Surface Water Quality Technical Advice

As Consent CRC169646 has not been exercised, I have focussed on the potential effects of the increase of nutrient losses from the baseline period to the proposed full development. I am assuming that the farms current nutrient losses are similar to the baseline period, and therefore, baseline nutrient losses indicates that what is currently being lost into the receiving environment.

The proposal is a N increase over the combined properties of 12 to 39 kgN/ha/yr (225% increase – an additional 12 tonnes N) and an increase of P loss from 0.05 to 0.15 kgP/ha/yr (200% increase – an additional 0.15 tonnes P). This is a significant increase in nutrient losses into a highly valued and sensitive environment compared to existing/baseline losses.

In relation to the existing nutrient loads and load limits (as measured/calculated for the upstream site at SH1), the current nitrogen load (rolling 6 year average up to 2020) is 570 tonnes/yr which is well below the HWRRP limit of 963 tonnes/year. The current phosphorus load is 9.3 tonnes/year which is just under that HWRRP plan limit of 10.7 tonnes/year. However, this is the first year since the plan became operative that the phosphorus load is less than the plan limit. Given the variability in nutrient loads (function of in river concentrations and flows), it is possible the river will exceed the P limit again in the future.

The load limits were established, alongside in river nutrient concentration limits to prevent adverse effects on aquatic ecology, cultural and recreational values from proliferation of undesirable algal (periphyton) growth and toxicity risks to aquatic fauna. While we do not have a lot of data for the Hurunui River below SH1, one site has been monitored on a quarterly basis since 2016. Nutrient data for that site indicates concentrations are currently below the limits set out in the HWRRP. We do not have periphyton biomass data for that site, but do have observations of periphyton cover, which generally do not indicate prolific nuisance growths, except for early this summer (December 2020) when nuisance periphyton cover was noted.

Overall, while the current nutrient status of the Hurunui River is generally better than the limits set out in the HWRRP, there remains uncertainty about the cumulative effects of other recently consented farming activities that increase nutrient limits, plus the additional impact if this application was granted. One option to address this uncertainty, is to require monitoring of the Hurunui River and Honeymoon Creek to assess over time the impact of this proposed activity, at least in terms of nutrient effects on the Hurunui River.

In terms of mitigations proposed, as set out in the draft consent conditions, I agree that many of the conditions, particularly conditions 2 to 7 could significantly help towards mitigating risks associated with the proposed development and intensification of the property. However, I cannot say with confidence that the proposal including mitigations, would not cause the limits to be exceeded at some point in the future, especially taking into consideration the cumulative effects of other recently consented property developments. Having a robust monitoring and response strategy can improve confidence that the limits are not exceeded and enable rapid response should an exceedance occur.

Let me know if you want further information,

Cheers
Shirley

Summary of proposed from Tech Request Form….

Mr N J & Mrs L M Harris & Harakeke Nominees Limited (the applicant) has applied for a land use consent to use land for farming at Hurunui Mouth Road, Domett.

2. The proposed farming area is 478 hectares. The property is currently run as a partially-irrigated sheep and beef, and dairy grazing operation, described as two blocks:

1. *Wharenui Block*, which has approximately 353 ha of farmed area and is owned by the applicant; and
2. *McLaughlan's Block*, which has approximately 125 ha of farmed area and is leased by the applicant.

The property is adjacent to the Hurunui River, and includes approximately 5.2 km of river frontage.

The proposed scenario increases the total irrigated area, with an increase in stocking rate resulting from the higher production.

The applicant previously held a consent to farm, CRC169646, which expired in February 2018. CRC169646 was modelled for a dairy farm on the Wharenui Block, as the previous owner wished to scope the potential for a future conversion. The conversion has not occurred.

The applicant seeks to obtain a new consent to farm incorporating irrigation on both Wharenui Block and McLaughlan's Block, with a total farmed area of 478 ha.

The applicant has concurrently applied for consents to take and use water for irrigation (CRC181649 and CRC181686), and for a suite of consents for the retrospective establishment and ongoing maintenance of a bore in the Hurunui River (CRC190984, CRC190985, and CRC190986). The three consents relating to the bore were granted in January 2020, with the water permits remaining on hold to be processed alongside the farming consents.

Currently, the farm blocks are operating as two separate operations:

3. 353-ha used as a partly-irrigated beef and dairy grazing block (Wharenui block); and
4. 125-ha used as a dryland sheep grazing operation (McLachlan block).

The average nitrogen and phosphorus losses to water, between the two blocks in the 2012/2013 season, were 12 kg N/ha/yr and 0.2 kg P/ha/yr respectively.

The applicant is now proposing to increase the irrigation area from 300-ha by a further 65-ha, bringing the total irrigated land to 365-ha. With this increased irrigation area and overall higher production (with the inclusion of fodder crops), the applicant also wishes to increase their stocking rates.

Modelled on this future scenario, nitrogen and phosphorus loss to water amounts are 39 kg N/ha/yr and 1.1 kg P/ha/yr, meaning a 225% increase in nitrogen loss and a 450% increase in phosphorus loss above the baseline period loss rate.

As noted above, CRC169646 was granted in 2015 to change land use as the land owner at the time proposed to convert their property to a dairy farm. The Nitrogen Discharge Allowance (NDA) associated with this consent was 20 kg N/ha/yr based on

OverseerFM version 6.1.3, (based on the current OverseerFM version (6.3.4) the NDA is 29 kg N/ha/yr). Therefore there is a 34% increase from the consented NDA and the proposed scenario. While there was no PDA associated with CRC1696466 the difference between the proposed scenario and the OverseerFM modelling associated with CRC169646 is a 41% decrease.

The applicant has provided a description of the affected environment in Section 2 of the AEE (pages 8-11) which accompanied the application.

In addition, I note:

5. The site is adjacent to and slopes down toward the Lower Hurunui River mainstem on the Domett Plains;
6. The applicant's property is located below the SH1 flow recorder site;
7. The property is located within the Hurunui and Waiau Nutrient Management Zone;
8. There are intermittent ephemeral streams and gullies that run through the applicant's property;
9. Wharenui Block contains an approximate 100 metre strip of riparian zone in between the south boundary and the Hurunui River;
10. The Hurunui River is classified as a Statutory Acknowledgement Area under the Ngāi Tahu Claims Settlement Act 1998;
11. The Hurunui River is a wetland of regional importance, is a site of special wildlife significance, and is an important river for native river birds and open water habitat;
12. The Hurunui River has a high degree of naturalness and is an area of regional importance; in the upper reaches;
13. The Hurunui River mouth is a wetland of high significance (Hurunui River Hāpua) and is an area of significant natural and physical values (Schedule 2 of the Regional Coastal Environment Plan);
14. The Hurunui River has important recreational values;
15. The applicant's property contains flats and some terraces;
16. There are numerous aerially identified wetlands on the property;
17. The applicant's property lies within the rohe of Te Rūnanga o Kaikōura. There are no silent files within the vicinity of the property;
18. The soil types on the farm include Barrhill, Mayfield, Darnley, Wakanui, Waimakariri, Rakaia, Rangitata, Eyre and Selwyn which range from imperfectly draining to well-draining soils, with the majority of the farm containing well-draining recent alluvial soils;
19. The property intercepts the protection zone of the Hurunui Lower Rural Water Scheme;
20. There are no freshwater bathing sites, or salmon or īnanga spawning sites, within the property or 1000 metres of the property;
21. There are no other cultural, historic, or conservation values located within or adjacent to the property;

14. The Hurunui River is the most sensitive of the receiving environments within the vicinity of the property given the number of values associated with it. It has importance to the local and wider community for its cultural, recreational and ecological values as outlined above.

15. Table 1, containing data provided by Mr Tim Davie, Chief Scientist, Environment Canterbury, shows the in-river loads for Dissolved Reactive Phosphorus (DRP) and Dissolved Inorganic Nitrogen (DIN) from 2011-2017 against the HWRRP. Table 2 shows the phosphorus concentration (Dissolved Phosphorus) against the HWRRP. The nitrate-nitrogen concentrations for the mainstem are under the limits in the HWRRP[1].

Table 1

Hurunui River loads	**Hurunui at Mandamus**		**Hurunui at SH1**	
Schedule 1 load limit	**DIN (tonnes/year)**	**DRP (tonnes/year)**	**DIN (tonnes/year)**	**DRP (tonnes/year)**
HWRP Schedule 1 limits	**39**	**3.2**	**963**	**10.7**
6 yearly average for year ending	**52.25**	**3.45**	693	15.9
June 2015	54.4	3.9	809	18.8
June 2016	54.6	3.8	714	15.9
June 2017	51.7	3.5	607	14.4
June 2018	56.3	3.7	733	19.2
June 2019	52.9	3.5	729	18.0
June 2020	43.6	2.3	570	9.3

Overseer modelling

16. The applicant has provided Overseer (version 6.34) modelling, undertaken by GHD and Lowe Environmental Limited, describing the nitrogen and phosphorus baseline, and the proposed scenario of the applicant's entire farming operation (492 ha total).

17. The existing farming system modelled as two separate blocks (Wharenui Block and McLaughlan's Block) in 2017 is as follows:

a. 300 ha of irrigation within the 492-ha property (as authorised by a current consent CRC156900);

b. Stock: 1,000 R1's, 500 R2's, 2,000 ewes, and 800 lambs;

c. Crops: None, all pastoral;

d. Fertiliser: February Super Phosphate applications, with February, September, November Urea applications on some areas of farm.

18. The total nitrogen loss to water for the nitrogen baseline is 11,838 kg N (24 kg N/ha/yr) and a total phosphorus loss to water of 277 kg P (0.56 kg P/ha/yr).

19. The proposed scenario of both Wharenui Block and McLaughlan Block has been modelled by Overseer version 6.3.0, incorporating the additional irrigation, cropping blocks and stock classes as follows:

a. 365-ha of irrigation within the 492-ha property (to be authorised by new consents CRC181649 and CRC181686);

1. Stock: 1,100 R1's, 1,100 R2's, 2,000 ewes, and 800 lambs;
2. Crops: Pastoral and 70-ha rape/fodder;

3. Fertiliser: February Super Phosphate application, September and November applications of Urea, and February application of Urea on irrigated land.

   The applicant's calculation of the nitrogen and phosphorus losses are summarised in the table below:

Wharenui Block	**Nitrogen**		**Phosphorus**	
	Total kg	Kg N/ha/yr	Total kg	Kg P/ha/yr
Baseline	4220	12	56	0.2
Discharge Allowance for CRC169646	9422	26	237	0.7
Proposal	10572	30	39	0.11
Difference between baseline	150% increase		30% decrease	
Difference between CRC169646	15% increase		507% decrease	

21.

McLachlan Block	**Nitrogen**		**Phosphorus**	
	Total kg	Kg N/ha/yr	Total kg	Kg P/ha/yr
Baseline	1499	12	17	0.1
Proposal	2631.3	21	29	0.1
Difference	75% increase		41% increase	

22.

Wharenui +McLachlan Block	**Nitrogen**		**Phosphorus**	
	Total kg	Kg N/ha/yr	Total kg	Kg P/ha/yr
Baseline	5719	12	73	0.15
Discharge Allowance for CRC169646 + McLachlan baseline	10921	22	254	0.5
Proposal	18608	39	220	0.5
Difference between baseline	225% increase		201% increase	
Difference between CRC169646 + McLachlan baseline	77% increase		15% decrease	

23. The applicant has shown through the use of Overseer modelling that the nitrogen and phosphorus loss from the land will increase above the 10 percent requirement under the HWRRP and

as such the proposal has triggered a change of farming land use consent requirement under Rule 11.1 of the HWRRP.

24. The applicant has assessed effects on water quality of the river from the proposed activity against relevant water quality sites.

25. There is one water quality site directly adjacent to the property (SQ34442), two sites approximately 2.5 km downstream from the property (SQ34420 and SQ34421) and one site further downstream near the Hurunui mouth (SQ35848). The Hurunui mouth is approximately 4 km downstream of the applicant's property.

26. Periphyton information is only available at SQ34420 (above the swing bridge near the mouth) and no chlorophyll *a* has been recorded at any of the sites. The most recent data is from SQ34420 dated 17 July 2019.

27. The applicant details that from the information available, periphyton levels in the river fluctuate. At the five previous samplings no long filaments have been observed; thick mats have covered 1-15% of the surface area and the total cover has ranged from 15% to 70%. Periphyton is a function of flow, water temperature and nutrients, and an increase in one of these may not necessarily cause an increase in the periphyton levels. The limits in the HWRRP relate to long filamentous algae and chlorophyll *a*. Due to there being no available information on existing chlorophyll *a* concentrations the applicant considers that no comment can be made in relation to this limit, other than to say an increase in periphyton biomass is likely to have a corresponding increase in chlorophyll *a* levels.

28. The HWRRP sets a limit that long filamentous algae of the 95th percentile of monthly periphyton biomass measurements shall not exceed 20% cover of filamentous algae more than 2cm in length. The most recent observations at SQ34420 have observed no long filamentous algae present.

29. The consultant considers that the record of periphyton sampling is not long enough to be able to conclusively state that periphyton is increasing on a regular basis. Due to the existing low levels of long filamentous algae, the likelihood of an increase in P from the proposed activity causing the periphtyon limits of the HWRRP to be exceeded at any site downstream of the property is very small.

30. Sites SQ34441, SQ4442, SQ4421 (three sites closest to property) were last sampled for nitrate-nitrogen concentrations in 2002. The applicant details that during the sampling period from February 2001 to May 2002, the Nitrate + Nitrite N concentrations and the DRP concentrations varied with the highest levels of both being observed at SQ34441 – located above the applicant's property and the lowest levels at SQ34442 located adjacent to the applicants property.

31. The applicant has compared data against HWRRP limits in the following table:

	Av at 3 WQ sites		HWWRP limits policy 5.3
N + N mg/L	SQ34441	0.41	2.3 and 3.6 (below Mandamus recorder-only nitrate N in policy 5.3)
	SQ34442	0.41	
	SQ34421	0.44	
DRP mg/L	SQ34441	0.011	0.0044
	SQ34442	0.007	

	SQ34421	0.009	

32. As demonstrated in the table above, the DRP level has already exceeded the limit under plan and the nitrate N concentration is below. Note these results are from 2002.

33. While the above table shows N concentrations well under the plan limits, the Description of the Environment section of this report, shows that the N concentrations are under the limits and the N load as set under Schedule 1 is just under. While N concentrations and loads are not recorded as being breached at this time, it is essential that any effects arising from the activity do not cause an exceedance to these limits.

Wharenui Block

34. Relating to the Wharenui Block farming land use consent (CRC169646), a site visit was undertaken by Mr Ian Brown and Mr Michael Bennett of the CRC on 20 May 2015. The site visit was taken to assess potential nutrient loss pathways on the property and potential mitigation to ensure nutrient loss is contained within the property. See HPCM REF: C15C/80735 for Mr Brown's full report.

35. In relation to this new consent, the following notes from Mr Brown are relevant:

1. The applicant is proposing that the area of Rangitata soils located closest to the Hurunui River remain as dryland. These are the shallowest soils on the property with the highest N leaching potential. In addition there is an extensive area of riparian vegetation that bounds the river. The dryland area together with the riparian vegetation provides a substantial nutrient buffer between the main farming area and the river. Having viewed the site Mr Brown supports this view;
2. There are a number of drainage channels which cross the lower flats. At the time of the visit these were all dry. Some of these channels originate on the neighbours property on the other side of State Highway 1. The channels have been recorded as 'intermittent' in the application and the applicant has confirmed that these channels do carry water from time to time. Mr Brown expects all dairy stock to be excluded from these channels;
3. Practices to minimise P losses that are expected to be included in the FEP:
    1. Soil Olsen P levels should not exceed agronomic optimum levels (excessive soil P levels can result in P leaching.)
    2. Seepage areas identified and managed to contain nutrient losses to waterways. This may include the creation of wetlands downstream of any seepages. (Note: During the visit no seepage areas were identified. This is not surprising given the dry conditions. However, under irrigation seepages may occur particularly from terrace edges.)
4. In order to minimise nitrogen losses from the proposed dairy unit (which was modelled as the proposed scenario for CRC169646), Mr Brown expects the property owner to adopt and be operating at a level of good management practices (GMPs)[2] as defined by the industry agreed GMP's (as a minimum).
5. Mr Brown also expects the property owner to demonstrate through their FEP, a degree of 'future proofing' of their operation by adopting practices which go beyond GMP. Such practices include, but are not limited to, the use of variable rate irrigation and precision agriculture technologies.

36. In order to ensure that the modelled increase in nutrient loss from the proposed activity does not reach the river, I also recommend that the above points noted by Mr Brown from the site visit, be adopted as conditions of the consent and requirements under the FEP process. See Appendix

1 for the recommended conditions.

McLaughlan's Block

37. A farm visit was undertaken on 20 May 2015 by Emma Barr, Mr Brown and Mr Bennett. This site visit was taken to assess the potential nutrient loss pathways on the property, focussing on the McLaughlan Block. The following points are relevant:

1. Visit to the Wharenui Block sediment traps and riparian exclusion zones, which were wetter areas of the property fenced off from stock.
2. Visit to the lower terrace of McLaughlan's Block, at the closest point to the Hurunui River, and drove through Honeymoon Creek. The lower terrace is only a few metres in elevation above the active river channel, and bordered by willow trees on one side and a steeper tree-covered terrace on the other side.
3. The applicant is proposing that an area of property located closest to the Hurunui River remain as unused dryland. This will provide a good nutrient buffer between the farming area and the river. The applicant will also not irrigate within approximately 200m of the lower reaches of Honeymoon Creek. See image below (red shaded area not to be irrigated).

4. The applicant wishes to irrigate the remainder of the lower terrace.

38. Both site visits confirmed that the applicant is willing and able to establish nutrient management practices on the property. Thus far, the applicant has established fencing and planting of drains/seeps, created sediment traps and incorporated deficit irrigation practices onto the Wharenui Block.

39. By integrating irrigation onto McLaughlan's Block, the applicant is proposing to commence wetland enhancement and fencing areas of Honeymoon Creek. The applicant is proposing to incorporate the following strategies:

1. Use of an environmental farm advisor to compile the Farm Management Plan, and prepare a wetland and riparian planting plan (and provide a schedule for this to occur).
2. Adherence to the Farm Management Plan (FMP)
    1. Targeted fertiliser applications to ensure buffer of 20 m from wetlands and waterways
    2. Identification of Phosphorus Loss Risk Zones
3. Identify seeps and wetland areas and fence these off to prevent stock access. This is to be combined with riparian planting along margins of the Honeymoon Creek in its lower reaches.
4. Enhancement of wetland areas through clearing of weeds and planting of native plants.
5. Use of sediment traps in ephemeral / overland flow paths. This is similar to those already installed on Wharenui and Glenturret Blocks.

The applicant considers that as the mitigation proposed specifically relates to P mitigation as this is the parameter that has seen the HWRRP levels already exceeded and also has specific mitigation measures for the lower terrace of the property. The proposed mitigation measures will help to ensure that any increase in N and P will be contained within the applicants' property.

> Due to the extensive mitigation measures recommended in Ian Brown's report and the fact the applicant has confirmed these will be included as conditions of consent, along with the completion and auditing of a Farm Environment Plan; the applicant considers that the likelihood of the increased nutrient loss from the property causing the periphyton, DRP or Nitrate + Nitrite N concentrations in the Hurunui River downstream of the applicants property to exceed or further exceed the limits set in the HWRRP is very small.

My question is, do you consider the mitigation proposed by Ian and the applicant to be appropriate for the application, and do you consider that the applicant's assessment (that with the mitigation it is unlikely for this farm to cause any exceedance in the limits) is correct?

Condition 7b – Exclude intensively farmed stock from any water bodies, and ephemeral swales when water is present.

<u>Groundwater technical advice</u>

As discussed, I agree these is a risk of adverse effects on groundwater and on the receiving surface waterways from the proposed irrigation and land use intensification. I am not sure these have been adequately assessed in the application, because they do not appear to have taken into account a consented discharge of 15 000 kg N/yr which partially overlaps with the property that I understand allows a discharge of up to 200 kg/N/ha/yr over part of the Wahrenui block (CRC185739).

I do think monitoring shallow groundwater sites on the property (e.g. purpose installed wells, springs, seeps and drains) could be a useful tool for tracking effects of the changes in land use on water quality. Monitoring could be tied back to trigger values and actions for reducing inputs/losses from the famring land use. The applicant would need to monitor for nutrient species (total nitrogen, nitrate, total phosphorus and dissolved reactive phosporus) and pathogens in groundwater along the downgradient boundary of their property (basically the the boundary along the river) and also have a comparitive sites on the upgradient side to check what was coming in from other sources. I would recommend at a minimum quarterly sampling to capture any seasonal variations, but surface water scientists may prefer more frequent e.g. monthly or even continous loggers to capture individual rainfall events.

Because of the elongated nature of the two blocks and the intersection with small (possibly intermittent) surface water courses across the property, they would probably need several monitoring sites. They would need to engage a competant hydrogeologist/environmental scientist to design a suitable programme.