Before the Commission
Appointed by the Otago Regional Council

Under	the Resource Management Act 1991
In the matter of	Application RM18.004
By	**Pioneer Energy Limited** Applicant

Statement of Evidence of Jayde Edward Malthus Couper for the Otago Fish and Game Council.

28 June 2022

Otago Fish & Game Council

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Qualifications and experience

1. My full name is Jayde Edward Malthus Couper.
2. I am employed as a Fish and Game Officer / Ecologist by the Otago Fish and Game Council. I have been employed by the Otago Fish and Game Council since September 2021, prior to that I was employed as a Fish and Game Officer by the Central South Island Fish and Game Council from December 2013 to September 2021. As part of the roles mentioned above, I have gained experience on ecological and fishery monitoring and how those factors affect angling amenity. I also have experience at statistical analysis and statistical modelling.
3. I hold a Bachelor of Science in Environmental Science and Water Science and Technology from Lincoln University.
4. I have visited Lake Onslow on multiple occasions for; spawning surveys, angler interviews and to fish the lake.

Code of conduct for expert witnesses

5. I confirm that I have read the Code of Conduct for expert witnesses contained in the Environment Court of New Zealand Practice Note 2014 and that I have complied with it when preparing my evidence. Other than when I state I am relying on the advice of another person, this evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

Scope of evidence

6. I have been asked to prepare evidence on RM18.004 by the Otago Fish and Game Council, in relation to the ecology and fishery values of Lake Onslow at varying drawdown speeds.
7. My evidence describes the ecological effects that may arise from a change in the lake drawdown, discusses the four lake drawdown scenarios and evaluates adverse effects between the scenarios with the

information on hand. The scenarios are as presented in section 6.1.2 of the s42A Officer's Report. I adopt and use these descriptions.

8. In preparing this evidence I have reviewed:

   a. Pioneer Energy Consent Application to amend two consents associated with the Lake Onslow hydro scheme

   b. Application – Amendment to application – 21 June 2021

   c. Section 42A report – Pritchard, 14th June 2022

   d. Section 95 report – Pritchard, 1st November 2021

   e. Lake Onslow Lake Bed Profile and Invertebrate Survey – Dungey, September 2017 (included in the application)

   f. All further information requests

   g. Review of Pioneer Energy Ltd amendment to consent for Lake Onslow - Mark James (AES) 16th July 2018 (revised 28th August 2018)

   h. Memo (Lake Onslow variation – review of monitoring plan) Mark James, 13th October 2021

   i. The evidence of Mr. Ross Dungey

   j. The evidence of Ms. Annabelle Coates of Babbage Consultants

   k. The evidence of Mr. Antony Jack

   l. The evidence of Mr. William Nicolson

   m. The evidence of Ms. Kay Booth

   n. Technical Evidence (Peer review of lake levels model) by Tiago Teixeira and Lobo Coutinho Babbage Consulting Limited, 10th June 2022

   o. Fish and Game Submission, 2nd December 2021

   p. Teviot Anglers Submission, 1st December 2021

9. My evidence will address the following matters:

   a. Analysis of the Model

   b. The current ecology of the Lake

   c. Ecology of the Lake/ Teviot River under Scenario B

d. Changes to ecology of the Lake/ Teviot River if Scenario C was introduced

e. Expectations of the ecology under Scenario D

f. Response to the Lake Onslow Monitoring Plan/ cobble planting idea

Scenario model limitations

10. The assessment of the effects of the theoretical scenarios B and C and the comparison between them relies on lake level information provided by a Model[1] provided by the applicant. This is seen in Table 6 of the s42a report and paragraph 30 of Ms. Coates evidence. However, the Model has a number of shortcomings which mean that relying on it to predict the effects of different draw down regimes is problematic. When using the model, the user must be cognisant of the issues and consider conclusions in light of the uncertainty they create.

    a. The Model is not based on actual flows into the lake, instead it is modelled from an adjacent catchment. Teixeira and Coutinho state "the reliability of the Model is heavily dependent on the accuracy of the single inflow data used, and how well it represents overall inflows (runoff from the catchment, direct precipitation, groundwater) and outflows (evaporation, groundwater leakage) to the Lake".[2]

    b. The Model estimates a roughly 15-year period however testing has only been carried out on very limited set of data; a two-month period in 2013, just over one month in 2016 and just under six months in 2019.

    c. Of the three calibration periods tested, the least conservative correction factor (0.688) has been used in the s42a assessment

[1] Antony Jack Evidence Para 32 Figure 7

[2] Technical Evidence (Peer review of lake levels model) by Tiago Teixeira and Lobo Coutinho Babbage Consulting Limited, 10th June 2022 page 2

of effects. I note that the calibration period covering the longest and most recent period in 2019, gave the lowest correction factor at 0.61.[3]

d. There has been no statistical analysis provided on how well the modelled levels match the measured levels in the calibration periods, outside of what is presented by Teixeira and Coutinho in Figures 1 and 2 of their report. We have no working to rely upon for the two additional calibration periods introduced by Mr Jack.

e. There has been no analysis provided on if expected inflows will reduce in future due to climate change.

f. Fish & Game was not able to provide me with the raw data that underpins the Model. This meant I was unable to zoom in on particular parts of the Model or carry out any investigative statistics. It is not clear to me which experts were provided the data.

11. Because of these issues, I recommend considering conclusions based off of these models with a moderate degree of uncertainty. This is a critical point as the modelling underpins much of the evidence to date.

12. Figure 1 in Ms. Coates evidence[4] is directly referred to ten times and her evidence is almost entirely based around it. I have compared Figure 1 of Ms. Coates evidence to the Model charts made available up to now. The chart has no resemblance to the original Taieri based model[5] or the model with the 0.688 correction factor applied.[6]

13. Ms. Coates Figure 1 correlates to some extent but not entirely with the discounted Waipori derived dataset[7] which estimated inflows to be 50%

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[3] Antony Jack Evidence Para 29

[4] Annabelle Coates Evidence Para 16

[5] Antony Jack Evidence Para 32 Figure 6

[6] Antony Jack Evidence Para 32 Figure 7

[7] Antony Jack Evidence Para 27 Figure 5

higher than the uncorrected Taieri derived Model.[8] Ms. Coates Model in Figure 1 suggests that the lake never reaches the minimum lake level under Scenario B, which is inaccurate. Ms. Coates Model in Figure 1 has multiple periods where the actual lake level (in grey) is lower than the theoretical maximum takes in both Scenario B (orange) and Scenario C (Blue). This is unfeasible under the constraints of Scenario B and C.

14. I question where data for Ms. Coates Figure 1 has been sourced and whether evidence relying on it can be trusted as accurate.

Existing ecological values in Lake Onslow and comments on how they are affected by lake level and drawdown

15. I accept and adopt the description and background to Lake Onslow detailed in the s42a report.[9]
16. I accept and adopt the Fish and Game submission on the fishery values in the Lake.[10]
17. The Lake has prolific brown trout spawning habitat in the North and South Branches of the Teviot River and Fortification, Armstrongs and Boundary creeks, recent spawning surveys are referred to in Appendix 3 of the Fish and Game submission. These confirm this account.
18. Along with ample spawning grounds, the tributaries also contain healthy riparian vegetation cover, large macrophyte beds and areas of cobbles. This habitat provides significant juvenile rearing capacity. I will return to this point when discussing carrying capacity of the lake.

<u>Lake ecology and invertebrates</u>

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[8] Antony Jack Evidence Para 26

[9] S42a report Section 4.1

[10] Fish and Game Submission, 2nd December 2021

19. I generally accept Mr. Dungey's evidence the current ecology of the Lake[11] although in my opinion he has overstated the significance of the Cawthon study and follow ups[12].

20. The main driver of the production within the productive band discussed by Mr. Dungey[13] is the presence of macrophytes. In his review for AES, Mr. James states "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"[14] and that they "are of concern because of their role as refuge and a substrate for invertebrates and refuge and habitat for trout and other fish in the lake"[15]

21. Recent invertebrate samples found that worms, chironomids and caddisfly were the dominant species in the Lake[16]. Earlier surveys also show water boatmen (*Sigara* sp.)[17] which are an excellent food source for trout were very abundant in the margins of the lake.

22. Macroinvertebrates in the lake feed trout directly but also provide food for bully species which in turn provide food value to trout, however, this effect requires time. Chironomids provide a significant food source for bully species. If the macroinvertebrate production is reduced by habitat loss it will negatively affect bully species and trout.

23. Chironomid species are considered a low value food source for adult trout[18] as most of their lifecycle is spent partly buried into mud beds and they are particularly small and contain a low proportion of metabolizable energy.

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[11] Ross Dungey evidence para 8-10, 12-14

[12] Ross Dungey evidence para 13

[13] Ross Dungey evidence para 8,9

[14] Mark James Review 28th August 2018 Page 4

[15] Mark James Review of LOMP Memo – 13th October 2021 Page 2

[16] Dungey 2017 table 10

[17] Freshwater Biological Assessment of Environmental Effects for the Proposed Central Electric Ltd Horseshoe Bend Hydro-electric Scheme on the Teviot River, Central Otago – Stark and Hayes 1997 Section 4.2.3.3

[18] ASSESSING AQUATIC INVERTEBRATE PREY INDICES FOR FISH: TROUT - Shearer and Hayes,2019

24. Chironomid species also directly contribute to adult trout growth however that is largely limited to periods when large numbers of chironomids hatch. Chironomids slowly float upwards through the water column during their hatch so are significantly more vulnerable to predation. Chironomids need to hatch in high enough densities to make it bioenergetically favourable for trout (particularly large trout) to forage for them.

25. As trout grow larger, they shift to higher value food items that provide more calories relative to the energy required to forage them. In Lake Onslow these are likely to be caddis species, damselflies, juvenile brown trout, common bullies, kōura and cicadas when they are available.

26. Caddis and damselfly species in the Lake are likely to live almost exclusively amongst aquatic macrophytes.

27. Caddis species will colonise cobbled habitat however my observations of the Lake suggests very little hard substrate except for in a very narrow band just below the lakes maximum water height. Mr. Dungey estimates that 15% of the shoreline consists of rocky/ gravel substrate. [19]

28. The current high productivity and fisheries values in the Lake currently under Scenario A are a product of the high productivity of macrophytes and macroinvertebrates that thrive when the Lake is high and stable. When the Lake level drops for significant periods, these values are reduced and take time to recover.

<u>Habitat assessment at lower lake levels</u>

29. I am relying on Mr. Dungey's report that states "the substrate in Onslow is almost entirely fine and very fine sediment[20]" and "At all sites mud quickly became the main characteristic of the bed. Even where gravel

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[19] Ross Dungey evidence para 29.1(b)

[20] *Lake Onslow Lake Bed Profile and Invertebrate Survey – Dungey, September 2017* para 22

was present at the shoreline mud accumulated very quickly with depth so that before the bed levelled off mud dominated the samples"[21]

30. I note that Mr. Dungey in his evidence also states that "we have not been able to observe whether the shoreline characteristics remain constant at lower lake levels"[22]. As there is little evidence of significant areas of hard substrate in the bands that Mr. Dungey assessed. It is a fair assumption that there is little to none present near the Lakes minimum level.

31. The proportion of mud at lower levels is likely to be increasing due to the large amount of sediment available in the Lake footprint. Varying lake levels allow wave action to work on more areas of shoreline and move finer sediments to lower levels.[23]

32. There is general agreeance from the ecologists that the Lake is more productive when it is held at high and constant levels.

33. I have no information on hand from the application and evidence to date which gives me confidence that an accurate assessment of the lake substrate at lower levels has been undertaken, and conclusions made about related adverse effects relating to hard substrate, outside the observations of Mr Dungey in my paragraph 29.

Production boost from re-flooding events

34. I agree with Mr. Dungey that plant and macroinvertebrate production declines during a period of reduced lake level[24] and that when re-flooding occurs there is a spike in production as habitat is recolonised[25].

35. This effect requires the lake to remain at the increased level for a long enough period for macroinvertebrates to recolonise and live to a life stage where they can be consumed by trout. Chironomid species are

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[21] *Lake Onslow Lake Bed Profile and Invertebrate Survey – Dungey, September 2017* para 9

[22] Ross Dungey evidence para 29.1(b)

[23] The Lake Managers Handbook, Mark James for MFE

[24] Ross Dungey evidence para 9

[25] Ross Dungey evidence para 10

likely to be the first to utilise the new habitat. Mr. Dungey reports that the chironomid life cycles may be completed in 2-7 weeks[26]

36. Mr. Dungey's literature review suggests that the magnitude of this productivity bump is not uniform between sites and studies.[27]

37. Mr. Dungey's report looks at sites on the Lake on three occasions. The report states that the differences in macroinvertebrate density between the 1993 and the 2016/2017 samples almost certainly reflects slow increase in lake levels in the lead up to the 1993 sampling.[28]

38. The monitoring carried out to date is insufficient to suggest the productivity boost from a re-flooding is larger than the negative effects of the drawdown.

39. The monitoring only covers one re-flooding period at one of the sites (the boat ramp site). This sample pre-dates the comparison samples by a period of over 20 years, which makes it very difficult to say that the increase in macroinvertebrate abundance is due to the rising lake levels.

40. The study looked only looked at macroinvertebrate density, it hasn't considered their relative sizes/ metabolizable energy. Food values of the species present are only briefly mentioned for annelids/ oligochaetes.

41. The major change between the 1993 sample and the follow ups is a major decrease in the density of annelids/oligochaetes[29]. Mr. Dungey notes that annelids are not readily available to trout due to them being buried in the sediment.[30]

42. The other key change is a significant increase in the proportion of caddis. Caddis made up between 0.1-0.7% of the samples in 1993 and 7-74%

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[26] *Lake Onslow Lake Bed Profile and Invertebrate Survey – Dungey, September 2017 Page 25*

[27] *Lake Onslow Lake Bed Profile and Invertebrate Survey – Dungey, September 2017 Page 23*

[28] *Lake Onslow Lake Bed Profile and Invertebrate Survey – Dungey, September 2017 Page* 31

[29] *Lake Onslow Lake Bed Profile and Invertebrate Survey – Dungey, September 2017* Table 10

[30] *Lake Onslow Lake Bed Profile and Invertebrate Survey – Dungey, September 2017 Page* 26

of the 2016/ 2017 samples[31]. Caddis are a particularly high value food item for trout.

43. Although the monitoring showed an increase in macroinvertebrate density, the small number of sites and dates and the change in species composition mean it is insufficient to provide evidence that there is a net increase in productivity following a drawdown event.

The effects of cicadas on the ecology and fishery

44. Cicadas are another important food source in the Lake. They do not hatch in large numbers every year but are an important food source for trout in years where they are available. Cicadas can supply a large amount of energy to trout in the lead in to spawning and provide a productivity boost to the trout population.

45. I agree with Mr. Dungey's assessment that angling is excellent during a cicada hatch and that anglers target these periods.[32]

The effect of different outflow restrictions on lake ecology

46. When the Lake is at low levels the outflow is largely constrained by drawdown rate, the maximum discharge rate is only limiting at high lake levels and/or when there are high inflows.[33]

47. Limiting the flow through the dam based on drawdown levels contributes positively to the Lakes currently productive ecology. At high lake levels and inflows, the flow through the dam can be high with minimal effect. As lake levels drop and the effects of taking more water become more ecologically damaging, the take from the Lake is restricted.

Carrying capacity of the Lake

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[31] *Lake Onslow Lake Bed Profile and Invertebrate Survey – Dungey, September 2017* Table 10

[32] Ross Dungey S92 response, August 2021- Page 6

[33] Antony Jack Evidence Para 16 Figure 3

48. I disagree with Ms. Coates' statement that "The lake is unlikely to be at carrying capacity for trout under any water level".

49. Carrying capacity is "the number of individuals of a particular population that the environment can support."[34]

50. Trout are likely to be at or very near carrying capacity at all times due to the excellent spawning, rearing and food sources outlined above and therefore limited by the habitat available. There are good indications that the lake is currently at carrying capacity as the trout are abundant but relatively small. The key driver of habitat availability is the Lakes level and stability.

51. Being at carrying capacity, means that the trout population will reduce when the amount or quality of habitat is reduced.

Existing ecological values in the Teviot River– Scenario A

52. I agree with Ms. Coates[35] assessment of the Teviot River under Scenario A.

53. I note that events where the Lake reaches full will provide flushes down the river and are likely to positively contribute to the river's ecology.

Likely ecological effects on Lake Onslow – Scenario B

54. Table 1 below was produced by Mr. Dungey and shows the Lake area at different water levels. I note that the area calculations appear to incorrect in the table as the lake is approximately 1,000[36] hectares when full. I have presumed this is a conversion error and that the areas are too large by a factor of ten, but otherwise correct. Despite the error the information in the table is useful. To account for the error, I have calculated the size of the lake at differing lake levels relative to full.

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[34] C. Molle Jr – Ecology Concepts & Applications, 2008

[35] Annabelle Coates Evidence Para 23

[36] Antony Jack Evidence Para 9

Table 1: Extent of Lake Onslow area at differing lake heights based on Dungey 2017:12 with the percentage area relative to a full lake added by me.

Water Level (metres below dam crest)	Area (ha)	Percentage of area relative to full lake
0	10,940	100%
-0.5	10,150	93%
-1	9,355	86%
-1.5	8,563	78%
-2	7,770	71%
-2.5	6,978	64%
-3	6,185	57%
-3.5	5,393	49%
-4	4,600	42%
-4.5	3,808	35%
-5	3,015	28%

55. Under Scenario B the lake will be at low levels for long periods. The Model suggest that the Lake would be at (or below) the minimum level (-5.2m) for 49 percent of the time.[37] At the minimum level the lake is less than a third of the size of when it is full (Table 1).

56. Under Scenario B I would expect the Lake to be relatively unproductive ecologically. As the lake is small, the productive band around the edges would also be small. I believe there is general agreement amongst the ecologist on this.

57. I agree with Ms. Coates assessment that "Cicadas generally only fly relatively short distances and therefore reduced lake levels may result in less inputs to the lake itself"[38], and that "low lake levels during cicada hatches are unlikely to result in <u>signficant</u> (sic) adverse effects ecologically". (my emphasis added)

58. There is likely to be a minor effect ecologically from low lake levels during a cicada hatch as the food resource they provide is immense but

[37] Peer review of Model by Tiago Teixeira and Lobo Coutinho of Babbage Consulting Limited dated 10 June 2022 - Page 5

[38] Annabelle Coates Evidence Para 64

occurs for a short period of time and in only some years. Food resources outside of this time are likely to drive overall ecological productivity.

59. However, there is likely to be a large decline in angling activity and satisfaction as anglers miss out on the excellent fishing that abundant cicadas provide, as Mr. Dungey puts it “an anglers’ Eldorado”.[39]

60. As cicadas hatch in late summer, which is a time of low rainfall, there is likely to be little cicada fishing under Scenario B as the lake will often be a significant distance from the permanently dry tussocks where the cicadas hatch from.

61. Macrophyte beds, which I have identified the ecologists agree are primary drivers of ecological productivity, would be present in Scenario B however they would be less prolific than in Scenario A due to the reduction in the productive band. This band is smaller due to a smaller lake and a reduction in the amount of shallow habitat.

62. There would be production spikes as the Lake reaches higher levels in large rainfall events although the short extent of these re-wetting events mean they would produce a much smaller bump in production than the same rainfall event under Scenario A. The smaller size of the Lake at lower levels also limits the effect of these production spikes.

63. It’s possible that the lake would stay high enough for long enough for the faster establishing species such as chironomids to carry out a life cycle. This is more likely in the steeper, less productive areas that are affected by drawdown at a slower rate.

64. The trout population in the Lake under Scenario B will have the same spawning and rearing input with reduced food resources for adults in the lake. Therefore, I would expect the population would consist of a low number of smaller trout although in high densities. The fishery will be in a much poorer state than under Scenario A.

Likely ecological effects on the Teviot River – Scenario B

[39] Ross Dungey S92 response, August 2021 Page 5

65. Assessing the effects on the Teviot River is difficult without knowing the actual or expected in flows to the Lake.

66. Ignoring factors such as Lake evaporation, which I have sparse information on and therefore cannot assess, the flow in the Teviot River would be equal to the inflows into the lake for a significant period of time (any time the lake is at minimum level).

67. If there are periods where the inflows are less than the minimum flow and the lake is at the minimum level, then at least one of the consent conditions would be breached.

68. If the inflows remain above the minimum Teviot River flow I would expect the flow regime to look similar to before the dam was put in except the flood peaks would be drawn out over time by the restriction on drawdown.

69. I would expect the Teviot River to have ecologically healthy and varied flows under Scenario B.

Likely ecological changes on Lake Onslow – Scenario C vs Scenario B

70. Like Mr. Dungey[40], I cannot identify any likely significant adverse effect on the lake ecology (which includes the trout population) resulting from an increase in drawdown rate up to 400mm/week when using Scenario B as the baseline.

71. I adopt Teixeira and Coutinho's comparison that states "Scenario B raises the lake level from the bottom limit more often, while Scenario C drops the lake level to the bottom limit quicker."[41]

72. Under Scenario C the Lake remains at its minimum level for a significantly great proportion of the time, increasing from 49% to 69%.

[40] Ross Dungey evidence para 22

[41] Technical Evidence (Peer review of lake levels model) by Tiago Teixeira and Lobo Coutinho Babbage Consulting Limited, 10th June 2022 page 7

73. The Lake would only go above the minimum level in large rain events and would be drawn back down to the minimum level faster than in Scenario B[42]

74. The relative stability of Scenario C will allow macrophytes and the macroinvertebrates that rely on them to establish stable populations however they will be limited by the small average size of the Lake.

75. There will be less frequent production spikes as rain events that fall between the two drawdown rates would no longer increase the Lake level.

76. The productive spikes from re-flooding will be of a lesser magnitude than under Scenario B as higher lake levels will be drawn back to the minimum level faster. Macroinvertebrate production for even short life cycle macroinvertebrates like chironomids is likely to be non-existent outside of the permanently wet areas.

77. A significant proportion of Mr Coates assessment of Scenario C appears to be looking at effects that fall under Scenario D. There are examples of this in paragraphs 28, 30, 38. I consider these assessments to be irrelevant to the assessment of Scenario C.

78. There are also many effects that are compared to "natural" effects i.e. "The lake may naturally experience persistent low levels as a result of natural conditions"[43]. These references are frequently used to discount the impacts of the drawdown. As there is no Lake under "natural" conditions, I recommend that these statements be viewed with caution.

Likely ecological effects on the Teviot River – Scenario C vs Scenario B

79. Taking into account the assumptions I have made under Scenario B, I would expect the Teviot River would look almost exactly the same under Scenario B and C.

[42] Antony Jack Evidence Para 32 Figure 7

[43] Annabelle Coates Evidence Para 28

80. Under these scenarios, flood peaks in the tributaries would be drawn out over a short period, this period would be shorter under Scenario C than B.

81. I disagree with Mr Dungey[44] and Ms. Coates[45] analysis that there would be benefits to the river from reduced temperature flowing on from higher flows in summer. This analysis seems to be based on Scenario D rather than C. Under both Scenario B and C the flow in the river in summer is very low due to low inflows and the inability for the dam to store the higher winter flows. Further to this, Lake water is likely to be warmer than that of the downstream Teviot tributaries meaning that increasing flow through the dam could increase Teviot River temperatures.

Likely ecological effects on Lake Onslow – Scenario D

82. The effects of Scenario D are difficult to analyse as the lake level regime could range from something similar to Scenario A (Lake frequently full and stable and drawn down to around -2.5 in dry years) to Scenario C (Lake is at the minimum level 69% of the time and is quickly drawn back down following rain events).

83. I disagree with the statement by Ms. Coates that "the comparison of historical data under the two theoretical regimes, does provide a reasonable picture of how the lake may behave, if the drawdown rate is increased." This is an inaccurate statement as Mr. Jack states it is unlikely that Scenario C will be utilised. In my opinion the comparison of historical data under the two theoretical regimes provides almost no indication of how the lake would behave in real world conditions.

84. I rely on Mr. Jack's evidence that the increased drawdown is most likely to be utilised arise during dry years when lake levels are already low due

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[44] Ross Dungey S92 response, August 2021 page 2. I acknowledge that Mr. Dungeys statement was made before the directive to look at the differences between Scenario B and C

[45] Annabelle Coates Evidence Para 41

to low inflows[46]. The period described by Mr. Jack is also when an increased take will have the most negative ecological effects.

85. The effects on the ecology and trout fishery in the Lake under Scenario D could be anywhere from less than minor if the variation is used seldomly to extreme if the variation is used to its full extent. With the information in on hand, I am unable to make this assessment.

86. I note that Mr Dungey does not make an assessment on scenario D.

87. I also note that Ms. Coates expressed difficulty with the analysis of Scenario D.[47]

Likely ecological effects on the Teviot River – Scenario D

88. The effects on the Teviot River are difficult to analyse without knowing what the flow regime would look like. If flows increase in summer, there may be a benefit to trout populations. The consequent reduction in flows in winter could negatively affect spawning in the river.

Response to the Lake Onslow Monitoring Proposal (LOMP)

89. In general, my opinion is that the LOMP proposed by Mr. Dungey is ecologically robust, however I have concerns it doesn't monitor angling satisfaction, usage or amenity values.

90. The competition data referred to in the LOMP also records the catch per hour[48], this would be a useful addition to the LOMP. However, it does not absolve the need to gather the above amenity information.

91. Macroinvertebrate data needs to be analysed taking into account biodiversity and food values of invertebrates, so a large increase in worms does not indicate a significant increase in productivity.

[46] Antony Jack Evidence Para 32 17

[47] Annabelle Coates Evidence Para 51,54

[48] Dungey 2013 – Report of the Annual Pioneer Generation Ltd. Sponsored Fishing competition 2013 & comparison with previous years.

Addition of hard substrate to the Lake

92. I agree with Ms. Coates assessment that the addition of rocky areas would increase invertebrate habitat.[49]

93. I do not agree with Ms. Coates assessment that that "Rocky areas would mean macroinvertebrates were not reliant on macrophytes to provide habitat for spawning and feeding." In theory, I suggest that rocky areas would make macroinvertebrates less reliant on macrophytes but does not completely remove their necessity within the lake ecosystem,

94. I agree with Mr Dungey's assessment that the addition of rocky areas would require an assessment of what is presently available at lower levels[50].

95. I also note that to add rocky areas in suitable places requires certainty on water levels under Scenario D which has not been provided.

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Jayde Edward Malthus Couper

28 June 2022

[49] Annabelle Coates Evidence Para 63

[50] Ross Dungey evidence para 29