13 April 2017

Environment Southland
Private Bag
Invercargill.

Danielle Petricevich, Consent Officer

Dear Danielle

1. Application APP-20171005 for an Expanded Dairy Farm and New Dairy Farm by Schrader Mains Limited, 514 Rimu-Seaward-Downs Road, Mokotua.

1.1 Background

An application was made by Schrader Mains Limited for authorisations to discharge shed or standoff pad effluent, take groundwater, convert land to dairying, construct effluent storage and construct a new bore at the property at 514 Rimu-Seaward-Downs Road, Mokotua.

The omnibus application contains the following consent applications as listed in Table 1.

Table 1: List of activities, authorisations and associated consents

Activity & Consent Sought	Previous Authorisation?	Activity Status
Discharge shed effluent and standoff pad effluent	No, new	Discretionary
Water take consent for groundwater abstraction	No, new	Discretionary
Land use consent to convert to dairying	No, new	Discretionary
Land use consent to use land for dairy farming	Transitional	Discretionary
Land use consent to construct effluent storage	No, new	Restricted discretionary
Land use consent to construct (new) bore	Existing bore on site. Addition of new bore.	Controlled

In terms of effects assessment, the dairy farm land use and effluent discharge are the two activities of any significance. The groundwater takes are minor takes from an allocation zone with a healthy allocation buffer, and is therefore neglected from further consideration.

1.1.1 Brown, Imperfectly Drained and Gley Soils – Lateral Drainage

The Schrader Mains farm has approximately 103 ha of gley and imperfectly drained soils such as those in the Woodlands and Dacre soil classes. The soil physical properties of these soils are such that the shedding of excess soil water favours lateral drainage. This lateral drainage is either natural interflow or assisted by artificial drainage structures (buried tile drains or open farm drains). The footprint of these soils is roughly coincident with the Gley physiographic zone across the Schrader Mains farm. The physiographic zone detail for gleyed zones notes the following features:

- Soils are generally fine textured, prone to water-logging, and have extensive artificial drainage (mole and tile drains).
- Some nitrogen is removed from water infiltrating through the soil zone via denitrification (lost as nitrogen gas).
- Loss of nutrients, sediments and microbes via artificial drains following heavy or prolonged rainfall are a key feature of this zone.
- When soils are wet, excess water from rainfall in flatter areas will flow via an extensive drainage network to nearby streams.
- In undulating areas excess water may also flow across the land surface as overland flow (runoff) during heavy rainfall.
- Some water will slowly make its way down to underlying aquifers.
- Aquifers are shallow and interconnect with streams and drains

The Roslin Consultancy Overseer modelling of nutrient loss to water included in the AEE does not distinguish the mode of water drainage between leaching (deep drainage) or lateral (runoff or artificial) drainage. The default is to assume that soil water excess from the imperfectly drained and gley soils will take a somewhat more direct route to the surface water network. Mapping of artificial drainage in Southland (Pearson, 2016) characterises the intensity of land drainage across the Schrader Mains farm as moderate. A relevant consequence of the above mode of land drainage is that primary contaminants such as ammoniacal nitrogen and particulate / total phosphorus enter surface water.

2. Standard of Environmental Effects Assessment

2.1 Applicant's Existing Environment Descriptions

The existing environment, relevant to effects on water quality is well and coherently described in the Technical Report. There is little detailed description of quantification of the hydrogeology, although to have done so may have provided little substance to subsequent water quality discussion. There is a large volume of water quality, land use emissions and aquatic ecological information developed for responses to Waituna Lagoon's poor ecological condition. The Technical Report author has summarised these in a concise and representative fashion that assists her later discussion of environmental effects.

2.2 Applicant's Assessment of Effects

The application goes through a well-structured development of assessments from farming practices, Farm Dairy Effluent design, infrastructural sizing & design to assist water quality protection, nutrient budgeting to receiving waters quantifications. The application documents combine and amplify the following:

- While the Waituna catchment including Waituna Creek, Carran Creek and Moffat Creek discharges into the Waituna Lagoon and contributes to its poor ecological condition, the discharges of the Waituna Creek are primarily responsible for the bulk of nitrogen loads received at the lagoon. So, nitrate nitrogen mobilisation is the principal issue associated with the upper Waituna Creek farmland.
- Nitrate nitrogen leaching to groundwater, which is flushed into Waituna Creek in its middle reaches seasonally thus transporting much of the lagoon's annual nitrogen load, is largely restricted to the Waikiwi (moderately well drained) soil class. The Waikiwi soil class is not present at the 514 Rimu – Seaward Downs Road property, so vertical nitrate leaching is thought to be negligible.
- Overseer predicts the nitrogen loss load would decline from 4.1 tN/yr for the existing (2015-16 season) land use of beef grazing and dairy support, to 2.5 tN/yr under the proposed milking operation.
- The nitrogen loss load of the proposed dairying operation would be 2.5 tonnes per annum, against 222 tN/yr realised load entering Waituna Lagoon (Snelder et al, 2014) from the wider catchment.
- One aspect the Technical Report author has not cover in detail is the tendency of the middle Waituna Creek to flush of groundwater nitrate nitrogen discharges as a relatively discrete slug

or pulse in late Autumn to late winter, having built up in the shallow aquifer over the preceding growing season (Wilson & Rekker, 2016). This pulse thus avoids much of the *in situ* nitrogen removal by creek channel macrophytes and algae by falling outside of higher sunlight hours and warmer temperatures.

- The nitrogen losses, including nitrate, ammonia and ammonium forms, would discharge through overland flow and artificial drainage in response to relatively shallow depths of excess rainfall, probably distributed more evenly throughout the climate cycle. These multiple, discrete pulses of nitrogen are more likely to be removed by creek channel macrophytes and algae by occurring inside periods of higher sunlight hours and warmer temperatures.
- Conversely, Overseer phosphorus losses would increase under the proposed land use, although the application makes the case that many of the mitigation practices proposed to limit runoff and artificial drainage mobilisation of phosphorus are not considered or rewarded in the Overseer model. So, the increase in phosphorus losses equating to an additional 31 kP/yr (based on 103 ha, 78 – 47 = 31 kgP/yr) may be to some extent an artefact of current Overseer model limitations.
- The resulting mean drainage phosphorus concentrations of the proposed land use do not exceed the 0.33 gTP/m^3 standard set for flowing surface waters (Technical Report, page 19, Table 8).
- The Technical Report sets out that 23 out of 28 Environment Southland farm-based GMPs or water quality mitigations for the Gleyed physiographic zone (Environment Southland, 2016) have been adopted and proposed in the application.

Overall, the consent applications as a whole and the Technical Report that draws on the AEE-associated documents provide a well support assessment of effects of the proposed land use on water quality, and Waituna Lagoon in particular. The Technical Report concludes by saying -

"If there is an increase in phosphorus loss from the property, it could contribute to additional periphyton growth and add to eutrophication issues in the Waituna Lagoon".

This is a reasoned assessment, however it needs to be tempered by recalling that the Overseer model runs in terms of phosphorus losses to water do not differentiate the forms (either dissolved reactive, particulate or organic) of phosphorus and do not consider many of the GMPs advanced to retain farm phosphorus discharges.

3. Summary of Review

3.1 Adequacy of Assessment Information

The AEE and attached technical detail relating to the water quality effects of converting land to dairying are mostly adequate to the task. Discussion within the Technical Report crystalizes the main accepted concepts for nutrient transport within the catchment relevant to the Schrader Mains situation. This provides some confidence that the author of the Technical Report has employed adequate insight and analysis of the range of water quality effects. The overseer model runs are somewhat outside of my area of expertise, so I must take the results summaries at face-value. Much of the AEE pivots on these results, so an expert review may be justified.

3.2 Effect of the Proposed Activities

I have concentrated, almost to the exclusion of all else, on the water quality effects of the land use change by converting to dairying. I consider this is the pivotal aspect of the application and justifies the most attention given the vulnerability or sensitivity of the downstream lagoon receptor. The Schrader Mains farm has natural advantages of imperfectly drained soils, a lack of the moderately drained Waikiwi class soils and light relief. These features mean that the farm can be managed to retard the mobilisation of agricultural soil contaminants and the soil profile need not be bypassed by drainage to the underlying shallow aquifer. The Overseer model runs suggest that the proposed dairying conversion could be considered a form of remediation on the current land use's discharges. Certainly, the residual discharges after the proposed mitigation are as low as realistically feasible for the Waituna climate setting, short of perhaps additional mitigation by housing the cows with Cut-and-Carry fodder management (Herd Homes, etc.).

4. Closure

I trust that the above assists with assessing this application. I can be contacted by telephone or email any matter contained herein.

Yours sincerely,

Jens Rekker
Hydrogeologist.

5. References

Pearson, L. 2016. Artificial subsurface drainage in Southland. Environment Southland Technical Report Publication No 2015-07, January 2016, Invercargill.

Snelder T; Fraser, C; Hodgson, R; Ward, N; Rissman, C; and Hicks, A. 2014. Regional Scale Stratification of Southland's Water Quality – Guidance for Water & Land Management. Aqualinc Research Ltd report number C13055/02, March 2014, Christchurch / Invercargill.

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