage to be constructed at intervals along its length and at its termination point. Given the size and length of the proposed high race and its potential to capture runoff it is anticipated that considerable buffer storage will be required. Once design of the scheme and the potential high race is confirmed an assessment of the buffer storage requirements and the potential to irrigate from the buffer storages should be completed.

A review of existing resource consents to water take, currently being undertaken by Golder (2014b) indicates that there are a considerable number of takes from Chatto Creek. The potential to transfer or share these consents should be investigated, particularly if there is opportunity for a large scheme to supplement low flows in Chatto Creek via either the proposed high race or the Omakau Main Race, thereby allowing increased take from some of the upper tributaries. Co-ordinated water management, such as via a water users group, usually increases the availability of water to the users. The potential for maximising the benefit from the existing takes via improved water management at a sub-catchment level may warrant further investigation.

6.0 CONCLUSIONS AND RECOMMENDATIONS

The key conclusions from this preliminary assessment are as follows:

- Given its location, using water stored in Falls Dam to irrigate the Moutere Disputed Spur Road area, will always be difficult and expensive given the extensive distribution network required. Unless more water can be stored at Falls Dam than is currently expected under the proposed 27 m raise it is anticipated that local solutions will be required in order to increase irrigation in the Moutere Disputed Spur Road area.
- Given the expected high cost of irrigation water, land uses and crop types that maximise the benefit per unit of water are likely to be necessary. Low water demand crops such as lucerne and irrigation practices that minimise water use (efficient spray irrigation, piped supply, water harvesting and buffer storage) are likely to be required.
- It is anticipated that a combined approach which uses a variety of water sources (existing schemes, private takes, possibly groundwater, increased on-farm storage etc.) and which optimises water management on-farm and at a sub-catchment level via a water users group will be the most beneficial.

Should the landowners in the Moutere Disputed Spur Road area wish to proceed to the Stage 2 – pre-feasibility assessment we recommend that Stage 2 focus on the following items in order of propriety:

1) Assessment of the existing takes within the sub-catchment to determine if there is potential to improve water availability and usage though management at a sub-catchment level.
2) Identification of potential on-farm storage sites and particularly buffer storage sites near the end of the proposed high race or the Omakau Main Race.
3) Assessment of current by-wash practices from the Omakau Main Race and if there is potential to harvest some of this water for use in the Chatto Creek catchment.
4) Confirm potential for utilising groundwater and if MAR would be viable.
5) Following completion of the Falls Dam storage assessment and confirmation of the potential irrigation supply areas, the potential or otherwise for supplying Moutere Disputed Spur Road area from either the proposed high race or an upgraded/expanded Omakau Main Race should be assessed. If there is potential to supply irrigation water to the area, then a high level costs benefit assessment for the two options should be completed.

7.0 CLOSING REMARKS

We trust this letter provides guidance on the water supply options for the area adjacent to the Moutere Disputed Spur Road. If you have any queries or wish to discuss the above please contact Ian Lloyd (illoyd@golder.co.nz or telephone 03 377 5696).

Yours sincerely

GOLDER ASSOCIATES (NZ) LIMITED

Ian Lloyd
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Attachments: A. Report Limitations
B. References

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Attachment B: References

Aqualinc, 2012a. *Manuherikia Catchment Study: Stage 1 (Land).* Report numbered C12040/1 prepared for the MCWSG, dated 12 November 2012. Electronic copy (file name Manuherikia_Stage 1_Land_FINAL.pdf) available from the MCWSG website, www.mcwater.co.nz.

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Golder 2014a *MCWSG Feasibility Study – Groundwater and Drinking Water Supply Review*. Letter from Golder to the MCWSG, reference number 1378110270-211-LR-Rev0 dated 2 April 2014.groundwater report

Golder, 2014b. *Manuherikia Feasibility Study – Consent Review – Current Resource Consents*. Letter from Golder to the MCWSG, reference number 1378110272-Rev1 dated 2 April 2014.

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