

Overseer was used to model losses of N and P below the root zone on the subject property before and after the proposed dairy farm expansion:

	Current	Proposed
N loss per ha per year (kg/ha/yr)	51	45
Total N loss per year (tonnes/yr)	24.7	21.9
P loss per ha per year (kg/ha/yr)	1.1	1.2
Total P loss per year (tonnes/yr)	0.56	0.579

The modelling indicated that N losses below the root zone would decrease as a result of the proposed expansion, but that P losses would increase by 19kg/yr. Further assessments, dated 14 November and 19 November 2018, were provided to ES to support the AEE's conclusion that P losses would decrease as a result of the expansion and good management practices (GMPs), and not increase. Evidence provided shows that losses of P will decrease by at least 57 kg/yr as a result of the proposal.

ES have requested the following further information:

- Consideration of the change in effects expected in relation to nitrogen, phosphorus, sediment, and *E. coli*;
- Consideration of the change expected in each of the individual waterways that flow through the property (the Wairio, Waicolo, and Opio streams); and
- Consideration of the change expected in downstream waterways, and the Jacobs River estuary.

These matters are discussed further below.

### **Changes in effects expected in relation to N, P, sediment and *E. Coli***

The AEE and supporting information strongly indicates that losses of N and P will decrease as a result of the proposal. The contaminant pathways for P and N losses differ. N travels wherever water travels whereas, P tends to "ride" the sediment and so mostly enters water via above ground flow visible to the eye. Sediment shares the same contaminant pathway as P, and so GMPs that address P will address sediment, and vice versa. The predominant transport mechanism for *E. Coli* is via attachment to particulate matter, and so GMPs that address P and sediment will also help to reduce *E. Coli* transfer. *E. Coli* can also be transported via deep drainage, although *E. coli* are normally quickly attenuated in the subsurface because of a wide range of attenuation processes including filtration, dispersion, die-off, predation, etc. Nonetheless, GMPs that address N losses via deep drainage will also help to address *E. Coli* losses to groundwater.

The proposal seeks to significantly reduce the amount of intensive winter grazing being undertaken on the Northern Block, which will ensure more permanent pasture cover, lower stocking rate and better management of CSAs. This will undoubtedly decrease the risk of P loss to water, as discussed and agreed upon during our site visit on 19 July 2018, and at our meeting at ES on 27 September 2018. This, along with the GMPs described in the original consent application, the draft FEMP and the further information dated 14 and 19 November will ensure that losses of N, P, *E. Coli* and sediment to water are reduced as a result of the proposed dairy farm expansion.

Overall changes in effects that will occur include:

- Improved maintenance of soil structure and soil quality across the property;
- Reduced risk of adverse effects on groundwater quality from activities on the property;
- Improvement in surface water quality in the creeks that run through the property; and
- Reduced risk of adverse effects on surface water quality in downstream watercourses and Jacobs River Estuary.

**Consideration of the change expected in each of the individual waterways that flow through the property (the Wairio, Waicolo, and Opio streams)**

Neither the Wairio Stream nor the Opio Stream run through any part of the property, but do flow in the general proximity of the property, or in the case of the Opio along the boundary of the property. The Wairio Stream is located approximately 580 metres to the west of the farm, on the other side of the Otautau Nightcaps Road and is not affected by any activities on the subject property.

The Opio Stream runs along the eastern boundary of the Eastern Block. The Opio Stream has already been fenced off and has established riparian vegetation in place. No changes in water quality in the Opio Stream are expected as a result of the proposal.

There are no waterways that run through the Northern Block or the Eastern Block. The only named watercourse that runs through the existing dairy platform is Waicolo Stream (aka Waikoura Stream). This stream runs along the eastern boundary of the Northern Block and through the middle of the existing dairy platform.

An improvement in water quality in this creek will occur as a consequence of implementation of the following:

- Reduction in stocking rate across the entire property;
- A significant reduction in the intensity of the wintering activity on the Northern Block;
- Improved soil structure and a reduction in the amount of exposed soil;
- A lane that runs alongside a drain that discharges into Waicolo Stream will be decommissioned;
- Improved management of CSAs through implementation of the FEMP; and
- Adoption of other GMPs as outlined in the FEMP.

These changes will result in the following:

- Less run-off of sediment and associated contaminants to water;
- Reduction in N and P losses below the root zone and to water (which serve as a proxy to indicate a reduction in *E. Coli* and sediment losses);

All waterways have been fenced from stock and there is extensive riparian planting already in place. Overall, the proposal will result in an improvement in water quality in Waicolo Stream compared to current water quality.

We are confident that there is a significant body of New Zealand and overseas publications that support our conclusions. However, we acknowledge that given the scale of the farm it would be hugely challenging to actually demonstrate water quality improvements unless many years of intensive near continuous water quality monitoring of the Waicolo Stream was undertaken in the vicinity of the property using continuous measurement methods prior to the proposal occurring so that the baseline is fully understood for comparative purposes.

### Consideration of the change expected in downstream waterways, and the Jacobs River estuary

The subject property lies within the catchment of the Otautau Stream, which is a tributary of the Aparima River, which eventually discharges into the Jacobs River Estuary. The following table provides a summary of the state and trend in water quality at the nearest downstream LAWA monitoring site.

#### Summary of State and Trend at the Otautau Stream at the Otautau – Tuatapere Road site

	State	NOF Band Annual Median	Trend
E. Coli	In the worst 25% of all lowland rural sites	E – high risk of infection to waders/boaters	Likely improving
Clarity	In the worst 25% of all lowland rural sites	N/A	Indeterminate
Total Oxidised N	In the worst 50% of all lowland rural sites	B – some growth effect on up to 5% of species	Likely improving
Ammoniacal N	In the worst 25% of all lowland rural sites	A – 99% species protection level. No observed effect on any species tested.	Indeterminate
Dissolved Reactive P	In the worst 25% of all lowland rural sites	N/A	Likely degrading

For the reasons outlined earlier (and in the AEE and supporting information), the risk of adverse effects on water quality resulting from activities on the subject site will be reduced. Water quality at the Otautau Tuatapere Road monitoring site is showing signs of improvement for some water quality variables, and the proposal will help to ensure continued improvement in water quality at this site.

Levels of DRP are likely degrading at the Otautau Tuatapere Road monitoring site, however, the proposal seeks to reduce the amount of P being lost from the subject property, which will in turn help to contribute improving water quality at this downstream site.

The AEE describes the state of the environment in the downstream Jacobs River Estuary. Water quality in the estuary is moderately to highly degraded (low clarity, elevated faecal coliforms, elevated nutrients) with eutrophication and sedimentation having been a major issue within the estuary since at least 2007. The proposal seeks to reduce the amount N, P, *E.Coli* and sediment lost to water, which will in turn reduce the loading of these contaminants in the estuary. A reduction in loading of these contaminants to the estuary will reduce the risk of adverse effects associated with elevated levels nutrients, sediment and microbial contamination.

We emphasise that we are confident about the reduction in contaminant losses that would result as a consequence of the proposal. However, we also acknowledge that this is just one relatively small farm in a large catchment and that meaningful improvements in downstream water quality will only be observed if similar improved management practices are adopted over a significant proportion of the catchment.