Pattle Delamore Partners Limited

TECHNICAL MEMORANDUM

INVESTIGATION	Resource Consent Application Review for Smallburn Limited Partnership	**PROJECT**	Otago Regional Council Consent Reviews
CLIENT	**Otago Regional Council**	**PROJECT NO**	C032635128
CLIENT CONTACT	Kirstyn Lindsay	**PREPARED BY**	Cameron Jasper
CLIENT WORK ORDER NO/ PURCHASE ORDER		**SIGNATURE**	
		DATE	24 February 2020

1. Introduction

Pattle Delamore Partners Ltd (PDP) has been engaged by Otago Regional Council (ORC) to review potential impacts to groundwater related to a resource consent application from Smallburn Limited (the Applicant) to replace their existing deemed permits (96320 and 96321) to take surface water (via a diversion of Breakneck Creek (Amisfield Burn tributary) and the Amisfield Burn, respectively, into the Amisfield Race) for the purpose of stock water and irrigation within the Five Mile Creek catchment. The Applicant operates a telemetered water meter for the Amisfield Race immediately below the Amisfield Burn intake location (96321). The Applicant's current deemed permits for the Amisfield Burn and its tributary (Breakneck Creek) (96321 and 96320 expiring 1/10/2021) allow for the take of surface water from the Amisfield Burn catchment up to 350,000 L/hour (about 97 L/s), and according to the flow (abstraction) data from the Amisfield Race monitoring site, the Applicant has rarely exceeded this rate since 2013. The Amisfield Race diverts surface water from the Amisfield Burn catchment into the Park Burn catchment to the southwest. The Applicant is proposing to maintain the maximum rates of take under 96320 and 96321 in their proposed replacement consent.

The applicant also seeks renewal of deemed permit 94394, which allows for the take of surface water from the Park Burn up to about 28 L/s into the Park Burn Race (above the Amisfield Race discharge into the Park Burn). The Applicant also holds water permit RM15.007.01, which allows for the take (at the same location of deemed permit 94394) of 222 L/s from the Park Burn. The two takes from the Park Burn described above are diverted via the Park Burn Race to the Five Mile Creek catchment to the southwest. The point of take for the Park Burn Race (RM15.007.01 and 94394) is upstream of the point of discharge of the Amisfield Race into the Park Burn. The Applicant operates a telemetered water meter for the Park Burn Race just below the point of take (RM15.007.01 and 94394). The Applicant holds consent RM15.007.01 (granted in 2015), which allowed the transfer of the point to take (under deemed permit 96470) on the Park Burn to a lower (downstream) point of take (flooding in 1999 destroyed the original point of take). The point of take under permit 96470 was moved to an established point of take under permit 94394. RM15.007.01 essentially replaces 96470, which was surrendered. The combined authorised rate of take from the Park Burn under RM15.007.01 and 94394 is about 250 L/s. Flow data from the Park Burn Race monitoring site described above indicates the Applicant has only abstracted up to about 150 L/s at most since 2013. Based on this, the applicant is proposing to reduce the combined maximum rate of take to 120 L/s to better reflect their requirements under a proposed replacement consent that combines permit 94394 and RM15.007.01 into a single consent.

The Applicant is proposing to retake the total 97 L/s of water (sourced from the Amisfield Burn catchment) from the Park Burn via another race located to the south of the Amisfield Race point of discharge into the Park Burn.

This race diverts water sourced from the Park Burn (bolstered by the 97 L/s discharge sourced from the Amisfield Burn catchment) to Five Mile Creek. This proposed retake of water is not considered relevant to the Park Burn (in terms of groundwater effects) and should be considered for the proposed replacement consent for permits 96320 and 96321 related to the Amisfield Burn catchment.

The Applicant is proposing to retake up to about 217 L/s (97 L/s from the Amisfield Burn catchment plus 120 L/s from the Park Burn catchment) from Five Mile Creek via a race the further diverts water southwest to the Applicant's two storage ponds (combined storage of 140,000 m^3) in the vicinity of the Applicant's 320 ha irrigation area and stock supply (currently serving around 7,000 sheep and 250 cattle) within the Five Mile Creek and Low Burn surface water catchments. The proposed retake of water (sourced from the Park Burn and Amisfield Burn catchments under the deemed permits described above) at Five Mile Creek is at the original location of permit 96322, which is now surrendered by the Applicant. In terms of groundwater effects, this proposed 217 L/s retake of water should be considered relevant only to the proposed replacement consents sought by the Applicant in the Amisfield Burn and Park Burn catchments only. In this circumstance, Five Mile Creek is not interpreted as being abstracted from and serves effectively as infrastructure connecting the two race networks (Amisfield Race and Park Burn Race) within the Five Mile Creek catchment.

The Applicant has proposed (in addition to the maximum rate of retake at 217 L/s), 490,302 m^3/month and 2,297,463 m^3/year sourced from the point of retake (original permit 96322 take location) for a duration of 35 years. The Applicant has proposed the maximum monthly and annual abstraction volumes above based on Aqualinc efficiency of use calculations with regards to the combined irrigation and stock requirements.

The closest designated aquifer is the Lowburn Alluvial Ribbon Aquifer (within the Low Burn surface water catchment) southwest of the Applicant's points of take in the Amisfield Burn and Park Burn catchments. Theoretically, based on the geometry of the Applicant's irrigation areas and the interpreted hydrogeologic setting, the Applicant's takes from the catchments to the northeast are introducing additional water resources (via irrigation losses to ground) to an area within the Low Burn surface water catchment in the vicinity of gullies that drain into the Lowburn Alluvial Ribbon Aquifer area. The proposed takes are interpreted to be potentially beneficial to the closest designated aquifer, from a groundwater quantity perspective.

According to the ORC database, there is a potentially affected draft/recommended aquifer (Pisa Groundwater Management Zone) flanking the western side of Lake Dunstan downstream of the Applicant's takes in the Amisfield Burn and Park Burn catchments. Although this groundwater management zone extent mostly corresponds to the extent of the Late Pleistocene river deposits (gravelly alluvium between Lake Dunstan and SH6) and Holocene river deposits (gravelly alluvium extending up the valleys of the lower foothills to the bedrock base of the Pisa Range metamorphic rocks flanked by glacial till deposits), it appears that ORC has primarily delineated this zone based on the topography of the land surface where the foothills extending from the Pisa Range transition into the lower flatter areas on the western side of Lake Dunstan and up the lower valley fill areas of Five Mile Creek, Park Burn, and Amisfield Burn.

Bores in the area appear to be primarily concentrated towards Lake Dunstan within the extent of the alluvium between SH6 and the lake. The hydrogeologic setting is such that any surface water flow within the Amisfield Burn and Park Burn that is lost to groundwater above (upgradient) and outside of the Pisa Groundwater Management Zone is expected to arrive as groundwater inflow on the northwest side of the zone. Additionally, surface water flow losses within the Pisa Groundwater Management Zone above the points of inflow into Lake Dunstan are expected to bolster the groundwater supply. According to LAWA, the Amisfield Burn and Park Burn surface water catchments are overallocated. It is also noted on the LAWA database that the Amisfield Burn and Park Burn are likely to naturally run dry prior to reaching Lake Dunstan due to losses to groundwater.

The Applicant's three primary take locations related to the proposed replacement consents from the Amisfield Burn and Park Burn appear to be located within the upper reaches of the catchments with the Breakneck Creek take over the basement (schist) rocks and the Amisfield and Park Burn takes over the upper areas of recent gravelly river deposits. The Pisa Groundwater Management Zone is then further downstream, which has, according to ORC, 2,234,080 m^3/year of groundwater available for allocation. This volume of groundwater available for allocation is less than the Applicant's proposed take of 2,297,463 m^3/year, indicating that, if this was treated as a groundwater take, there would not be sufficient water available for allocation in the proposed zone.

Mid-summer flow gaugings (with all surface water abstractions ceased 24 hours prior to the survey) on 15 January 2019 provided by the Applicant demonstrates that the Amisfield Burn and Park Burn gain within their upper reaches in the vicinity of the three takes and then lose significantly to groundwater as they flow out of the hard rock (schist) Pisa Range over gravelly alluvium towards their points of discharge into Lake Dunstan. According to the flow gauging survey and field observations provided by the Applicant, the Amisfield Burn in its natural setting will not always reach Lake Dunstan as described below.

According to the flow gauging survey and field observations provided by the Applicant, it is possible that the Park Burn in its natural setting will not always reach Lake Dunstan. This agrees with the LAWA database that notes this waterway is likely to run dry in its natural setting. The flow gauging results show that about half of the Park Burn flow (at the time of the gaugings) was lost to groundwater across the upper area of the Pisa Groundwater Management Zone and SH6. Access to the lower Park Burn was limited by the quarry in the vicinity of Lake Dunstan, so it was unclear at the time of the survey if the Park Burn would have reached Lake Dunstan. Although satellite imagery suggests that the Park Burn surface water does not reach Lake Dunstan, the imagery could have occurred at a time when surface water diversions were active.

The flow gauging results show that the Amisfield Burn lost about a third of its flow (211 to 153 L/s) between the confluence with the Breakneck Creek (in the vicinity of the Applicants take) and the downstream site (about 2 km downstream above SH6). The relative rate of loss to groundwater then increased where about half of the flow was lost over about 600 m between the site above and below SH6 (153 to 72 L/s). Over the final stretch of Amisfield Burn all the remaining 72 L/s was lost to groundwater over about 700 m before reaching Lake Dunstan. The Applicant has noted the ORC flow monitoring on the upper reaches of the Amisfield Burn since 2013 indicating a mean annual flow of 162 L/s and a mean annual 7-day low flow of 65 L/s. Given the gauging survey and the ORC statistics on flow, it is likely that the Amisfield Burn in its natural setting is generally lost to groundwater prior to reaching Lake Dunstan.

Depth to groundwater information available through ORC suggests that bores in the vicinity of SH6 and the Amisfield Burn and Park Burn are generally about 30 m deep with groundwater at about 20 m bgl. The Amisfield Burn, Breakneck Creek, and Park Burn in the vicinity of the Applicant's current/proposed takes represent a combination of hard rock aquifer, snowmelt, and precipitation contributions outside of the Pisa Groundwater Management Zone. It is expected that the existing/proposed takes reduce natural groundwater recharge to the proposed Pisa Groundwater Management Zone and could therefore potentially impact groundwater levels at supply wells and surface water bodies, the overall groundwater resource and reduce the potential for contaminant dilution. A consideration of these potential effects is outlined below.

2.1 Effects on the overall groundwater resource

It is understood that surface water inflows from the Amisfield Burn and Park Burn, and other streams flowing towards Lake Dunstan, are included in ORC's calculation of allocation status for the proposed Pisa Groundwater Management Zone. ORC may therefore wish to consider accounting for the takes in the groundwater allocation block, in addition to surface water, to recognise the potential reduction in recharge. Specific effects on current

groundwater resource users are considered in Section 2.3 of this memo. Given the magnitude of this take compared to the available allocation, the effects on the overall groundwater resource could be significant. We also note that there are other deemed permits where replacements consents are sought that are currently being reviewed by ORC, so the allocation limit could be further exceeded. Although, as noted above, this is not a new abstraction. Given the allocation limit is a proposed limit and these are replacement consents, further consideration should be given to how these permits should be best accounted for in the groundwater and surface water allocation blocks.

2.2 Effects on surface water bodies

The specific effects on surface water and ecology from the abstractions are being considered by others reviewing this application. From a groundwater perspective, reduced recharge to an aquifer can affect any connected wetlands or spring fed-streams via a reduction in groundwater levels. There are no wetlands identified by ORC as regionally significant wetlands in the potentially affected area. The closest significant wetland is the Bendigo Wetland, which is hydraulically connected to Lake Dunstan at the north of the lake. Inspection of aerial imagery does not indicate any obvious wetlands or spring-fed streams bordering the courses of the Park Burn or Amisfield Burn in the potentially affected areas between the takes and Lake Dunstan. This is expected given the natural hydrogeologic setting where groundwater becomes relatively deep and disconnected from the Park Burn and Amisfield Burn. On this basis, adverse effects on connected surface water bodies as a result of reduced groundwater recharge are not expected to occur as a result of the proposed diversion. Ultimately, there will however, be a reduction in groundwater flow into Lake Dunstan/the Clutha River. There are no current allocation limits for these water bodies, although ORC have commenced a process to develop limits.

2.3 Effect on nearby bores

The Applicant has noted that the closest groundwater take consents are over 4 km to the southeast of the takes and has stated that, based on the separation distance, that no adverse effects are expected. A review of bores on the ORC database shows a domestic bore (G41/0202) about 3.5 km southeast of the Applicants Park Burn tributary take. This bore is noted as shallow (5 m deep) at about 150 m distance from the main stem of the Park Burn. This bore does not appear to be well located based on satellite imagery, however dwellings in the vicinity of this bore are similarly located near the Park Burn. The ORC database does not include depth to groundwater information for this bore. The GNS geologic map suggests that this shallow bore is completed within gravelly Holocene river deposits in close vicinity to glacial tills. Given the information above, it is unknown to what extent, if at all, this bore relies on elevated groundwater levels as a result of natural groundwater mounding (via losses to groundwater) in the vicinity of the Park Burn. A simple assessment of groundwater throughflow in the immediate vicinity of bore G41/0202 across a 150 m wide area (with a 4 m saturated thickness) considering the ground surface gradient (about 0.03 m/m) as a proxy for the lateral hydraulic gradient and a low-range (86.4 m/day) hydraulic conductivity for gravels, results in a groundwater flow of about 17 L/s. Such a flow if intercepted by the shallow domestic bore's small capture zone could likely accommodate long-term drawdown effects as well as domestic use. This throughflow is expected to occur naturally (with or without the surface water takes) as a result of the overall groundwater system primarily due to aquifer recharge into the gravelly alluvium from hard rock aquifer sources

A review of bores on the ORC database shows that the closest potentially effected bores are generally in the vicinity of SH6 flanking each side of the Amisfield Burn. These bores are around 30 m deep (within the area of Late Pleistocene and Holocene gravelly river deposits at the land surface) with relatively deep groundwater levels up to about 20 m bgl. The bores transition to have slightly shallower depths with shallower depth to groundwater observations toward Lake Dunstan in the vicinity of the Amisfield Burn. This is most notably demonstrated by bore G41/0346 (15 m deep with a 3.5 m depth to groundwater) adjacent to Lake Dunstan and the Amisfield Burn point of discharge into the lake.

Given that the Amisfield Burn and Park Burn are interpreted to only reach the lake on occasion during higher flow events (likely stormwater dominated flows) and that mounding effects associated with these flows in the relatively permeable alluvium would only be expected to be temporary (on the order of hours to days), it is unlikely that these bores rely on direct mounding effects specific to flows from these waterways. Constant head boundary effects from Lake Dunstan (with a likely direct hydraulic connection) as well as the other recharge to the overall groundwater resource within the Pisa Groundwater Management Zone, together with this being an existing abstraction, means that the levels in supply bores are unlikely to be adversely affected .

Given the assessment above, adverse effects on neighbouring bores due to lowered groundwater levels or reduced capacity for contaminant dilution are not expected to occur as a result of the proposed take from the Amisfield Burn and Park Burn.

3.0 Conclusion

In conclusion our assessment of the proposed take indicates the following.

- The taking of surface water is expected to reduce groundwater recharge.
- It is considered that sufficient information has been provided for assessing the effects on groundwater.
- Based on the absence of potentially affected bores and connected surface water bodies, no residual flow specific to groundwater effects is considered necessary.
- No specific groundwater conditions are considered necessary.
- Given the recharge from Amisfield Burn and Park Burn have been provided for in ORC's allocation calculations for the proposed Pisa Groundwater Management Zone, ORC may wish to consider accounting for the takes in the groundwater allocation for this area. Given it is a proposed allocation limit, further consideration should be given to how these permits should be best accounted for in the groundwater and surface water allocation blocks.