

ENVIRONMENTAL PROTECTION AUTHORITY
BEFORE AN EXPERT CONSENTING PANEL
IN THE MATTER OF THE FAST-TRACK APPROVALS ACT 2024
AND IN THE MATTER OF AN APPLICATION BY MATAKUNUI GOLD
LIMITED UNDER SECTION 42 OF THE FTAA
FOR THE BENDIGO-OPHIR GOLD PROJECT
APPLICATION NO: FTAA-2507-1089

Hearing: Held in Monarch Room, Willeston Conference Centre,
11-15 Willeston Street, Wellington Central

Date: 11 June 2026

Panel: Hon Matthew Muir KC (Chair)
Gina Sweetman
Roger MacGibbon
Peter Kensington
Tim Mulliner

Counsel: Joshua Leckie, Lane Neave, for the Applicant
Rob Enright and Jen Vella for Environmental Defence Society
Sally Gepp KC for Fish and Game

Expert: Ms McArthur

TABLE OF CONTENTS

MS McARTHUR PRESENTS HER EVIDENCE ON BEHALF OF FISH AND GAME:	5
Topic 1: Uncertainty Around Contaminant Load To The Receiving Environment:	5
QUESTIONS FROM THE PANEL:.....	7
CROSS-EXAMINATION BY MR ENRIGHT:	11
FURTHER QUESTIONS FROM THE PANEL:.....	12
CROSS-EXAMINATION BY MR LECKIE:	13
Topic 2: Lack of Ecological Assessment of Receiving environment:	16
QUESTIONS FROM THE PANEL:.....	17
CROSS-EXAMINATION BY MR ENRIGHT:	19
QUESTIONS ARISING FROM THE PANEL:.....	20
FURTHER CROSS-EXAMINATION BY MR ENRIGHT:	22
CROSS-EXAMINATION BY MR LECKIE:	23
QUESTIONS ARISING FROM THE PANEL:.....	23
Topic 3: Water Quality Compliance Limits	24
QUESTIONS FROM THE PANEL:.....	25
QUESTIONS ARISING FROM MS GEPP:	27
Topic 4: Adaptive Management	27
QUESTIONS FROM THE PANEL.....	28
CROSS-EXAMINATION BY MR ENRIGHT:	30
CROSS-EXAMINATION BY MR LECKIE:	30
QUESTIONS ARISING FROM THE PANEL:.....	30
Topic 5:	31

1 **Hearing commenced at 3 pm on 11 June 2026**

2 **Mr Muir:** Afternoon everyone, and welcome to I suppose it could be described as
3 a satellite hearing in relation to geo-chemistry, water quality and hydrology.
4 Ms McArthur is overseas, I think, from the weekend, is that right, Ms McArthur?

5 **Ms McArthur:** From Monday, sir, yes.

6 **Mr Muir:** From Monday. Well I hope you have a lovely trip, and Forest and Bird
7 requested that we make special arrangements to hear from her, which having
8 reviewed the contents of the joint witness statement appears entirely appropriate.
9 Because I think it could quite probably be observed that looking at the product of
10 the expert conference in relation to this, that you had concerns which possibly
11 even stood out from those of some of the other non-applicant experts, in terms of
12 their intensity, in relation to issues such as uncaptured and untreated seepage, and
13 the frailties, as you see them, of the adaptive management framework, in
14 particular, but some other issues also.

15 And I don't know whether Ms McArthur, other than my brief discussion with you
16 about 10 or so minutes ago, whether you had received from Forest and Bird advice
17 of the way in which we jettisoned all the best laid plans of mice and men earlier
18 in the week, with our various experts and decided that probably one of the better
19 ways in which to approach the questions of expert difference and agreement was
20 to invite our experts to settle, at the commencement of each of these concurrent
21 hearings, albeit not in your case, an agenda of items that they considered we
22 should necessarily traverse today.

23 So although again we're having to adapt as we go on, and in the particular
24 circumstances of your availability we may end up with a different set of topics
25 when we have all the balance of the experts next week. I thought it appropriate
26 that we should do something similar to the extent of just identifying what you
27 think are the key issues that we should be – we should have a touch-point with
28 you today and give the opportunity also, of course, for cross-examination while
29 we have you available.

30 Now, I should just indicate at the outset that we're meeting today for the first time,
31 although I'm sure you've met other members on our Panel before. Just quick
32 introductions. I'm Matthew Muir, I'm the Chair of what is the called the BOGP
33 Panel. With me Gina Sweetman, to my left, a highly experienced Hearings
34 Commissioner and Planner. To her left again is Mr Roger MacGibbon. He is an
35 expert Ecologist. And the obvious cross-overs between the work that you have
36 been doing and some ecological issues, in the context of this application will be
37 apparent. And to my right, Mr Kensington who is well known I sense to you, and
38 is a Landscape Architect. Yes, of course, and of course, one of our Panel, Mr Tim
39 Mulliner is coming in and joins us remotely. The balance of the Panel, which is
40 the other two of the Panel will be either today, or at some stage, in the near future,

1 observing these proceedings either simultaneously or at some later time, and/or
2 will be reviewing the transcript of today's proceedings, which is being completed.
3 And then in terms of counsel, we have for the applicant Mr Leckie and I think
4 probably known to you, Ms Sally Gepp KC who represents Sustainable Tarras,
5 and I think others during the course of this proceeding.

6 **Ms Gepp:** Yes, so sir just to correct the record Ms McArthur is here for Fish and
7 Game but she is my witness.

8 **Mr Muir:** Oh you're here for Fish and Game today.

9 **Ms Gepp:** I'm here for Fish and Game, and I have no involvement with Forest and
10 Bird today.

11 **Mr Muir:** Right, okay.

12 **Ms Gepp:** [over speaking] Ms McArthur.

13 **Mr Muir:** So you're wearing the Fish and Game hat today.

14 **Ms Gepp:** Well it's got little flies in it so - - -

15 **Mr Muir:** Very good. Well as a long-term fly fisherman you're in extremely
16 sympathetic hands today.

17 **Ms Gepp:** Sir, Ms McArthur is aware of how the two previous hearings have run.

18 **Mr Muir:** Oh Right.

19 **Ms Gepp:** Because I've let her know that.

20 **Mr Muir:** Oh I see. Very good.

21 **Ms Gepp:** So she has put some thought into her five key issues.

22 **Mr Muir:** That's good. And then I think that you can also expect, we've got
23 Mr Enright I think? Have we got Mr Enright on screen yet?

24 **Mr Enright:** Yes sir. Hopefully you can hear.

25 **Mr Muir:** And Ms Vella, and you may be aware that Mr Enright and Ms Vella,
26 they appear for EDS, and they've given notification of an intention to cross-
27 examine you. That may be in the nature of the sort of questions that Government
28 back benchers send to their cabinet ministers, and that I don't – I don't infer
29 hostility to any of your positions, on the part of Mr Enright. But he, of course, has
30 an opportunity to do so, and will no doubt draw out matters that he considers
31 appropriate to his client's position.

32 So with that brief introduction, I don't what's happened – oh yes our whiteboard
33 is over there to the left, and we have our wonderful scribe her to my left. We're
34 going to see whether we can just identify what you think are the matters that we
35 should be talking about today.

1 **MS MCARTHUR PRESENTS HER EVIDENCE ON BEHALF OF FISH AND**
2 **GAME:**

3 **TOPIC 1: UNCERTAINTY AROUND CONTAMINANT LOAD TO THE**
4 **RECEIVING ENVIRONMENT:**

5 **Ms McArthur:** Thank you, sir. And thank you for the opportunity to hear a little bit
6 earlier. It's much appreciated. I have five key issues. There are a few subpoints
7 to speak to under those. But if I give you all five as a list to start off with, that
8 will be useful.

9 Okay, the first key issue is the uncertainty around the contaminant load to the
10 receiving environment. And the second issue is a lack of ecological assessment
11 of the wider receiving environment, outside of the project site. The third is the
12 water quality compliance limits. Fourth is adaptive management as a general
13 topic. And the final is, assessment of significant adverse effects on aquatic life
14 and other values, largely with respect to section 107 matters.

15 **Mr Muir:** Well what we're going to invite you to do Ms McArthur is to address
16 us on the first of those topics, briefly. We try to confine this to two or three
17 minutes, or thereabouts. Then the format, that you've probably been told by Ms
18 Gepp, will be that we will then ask some questions from the Panel, and then we
19 will pass over to counsel for any cross-examination. And then we will round back
20 to the Panel for any issues that emerge out of the cross-examination, and we will
21 just move sequentially through those five topics in that format, if it's all right with
22 you.

23 **Ms McArthur:** Yes, thank you.

24 **Mr Muir:** Very good, thank you. Uncertainty of contaminant load to the receiving
25 environment.

26 **Ms McArthur:** Thank you sir. I've thought about this in my head as a cascade of
27 uncertainty. One of the largest tools of bringing together the various parts of the
28 application is the water load balance model. And that is the model for determining
29 how water and contaminants will move through the site over time. And, in my
30 view, there's quite a lot of uncertainty of the inputs to that model.
31 And the model is quite critical to being able to understand the effects, but also in
32 terms of the site management for development of treatment systems, and in
33 various others adaptive management feedback. So it's interlinked.

34 In terms of uncertainty, I think we've noted in the second JWS at paragraph 35
35 there's a discussion from the experts about that model and the uncertainty. And
36 at paragraph 37, some of the experts, and I have listed a few of the areas where
37 there is uncertainty and the sensitivity of the model to those uncertainties hasn't
38 been tested.

1 And what I mean by model sensitivity testing is that there's a raft of inputs to the
2 model, and then it does the modelling on a daily timestamp. But in terms of those
3 inputs, some inputs have a greater bearing on the outputs of the model than others.
4 So some inputs, the model is more sensitive to some inputs of information that go
5 in, in terms of how big a magnitude of difference that has on the output.

6 **Mr Muir:** Is that the same model that other experts at the Joint Conference were
7 critical of as sort of impenetrable? Or are we talking a different model?

8 **Ms McArthur:** I'm not sure we called it impenetrable. But I believe - - -

9 **Mr Muir:** You didn't use that word, but there was criticism of the mode - - -

10 **Ms McArthur:** Yes.

11 **Mr Muir:** - - - and then there was seemingly blow back from the applicants that
12 really this type of modelling should be regarded as anticipated and legitimate?

13 **Ms McArthur:** Yes, and it is a legitimate approach, certainly. It's what – what is
14 termed in the JWS site wide transient water load balance model.

15 **Mr Muir:** Yes.

16 **Ms McArthur:** And so that is sensitive to the inputs that go into it, in terms of how
17 much certainty we can have in the outputs that come out of that model. So that
18 model tells us the contaminant loads on a yearly basis that can be expected through
19 time under various different scenarios.

20 And there's been – there's a scenario called the “net percolation 20 treated
21 scenario” and the outputs of that model are the concentrations that the applicant's
22 experts are relying on to say, “This is how much we think of each contaminant is
23 going to discharge into the environment post treatment”. So that's important from
24 an effects management and assessment perspective.

25 Because the model is a load balanced model, loads of contaminants are highly
26 driven by how much water there is moving with those contaminants. So if you
27 have a concentration of a contaminant coming out of a particular waste stream,
28 say the – the drainage from the ELF, how much water moves is very important for
29 how much load comes out of the model.

30 So the types of things that affect the load are variability in climate. So that's not
31 necessarily climate change, but climate change is another variable. That's simply
32 variability in our normal climate cycles that we have in the South Pacific. We
33 have a kind of inter-decadal cycle where we have a wet period, and a dry period.
34 So that sort of fluctuation can have quite major effects on the transport of
35 contaminants with water. How much net percolation comes through the ELFs and
36 carries contaminants with it.

37 **Mr Muir:** What is the average annual precipitation in this part of the Dunstan
38 Range. Is it 20, the old – in old terms, 20 inches or less?

1 **Ms McArthur:** Oh I don't know if I could tell you in inches. It's very low. I have the
2 number 6-800 mls. I – I couldn't tell you off the top of my head, if that's the –
3 but it's very low. It's a very dry part of the country.

4 **Mr Muir:** The driest?

5 **Ms McArthur:** Yes. Central Otago. But there is variability in that through time. So
6 it's not always dry. There are wetter years than others.
7 Another variable is if the water quality that comes out of the TSF and the ELF's is
8 poorer than expected, the model can be quite sensitive to that. The outputs might
9 be quite different. If the dewatering estimates are different, and so there are chains
10 of uncertainty going into the model as inputs, and the main criticism that myself
11 and some of the other experts have had, is that we don't think the worst case
12 scenario for each of those inputs is reflected in the modelling. So often there are
13 average numbers used, or there are somewhat optimistic, is one way of putting it,
14 optimistic scenarios, in terms of net percolations. Quite an optimistic scenario
15 that's gone in there.

16 And so in terms of assisting you with understanding the effects it provides a great
17 deal of uncertainty as what the whole envelope of effects might look like, from
18 best case to worst case scenario. And I can't tell you with any confidence where
19 we sit in terms of what has come out of them.

20 **Mr Muir:** Does that cover off the point?

21 **Ms McArthur:** I'll just check.

22 **QUESTIONS FROM THE PANEL:**

23 **Mr Mulliner:** Could I ask a quick question please Ms McArthur?

24 **Ms McArthur:** Yes.

25 **Mr Mulliner:** When we talk about the contaminant load and what the applicant has
26 presented, are you specifically referring to the operational phase, or the closure
27 phase, or is there a specific timeline you're more concerned about?

28 **Ms McArthur:** I think there's different uncertainties with different phases of the mine.
29 So during the operations phase that's very, as I understand it from Dr Weber, that's
30 very reliant on how the engineering is undertaken in terms of oxygen ingress to
31 the ELF and how it is built to reduce the source of contaminants coming in.
32 But then once we move into closure phases, where we have active treatment, that's
33 also got uncertainty in terms of the quality and the volume coming through the
34 system and carrying contaminants with it, and therefore the efficacy of treatment
35 of that waste stream, and then the concentrations that come out post treatment.

36 So there's differences. I think there's the operational phase is largely about how
37 those engineered structures are developed. As I understand it, not being an
38 engineer, but Dr Weber has very helpfully described that to us in conferencing.
39 And then during the closure phase it's really about how does the water move?

1 What is the concentration of contaminants and how does that change through that
2 long life span of active and then eventually passive treatment?

3 So there's a range of uncertainties in both of those areas.

4 **Mr Mulliner:** Okay, thank you. So would you regard, bearing in mind that the
5 timeframe from – if the project was to go ahead – the timeframe from development
6 to closure, would you – would you suggest that the applicant has significant
7 opportunity, I guess, to address those uncertainties and variability during the
8 operational phase to feed into that closure phase, when there may be an active or
9 passive treatment systems?

10 **Ms McArthur:** There's certainly an opportunity and we spent quite a lot of time
11 discussing what that might look like, in conferencing this week. And there's
12 definitely an undertaking by the applicant's experts to continue to update those
13 inputs and to try to reduce that uncertainty and to continue to re-running – to
14 continue re-running and reviewing that model as the mine phases progress. Yes,
15 there is opportunity for that to occur.

16 **Mr Mulliner:** So bearing in mind the reservations, I guess, voiced in the expert
17 conferencing, does that give you some confidence that the applicant's moving in
18 the right direction to address a lot of that uncertainty?

19 **Ms McArthur:** I wouldn't say, "a lot". I couldn't tell you how much, in terms of scale,
20 will be addressed because it's a future process that I haven't seen. But given what
21 we've discussed, there are opportunities to reduce some of the uncertainty and to
22 start to run some sensitivity analysis through the model which is quite critical. We
23 don't really – we don't have any understanding of how sensitive the model is to
24 various inputs at this time. And I think that that will be useful.

25 That being said, there's still a further cascade of uncertainties with respect to
26 treatment and triggers for treatment, and what quality will be post the actual
27 phases, when all of the construction, and operations, and engineering has been
28 completed. So once we begin to move into the post-closure phase, the
29 opportunities for changing things are – are a little bit reduced, which I'll come to
30 when we talk about adaptive management. But yes there are opportunities
31 definitely to improve the model through time, and that's really an expectation that
32 we all had during the conferencing.

33 **Mr Mulliner:** Thank you. I don't have any further questions on that point.

34 **Mr Muir:** Any other Member of the Panel have any questions in relation to topic
35 1?

36 **Ms McArthur:** I have a couple of smaller points sir, when you've got a moment.

37 **Mr Muir:** Yes, of course.

1 **Ms McArthur:** So that's the uncertainty and sensitivity analysis. I think one of the
2 examples that I'll give you, that might be worth thinking about, when you have
3 the other experts up here, and it's difficult for us to talk about that together,
4 because we aren't.

5 But there's an example that Dr Weber had in his RFI response, part 1-13, which
6 was looking at the sensitivity of the model outputs in terms of the loads of
7 contaminants with respect to different pit wall run-off source terms that went into
8 the model. And he has, at paragraph 35 of his RFI response – that was quite a
9 significant change from the heap load for sulphite originally being at 50 years. So
10 that being the estimate as to how long active treatment would be required. And
11 then when looking at a more sensitive source term input for the pit wall run-off,
12 that peak sulphate load shifted out to 85 years. So that's just an example of how
13 sensitivity can alter the outputs of the model, just to further explain what I was
14 meaning by sensitivity.

15 One of the other issues, which we do get to down the list, is how the proposed
16 limits interact with the model inputs, and those two things are quite different. The
17 model outputs are significantly different concentrations and much lower than the
18 compliance limits, as they currently sit. Which is – it's difficult to see how those
19 two things will interact, because we've got a treated modelled output of the model,
20 but we've also got an undertaking that treatment systems will be built to meet the
21 compliance limits. And those are two very different trajectories of contaminant
22 concentration.

23 **Mr Muir:** And don't you even go further and suggest that in relation to, for
24 example, sediment levels, that meeting compliance limits should not be the
25 objective, here. You seem to almost approach it on a "do little harm" basis.

26 **Ms McArthur:** Sorry sir, I'm not – I'm not sure which paragraph you're referring to.

27 **Mr Muir:** If I could just go back to the JWS, the second, the most recent report:
28 "MG, JP, AB, JW and KM do not consider that the proposed trigger at [16](i)
29 above is appropriate. They also consider that the direct application of the 50% of
30 DGV may not be an appropriate trigger value for all metals noting that baseline
31 concentrations are currently unknown. Sediment triggers should ultimately be
32 developed from baseline data and should be set at a level where there is a
33 demonstrable degradation from baseline conditions ..."

34 Even if, for example, what was contemplated was something that sat within a NZG
35 Guideline.

36 **Ms McArthur:** Just reminding myself of the wording of that paragraph. That's with
37 respect to the triggers to construct the active water treatment plant.

38 **Mr Muir:** Yes.

39 **Ms McArthur:** The reason why we want to go with the 50 per cent of default guideline
40 value is that this is in sediment. So rather than in the flowing water itself. The
41 default guideline values for sediment are quite high. So if looked, the applicants

1 look to use the high threshold of that, that's a very large shift from the current.
2 We don't have good baseline information. We've got a little bit of baseline
3 information. That's a very significant departure from current state. And so we
4 have suggested, as a group of experts, that 50 per cent of the way there should be
5 a good trigger to start looking at, let's get our active treatment train underway.

6 And the reason for that, is we've still got approximately 21 months of time, from
7 the initiation of let's put in active treatment, to actually having an implemented
8 plant. And if we're starting to see a really major shift in the contaminants in the
9 sediment from baseline, that would indicate that that is the time to get moving on
10 getting that active treatment system ready to respond to the higher concentrations
11 that may be coming.

12 **Mr Muir:** Well 18 of the JWS needs some qualification, from your perspective?

13 **Ms McArthur:** 18 is the performance, a performance limit as opposed to a compliance
14 limit. So that's really about monitoring within the mine footprint to determine
15 what the contaminant flows are looking at, looking like during operations. And
16 it's not what is the concentration leaving the site in relation to the compliance
17 limit? It's looking at, do we need to start building a treatment system before the
18 site starts to discharge water, yes sir. So that's within the site, how are we
19 performing against what we've expected to see?

20 **Mr Mulliner:** Can I just ask a related question there, on – I hope we're not going to
21 another topic – but so in that 18, so there's a number of experts, including you,
22 that talk about this 50 per cent of DGV is not appropriate as the baseline of
23 concentrations are known. However, I do note that in the JWS there is mention
24 of an extended baseline service water quality data set. [inaudible 36:29] I forget
25 the exact numbers but - - -

26 **Ms McArthur:** Yes.

27 **Mr Mulliner:** - - - that comes out to more current, I guess. So in the light of that
28 potentially, well in the light of that extended surface water quality data set, would
29 you, I guess, reconsider your position in terms of that trigger value, bearing in
30 mind that that now – and there is some reference to from the experts [inaudible
31 37:01] that now we've got that extended baseline data set, that's probably
32 considered suitable to assess the baseline?

33 **Ms McArthur:** Yes, and Dr Weber made that data set available to me and I have – I
34 have analysed what the statistical concentrations look like from the wider data set,
35 compared to the smaller data set that was used in the application and they are fairly
36 similar. So what that confirms for us is that baseline concentrations are very, very
37 low. And default guideline value is still a very long way from those
38 concentrations, which, for most of the metals, are below the level of detection.
39 And so as the experts that agreed with that paragraph considered if you were
40 getting 50 per cent of the way towards your compliance limit from an undetectable

1 level of contaminant, then you should really be starting to stand up your treatment
2 system in preparation for an increasing contaminant load.

3 **Mr Mulliner:** Thank you.

4 **Mr Muir:** Does that close out your presentation on issue 1, Ms McArthur?

5 **Ms McArthur:** Just checking. And there's the other issues around uncertainty. I'll just
6 list them off. I won't take more time with them. Is that the water load balance
7 model doesn't account for any uncaptured, or untreated seepage. So there may be
8 additional contaminant on top of what the model anticipates.

9 We have very little data on how contaminants move when they leave the site
10 through the surface and ground water system, and that's an issue of quite high
11 uncertainty.

12 The active treatment phase seems technically feasible but goes out for a very long
13 period into the future, and then uncaptured seepage may remain an issue over that
14 timeframe.

15 So the feasibility and resource required, I don't know whether that's been assessed
16 against the lower compliance limits, that some of the experts have recommended.
17 So I'm not sure where that sits in terms of how feasible the active treatment is to
18 respond to a changing compliance limit.

19 And that the passive treatment regime, at the moment, is completely uncertain.
20 We don't really know what that will look like, which is a long time out in the
21 future for the Shepherds Creek discharge, but is quite soon for the Rise and Shine
22 discharge over that side of the catchment. And we've made some agreements
23 about how to do an adequate lead in study for that. But we don't have any
24 performance limit that's currently defined for passive treatment.

25 **Mr Muir:** Thank you. Are there any other questions. Mr Mulliner, first, no?

26 **Mr Mulliner:** Nothing more from me.

27 **Mr Muir:** Thank you. Any other Panel Member? Thank you. So Mr Enright or
28 Ms Vella, cross-examination on this topic?

29 **CROSS-EXAMINATION BY MR ENRIGHT:**

30 **Mr Enright:** Thank you. I suppose – thank you sir. The main question, Ms
31 McArthur, was just to build on Commissioner Mulliner's question to you, which
32 was around there being opportunity to reduce uncertainty, the cascade of
33 uncertainty during operation of the proposal, if it were approved.

34 I just want to test that with you a little bit further around whether that is your
35 recommendation, or whether you have a different recommendation on whether
36 that information would be needed now rather than post approval, in the context of
37 the operation itself?

1 **Ms McArthur:** My view, as opposed to a recommendation, my view is that the scale
2 and the duration of effect are both large. The uncertainty is also large, and to me
3 that – that speaks to a large envelope of potential effect. And the degree of
4 uncertainty, which makes it very difficult for me to advise the Panel on the degree
5 of expected effects over that long timeframe.

6 So at the moment, that ability to assess the effects is highly uncertain. And from
7 my perspective, I can't look into the future to see what the applicant is
8 anticipating. So I can't advise you the degree to which changes will improve the
9 ability to determine the effects with greater confidence, which is the difficulty for
10 me in advising you as the Panel.

11 Sensitivity analysis could improve the sensitivity of the model. But there are still
12 areas of uncertainty that sit outside the model as well, with respect to seepage and
13 transport through those surface and ground water system, that are still remaining
14 outstanding issues.

15 I'm not sure if that constitutes a recommendation, but that's my view, is I have a
16 real difficulty with giving you a confident view of the degree to which the effects
17 can be managed into the future for several hundred years.

18 **Mr Enright:** And perhaps drawing on your experience of other large infrastructure
19 projects, which may or may not involve mining. But in terms of the context, or
20 the values that you've identified, what are your views – what's your view on you
21 know putting on – if you think about risk as being probability plus impact, you
22 know how does that level of uncertainty you just described, compare to other
23 projects you've been involved with, for example?

24 **Ms McArthur:** I think in terms of scale of effect and probability, I think if we get this
25 completely wrong, the scale of effect could be quite great. The probability of that
26 I currently can't comment on because of the level of uncertainty at the moment.
27 Some of the issue arises, and I'll probably speak to that on the next point, of not
28 really understanding what the potential effects are even at this stage, with what
29 we know beyond this – once that contaminant and water flow leaves the project
30 site itself. I think we have a very low understanding of what that effect looks like,
31 even now, given the information that we've got.

32 So to be able to try and give you an accurate and confident view of the probability
33 of a particular scale of effect, I just cannot give you that at the moment.

34 **Mr Enright:** Thank you. And sir, I understand I've got a blank screen for my camera.
35 I'm sorry about that. I didn't – I'll see if I could fix that technical problem, but
36 those are my questions on that first topic, thank you.

37 **FURTHER QUESTIONS FROM THE PANEL:**

38 **Mr Muir:** Disembodied although you are, you came loud and clear. Right. Could
39 I just ask perhaps what you might think an unusual question? You have focused,

1 particularly in the context of your responses to Mr Enright on these significant
2 uncertainties from your perspective.

3 Could you just imagine for a moment that you had been briefed by MGL on this,
4 how would you have resolved those uncertainties? Are they resolvable? Or do
5 you have to allow for these contingencies and then look at how you would respond
6 to them were the testing to indicate?

7 **Ms McArthur:** I think there are some issues that sit in that basket, sir, which is a little
8 bit of needing to understand, as we go. But there is a much larger basket of having
9 done some work upfront. For example, understanding the baseline water quality
10 in the wider receiving environment. Understanding how the transport of
11 contaminants operates beyond the site.

12 **Mr Muir:** Well how does one come to that understanding? Would you say that
13 you actually have to pour dye in at the top of the valley and see what emerges at
14 the bottom?

15 **Ms McArthur:** No, by collecting data sir, and modelling the movement of that through
16 the environment, and by assessing values in the receiving environment, and
17 having an understanding of what contaminant effects on those values could be.

18 **Mr Muir:** Do you think that it is technically possible to have, within a suite of
19 results, that is more comprehensive than those on which MGL's, the experts
20 engaged by MGL have premised their report?

21 **Ms McArthur:** Unequivocally yes.

22 **Ms Sweetman:** I was going to ask you a question, Ms McArthur, but I think it's
23 probably what you intend to cover in question 4, or item 4, in terms of whether
24 these uncertainties are able to be managed through conditions in management
25 plans? But is that number 4?

26 **Ms McArthur:** If I could ask that we hold it to number 4, I might provide better context.

27 **Ms Sweetman:** Yeah, no, thank you. Thank you.

28 **Mr Muir:** Thank you. Now Mr Leckie?

29 **CROSS-EXAMINATION BY MR LECKIE:**

30 **Mr Leckie:** Thank you sir. Yes just a couple of question for Ms McArthur on this
31 topic. Good afternoon, Ms McArthur.

32 **Ms McArthur:** Afternoon.

33 **Mr Leckie:** I just have one question on para 28 of the second joint witness statement
34 which is around your comments on passive treatment. Have you got it there?

35 **Ms McArthur:** Yes I have.

1 **Mr Leckie:** There you highlight the importance of the compliance limits to manage
2 effects.

3 **Ms McArthur:** Yes.

4 **Mr Leckie:** You'll be familiar with the proposed conditions of consent in the
5 Regional Council set of conditions, in particular the conditions from 12, the suite
6 of conditions from paragraph 12 onwards?

7 **Ms McArthur:** I'll just open those, if I can find them. Is that the - - -

8 **Mr Leckie:** Well it's in a specific Schedule 2 – sorry Schedule 2, general conditions
9 within the jurisdiction of the Otago Regional Council. If you can't find them, I
10 can – I can put them to you. I'll give you a moment.

11 **Ms Sweetman:** Which [inaudible 49:35] were you referring to Mr Leckie?

12 **Mr Leckie:** EO4.

13 **Ms Sweetman:** And which conditions?

14 **Mr Leckie:** That's in 12 onwards. Under the heading "Surface water monitoring".

15 **Ms McArthur:** I'm having trouble finding it.

16 **Mr Muir:** Let's see if we can get a screen in front of you that's –

17 **Ms McArthur:** Thank you. Condition 12?

18 **Mr Leckie:** To the heading "Monitoring and Compliance" in condition 12.

19 **Ms McArthur:** Yes, I'm with you now.

20 **Mr Leckie:** Great, thank you. And the compliance limits for surface water are
21 contained at condition 14, at the bottom of that page.

22 **Ms McArthur:** Yes.

23 **Mr Leckie:** And the conditions go on, and at 15, 16 and over the page at 17, are the
24 ground water compliance limits.

25 **Ms McArthur:** Do they account for the new conditions in - - -

26 **Mr Leckie:** Yeah, in-between they'll be the tracked conditions, new condition 6,
27 and new condition 5 which follows new condition 6.

28 **Ms McArthur:** Yes [inaudible 51:23]

29 **Mr Leckie:** My question's a relatively short one. Your comment there was in
30 relation to passive treatment and the importance of compliance limits.

31 **Ms McArthur:** Yes.

32 **Mr Leckie:** Would you agree that in both these context of the surface water
33 compliance limits, and also the ground water compliance limits, those – those

1 apply regardless of whether you're in an active treatment phase, or a passive
2 treatment phase, don't they?

3 **Ms McArthur:** Yes. Yes, they do.

4 **Mr Leckie:** Thank you. And just touching on the questions, so at page 35 onwards
5 of the second joint witness statement, around the – I'm done with conditions –
6 around the water load balance model.

7 **Ms McArthur:** The second statement. Sorry what was the paragraph?

8 **Mr Leckie:** Second statement, paragraph 35 onwards. It's similar paragraphs that
9 you've been taken to already this afternoon.

10 **Ms McArthur:** Yes.

11 **Mr Leckie:** And you'd agree that the – one of the roles of the model is to provide
12 data that can guide that water treatment methodology. Do you agree with that
13 statement?

14 **Ms McArthur:** Yes, although the outputs of the model give various water treatment
15 scenarios fed into them. So I think it's a little bit around the other way, in terms
16 of the treatment performance is an input to the model.

17 **Mr Leckie:** Thank you, Well that's simple. And you made some concerns around
18 uncertainty and risk. Would you agree that that uncertainty reduces as the life of
19 the mine progresses and there's more information available?

20 **Ms McArthur:** I'm concerned that the peak load that we see from the model output is
21 a very long way into the future. And changes to the sensitivity of the model, as
22 you go, because I won't be there, changing the model as you go will give you a
23 forecast out from each step. But there's still – I don't know that that gives us the
24 full picture of when things peak, when they tail off, when various treatment
25 systems come on line or go off line, and are replaced by others. But I still think
26 there's large uncertainty in what that timescale looks like. Certainly improving
27 the data that goes into the model, based on actual measured data, reduces
28 uncertainty. But the degree to what it can be reduced still relies on what is the
29 variability of things outside of MGL's control, like climate variability and rainfall
30 and other things like that, that feed into the model as well.

31 **Mr Leckie:** Thank you. And the ability to improve that data improves as time goes
32 on, doesn't it?

33 **Ms McArthur:** Yes, as long as the spectrum of inputs is put in there. So some of the –
34 some of the issues I said earlier is that, you know, the worst case and the best case
35 are not necessarily input, and I think that that really needs to occur in any future
36 modelling scenario. So, if you did do that, and you have improved information,
37 uncertainty would reduce. But there are areas, as I've mentioned, outside of the

1 model, like seepage and like climate variability that improving your data can't
2 improve your certainty with.

3 **Mr Leckie:** Thank you, they are my questions on the first question.

4 **Ms Gepp:** Sir before you – before you move on to the second issue, I would like
5 to clarify something that – in a question that you put to Ms McArthur. You asked
6 her whether this was the model that was discussed in conferencing, and there was
7 some issues around the impenetrability of it, and then some push back. Because
8 I believe you might be thinking about the off-set model that's discussed in the
9 lizard plan.

10 **Mr Muir:** Ooh, well I've been reading. Perhaps you can - - -

11 **Ms Gepp:** Which came out at the same time. Yes, and there's a very definite
12 reference to impenetrability, and then a push back by the applicant's witnesses.
13 And Ms McArthur won't know that because she hasn't read lizards. She's got a
14 big enough pile without that. So I just wanted to clarify that I don't think that is
15 the model that ...

16 **Mr Muir:** I see. Well you can forgive me Ms Gepp that the volume of material -
17 - -

18 **Ms McArthur:** I can't help you with lizards.

19 **Ms Gepp:** But I think the point is that the witnesses understand the model. They
20 don't have an issue with the model. They just are talking about what it does and
21 doesn't show in the joint witness statement.

22 **Mr Muir:** Thank you for clarifying Ms Gepp. Very good. We'll move on to topic
23 2, Ms McArthur, to see if we could make the initial presentation just that little bit
24 shorter.

25 **Ms McArthur:** Yes.

26 **Mr Muir:** You're in possibly the privileged position of all of the experts in that
27 you have the floor to yourself. And I just don't want any criticism to be had that
28 you're getting a better run than others.

29 **Ms McArthur:** You'll be pleased to know sir, that there's a lot less points under the
30 remaining topics.

31 **Mr Muir:** Thank you.

32 **TOPIC 2: LACK OF ECOLOGICAL ASSESSMENT OF RECEIVING**
33 **ENVIRONMENT:**

34 **Ms McArthur:** That was a large area. The second topic being lack of ecological
35 assessment of the receiving environment. This has been quite a difficulty. Even
36 some of the assessment on site hasn't really given us what is – what is the – there's
37 no clear assessment of ecological effects of the project on aquatic life and water-

1 based values. So beyond the site, or really within the site, in some instances as
2 well.
3 So there's been no identification of values, ecological values, or other values, like
4 irrigation, stock water, recreational values beyond the site footprint. That would
5 be, to my mind, standard practice. So that's made it more difficult for those, who
6 are not the applicant's team, more difficult for other experts to understand the
7 effects, because they have not been looked at. Usually we would get an
8 assessment of ecological effects, or an assessment of, you know, water quality
9 effects outside of the site and downstream of a catchment. And then we could talk
10 about what we thought about those effects and the degree of them.

11 Here we're in a vacuum of information. So, in my statement, I have attempted as
12 best I could to back-fill that so that I can assess the application against those values
13 outside of the immediate site foot print.

14 **QUESTIONS FROM THE PANEL:**

15 **Mr Muir:** Mr Mulliner, any questions arising out of this topic?

16 **Mr Mulliner:** Not quite yet. I'm thinking.

17 **Mr Muir:** Well while you're gestating there, Mr Mulliner, we will ask Mr
18 McGibbon.

19 **Mr MacGibbon:** Look just for clarification on that one, so you mentioned the uses of
20 water downstream, as well ecological assessment needing both really. So where
21 the water's being used for irrigation, stock water, that sort of thing, plus an
22 assessment of the ecology of those downstream catchments.

23 **Ms McArthur:** Yes.

24 **Mr MacGibbon:** Okay, well what sort of – are you suggesting that additional work
25 should be done now? Or is that possible to be done now to provide us with more
26 information? What would you be suggesting?

27 **Ms McArthur:** Well I think – I think the experts collectively have done some work
28 towards understanding those values. There's still a dearth of information in terms
29 of baseline water quality. So we don't have water quality information for the
30 Bendigo Creek. We don't have water quality information for the Ardour
31 Aquifer. We have water quality information for the Lindus, because it is an ORC
32 monitoring site. So there was information to look at there, although the applicant
33 didn't assess that information. So, I think we've probably identified the values
34 for the applicant and the information that is there, but we still have holes in the
35 information that we have before us, simply because it hasn't been collected?

36 **Mr MacGibbon:** Perhaps just carry on with that, do you think the in-stream ecological
37 values are understood, downstream and up? Well yeah we're aware aren't we,
38 that there seems to be no, for example, fish up in the project site at all. But do we
39 know where they are downstream, for example?

1 **Ms McArthur:** Dr Allibone did do some work on fish in the wider catchment, not
2 within the Lindus footprint, down the bottom end. So we do know where fish are
3 in the wider catchment. We don't have a great understanding for macro-
4 invertebrate communities, and we have a very low understanding of water quality
5 in the systems between the project site and the wider rivers.

6 **Mr MacGibbon:** Thank you.

7 **Ms Sweetman:** Is this information we should have now, Ms McArthur, and why would
8 we need it now?

9 **Ms McArthur:** You would – it is information you should have now. It's one thing to
10 monitor where things are. It's quite another to pull that monitoring data together
11 and provide an assessment of what the effects of the application are on those
12 values. So those are two separate things.

13 First of all, you assess the receiving environment, you understand the values, you
14 gather the data, you understand the potential outputs of the project, and then you
15 provide an assessment of the scale of effect. That is important to you, as a Panel,
16 because you have to make a decision based on the effects. And I think I've put in
17 this number 5, but it's probably becoming pertinent now, is the ability to assess
18 against section 107, as to whether you understand, and can be satisfied that you
19 understand whether there is a significant adverse effect on aquatic life or not. And
20 I don't think I can advise you on that, given what we know currently.

21 **Mr Muir:** Well the invertebrate life are within the streams until they go to ground,
22 which they all do, and then become part of the aquifers. That's the position, isn't
23 it?

24 **Ms McArthur:** They do. With respect to Bendigo Creek, that does appear to
25 periodically connect with the Clutha system, because we find juvenile and
26 migratory fish, and they – they have to swum up from the Clutha. So I think Dr
27 Allibone – yearling trout in there which would've had to have come up from the
28 Clutha system and into the stream. So there's an indication from the ecology that
29 that system connects more readily to the wider surface water network, certainly
30 the Shepherds Creek does, yes. But the macro invertebrates don't tend to shift.
31 They exist in the streams as they are, yes.

32 **Mr Mulliner:** Without wanting to start moving into the next question, but it is related,
33 do you consider that if there were, what you would consider appropriate
34 compliance limits – well I guess bearing in mind that this site is quite constrained
35 and, as the applicant has outlined, that they think due to that quite tight constrain
36 they can control, I guess, various discharges. And I know there's some discussion
37 around about the applicant's ability to do that. But assuming that they can control
38 those various water discharges from the site, and constrain them to the valleys,
39 then would you admit that by applying appropriate compliance limits, that are

1 based on, I guess, current background variations in water quality, that those
2 downstream effects can be avoided?

3 **Ms McArthur:** The compliance limits are the – are the primary control on downstream
4 effects. As long as we capture all of the outputs from the site, to be able to measure
5 against those compliance limits. So if we accept the assumption that all of the
6 contaminants are captured from the system, and they all run through the
7 monitoring points, then yes we should be able to control the degree of effect with
8 the compliance limits, if they are set appropriately.

9 **Mr Mulliner:** Because I think that in – the applicant's experts obviously aren't here
10 to answer this question, but it will be asked I guess of them next week. So their
11 position is that they will be able to capture those contaminants loads and they have
12 provided appropriate water quality conditions based on the background. So on
13 the basis of that, I would say their position will be that they will – they are
14 addressing those downstream impacts?

15 **Ms McArthur:** I don't agree that the current compliance limits are adequate to do that,
16 yes.

17 **Mr Mulliner:** Yeah I understand. That's a topic for - - -

18 **Ms McArthur:** The next time, I think, yes.

19 **Mr Mulliner:** Right, thank you.

20 **Mr Muir:** Any more Panel questions relating to this second issue? Mr Enright?

21 **CROSS-EXAMINATION BY MR ENRIGHT:**

22 **Mr Enright:** Thank you sir. I understand you can see me now, and hopefully I don't
23 look too much like a back bench MP at the moment. Ms McArthur, I just wonder
24 if you could explain the relationship between removing uncertainty on identifying
25 the values and how that relates to setting limits and mitigation?

26 **Ms McArthur:** That's a very big question, but I will try to be concise in my answer.
27 Understanding the values in the receiving environment is fundamental to effects
28 management. If you do not know what you are trying to achieve, or protect in that
29 wider environment, then you cannot manage your effect. You simply don't have
30 a target essentially to which you're trying to apply your management and apply
31 your mitigations that you have. If you understand the values and you understand
32 the degree of effect of a particular activity, then you can work out is there a way
33 we can mitigate that effect? What options do we have? And then you can re-
34 evaluate what the effect on those values is, applying your mitigation scenario.
35 Which would be usual practice in an [inaudible 1:08:20]. That is how I would
36 undertake one.

37 **Mr Enright:** So given that your assessment of, as you've identified [inaudible
38 1:08:33] to the lack of ecological assessment of the receiving environment, what's

1 your position here on whether there is sufficient information now and you can
2 simply rely on adaptive management later, if the project were approved or whether
3 there are fundamental gaps? Where do you stand on that?

4 **Ms McArthur:** Sorry, can you describe what you mean by fundamental gaps? I'm not
5 sure I completely understand.

6 **Mr Enright:** Well I'm happy to be corrected by you. But my understanding of your
7 second topic is that there is a lack of ecological assessment of the wider receiving
8 environment. And I've called that an information gap, but maybe that's an
9 inadequate way of expressing it. But I'm just trying to drill down with you on, in
10 terms of your expertise and experience, whether these are matters that can be
11 resolved later, or whether they are too fundamental because of the risk of reversal
12 impacts? For example, to – to key values?

13 **Ms McArthur:** Okay, I think I'm following. I think there's – there's two things that I
14 would put forward in terms of an answer. One is, once you've determined your
15 values, and you've looked at your effects of your activity, and you've applied
16 mitigations, limits are a really important part of that. So, you need to understand
17 to what degree can you impact a system before there is a change that is over a
18 threshold or is considered unacceptable, or is significant. Need to know what that
19 line is. Your limit should stand between your activity and the values you are trying
20 to protect. The limit should be, "This is the line at which we predict or know the
21 effect will be beyond a certain level". So that's one issue.

22 The limits were not set cognisant of the receiving environment and what was
23 trying to be achieved in that receiving environment, because that wasn't known.
24 So the limits did not account for that.

25 How we go with potential irreversible impacts I don't think we necessarily have
26 the information now to be certain whether or not there will be irreversible impacts
27 over time, largely because of that cascading uncertainty that I spoke to in the first
28 – in the first response, and because of the long time scale. So we have long time
29 scale of impact. We also have a long time scale of environmental variability that
30 goes on at the same time. The interaction between those two things are certainty
31 of determining the effect gets less over time, because the environment is more
32 variable and the scale of impact is long.

33 So, for example, climate change, 200 years into the future, I don't really know
34 what that prediction looks like, or what that environment looks like. So there's an
35 issue with trying to predict a long time scale into the future about what the degree
36 of effect is, and whether any of the effects will be irreversible or not.

37 **QUESTIONS ARISING FROM THE PANEL:**

38 **Mr Muir:** Talking about this specific receiving environment, what values, as such,
39 would one expect to have seen as identified?

1 **Ms McArthur:** For starters the trout fishery values were not identified and they are
2 locally to nationally significant, depending on what water body you're looking at
3 in the receiving environment.

4 **Mr Muir:** So this is Lake Dunstan and its tributaries?

5 **Ms McArthur:** Yes, yes sir. Through the Clutha and up into the Lindus. The Lindus
6 is a really high value trout spawning fishery and it provides approximately 10 per
7 cent. Ten per cent of the fish move up the Lindus to spawn for the Dunstan fishery.
8 So it's not an insignificant value. I understand there is water use from the Ardour
9 Aquifer in terms of irrigation and stock use. It wasn't identified, and drinking
10 water.

11 **Mr Muir:** Trout, these are both brown and rainbow trout?

12 **Ms McArthur:** I believe there are only brown trout in this system, sir. We didn't have
13 macro invertebrate information for Bendigo Creek or for the Lindus. I think there
14 was some EDNA assessment that was undertaken. But that's largely indicative in
15 terms of macro invertebrates. It's better to actually sample them. I understand
16 there's some difficulties with the environment.

17 We don't know what the periphyton status is in those water bodies, that can be
18 influenced by nitrogenous contaminants that come out of the mine site. We don't
19 know the baseline water quality in many of those water bodies, Bendigo Creek
20 and the Aquifer. So that understanding of the values is patchy, I think, at best.
21 Understanding the water quality value is really important for an activity that
22 discharges contaminants.

23 **Mr Muir:** [over speaking] value that's a hard assessment of water purity and the
24 constituents of that water and the extent to which it carries existing load of any
25 sort, including obviously an elevated arsenic load. But doesn't – I'm just trying
26 to find the boundary between these values, that you say should've been identified,
27 and just what I would – I would colloquially call a better testing regime of the
28 existing water bodies?

29 **Ms McArthur:** Sir, we usually apply values as per national instruments. So we apply
30 the National Policy Statement for Freshwater Management, which sets out a range
31 of values in Appendix 1. And - - -

32 **Mr Muir:** I'm just interested in which particular – which among those particular
33 values were most apposite this case, which were not properly interrogated in your
34 view?

35 **Ms McArthur:** Well I did not see an assessment of the MPSFM values by any of the
36 experts.

37 **Ms Sweetman:** And that's something we would normally expect to see in an
38 application?

1 **Ms McArthur:** Yes, that's correct.

2 **Ms Sweetman:** Has the Regional Council, through it's proposed Otago Regional Policy
3 Statement, done a – undertaken any type of value assessment for this FMU?

4 **Ms McArthur:** Yes. Testing my brain, but there is a schedule of values that applies to
5 the Lindus, and resulting from that schedule of values, I believe there's the water
6 quality standards in schedule 15, which I've referenced in my evidence. I believe
7 they - - -

8 **Ms Sweetman:** Schedule 15 of the RPS?

9 **Ms McArthur:** Of the Regional Plan, I think, which is the old Regional Plan, because
10 the Regional Council started to undertake the new process and then were stopped
11 by the Government. So I believe there's some work in progress on values, but I
12 haven't looked at that. I've only looked at the Operative Plan. Might be Schedules
13 1 and 2. Sorry, I don't have the water plan here I don't think. Yes, the Regional
14 Council have identified some values. I don't have them in front of me.

15 **Mr Muir:** I probably interrupted you there. Additional cross-examination?

16 **FURTHER CROSS-EXAMINATION BY MR ENRIGHT:**

17 **Mr Enright:** Thank you sir, the only other point that I wish to raise was just you were
18 asked by the Chair to describe values. One of them you referenced in your
19 statement of evidence, at para 184. You don't need to turn to it, but it was
20 referencing, as an unaddressed effect, contaminant accumulation in Ardgour and
21 Bendigo Aquifers. And I just wonder if that's relevant in the current context?

22 **Ms McArthur:** Sorry what was the paragraph reference?

23 **Mr Enright:** If you'd like to refer, it's your paragraph 184, under the heading,
24 "Unaddressed effects".

25 **Ms McArthur:** Yes.

26 **Mr Enright:** And I just wondered if that was one you didn't mention in answer to the
27 Chair, but whether it was relevant?

28 **Ms McArthur:** The reason I've listed it there is that when we assess, there's a national
29 compulsory value for ecosystem health in the National Policy Statement for Fresh
30 Water, and there are five components that contribute to ecosystem health. I think
31 I've listed them somewhere else in my evidence: water quality is a key component
32 of ecosystem health in its own right. So even if you look at the aquatic life, the
33 fish and the macro invertebrates, understanding water quality is a key component,
34 water quantity, habitat and whether the ecological processes are functioning in a
35 healthy manner. So we have to know the water quality going into the system.
36 And if those contaminants accumulate in the aquifers and then flow through into
37 the surface water, that's an important thing to understand.

1 One gap is the actual ecosystems within the aquifers themselves have not been
2 assessed. I can't find any information on the invertebrates that live within the
3 aquifers, or whether they are present or not. But they are found in aquifers in the
4 Otago region. So that's an area that we have zero information on. And those
5 invertebrates can be quite sensitive to nitrogen and other contaminants. So it's
6 another reason why we would want to look at contaminant accumulation in the
7 aquifers.

8 **Mr Enright:** Thank you. And thank you sir, those were my questions on this topic.

9 **Mr Muir:** Thank you. Mr Leckie?

10 **CROSS-EXAMINATION BY MR LECKIE:**

11 **Mr Leckie:** Thank you sir. Just one question, Ms McArthur. You fairly identified,
12 in answers to some questions earlier, that Mr Allibone had identified, or assessed
13 and identified the presence of trout in the environment downstream from the site.
14 Is that a fair recollection I have?

15 **Ms McArthur:** Yes.

16 **Mr Leckie:** Mr Allibone's report described that brown trout population as very
17 small and land-locked, due to the infrequent and intermittent flow of the nature of
18 the creek downstream of the Bendigo Loop Road.

19 **Ms McArthur:** Yes.

20 **Mr Leckie:** Would you agree with Mr Allibone's assessment in relation to that trout
21 population?

22 **Ms McArthur:** Yes, in Bendigo Creek, and but the presence of the juvenile trout
23 suggests that Bendigo was recently connected to the Clutha system because of the
24 age of those trout. So we don't know the frequency of that connection, but we do
25 know that it happens.

26 **Mr Leckie:** You would agree it's infrequent, in Mr Allibone's words, infrequent?

27 **Ms McArthur:** I couldn't tell you, because you would need data over a longer time
28 period of what age and size of trout you had found there. But, infrequent is
29 probably a reasonable word, if you don't know what the frequency is, but you
30 know it happens sometimes. Yes.

31 **Mr Leckie:** Thank you.

32 **QUESTIONS ARISING FROM THE PANEL:**

33 **Mr Mulliner:** So just, can I just ask a question on that? So the evidence for this
34 connection is based on the presence of the juvenile trout in Bendigo Creek is it?

35 **Ms McArthur:** Yes. Oh, and there was one other. There was a signature for kōaro,
36 which is the native galaxiid which is migratory, and Dr Allibone found an EDNA

1 signature for the fish. He didn't find any of the fish themselves, and that suggests
2 that those population are able to migrate periodically from Lake Dunstan up to
3 Bendigo Creek.

4 **Mr MacGibbon:** That was in Bendigo?

5 **Ms McArthur:** Yes.

6 **Mr Mulliner:** How would you go about, I guess, defining how often that connection
7 is?

8 **Ms McArthur:** That's a good question. I'm not sure how you would historically work
9 that out. There's probably ways some clever hydrologists might be able to help
10 you with it. I can't. Yeah, I can only use the ecological indicators to get an idea
11 of that. And all I can say is, it has happened relatively recently. Yeah, I'm sorry
12 I can't --

13 **Mr Mulliner:** Okay, thank you.

14 **Mr Muir:** Without re-establishing that connection, are these land-locked brown
15 trout destined to die? They're not breeding in that system?

16 **Ms McArthur:** I think by land-locked they're really generally land-locked in Lake
17 Dunstan and they spawn in the tributaries then go back in. I think Dr Allibone
18 found an adult trout of reasonable size, there was a photo, in Bendigo Creek. So
19 they can populate quite small streams and you can get quite abundant trout
20 populations within small streams. So they're not necessarily destined to die, no.
21 And I think when there's any opportunity for reconnection to occur, they will
22 happily pop out of there and back into the lake, if they get the opportunity.

23 **Mr Muir:** Topic 3.

24 **TOPIC 3: WATER QUALITY COMPLIANCE LIMITS**

25 **Ms McArthur:** Water quality compliance limits. I've touched on this a fair amount. In
26 the JWS we did get some reasonable agreement on the issue of 90 per cent species
27 protection versus 95 per cent species protection under the ANZ Framework. So,
28 I had recommended in my statement that the water quality limit for a number of
29 the metals under the Australia New Zealand Guideline, the ANZG, should be set
30 to protect 95 per cent of species.

31 Dr Ryder had set it at protecting 90 per cent of species. That was based really on
32 a fundamental difference of opinion on the characterisation of the condition of the
33 project site. So Dr Ryder had characterised this site as highly disturbed, whereas
34 my reading of the ANZG framework was that it came under slightly to moderately
35 disturbed in its present state, without the mine there.

36 And so to me those metals limits should be set more stringently in order to protect
37 all species and there was reasonable agreement amongst the experts on that issue,
38 in JWS 2, at paragraph 98. Dr Greer was of the same view as I was, prior to

1 conferencing. And I think a number of other experts agreed. I've got the
2 paragraph reference wrong which isn't -- apologies.

3 **QUESTIONS FROM THE PANEL:**

4 **Mr Mulliner:** So could I just -- are you suggesting there is a gradient among the wider
5 group of experts, including the applicant's experts, on the 95th per cent
6 compliance levels?

7 **Ms McArthur:** Paragraph 98. That doesn't look like it either, sorry. Wrong reference.
8 I'll do a search. It's JWS 1. It's JWS 1, paragraph 99. [inaudible 1:26:08]
9 apologies. Have you got that? Yes, I believe that's most of us, including the
10 applicant's ecology expert sitting in for Dr Ryder, Dr Palich, Julie Palich.

11 **Mr Mulliner:** Isn't Dr Boothroyd is it? He - - -

12 **Ms McArthur:** And Dr Boothroyd also, yes. So I think there was, it's useful to point
13 out for you that there was pretty good agreement across the experts in the JWS
14 that those limits should be made more stringent to protect a wider number of
15 species from toxicity from metals.

16 **Mr Muir:** We'll see where that lands in about 10 days time, when the revised --
17 it's the first series of revisions of the management plans and conditions are tabled.

18 **Ms McArthur:** The outstanding issue, I think, really with respect to water quality limits
19 are the nitrogen and ammonia limits. These are really quite significant in terms
20 of concentration on the limits that Dr Ryder has suggested for toxicity, and the
21 limits that are needed to protect ecosystem health. So Dr Ryder's limit, median
22 limit for nitrate is 2.4 mgs/litre and my estimate of protection of ecosystem health
23 to keep periphyton quite low, is approximately .2 mgs/litre. Dr Ryder's
24 compliance limit for nitrate is ten times larger than that which I would
25 recommend, and it is significantly greater than the current background
26 concentration, which for the stream sites on the project footprint are around about
27 .2 mgs/litre off the top of my head, and in the Lindus are much, much lower than
28 that.

29 The reason we have such a divergence of view on this matter, is that Dr Ryder is
30 looking only at the toxic effect nitrate on aquatic organisms, whereas I am looking
31 at the limit needing to be set at the ecosystem level. And there is a divergence in
32 the difference between protecting, simply to stop the contaminant killing things
33 directly, which is the toxicity limit, and providing a low enough concentration of
34 nutrients to ensure that the system doesn't get over-run with nuisance periphyton
35 and therefore have cascading ecological effects into other lifeline macro
36 invertebrates and fish.

37 **Mr Mulliner:** Would you agree that this is where the contaminant load water balance
38 model comes into the picture, and that so you [inaudible 1:29:48] the nitrate is a

1 toxicity limit, the 2.4 but if it only occurred periodically, would you have a
2 problem with that?

3 **Ms McArthur:** Well it depends on whether you're talking about the median nitrate
4 concentration, which is the current compliance limit, the 2.4 mgs/litre is set as a
5 median. So it allows for much higher and much lower concentrations 50 per cent
6 of the time.

7 **Mr Mulliner:** Understood.

8 **Ms McArthur:** You need the median to be quite low in which case you can have 50 per
9 cent of the time more than the limit at which you set. Sorry I'm not sure I'm
10 explaining that very well.

11 **Mr Mulliner:** No, perfectly.

12 **Ms McArthur:** It allows for variability around the limit, if that was the question, yes.

13 **Mr Mulliner:** So, sorry, noting that joint witness statement and I assume it's the first
14 one -- I haven't made a note there -- that they do intend to provide an updated
15 estimates of the efficiency of the level of nitrate/nitrogen through the treatment
16 process.

17 **Ms McArthur:** Yes. That currently is a high level of uncertainty for me because nitrate
18 removal is not easy, and waste water treatment plants, for various types, industrial
19 and municipal sewage, and others, removing nitrate is difficult and expensive.
20 And so that's why I have some reservations about the ability of passive treatment
21 to adequately remove nitrogen to the degree required to meet a better compliance
22 limit. A more protective compliance limit, which I think is necessary, as do some
23 of the other experts.

24 **Mr Muir:** Anything further emerging from that? Item 4.

25 **Mr MacGibbon:** Sorry, Mr Chairman, just before you do, Ms McArthur the 0.2
26 mgs/litre just what's the basis for that? Is that a standard ecosystem sort of level?
27 Or is it specific to here? Where do you --

28 **Ms McArthur:** That was a model done by Snelder and Fraser for the Otago Region
29 specifically to control periphyton growth. There are national look up tables that
30 we apply, but they have taken that national model and used just the Otago sites to
31 develop more region-specific nitrogen and phosphorous levels.

32 **Mr MacGibbon:** So would I be right in suggesting perhaps it's lower than many other
33 parts of the country, that level?

34 **Ms McArthur:** It is, but it is relative -- well the concentration is not necessarily lower
35 than many other parts of the country, but it's relative to the fact that in Otago you
36 don't -- your flood frequency, floods are very far between. And when you don't
37 have floods to wash the periphyton away, it grows and grows. So it doesn't take

1 much nutrient to grow green grass on the bottom of the river essentially, and it
2 stays there for a long time.
3 The 2.4 toxicity limit, that's only exceeded in the very rare number of places,
4 which is largely only highly intensified agricultural systems around Canterbury,
5 and a couple of places in Southland. So 2.4 mgs/litre of nitrate is highly unusual
6 to find in New Zealand water, surface water.

7 **Mr McGibbon:** Thank you.

8 **QUESTIONS ARISING FROM MS GEPP:**

9 **Ms Gepp:** Sir, can I ask a question arising from Commissioner McGibbon's
10 question?

11 **Mr Muir:** Yes.

12 **Ms Gepp:** Thank you. Ms McArthur, sorry from Commissioner Mulliner's
13 question. And it was on an earlier topic, Ms McArthur, but it relates to this topic.
14 He said that the applicant's position is they will be able to capture contaminant
15 loads and they've provided appropriate water quality conditions based on
16 background. Can you comment on whether the water quality limits are based on
17 background?

18 **Ms McArthur:** No the water quality limits are not based on background in any way.
19 No.

20 **Mr Muir:** Takes us now, issue 3. I haven't left anyone out, have I on this topic?
21 No. Thank you. Adaptive management.

22 **TOPIC 4: ADAPTIVE MANAGEMENT**

23 **Ms McArthur:** I think there's a couple of key issues arising from the proposed adaptive
24 management which create uncertainty for me. One of them is the time lag that's
25 inherent in a few different areas, that have been identified as being managed
26 through adaptive management. There's a lag in terms of identifying an issue. So
27 you take a water quality sample, for example, in your performance monitoring
28 that's highly elevated in a contaminant, time from which you take that sample,
29 through to the time at which you've collected enough samples through time to
30 know that's not an anomaly and there is something going on, is one lag. And then
31 you have another lag in terms of assessing that and determining the appropriate
32 response, or source control that you need to do. And then you have further time
33 lag in terms of implementing that response.

34 So I'm concerned that the time at which you might initially detect an effect can
35 be – and then respond, develop a response to it, and then implement the response,
36 could be quite significant. With respect to, if we said that performance monitoring
37 triggered the need for active treatment, you could start to collect samples in order
38 to determine with any certainty that you had an increasing trend, you would need

1 to collect a reasonable amount of data, and if you're collecting monthly, that
2 would be probably at least 12 months, if not more, to know that there was
3 definitely something going on. Then you've got to determine that you need to
4 undertake stand up of your treatment plant, which I think is approximately 21
5 months is the timeframe we've been given for how long it will take to do the full
6 lead in, and stand up a treatment plant.

7 So you may have potentially two or more, more, likely more years, between you
8 develop an issue from contaminants going into the environment to when you
9 actually respond to them. So time lag is quite a large issue.

10 QUESTIONS FROM THE PANEL

11 **Mr Muir:** Perhaps you wouldn't go from, if I could call it, from hero to zero within
12 some extremely short timeframe. Is this question more appropriately addressed
13 in the context of where the trigger limit is, as a percentage of what might be your
14 ultimate defining standard?

15 **Ms McArthur:** Yes, in some cases it does, and that's why we have recommended that
16 the performance trigger be 50 per cent of a limit to try and capture that upward
17 trajectory faster. And that's one way of managing it. In this system, in the
18 operation of the mine and the systems that treat water prior to discharge, the ability
19 to respond is not agile. And the ability to determine an effect is not agile either.

20 So what we don't want to do is get say one really high sulphate reading, and then
21 go, "Oh no we have to immediately initiate active treatment" because that's not a
22 reasonable thing to do. We need to know that that is an increasing trend through
23 time, which means we need time. So there is a lag in the system there, which is
24 difficult.

25 If you're looking at a standard waste water treatment plant, the agility to respond
26 to difficulties is generally faster because you've already got your plant in place,
27 and you might need to upgrade or rejig your plant to respond for a problem. Here
28 we have to have the full lead in to putting a plant in place, as well as detecting.

29 **Mr Muir:** Not that it would not have been thought about in advance?

30 **Ms McArthur:** Oh no, not at all. No. I'm not in any way saying that's the case. I'm
31 just saying we've asked how long will that take, and we've been told 21 months
32 is the timeframe for standing up that treatment system. Which is why the experts
33 have asked for there to be lead in time specified, which I think Dr Weber has done
34 in the joint witness statement, to say, "This is the lead time for passive treatment"
35 so that we know what that lag might be. We don't know what the outcome of that
36 is yet. But we know what the lag time is.

37 Some of the other issue with time lags is once we move into the closure phase, as
38 I said earlier, you've lost the ability to have some tools there to adapt to a problem.
39 So, some of the seepage and elevated concentrations of contaminants or higher

1 volumes of flow are very dependent on, as I understand it from Dr Weber, the
2 engineering of the ELF's and the TSF themselves. Once those are completed, if
3 you get a trajectory of rising contaminants, the options available for adaptive
4 management are less, because you've already done all of that system, and your
5 mine is closed essentially. So there's some issue there with the lag between when
6 we might measure an effect, got available then to adapt to reduce that effect.

7 You can't adaptively manage a contaminated aquifer once it is contaminated. You
8 have a very long remediation time scale that you really don't have any control
9 over.

10 **Mr Muir:** Well if you were to intersect the inputs then you would flush it through.

11 **Ms McArthur:** Yes.

12 **Mr Muir:** In lay terms, reasonably quickly.

13 **Ms McArthur:** I can't comment on the rapidity, and it depends on the effectiveness.
14 But if you monitor and you're in the aquifer, or you're in the Lindus River, where
15 the aquifer discharges, and that's where you pick up a contaminant, there's already
16 a considerable amount of contamination that's moved into that aquifer system,
17 that you can't adaptively manage.

18 **Mr Mulliner:** Could I just ask a quick question before we move on. So before you
19 were talking about the, well the lag time, and you mentioned a monthly I guess
20 compliance monitoring. Do you think there's room there for the applicant to use
21 the proposed continuous monitoring as more the, I guess a trigger, or to reduce
22 that lag response time?

23 **Ms McArthur:** Absolutely. That's the role of continuous monitoring is to try and get
24 an early warning system to the degree that you can. And we had some discussion
25 around that at conferencing, because I recommended a chemical oxygen demand
26 limit. But we've landed in a place where we're looking at dissolved oxygen
27 monitoring on the discharges from the treatment system.

28 So once the treatment systems are in place, the dissolved oxygen is continuous. It
29 pings a concentration every 15 minutes, so that gives you the ability to see
30 something going wrong much faster. But there is conductivity measuring which
31 is useful. So the continuous monitoring doesn't give you the full profile of
32 contaminants, but it can flag that there is an issue occurring. Then you need to
33 collect your data to find out what is the contaminant, because that tells you what
34 it's source, and then therefore what do we need to do in a management sense to
35 reduce the inputs of those contaminants.

36 I think the only other point I have was that currently the adaptive management
37 framework is not, I would say not well developed within the management plan.
38 It's difficult to see a clear line of sight between a particular issue and what the
39 adaptive management tools might be and how quickly they might be able to

1 implemented over the different mine phases. There is currently no information on
2 adaptive management for issues with passive treatment, or any performance
3 limits.

4 **Mr Muir:** Question from the Panel, additional questions from Commissioner
5 Mulliner? Mr Enright?

6 **CROSS-EXAMINATION BY MR ENRIGHT:**

7 **Mr Enright:** Thank you just one question, Ms McArthur, and it relates to the
8 evidence of Dr Morgan, who obviously will be on the panel on Monday. But she
9 identifies that, or queries the suitability of adaptive management of ground water
10 effects where the lag times are long, in the order of years to decades, and suggests
11 that a precautionary approach is needed for ground water, rather than adaptive
12 management. Do you have a view on that?

13 **Ms McArthur:** Yes, I think I stated an agreement with Dr Morgan, within the joint
14 witness statements on that point. I am not sure exactly where it is, but I can
15 definitely tell you but I do agree with her that there are areas that cannot be
16 adaptively managed. She's much more an expert in ground water, but the ground
17 water is implicitly connected to the surface water. So, from a surface water
18 perspective, I have the same issues that she has raised.

19 **Mr Enright:** Thank you sir, that was my question.

20 **Mr Muir:** Mr Leckie.

21 **CROSS-EXAMINATION BY MR LECKIE:**

22 **Mr Leckie:** Just one question, thank you sir. On the topic of adaptive management,
23 in particular around your concerns with lag time, would you agree that the required
24 – sorry, the necessary requirement to comply with the compliance limit, is one
25 important tool to reduce the potential risk of those lag times.

26 **Ms McArthur:** I think it reduces it a small amount. But the compliance limits are
27 statistical percentiles. So a median or a 95th percentile generally you would have
28 to collect at least 12 monthly samples to determine whether you were over or
29 under that limit. So there is still an implicit lag in there, between when you collect
30 a sample and when you actually understand there to be a breach, even of the
31 compliance limit. Yes.

32 **Mr Leckie:** Thank you.

33 **QUESTIONS ARISING FROM THE PANEL:**

34 **Ms Sweetman:** Can I just follow up on that? Is that why you recommended, when we
35 were talking about the first issue, about setting worst case scenario limits, instead
36 of averages?

1 **Ms McArthur:** Yes. Not so much in the setting of limits, but understanding what the
2 worst case scenario could be. You can then look at what that might mean in the
3 sense of the limit. Scientists don't really like to have absolute hard limits, because
4 there's always variability in the system, so you might ping a funny result at any
5 time. It's not necessarily a real result, which is why we use 95th percentiles
6 [inaudible 1:47:07].

7 **Mr Mulliner:** Would you consider that performance monitoring that's proposed to be
8 undertaken and associated trigger values with that performance monitoring to be
9 suitable to trigger various adaptive management practices?

10 **Ms McArthur:** Yes. That being said, how it's written currently within the plan and
11 within the way in which Dr Weber has described it, is if poor water quality is
12 indicated, and I don't know what those – I don't know what poor water quality
13 means in this sense, and I don't know what those trigger levels are. So that's
14 unknown at the moment. Yes, but theoretically you could.

15 **Mr Mulliner:** So you would be looking for quite defined trends, concentrations
16 associated with those to have confidence in the adaptive management process?

17 **Ms McArthur:** To have confidence that you would understand where you had a
18 problem, based on the data. I think that's the level at which a trigger limit assists.
19 This is at that front end of understanding when there's a problem.

20 **Mr Mulliner:** Thank you.

21 **Mr Muir:** That is our issue number 4. Issue number 5.

22 **TOPIC 5:**

23 **Ms McArthur:** I think sir, depending on the Panel's view, I may have already spoken
24 to that enough.

25 **Mr Muir:** I think that we have spent some time on related issues.

26 **Ms Sweetman:** Yeah, so your particular reference here is section 107(1)(e)(g)?

27 **Ms McArthur:** Yes. And also farm animal drinking water. (e) off the top of my head,
28 I don't – I'm not sure if it's (e) or not, consumption by farm animals hadn't been
29 considered, but we have looked at that through the joint witness statement, and
30 some experts have made some recommended limits with respect to safer
31 consumption by farm animals, and for irrigation.

32 **Mr Muir:** Mr Enright, have there been any anticipated questioning around that
33 issue?

34 **Mr Enright:** No sir. No, thank you.

35 **Mr Muir:** Very good. And probably not – no questions - - -

36 **Mr Leckie:** No questions, sir.

1 **Mr Muir:** - - - from Mr Leckie either. Good. Thank you. That concludes the
2 hearing, unless there's any matter my Panel wish to address in terms of the hearing
3 and could we express our thanks for making yourself available this afternoon, and
4 for the professionalism of your evidence, so much appreciated.

5 **Ms McArthur:** Thank you sir. Thank you for the opportunity to come today.

6 **Mr Muir:** That concludes this hearing, and we will resume tomorrow morning at
7 the earlier hour of 9 o'clock.

8

9 **Hearing concluded**