From:	Mark James
To:	Natasha Pritchard
Subject:	RE: Pioneer Energy Limited variation application - RM18.004 - Further information
Date:	Tuesday, 28 August 2018 8:55:16 a.m.
Attachments:	Review of Pioneer application final v2.pdf Invoice 1484 ORC Aug-18.xlsx

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Hi Natasha

I have updated my review to reflect the new information provided so can happy for this to be final now.

I have also attached the final invoice which completes the project.

Cheers
Mark

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Review of Pioneer Energy Ltd amendment to consent for Lake Onslow

Prepared for Otago Regional Council

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1. Background

Otago Regional Council (**ORC**) have asked Aquatic Environmental Sciences Ltd (**AES**) to provide a review of an application by Pioneer Energy Ltd (**Pioneer**) to amend their Resource Consent for:

- Water Permit (Dam) 2001.475 which is to dam the Teviot River with a 17 m high dam for the purposes of creating Lake Onslow for hydroelectric power generation and irrigation; and
- Water Permit 2001.476.V1 which is to take and use water non-consumptively from Lake Onslow at a maximum rate of 6 m^3/s for the purpose of hydroelectric power generation.

Both consents have restrictions on the rate at which the water level can be drawn down (Condition 2 and 3 respectively):

"The rate at which the lake shall be drawn down shall not exceed 0.2 m over any seven day period".

The application seeks to amend this condition so that *"The rate at which the lake shall be drawn down shall not exceed 0.5 m over any seven day period."* This would allow for the lake water to be released quicker and thus produce more electricity when required. No amendments to the rate of take, minimum operating level or the residual flows are proposed.

The background to the proposed amendment, the formation of Lake Onslow, the existing environment and an assessment of environmental effects (AEE) are provided in the application.

2. Scope of review

AES has been requested to provide a technical review of the application for ORC based on the documents provided namely:

- Pioneer Energy Ltd (2018). Resource consent application to Otago Regional Council to amend Water Permit (Dam) 2001.475 and Water Permit 2001.476.V1. Prepared for Pioneer Energy Ltd by Landpro Ltd.
- Dungey, R. (2018a). Lake Onslow Lake Bed survey and Invertebrate survey. Prepared by Ross Dungey Consulting for Pioneer Energy Ltd.
- Dungey, R. (2018b). Lake Onslow. Supplementary Information. Prepared by Ross Dungey Consulting.

- Stark, J.; Hayes, J.W. (1997). Freshwater Biological Assessment of Environmental Effects for the proposed Central Electric Ltd Horseshoe Bend hydroelectric Scheme on the Teviot River, Central Otago. Prepared by Cawthron Institute, Report No. 389.
- Stark, J.; Strickland, R.R. (1997). Assessment of the impacts of existing hydroelectric and irrigation schemes on aquatic biology in the Teviot Catchment. Report prepared by Cawthron Institute for Central Electric Ltd, Report No. 401.
- Memo from ORC to Pioneer Energy Ltd 11/1/2017.
- Data on lake levels for Lake Onslow.

Following the initial review by AES further information on extent and duration of low levels and on macrophytes, macroinvertebrates and fish distribution was provided on the 17th August.

This review is based on the above documents and extensive experience with lake research and management over 35 years, including leading large projects assessing the effects of hydroelectric generation and writing reports and publications on lake level management.

3. Review

The background and existing environment can be summarized as:

- Lake Onslow is a man-made lake formed in 1888 by damming the Teviot River to provide water for goldmining. The dam started operating for an irrigation and power scheme in 1924 and a new dam was built in 1982 which flooded additional land and increased the area from 367 ha to 830 ha;
- The minimum operating level is 679.9 m above sea level with a consented operating range of 5 m and usual operating range of 2.5 m. Low lake-levels are experienced about once every decade.
- Lake Onslow is recognized for its natural values (riparian vegetation, trout spawning), cultural values (Waahi taoka and Mahika kai) and provides a significant and valued regional trout fishery.
- The macroinvertebrate community in 1993 was dominated at a boat ramp site by annelid worms and in 2016 and 2017 at a “rocky” and a “muddy” site surveyed by a mixture of, chironomid larvae and caddis fly larvae.
- The high numbers of worms in 1993 was attributed to the recent rising lake levels which would have provided new habitat and increased productivity while the levels prior to 2016 and 2017 sampling were relatively stable.

- Effects on macroinvertebrate production could potentially adversely affect fish and the trout fishery.
- Land modification and intensification for agriculture has occurred in the catchment over the last 5 years which appears to have resulted in variations in nitrogen and phosphorus and will have an impact on water quality. Trophic state is assessed as eutrophic based on phosphorus and mesotrophic based on nitrogen and phytoplankton biomass.
- The main issue identified with increasing the drawdown rate in the AEE is the stranding of invertebrates in the shallow areas of the lake.

Assessment of Environmental Effects

1. The AEE is very brief and relatively superficial but does include an attachment on the latest surveys which included lake bed profiles and invertebrate surveys as well as a summary of literature information on the potential effects of lake level management on macroinvertebrates and fish. Further information was provided following a request from the ORC in August.

   Comment

   While I agree that aquatic macroinvertebrates can drive fish production, the driver of macroinvertebrate production, food webs and ecological processes are far more complicated than suggested. I am surprised that in the AEE and attached report:

   - *There is very limited if any attention to phytoplankton biomass, and the levels or seasonal changes that may occur. Elsewhere algal blooms are known to drive macroinvertebrate production, especially chironomid populations (references can be provided). Is there any information on the phytoplankton in the lake? Chironomid populations are usually the most important food source for bullies in these types of lakes which in turn will drive trout production.*
   - *Macrophytes play a big part in providing a 3-d structure for epiphytes that in turn are a major food source for invertebrates such as caddis, chironomid larvae and snails. I suspect that the "muddy/macrophytes" indicates there are important beds of macrophytes yet their distribution and the effect of drawdown on these is not discussed. No species were initially provided but the taxa present has now been clarified as Myriophyllum sp. and Potamogeten sp. Future surveys should confirm the species as some*

Potamogeten spp are introduced and some native. The distribution has been clarified as within the top 2 m and they are sparse below 3 m water depth.

- *Apart from saying there were numerous bullies they are not discussed further yet will likely be an important part of the food web leading to trout. Their importance was clarified in the supplementary information provided in August. Seasonal and annual changes in their populations could well be the major driver of trout production.*
- *The data describing the substrate is very rudimentary, but may be sufficient if it is just mud.*

2. The AEE and attached report (Dungey 2018a) suggest that disturbance created by drawdown is important in creating new habitat and potentially would increase macroinvertebrate habitat and food for trout. Potential effects of the faster drawdown being proposed would be "largely overshadowed" by effects of dry years, variations in lake level and rainfall which in turn would impact on light levels while recovery would occur as lake levels rose again.

   Comment

   Based on extensive work in natural and man-made lakes throughout the country I agree with the suggestion that variability in lake level can enhance macroinvertebrate productivity. Resetting of communities is important and some variability is important as it leads to greater diversity and recolonization by taxa such as chironomids. In many lakes this varial zone has a number of turf communities but none are mentioned in the surveys so assume there are none present. I also agree that natural variability in physical and biological processes between years will obscure any effects of the proposal.

3. It is noted in the AEE that earlier work by Cawthron Institute in the 1990s (see references above) suggested a drawdown of 0.2 m over seven days is sufficiently slow that it should not have any adverse impact on the littoral zone macroinvertebrates or fish and there was nothing to suggest that the present operations were having a significant adverse effect.

Comment

Unfortunately the earlier assessment did not talk about the maximum rate. I agree that 0.5 m over seven days or 7 cm/d occurring every few years for a short periods would not

have an adverse, detectable effect. However there is no data or models presented on the duration of these faster drawdowns or the resultant change to lower lake levels (even though they may be within the consented range). I would have expected to see more hydrological information provided however this is unlikely to alter the conclusion.

As stated in the attached report mean lake levels, minimum levels, lake level variation and the timing of these, along with effects of wind and wave action are likely to be major drivers of the invertebrate production and distribution. Onslow has been operating under these effects since 1983. Predictions on whether any of the lake level metrics will change with the proposed change drawdown were provided following a further information request. The predictions are that the lake level elevations will not change but they will be reached quicker. Recharge will depend on rainfall. The extent of the effects on the biota of these changes has also been clarified subsequently.

There is information on the existing hydrology and the issue of lack of clarity around effects on extent and duration of low levels and area exposed (compared with the present regime) have been clarified following a request for further information.

4. The common species are rapid recolonisers and have short life histories making them particularly well adapted to such environments.

Comment

The invertebrate communities found in lakes and response to lake levels change is well summarised and described in the attached report.

There is mention of migration if drawdown is slow enough but in my experience very few macroinvertebrates can migrate most will either bury themselves, close shells (in the case of bivalves or some gastropods) or will be exposed and recolonise through a new generation. The latter can happen relatively quickly as some of the macroinvertebrates have multiple generations per year.

5. Pioneer provided additional information through the initial S92 request which largely relates to hydrological characteristics and potential effects of the proposal on the Teviot River below Lake Onslow. There is some commentary on effects on lake levels.

Comment

I would have expected to have seen more commentary on the effect of the drawdown on lake levels and relate this to where important macroinvertebrate and macrophyte beds are and potential effects on bully and koura populations (koura are mentioned in the S92 response). Some further information on potential effects was provided as further supplementary information in August 2018. While this could have been more in-depth there is sufficient information provided now and further information would not be expected to change the conclusion.

6. There are no recommendations for monitoring.

Comment

Lake biological communities can show considerable month to month and year to year variation as well as long-term trends, for example, if water quality deteriorates. The change from high numbers of annelids (I assume these are aquatic oligochaete worms?) to more chironomids and caddis fly larvae is definitely a positive for the lake and its fishery and should be maintained.

As the author appreciates and discusses in the S92 response it is difficult to accurately predict effects on biological communities and to detect effects outside what is expected naturally because of this variability. I agree we would not expect to see changes in lake productivity or the fishery outside natural variation but if this is a highly valued fishery then this should be confirmed with some basic monitoring eg macroinvertebrates say every 5 years (add a few sites to the Teviot surveys) and at least following changes in angler use and catches.

It is not clear in the S92 response exactly what monitoring is proposed?

7. Summary and recommendations

- Based on my experience and information provided I agree that a change from 0.2 to 0.5 m drawdown rate over seven days will not have more than a minor effect on the ecological values of the lake and it will continue to support a valuable fishery. This amended drawdown rate is within the range that lakes experience naturally noting that this is a man-made lake and lake levels will vary at time scales from weeks to years to decades. Lake biological communities will often show considerable year to year variation as well as long-term tends if water quality deteriorates.

- This is supported by the surveys, literature search and assessment. Further information on potential effects on other aspects of the food web that may determine overall lake productivity have now been provided and support this conclusion.
- The role of macrophyte beds, algal blooms, koura and bullies was emphasized in subsequent information provided. They will be some of the main drivers of macroinvertebrate and trout production.
- Further predictions and assessment of hydrological features as well as links with the biota were subsequently provided and show that the extent and duration will not change from what the lakes experience now.
- If the lake is highly valued for its fishery and mahika kai then consideration should be given to adding a few lake sites to the Teviot River sampling and at least some basic monitoring, including angler use and catches. The proposed monitoring should be made very clear.