Before the Hearing Panel appointed by Canterbury Regional Council and Selwyn District Council

IN THE MATTER OF	The Resource Management Act 1991
AND	
IN THE MATTER OF	Applications CRC184166, CRC200500, CRC201366, CRC201367, CRC201368, CRC203016, CRC214320 and CRC214321 by Bathurst Coal Limited for a suite of resource consents to operate, rehabilitate and close the Canterbury Coal Mine.

SUMMARY STATEMENT

SECTION 42A REPORTING OFFICER
CANTERBURY REGIONAL COUNCIL

WATER QUALITY AND ECOLOGY – DR ADRIAN MEREDITH

DATED: 29 OCTOBER 2021

INTRODUCTION

1. My full name is Dr Adrian Selwyn Meredith. I am employed by the Canterbury Regional Council as a Principal Scientist (Surface water quality and ecology), I hold the qualifications of BSc (Hons 1st class) and PhD from the University of Canterbury.

2. While this is a Council Hearing, I acknowledge that I have read the Environment Court's Code of Conduct for Expert Witnesses as contained in section 7 of the Environment Court Practice Note 2014 and have complied with it in the preparation of this summary.

SCOPE OF REPORT

3. This report is an addendum to my primary Section 42A report which is included as an Appendix of the Section 42A Officer's Report circulated on 24 September 2021. The purpose of this addendum is to provide a summary of my report, respond to matters raised in the Applicant's evidence and submitter evidence, comment on the process and outcomes of expert conferencing, and overall update or note any material changes to the conclusions and advice arrived at by my evidence.

4. In preparing my report, I have read and reviewed the evidence tabled by the following witnesses for the applicant, and read and listened the summary evidence presented to the hearing and questions answered on that material by:

   Mr Eden Sinclair

   Dr Paul Weber

Dr James Griffiths

Dr Chris Hickey

Ms Sioban Hartwell

Dr Kristy Hogsden

Dr Garry Bramwell

5. I also attended a conferencing session with several of these witnesses. I found this conferencing session to be both very useful in filling in several important information gaps in the application (that were outlined in my evidence in chief and I will update in this report) but also found the conferencing to be very difficult as I was the only CRC witness invited to this all-day session.

6. The BCL witnesses attending covered a wide range of disciplines that deviated outside my areas of expertise but within the areas of expertise of many of my presenting colleagues (but who were absent). Both my sole attendance and the absence of other key witnesses has contributed considerable difficulty to my agreeing to the conferencing notes prepared by the applicants observer at the conferencing and achieving agreement on understandings. This would have been considerably easier if a range of comparable CRC witnesses had been present, or if the conferencing was reconvened with them present.

7. This report is therefore updated with the addition information gained and noting some agreements gained from the conferencing. Many other issues I discuss are currently considered outstanding issues or disagreements.

SECTION 42A REPORT SUMMARY

8. I do not repeat my S42A evidence in chief report conclusions or summary here, despite many or most of my key conclusions and concerns largely remaining unchanged. Instead, I propose to summarise or discuss a number of key issues, subjects, or themes that I covered in my evidence in chief and that have become clearer from information in applicant evidence and conferencing since preparation of my evidence. I therefore present a broader number of key issues to provide a coordinated consideration of the assistance provided by the additional applicant evidence, questioning responses from applicant witnesses, and information provided or agreed from expert conferencing. These therefore provide a more coordinated and complete summary of my concluding advice covering both agreements and disagreement with applicant witnesses. These issues will however inevitably not cover all issues in my original S42A report as they cover such a wide breadth of issues.

A. ADDITIONAL MONITORING SITES

9. In the application it was proposed to monitor contaminant losses only at two catchments/sites (Bush Gully Stream (CC20/24) and Tara Stream (CCO2/CCO2-tele)). I proposed that there was also potential for mining effects and drainages to Oyster Gully Stream and Surveyors Gully Stream (both important catchments in their own right). Further discussion has resolved agreement that Oyster Gully Stream will be both visually inspected for active seeps developing, and ongoing water quality monitoring at the CC12 site. Oyster Gulkly is still to decommission the remnant pit pond and pumps and reinstate natural drainage patterns. This monitoring proposed is therefore to verify that following active closure that no discharges/issues arise from

this catchment and their mudfish populations downstream. It was further agreed that Surveyors Gully catchment has had minimal mining disturbance and was part of the MOA primarily for future mining development that will not now occur. It was therefore agreed that it was not necessary to conduct further sampling at Surveyors Gully, but that visual observations for development of any active seeps should continue. Monitoring would only be required if such seeps on the mine site became a common feature.

B. MSR DESLUDGING PROCEDURES

10. In the initial application there was a lack of detail in the procedures and risks associated with the desludging of the proposed MSR treatment system. Subsequently Mr Sinclair has produced a desludging procedure/protocol appended to his evidence, and other details were discussed in the conferencing. Providing the desludging materials are disposed of to an appropriately identified off-site disposal facility, the issues with the operation of the MSR have now largely been agreed.

C. ANOXIC DISCHARGE FROM THE MSR

11. The MSR is essentially an operation to precipitate out contaminants in an alkaline and reducing environment. Inherently the discharge from the MSR will therefore be oxygen depleted. This runs the risk of carrying contaminants into the receiving environment in an anoxic or reduced state that will subsequently be precipitated upon reaeration. This situation is almost certain and requires aeration of the discharge from the MSR under a controlled situation. Dr Hickey agreed with me on this risk. However, the applicant prefers to monitor this situation and respond with a TARP procedure should such anoxia and precipitation of contaminants occur. This is therefore a situation where I consider a monitoring and TARP process is not appropriate, as the MSR processes will almost certainly demonstrate the generation of adverse effects while the monitoring approach occurs. It is not expedient to allow such anticipated adverse effects to occur such that it then must subsequently be rectified once it occurs. Such adaptive management TARPs should only occur when the effect is possible but unlikely rather than being almost certain.

12. We propose that an aeration and mixing system for the MSR discharge is designed as an implicit part of the infrastructure to avoid these effects. This issue could be resolved with further discussion/conferencing.

D. LOCATION OF DISCHARGE COMPLIANCE POINTS

13. There has been considerable discussion of the discharge compliance point beyond the Tara Pond spillway. Previously this had been strongly debated in previous consents and monitoring for a more distant CCO2-tele point. BCL initially favoured retention of the CCO2-tele compliance point, but experts have subsequently agreed that CCO2-tele be retained but only briefly for the active closure phase while a piped discharge from as mine sediment pond discharging close to CCO2-tele still exists, but on cessation of that discharge at the end of the active closure phase an engineered compliance point should be developed at the mixed MSR/NO2 decant discharge point. This is essentially and “end of pipe” compliance point.

14. The outstanding issues with this new compliance point is specifying how the two discharges are mixed and discharged (i.e. engineered structures). There has been ongoing debate of the structure of this but it should be readily resolved with some additional expert discussion/conferencing.

E. DESIGN AND MANAGEMENT OF THE NO2 PIT POND.

15. In my evidence-in-chief I criticised the lack of design detail of the proposed NO2 pit pond and that it appeared to be a large "lake" contained within the previous active mine pit. Subsequent responses have confirmed that the NO2 pit has/will be infilled with 14m of fill (possibly capping some PAF fill) such that the full pond will be approximately 3.5 metres deep. This alleviates some of my concerns of this being a deep mine pit lake, but the wind sheltered aspect means it is still highly likely to stratify (layer). My opinion on this was also confirmed by Dr Hickey. NO2 is also fed by an underdrain from the NO2 fill area that also encapsulates CCR and PAF materials, and so is not entirely a "clean" water pond filled only by surface water runoff. There remain some uncertainty as to what the final water quality of NO2 will be.

16. I recommend that NO2 pit pond should be actively monitored for stratification and an agreed strategy put in place for managing stratification as/ or before it happens. However, the applicant prefers to address this with another TARP determining response options if and after it happens. Again, I consider there is enough certainty and risk from this process that it should be addressed as part of the design, rather than letting the effect (stratification) occur and then determine how to manage it. Once stratification and associated water quality degradation occurs it is often very difficult to manage it into the future. This is a situation where prevention is infinitely preferable to treatment of subsequent adverse effects. I am therefore not supportive of a reactive TARP process for managing the water quality of NO2 pit pond. We already have too many artificial lake situations where failure to prevent early onset of lake stratification has generated a persistent or expensive problem to fix.

17. This is another issue that would benefit from more expert discussion to achieve agreement.

F. NO2 PIT POND DECANTING DISCHARGES.

18. The NO2 pit pond is proposed to perform a number of active and passive closure phase functions. One is to provide an adequate volume of water for diluting the CCO2 underdrain water after passing through the MSR to dilute Boron and Manganese. I have three concerns with this proposal.

19. Firstly, it is not guaranteed that NO2 pit pond water will retain the necessary "clean" water characteristics to be suitable as a dilution source. Subsequent evidence has responded by proposing use of 20 units of Malvern scheme potable water during the "active closure phase" while NO2 pit pond is developed. This is a suitable feasible active response provided CCO2 underdrain flows remain low.

20. If NO2 pit pond water is not suitable as a "clean water" source NO2 water may become a discharge liability with elevated contaminants such as Boron. The TARPS for NO2 therefore need to respond to two risks; 1. whether pit water quality is suitable as a decanted clean water supply, and 2. whether it can be discharged within compliance with trigger levels. The latter situation is inadequately dealt with, and primarily by dosing treatment with lime or NaOH. These treatments have their own issues.

21. Secondly, the evidence of Dr Weber notes that recent CCO2 underdrain flows have recently stabilised at low flows (median 0.076 l/s). He suggests this is a stable trend and that flows will continue to decrease. However, there is no mechanism reported/suggested as to why underdrain flows have so rapidly decreased/stabilised and continue to decrease. Reliance on such a pattern without an agreed understanding of the mechanism is risky. I have suggested the mechanism may be influenced by the recent (2020 and 2021) dry years that have seen little seepage

penetration into the landforms. I remain concerned tha a sustained wet year may see these trends reverse. I do however, acknowledge that the MSR is designed to treat up to 0.2 l/s (over twice the recent flow rate), and so conservatively has some spare capacity.

22. However at higher CCO2/MSR flows considerably more NO2 dilution water is required, and the potable supply cannot provide for that. Furthermore, the NO2 pit pond proposal has insufficient water yield all of the time. Dr Weber provides an analysis of "zero flow" occurrence under his scenario 7 showing short periods of diluting water being unavailable (NO2 drawn down below the decant level). In conferencing I pointed out that many of those events may be in close seasonal proximity to each other, such that the "zero water availability" would be seasonally much worse than the short "events" stated in Dr Weber's evidence. Dr Weber subsequently acknowledges this in his presentation with an amended Appendix 6 evidence table. In his presentation he agreed demonstrating that in1998 there would be 42 zero flow days over 3+ summer months. I suggest these are even worse in other modelled years with 2001 showing 19 zero flow days over 42 days, 2007/08 summer showing 23 zero flow days over a 50 day period and 2015 showing 42 zero flow days out of 63 days. These show the analysis illustrates these dry summers have periods where zero flow periods may exist for 50% or more of the time over 2-3 months. The same would probably have occurred over the past summer (2021). I agree these are somewhat conservative scenarios with high CCO2 flows, but also do not account for true water balances with evaporative losses from NO2 pit pond. Overall, these scenarios suggest that the decant flow proposals are uncertain or unreliable from a number of perspectives.

23. The final issue with the NO2 pond decant discharges is the method of delivery of the water to the MSR discharge as a diluting flow. The application proposes the discharge to be channelled down a large concrete flume channel from NO2 pond to Tara Pond, then discharge over the wide constructed concrete Tara Pond spillway. Both myself and Dr Hickey argued against the feasibility of this for a number of reasons. These concrete structures are designed to carry 1:100 year storm event flows rather than small flows of 0.48 l/s or less. Passing such small flows down long distances of exposed concrete surfaces risks four detrimental features. Firstly all of the decant flows may be lost to evaporation on the long distance of potentially hot sun exposed concrete surfaces. Secondly, the "clean" decant water would absorb alkaline contaminants from the fresh concrete surfaces. And thirdly such small flows on a concrete surface would rapidly grow sheets of filamentous algae in full sun exposure. Fourthly, such small flows poured into Tara Pond may not generate the corresponding outflow from the pond. To avoid all of these effects, Dr Hickey and myself recommended such small decanted flows should be retained in a pipe from the NO2 pond decant directly to the MSR dilution mixing point. This has not been totally accepted, but further discussion conferencing should resolve/confirm this.

G. BORON LIMITS AND EFFECTS.

23. It is agreed that dissolved Boron is the discharge contaminant/parameter that is most difficult to manage to trigger values. This was identified some years earlier and previous consent conditions invited CCM to investigate developing a site-specific Boron trigger value. Dr Hickey prepared such a value incorporating toxicity tests for additional inclusion of Canterbury mudfish and a green algae. This process was fraught with problems with appropriate methods not available in New Zealand.

24. A site specific trigger value was eventually agreed but this ended up almost identical to the new ANZG 90% species protection Boron standard. It is however notable that toxicity assessment could only be developed for growth of juvenile mudfish rather

than embryological development, that is largely the international standard for fish toxicity assessments. For this reason this juvenile mudfish toxicity value is not accepted in the ANZG or international databases, and remains only locally used here. An international Peer review we engaged was similarly sceptical but eventually recommended accepting the assessment with for the local purposes. I note this because this illustrates that the mudfish Boron toxicity value available to us is optimistic rather than conservative. It remains uncertain how sensitive mudfish egg and embryo development is to dissolved Boron concentrations.

24. Dr Hickey's comparison of mudfish egg development with trout embryo toxicity is not useful as trout eggs are very large and embryos contained within a very large yolk sac. These buffer trout embryo's from surrounding water contaminants and make them one of the most tolerant fish embryos. It would be more appropriate to compare mudfish with the zebra fish results. These discussions of actual mudfish Boron toxicity sensitivities are therefore not clear.

25. I therefore do not agree with Dr Hickey that on the basis of available information that mudfish can be considered tolerant of Boron, and thrive "happily" in high Boron water. Certainly juvenile and adult mudfish may survive in elevated Boron concentrations but the true test of whether they retain a "healthy population" in a "healthy waterway" is whether they can breed successfully and produce healthy viable young. I maintain grave reservations that elevated Boron concentrations may reduce or prevent successful reproduction of Canterbury mudfish, and may partially explain why they are absent for some distance below the CCM discharge site. On this basis I consider it is not appropriate to allow Boron concentrations beyond trigger levels to be discharged for periods beyond the compliance point through the natural waterway reaches (CCO2 to CCO3 and to CCO9).

26. The previously agreed Boron Trigger level equated to the 90th Percentile species protection level. There was a practical and pragmatic rationale to this decision when all other mine contaminant criteria are set at the 95% species protection level. However, with mine closure and water quality managed passively, it could be questioned why Boron and the other metals/elements should retain different protection levels. With mudfish as a threatened/endangered species it would be normal to set a high level of protection. Given the suggestion that contaminant flow rates and loads are decreasing, it may be feasible/practical to transition to a Boron 95%ile trigger value.

26. Furthermore it is not expedient to suggest Boron can be discharged above trigger levels beyond the discharge point so that aquatic vegetation can continue to accumulate the Boron levels. Such a strategy has been proposed for nutrient stripping in artificial constructed wetlands, but not in natural waterways. Also, such systems need to harvest or remove the nutrients (or contaminants) to maintain the stripping process. Proposing such Boron removal mechanisms in Tara Stream is not removing the Boron from the Stream but generating a greater pool of Boron in the stream ecosystem. This is not a sustainable strategy, particularly when previous years of mining activities will have already loaded the system up with Boron. I am not supportive of allowing for non-compliance with Boron trigger values so that it can accumulate in catchment vegetation.

H. SEDIMENTATION EFFECTS ON RECEIVING WATER STREAMS

27. The extent of cumulative adverse effects of the BCL mining activity (2012 to present) on the receiving environment is in many respects best demonstrated by the extent

(frequency and duration) of non-compliant activities (generally discharges) that have occurred from the mine site. There have been several diverging statements offered by BCL witnesses about the significance of the non-compliance of discharges from the mine site. I have assisted CRC compliance staff (Katie Nagy and Paul Murney) on a number of occasions with compliance effect advice for the BCL CCM site and offer the following clarification based upon my discussions with them and advice to compliance officers and site visits to assist with this.

28. Assessment of likely effects on the receiving environment appears to vary over time as both the pro-active compliance scrutiny has changed and actions by BCL have resulted. I therefore discuss compliance (or strictly non-compliance) patterns in significant time periods below.

Pre-2017

29. Prior to the granting of consents CRC170540, CRC170541 and CRC173823 (mid 2017) monitoring of the CCM site was sporadic with little attention paid to the site. Therefore, there was little pressure to ensure discharges were effectively managed while the mine was developing. There is therefore no conclusive evidence of inorganic sediment loss from the mine developments to Tara Stream and Bush Gully Stream prior to 2017. However, with the lack of regular compliance scrutiny, and the subsequent required enforcement actions in 2017 (below), it appears likely that there were significant inorganic sediment loss over this period of mine development prior to 2017, largely because of there being very little effective erosion control system (ECS) infrastructure on site prior to 2017.

2017

30. During 2017 several compliance site visits graded the discharge consents as "significantly non-compliant". Site works and mine expansion had progressed without adequate attention given to necessary erosion and sediment controls. The 2017 winter period was wet with several significant rain events, causing several non-compliant discharges to both Tara Stream and Bush Gully Stream. There were also non-compliant excedence events noted for metal contaminant trigger levels. Subsequently there were 27 individual infringement notices issued for separate sediment discharges to Tara Stream and Bush Gully Stream. It can be concluded from this pattern that the receiving environment of Tara Stream and Bush Gully Stream was challenged with significant loads of inorganic sediment from a large number of rainfall events in 2017.

2018 to present

31. On 11 January 2018 I attended a pre-arranged site visit with several other CRC staff to the mine site during heavy rainfall (approximately 70mm on the current and preceding day). On finding the North ELF stormwater ponds drawn down (low water level) despite the heavy rainfall, we found that there was insufficient bunding at the top of the North ELF disposal area to direct rainfall runoff to the stormwater treatment ponds. The majority of the area was discharging off the edge of the North ELF disposal area down a gully directly to Bush Gully Stream. I estimated at the time that the sediment loss would have been in the range of "tonnes lost". This resulted in a prosecution before the courts (Judge Dwyer) for a discharge of stormwater contaminants (clean sediment).

32. The aerial/drone footage shown by Mr Eden Sinclair for the North ELF (dated May 2018) at the beginning of this hearing illustrates that this area is also the area for active disposal, mixing and capping PAF and CCR. It therefore appears likely that this illegal discharge to Bush Gully Stream was not just clean sediment but may likely

have also contained significant amounts of contaminated material from PAF/CCR. This is likely as this event occurred in mid summer when disposal of such material occurs most frequently - when rainfall risk is generally low.

33. This prosecution illustrates that Bush Gully Stream, as recent as 2018, was inundated with high loads of inorganic sediment and possibly high loads of more toxic mine contaminants (PAF and CCR).

34. Following this incident the CCM site completed its Erosion control (ECS) infrastructure and practices. It also put in place measures to pump water up to a series of retention ponds to enable further treatment and storage of water until contaminant trigger levels could be achieved. This was also aided by 2018 being a dryer winter. These strategies have thereafter enabled the mine site to largely easily comply with discharge criteria.

35. These findings illustrate that CCM will have contributed significant loads of inorganic sediment and other AMD mine contaminants to the receiving environment (Tara Stream and Bush Gully Stream) particularly in 2017 and up until early 2018. However, evidence to date is that such loads may be insignificant since 2018.

36. The very recent high intensity rain-storm at the end of May 2021 may be an exception to this, as rather than being compliant, compliance could not be determined with much of the monitoring equipment lost or inoperable over this event.

37. I set out this compliance summary to assist in answering the questions of whether CCM has significantly contributed to the siltation and habitat degradation of the receiving environment streams (Tara and Bush Gully Streams). I consider there is significant compliance evidence to indicate erosional sediment losses from the CCM site will have significantly contributed to the silted up (degraded) state particularly of Tara Stream over much of the mining period (until 2018).

38. Further to this I also note the drone footage presented by Mr Eden Sinclair at the beginning of the hearing. The images along Tara Stream from CCO3 to CCO2 illustrated reaches with large areas of the stream bed showing bare surfaces with a distinct yellow colouration. This colour illustrated the distinct colouration of inorganic loessal sediments. Rather than illustrating a “densely vegetated wetland environment” I consider these images illustrate a highly silted up stream bed that in areas is not well vegetated.

39. I also note that Dr Hickey was asked about differentiating between sediment loss to Tara Stream from forestry compared to mine erosion, he noted that [non harvest] forestry losses would be brown muds and organic material, while erosional losses would be bright inorganic material. The drone footage is therefore usefully illustrative of the predominant sediment sources being inorganic erosional sources rather than forestry muds. I consider these interpretations lend weight to the conclusion that current sedimentation effects on Tara Stream between CCO2 and CCO3 appear to be relatively recent (years) and being most likely to be predominantly of land surface erosion origin. The mine site is the greatest area of such disturbed and erodible land surface in the stream reach.

40.

I. CONTAMINANT GENERATION AND MONITORING OF DISCHARGE PARAMETERS

41. The source of contaminants and determination of appropriate discharge parameters/monitoring are integrally linked issues. Since my initial evidence there has been considerable discussion on release of contaminants from both the mined material (particularly the PAF (Potentially Acid Forming)) waste material and the

CCR (Coal combustion Residuals (coal ash)) disposed of on site. In the initial application it was argued that PAF and CCR would have the same geochemical makeup because they both originated from the same CCM site material, and so the contaminant parameters would be very similar.

42. However, subsequent information from conferencing and in the evidence of Dr Weber, it has been agreed that the coal ash from Clandeboye Dairy Factory is a mix of Canterbury Coal and Southland Coal from Takitimu mine. I note in the subsequent analysis table referred to by Dr Weber (Memorandum 3 Table 5) that a further analysis refers to a blended sample from "Canty DHB". I presume this is the coal furnace at Christchurch Public Hospital. Previously we had been told that CCR originated from four Dairy factories supplied with Canterbury coal. Disposal of CCR from additional boiler sites raises further questions as to the uniformity of the CCR and its similarity to site waste rock. Both of these situations give cause for concern that CCR may have originated more widely from more sources than originally considered, and possibly more different coal origins.

43. These CCR sources have also only been disposed of relatively recently (the past 3 years) and are unlikely to have fully stabilised or losses from all of them not yet arisen in sampling of seeps and discharges. It is therefore prudent to maintain an open mind as to the likely contaminant matrix that might subsequently arise from this mine disposal site given a probable broader CCR source. This is another reason why I have continued to advise for ongoing regular broader scanning of potential contaminants, particularly metals and elemental contaminants than the small number of samples currently routinely analysed.

44. Dr Hickey also argued against the possibility of organic contaminants (i.e. PAH) being present in CCR disposed coal ash on the basis of his experience with ash disposal from Huntly Power Station. I also have experience with processes at Huntly Power Station having worked at its commissioning and noted in conferencing that Huntly pulverises coal to talcum powder consistency and blows it into the combined gas furnaces like a gas. Huntly therefore only produces a fine grey/white fly ash achieving complete combustion with this [at the time] state of the art coal furnace. However, again Dr Weber's Memorandum Table 5 distinguishes analysis of two ash components with significantly different elemental compositions - of "Synlait bottom ash" and "Synlait fly ash". These illustrate that the Canterbury boilers (as illustrated by the Synlait ash) and supplied with coal by CCM are not high efficiency boilers (like Huntly Power Station) and that there is likely incomplete combustion products in the ash, particularly the "bottom ash".

45. I also draw attention to the aerial or drone video footage shown at the beginning of the hearing by Mr Eden Sinclair. The footage of the North ELF disposal area in May 2018 illustrating CCR disposal and mixing behind the broad toe of the North ELF illustrated the CCR disposal as conspicuous black deposits (not white/grey fly ash characteristics). Black material illustrates incomplete combustion (and therefore high waste composition). This may also explain why such large volumes/weights of CCR have been disposed of at CCM (over 100,000 tonnes).

46. I therefore remain concerned that the CCR content and disposal may not be being portrayed accurately to assess the degree of contaminant loss, and that a conservative approach continues to be needed to avoid "surprises" in likely contaminants arising from the underdrain seepages from the CCR ELF disposal areas in the future. My concern, from a perspective of understanding the full suite of contaminant discharges to the environment is shared by my colleague Dr Massey in his geochemical evidence. I therefore confirm my original conclusion in my evidence-in-chief that further sampling of a more complete list of potential

contaminants will need to continue to be monitored into the foreseeable future to reassure us that there will not be "post mine closure contaminant loss surprises".

47. Therefore, while a core suite of mine contaminant parameters should be monitored regularly, there should also be occasional screening for a greater suite of potential metal, elemental, and organic contaminants to address this level of uncertainty, maybe annually, or when underdrain flows deviate from steady discharge.

J. RETENTION OF TREATMENT PONDS ON THE MINE SITE AFTER CLOSURE

48. It has surprised me that several of the treatment ponds on the mine site are proposed to be maintained in perpetuity. I have raised this for several reasons. Firstly, these ponds (North ELF ponds and Tara Pond; and subsequently NO2 pond) were designed and constructed to be actively managed stormwater treatment ponds. At the end of this phase such systems would usually be required to be decommissioned/removed. Their retention potentially has a number of effects on the hydrology, the behaviour of the contaminants intercepted and stored on their bed, maintaining appropriate limnology such that good water quality is maintained within them, and connectivity issues such as fish passage through them.

49. Hydrologically the ponds tend to even out the flow regime as they gain and lose water. In the passive closure phase they are proposed to be maintained full, but as with any natural water body such as a lake or wetland this in reality does not occur. Natural processes such as evaporation and seepage losses tend to push these systems into negative water balance particularly in summer, making them draw down and discharge intermittently. This inevitably makes their downstream receiving environment intermittently flowing also. They are also then refilled by small rainfall events that do not necessarily recharge the downstream reaches. This may be small but nonetheless adverse effect on flow regimes and the habitat they provide.

50. These treatment ponds were designed to intercept and store contaminants including inorganic sediment and contaminants bound to those sediments. In this situation this also includes contaminants lost from underdrain seepages. These stored contaminants can become a problem if they are remobilised by limnological or chemical processes in the water bodies. The most common process causing this is stratification (layering) of these waterbodies such that the bottom waters become hypoxic or anoxic. These conditions tend to mobilise contaminants by making them soluble/releasing them from their bonds to sediments. It is not uncommon to document these processes in constructed water bodies, requiring interventions to manage the problems. Dr Hickey agreed with me that such stratification was highly likely in the proposed NO2 pit pond even if the pond was only 3.5m deep. I note that Ms Hartwell confirmed that the North ELF Pond 2 is also a 3 metre deep design. It is also conceivable that it too could stratify in the future when not being actively managed.

51. These ponds should also not be assumed to maintain good water quality of the same quality as water flowing into them. They will inherently accumulate nutrients over time and become increasingly eutrophied (nutrient enriched) leading to a "greening" of their waters. This too can generate adverse effects on the qualities of the downstream receiving waters they discharge into.

52. Overall, there is a responsibility when constructing such water bodies that the processes described above do not adversely effect the downstream environment, particularly if it supports significant values or biota. This is particularly so if the water bodies are to be maintain in perpetuity. My concern is that these issues have not been identified or considered in the mine closure processes. They can lead to a

number of “unanticipated adverse effects” and a lack of accountability for these issues.

K. RECEIVING ENVIRONMENT MONITORING AND RESTORATION

53. The proposed monitoring of the receiving environments (Tara Stream and Bush Gully Stream) are largely based on standardised aquatic ecology surveys of aquatic insects and fish. Current survey results largely characterise the receiving environment as highly degraded. This approach is not useful as it allows BCL CCM to exit the site leaving the habitats in poor condition with aquatic fauna in low abundance or absent. This is particularly distressing when these two streams are part of an important population and habitat of the threatened/endangered Canterbury mudfish.

54. I propose that this degraded receiving environment is in many respects a consequence of the treatment of this environment by the BCL CCM mining activities. In issue 1 above, I set out the compliance action rationale that illustrates the CCM has discharged significant quantities of inorganic sediment to the streams particularly over 2017 and that these will be a significant driver of the poor state of Tara Stream in particular due to infilling of important habitat elements..

55. Excessive diversion and use of water on site to both maintain compliance and for processes such as dust suppression have starved Tara Stream of water. This will have made stream reaches intermittent flowing. Presence of water is an even more important pre-requisite for healthy stream environments.

56. Previous discharges of mine contaminants will also have stressed receiving environments. Together, these drivers (fine sediment accumulation, flow loss, and contaminants will have largely made the reach CCO2 to CCO3 in Tara stream uninhabitable to much aquatic biota, and particularly the Canterbury mudfish. A final stressor is the finer features of the water. It has been noted that Canterbury mudfish have a preference for “soft water” (low hardness: Harding et al 2007)), but water treatment at the mine site use or propose water hardener technologies to treat or manage contaminants such as with alum dozing and the MSR.

57. As BCL CCM propose to address the issues of contaminant loss/loads and to reinstate flows as they exit the site, it is appropriate that they take a more holistic approach to rectify the degraded state of the streams and rectify all degraded features. That is why I propose small elements of habitat improvement (nodes or refuges for mudfish to live and breed in). The concept of generating such nodes is widespread for protection or restoration of threatened or endangered fish species, particularly where the habitats are degraded often with the infilling of inorganic sediment (such as in Tara Stream). The applicants ecologist Dr Hogsden appeared resistant to the concept of habitat restoration. Advice on construction of such nodes or refuges is available from a number of practitioners or agencies that have worked on mudfish and other non-migratory galaxiids.

58. This approach is also consistent with the overall recommendations of Taumutu rūnanga where one of their three recommendations required all affected waterbodies should be restored. I consider these small steps to restore or reinstate habitat in the streams is as important as the replacement of lost wetland area.

59. I am not suggesting removal of all of the accumulated sediments within the waterway, just establishment of nodes of small deeper pools that will allow mudfish to establish/recolonise these stream reaches, and thrive where they should naturally exist. These pools are also the habitats where the macroinvertebrates (snails, worms, crustaceans, etc.) will proliferate better and provide the valuable food

sources for the mudfish. This will increase the overall resilience and importance of the Waianiwaniwa mudfish population.

60. Once this approach is taken, it will become easier to monitor the ecology with these reaches within these nodes and demonstrate tangible improvements.

61. In conferencing I was asked whether it was necessary to just demonstrate habitat improvements or whether mudfish recruitment and persistence should be a requirement. This is a difficult question to answer as ideally the endpoint should be genuine improvement in stream health with return of the valued biota. One would hope that if steps to improve all features of the stream environment were made, that opportunities to expedite the rapid recruitment/reintroduction of mudfish would follow. That is why the primary monitoring effort should be longitudinal surveys for presence and abundance of Canterbury mudfish and their macroinvertebrate food sources.

62. My discussion has focussed primarily on Tara Stream rather than Bush Gully Stream. As discussed earlier both streams have suffered from stresses originating from mining activities, and both are exhibiting a degraded state (Tara Stream with an absence of mudfish and Bush Gully stream with very low numbers than previously recorded. I consider restoration and monitoring of both streams is required and there is little if any justification for trade off efforts from one towards the other (i.e. Tara stream rather than Bush Gully Stream).

L. TARGET ACTION RESPONSE PLANS

63. These issues discussed above are by no means all of the issues needing to be resolved for the closure of the Canterbury Coal Mine, but give an indication of the breadth of issues and difference of opinion on these issues. The Targeted Action Response Plans (TARPs) are another major discussion topic. I and other experts were critical of the original TARPs proposed as being poorly worded and reliant on reliant on high level investigations. Significant improvements have been made in omitting or defining loose terms and bringing the necessary investigations into the Active Mine Closure phase head of the TARPS. However, some further discussion/conferencing could refine them further if time and opportunity allowed.

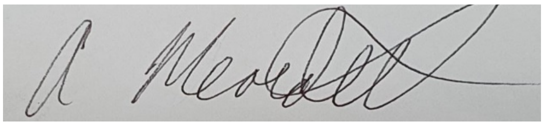
JOINT WITNESS STATEMENT/EXPERT CONFERENCING

64. As stated at the beginning of this report, the expert conferencing I attended was both useful and frustrating due in part to many experts not being invited to attend. However, that aside good progress on fleshing out many outstanding issues was made. However, there is scope for further significant progress to be made particularly with broader attendance.

CONCLUSIONS

65. Overall, the applications to progress closure of the Canterbury Coalmine have progressed a long way from the applications to continue mining to the first mine closure applications and refinements through this process. Initial frustrations were major gaps in understanding or absence of required details, but these have been increasingly provided or fleshed out. The proposals are still not complete, but more progress can be made on the strength of the progress made to date through evidence exchange and conferencing.

66. However, as from the issues discussed in my evidence-in-chief and this supplementary report there are still considerable risks and uncertainties in the mine closure proposals, and risks from future performance of this site.

Signed:  Date: 29 October 2021

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