Before a Hearings Panel Appointed by the Selwyn District Council and Canterbury Regional Council

Under	the Resource Management Act 1991
And	
In the Matter of	applications under section 88 of the Act by Bathurst Coal Limited in relation to the closure and rehabilitation of the Canterbury Coal Mine in the Malvern Hills, Canterbury

Statement of Evidence of **Sioban Doreen Hartwell (Water Quality)** for Bathurst Coal Limited

Dated: 1 October 2021

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INTRODUCTION

1. My name is Sioban Doreen Hartwell. I am a Civil Engineer and New Zealand Market Lead Water for GHD Limited (**GHD**).

2. I hold a degree in Civil Engineering (B.Eng) and am a chartered Civil Engineer and a Fellow of Engineering New Zealand.

3. I have over 25 years' experience as a civil engineer. My experience has been gained through involvement in a wide range of water infrastructure projects in New Zealand, Australia and the USA, with many of these projects being for mining clients.

4. Relevant to this evidence, I have assessed and prepared mine water management plans for a number of mine sites in New Zealand including for the Millerton, Cypress and Mt William North areas at Stockton, the Globe Progress mine near Reefton, and the Martha Mine in Waihi. Mine water management plans generally encompass hydrological assessments, water balance analysis, water treatment options reviews, erosion and sediment control reviews and assessment of effects of site discharges and water abstractions on receiving water flows and water quality.

5. I have provided support to Bathurst Coal Limited (**BCL**) in relation to site water management at their Canterbury Coal site since 2017, including collating their Environmental Management Plan in 2018 and providing 'on-call' technical support to the site team to review drainage and sediment pond sizing calculations and management approaches.

6. While this is not an Environment Court hearing, I have read and agree to comply with the Code of Conduct for Expert Witnesses in the Environment Court Practice Note 2014. This evidence is within my area of expertise, except where I state that I am relying on material produced by another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed in my evidence.

SCOPE OF EVIDENCE

7. I peer reviewed the "Final Landform Surface Water Management Report" (**Surface Water Management Report**), which is attached as Appendix 11 to

the Addendum AEE for Closure and Rehabilitation for the Canterbury Coal Mine (**CCM**), and the process used to analyse drainages and design stable drain liners.

8. I last visited site on 10 September 2021 to view the current status of closure works.

9. My evidence comments on water management including compliance monitoring as it relates to erosion and sediment control at the CCM site. My evidence also:

   (a) provides a brief description of the CCM site and surrounding environment from a surface water perspective;

   (b) outlines and comments on the proposed surface water management arrangements during the closure process and post closure for the final landform; and

   (c) responds to the relevant parts of the Council officers' Section 42A Reports.

EXECUTIVE SUMMARY

10. Since I first visited the site in 2017 I consider that BCL has made significant improvements in its approach to erosion and sediment control, including water treatment and proactive erosion prevention. This is evidenced in their record of compliance with its resource consent requirements over the last 2 years, which I have reviewed.

11. In terms of the design of the surface water management system for closure, I support the landform design to minimise erosion, drainage systems to convey runoff from rainfall associated with up to a 100 year return period event, and the proposal for treatment ponds/wetlands at Tara Gully and the Northern Engineered Landform (**ELF**) to be retained.

12. BCL's general approach to erosion and sediment control follows principles included in the Environment Canterbury (**ECan**) Erosion and Sediment Control toolbox (esccanterbury.co.nz/) which I have seen them apply successfully on site.

13. Based on my review of the Surface Water Management Report, supporting calculations provided to me by BCL and current progress on the CCM site, it is my view that BCL are taking a “best practice” approach to surface water management systems for closure to minimise sediment release.

14. Further, BCL advocates for an adaptive management approach through the closure and post closure period and I support this as it provides some flexibility to respond to any issues that arise over these periods.

15. As a result, I consider that BCL has minimised the potential for long term impacts on receiving water quality associated with erosion and sediment release.

SITE AND SURROUNDING ENVIRONMENT

16. The mine is located in the Malvern Hills, approximately 70km to the west of Christchurch. Land use immediately surrounding the site is a combination of commercial forest and farmland as shown in Figure 1.

17. The CCM site straddles two stream catchments with runoff from the CCM site flowing primarily to either the Bush Gully Stream or Tara Gully. Small areas of the CCM site also drain to the Oyster Gully and Surveyor Gully (south-west).

Figure 1 Site location (red) and surrounding land use

18. Operationally, runoff from the mine is directed to Bush Gully Stream or Tara Gully Streams via two consented treatment systems. All mine influenced water is directed to these systems for treatment prior to discharge. As detailed later

in my evidence, post closure surface runoff discharge will be more dispersed to reflect natural flow patterns and prevent concentration of flows.

19. The primary land uses in both Bush Gully and Tara Gully is forestry and agriculture, with little to no wetland habitat or riparian buffers. The Bush Gully Tara Gully and Oyster Gully streams are tributaries of the Waianiwaniwa River, a tributary of the Selwyn River. Surveyors Gully drains directly to the Upper Selwyn River. Beyond Bush Gully and Tara Gully, agriculture is the main surrounding land use, with dairy farming prevalent further downstream.

20. Stream hydrology during mining and post closure is described by Dr Griffiths and thus not covered in my evidence.

PERFORMANCE TO DATE

21. Discharged water quality is monitored at numerous locations within the mine site and downstream. These sites are shown in **Figure 2** attached to my evidence at **Appendix 3**.

22. BCL have existing conditions relating to turbidity that they are required to meet at monitoring sites CC02 and CC24 . The unit used for measuring turbidity is NTU which stands for Nephelometric Turbidity Unit. The higher the concentration of suspended solids in the water the higher the turbidity measurement. The values BCL are required to meet are:

    (a) No more than 50 NTU at CC02 (CRC170541)

    (b) Less than 50 NTU increase from CC24_turb, at CC24 (CRC173823)

23. Total Suspended Solids (**TSS**) values are measured monthly. There is no consent requirement for TSS except for a correlation between TSS and turbidity to be derived and reported annually. This correlation is useful because the turbidity measurements are continuous (every 15 minutes) and the correlation can then be used as an indication of TSS levels.

24. Recent compliance records are summarised in **Appendix 1** of my evidence. These records were extracted from Annual Water Monitoring Reports prepared by BCL and issued to ECan for the following periods:

    (a) 1 November 2017 to 31 October 2018;

(b) 1 November 2018 to 31 October 2019; and

(c) 1 November 2019 to 31 October 2020.

25. There were no recorded non compliances over the record I reviewed. There were two technical non compliances due to two reasons:

(a) No flow at the monitoring points.

(b) Inadequate sampling undertaken in storm events. BCL are required to undertake post rainfall sampling at least on a monthly basis. This did not occur in some instances. I understand from my conversation with BCL that there were practical constraints to taking samples on those days (no discharge to sample) and no actual non-compliance occurred.

26. Turbidity measurements were graphed within the annual reports provided to me by BCL. I have attached the graphs for the last two years for reference at **Appendix 2**.

27. My overall conclusion is that BCL has complied with discharge consent conditions over the last two years, including for the intensive rainfall event that occurred in May 2021.

28. BCL advised me that over the period of 29 to 31 May 2021 the accumulated rainfall for a 48 hour period exceeded the estimated 1:250 year rainfall event (240.8mm received vs 231mm HIRDS v4). It also exceeded the 1:100 year event for 24 and 72 hour periods. Based on discussion with the BCL site team, drainage and treatment systems performed very well. There was some surface running of constructed landforms due to pasture establishment only having been completed in late April, but no serious slips or adverse effects.

PROPOSED CLOSURE REQUIREMENTS

29. My understanding is that the CCM site will be returned post closure to either pasture or forestry. The closure plan developed by BCL involves re-contouring the CCM site to suit these land uses. I have attached the proposed closure drainage plan for reference as **Figure 3** at **Appendix 3**.

30. The recontouring has included review of drainage patterns and re-shaping where practical to avoid flow concentration. Where drains are required to

collect and convey surface water off site, BCL has adopted a 100 year return period design criteria. In my opinion this is an appropriate design criteria for permanent drains since it means there is a low probability of the drains being over-topped and the scour protection is in turn designed for a relatively rare event. This level of protection aligns with the design criteria applied for permanent diversion drains at other mine sites in New Zealand I have been involved with (e.g. Cypress mine Stockton)

31. I have reviewed the Surface Water Management Report and associated calculations spreadsheet, with my team at GHD. The aim of the review was to confirm, (and if necessary, refine), the approach used by BCL and check accuracy. To this end, spot checks on drain sizes were undertaken on values in the report by:

    (a) The same methods used in the report. The Kirby-Kirpach method is used by BCL to estimate the time of concentration which relates to the time for rainfall falling at the furthest extent of a catchment to the point of interest. This is then used to inform selection of a critical storm for drainage design (i.e., storm that generates the peak flow) and BCL used the Rational method for peak flow estimation. This is a standard approach to drain design.

    (b) The Hydraulic Engineering Circular No.15 (US Department of Transportation) for drain lining design was used by BCL. This was used primarily to check the size of riprap (rock lining). The key output of this analysis is a minimum rock size that will not move based on predicted velocities in the chosen design event.

    (c) Checks by GHD applied alternative approaches (CCC Rainfall and Runoff Guide for flow estimation, CCC Drainage Guide for drain lining) and generated similar results to BCL.

32. Based on this review I consider the methods used by BCL for drainage sizing to be in line with accepted engineering standards and to have been applied correctly. Furthermore, BCL's selection in both assumptions (rainfall data) and in design outputs (riprap size, culvert size etc.) are generally conservative (i.e., over designed).

33. Given the conservative approach taken to drainage design I would expect these drains to perform well. I do note that the drain sizing's are based on final

landforms and associated catchment definitions, hence there is a risk that after handover these catchments are inadvertently changed. It is thus important that as part of handover to farming/forestry this risk is acknowledged and the landform and catchment retained through ongoing compliance with the conditions of consent.

34. The revegetation and use of interim contour drains is also a very important component of erosion and sediment control.

35. BCL has demonstrated that they can re-establish re-vegetation. For example, when I first visited the site in 2017, the Green ELF was newly constructed with only topsoil cover and is now fully vegetated (with grass and well established gorse). This reduces runoff volumes as well as the potential for sediment release.

36. During my site visit on 10 September 2021, I was able to view some of the completed drains and discuss planned closure works:

    (a) I observed one of the completed permanent drains (Frew Hill) and stockpiles of riprap for the remaining drain construction. This is important because there is very limited locally suitable rock for riprap and shows BCL has been planning for closure works for some time.

    (b) Interim contour drains (constructed where practicable to avoid flow concentration) – I observed some of the completed drains on the North ELF and adjacent slopes.

    (c) Tara Gully – BCL advised they plan to replace the HDPE lined drain along the existing access road to the wetland (which is very steep) with a permanent concrete lined drain. This will discharge to the constructed small sediment pond which will overflow to the existing wetland area. An adjacent mussel shell reactor is in construction to provide long term Acid Mine Drainage treatment for underdrain seepage.

    (d) North ELF – The sediment pond to be retained (at request of farmer)- spillway protection is still to be constructed.

37. Overall, in my opinion the closure works that are in progress and are planned are appropriate, with both design and construction being in line with

acceptable good practice. My expectation is that the ongoing and future performance in relation to sediment release being minimised will continue if the works are progressed as planned, with associated continued compliance with consent conditions for turbidity.

RESPONSE TO SECTION 42A REPORTS

38. I have reviewed the Section 42A reports issued by both ECan and Selwyn District Council. As a general comment I did not identify any major concerns in relation to erosion and sediment control. However, I note the concerns relating to long term pond retention on low flow rates (refer response Dr James Griffiths), and the related issue of N02 water quality and quantity for dilution of the discharge from the Tara Gulley mussel shell reactor (refer response Dr Paul Weber).

39. In terms of sediment control, in the long term with vegetation established and all final contouring and drainage systems in place, there should be minimal sediment release to surface runoff, meaning both the Northern ELF pond and Tara pond may not be needed long term for sediment control. However, it would be prudent to retain both pond systems until the closure works are proven to be effective (as is currently planned).

40. Given at this stage there are some unknowns relating to the ultimate water quality treatment system necessary from N02 I do support the adaptive management approach BCL propose. Retaining the Tara pond until such uncertainties are addressed (e.g., through monitoring over time) is important since the pond may be needed as part of a mitigation approach.

41. Practically, should an adaptive management approach indicate a more simple system for controlling decant flows is not adequate, adjustment to decant rates using an automated system for controlling decant flow rates to meet dilution requirements could be achieved.

42. I note some concern is raised around the Triggered Action Response Plan (**TARP**) as it relates to managing water quality risk, and particularly reliance on further investigation. Adaptive management TARPs are planned by BCL to be developed post rehabilitation. In relation to erosion and sediment control I do not envisage the need for any major changes. However, I support

maintaining some flexibility in approach to cover an instance where performance criteria are not being met.

43. Dr Meredith also raises a concern relating to sediment below the discharge point and recommends removal of sediment and creation of deeper areas. I am concerned that such activity within a stream bed would be difficult to undertake practically without causing sediment release and I expect any sediment would be from a variety of sources within the catchment not just CCM[1].

44. I note that at paragraph 394 of the ECan Section 42A report there is a recommendation that the 50 NTU consent limit for turbidity that applies to location CC02 is retained (CRC170541) and that the turbidity limit "is assessed within the discharge itself at the discharge point". I do not consider this is practical or effective. The current monitoring system is located in-stream for practical reasons (access, depth and consistency of flow). If the discharge point is deemed to be the Tara pond spillway, I would expect periods of no or low depth flow and no recording as a consequence. I support the current location of the monitoring system.

45. At paragraph 395 of the ECan Section 42A report a number of actions are proposed associated with decommissioning the current water treatment system over the closure period. I consider the clauses practical and achievable and support their inclusion.

Sioban Doreen Hartwell
1 October 2021

[1] Section 42A Officer's Report, 24 September 2021 at [387].

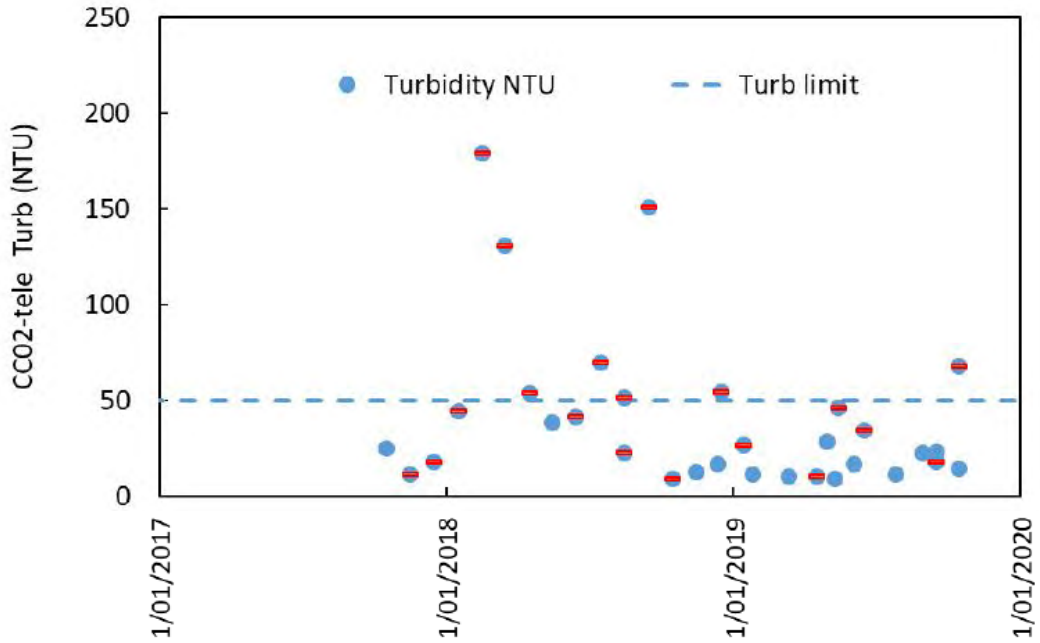
APPENDIX 1
COMPLIANCE REPORTING SUMMARY

Table 1- Compliance Reporting Summary

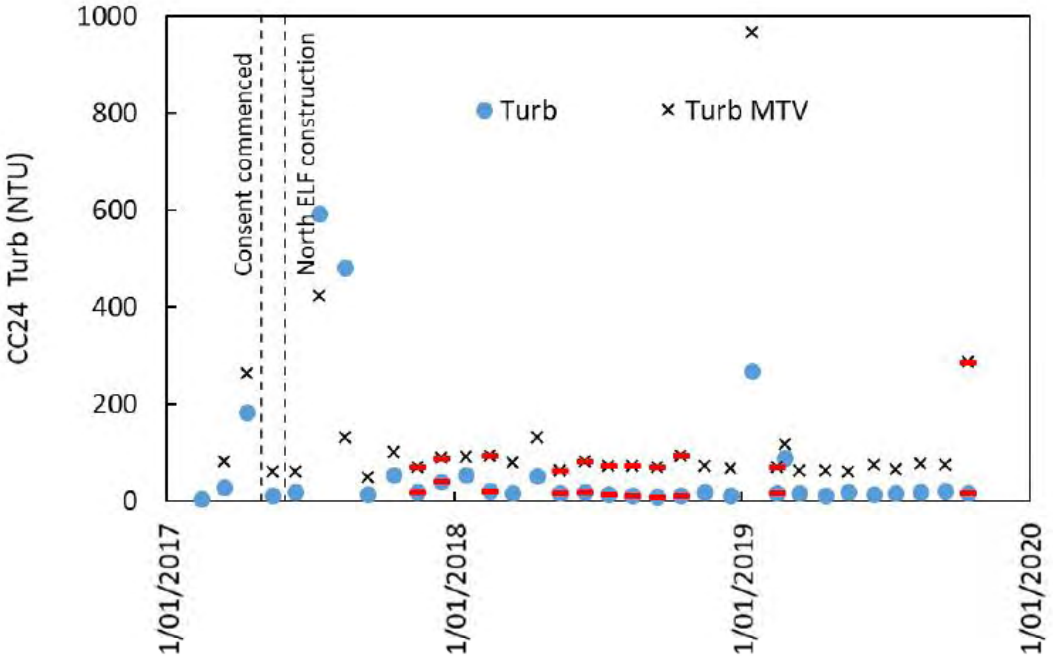
Date of Document Issue	Document Provided	Consent	Compliant?	Non-Compliance Reason
1/04/2018	Compliance Monitoring Report	CRC173823	Yes	
23/05/2018	Compliance Monitoring Report	CRC170541	Yes	
23/05/2018	Compliance Monitoring Report	CRC173823	Yes	
20/06/2018	CRC Site Visit	CRC170541	Yes	
20/06/2018	CRC Site Visit	CRC173823	Yes	
18/10/2018	CRC Site Visit	CRC170541	No	i. Did not satisfy monthly sampling requirements for rainfall associated discharge ii. Did not meet water quality criteria for Zinc, Manganese and Turbidity (associated with low flow/no discharge from mine site)
18/10/2018	CRC Site Visit	CRC173823	No	i. Did not satisfy monthly sampling requirements for rainfall associated discharge
7/01/2019	Compliance Monitoring Report	CRC173823	No	i. No sampling occurred in May and Oct 2019. Likely due to no flow from site. Background samples are acceptable in times of no flow. This did not occur
13/01/2020	Compliance Monitoring Report	CRC170541	Yes	
15/01/2020	Compliance Monitoring Report	CRC146449	Yes	
15/01/2020	Compliance Monitoring Report	CRC190172	In Progress	Treatment projects being constructed
30/01/2020	Compliance Monitoring Report	CRC170540	Yes	
15/09/2020	Compliance Monitoring Report	CRC173823	Yes	
16/09/2020	Compliance Monitoring Report	CRC190172	Yes	
8/01/2021	Compliance Monitoring Report	CRC170540	Yes	
8/01/2021	Compliance Monitoring Report	CRC170541	Yes	
1/04/2021	Compliance Monitoring Report	CRC170541	Yes	
27/05/2021	Compliance Monitoring Report	CRC170541	Yes	
27/05/2021	Compliance Monitoring Report	CRC173823	Yes	
1/08/2021	Compliance Monitoring Report	CRC173823	Yes	
15/09/2021	Compliance Monitoring Report	CRC170541	Yes	

APPENDIX 2
TURBIDITY MONITORING DATA

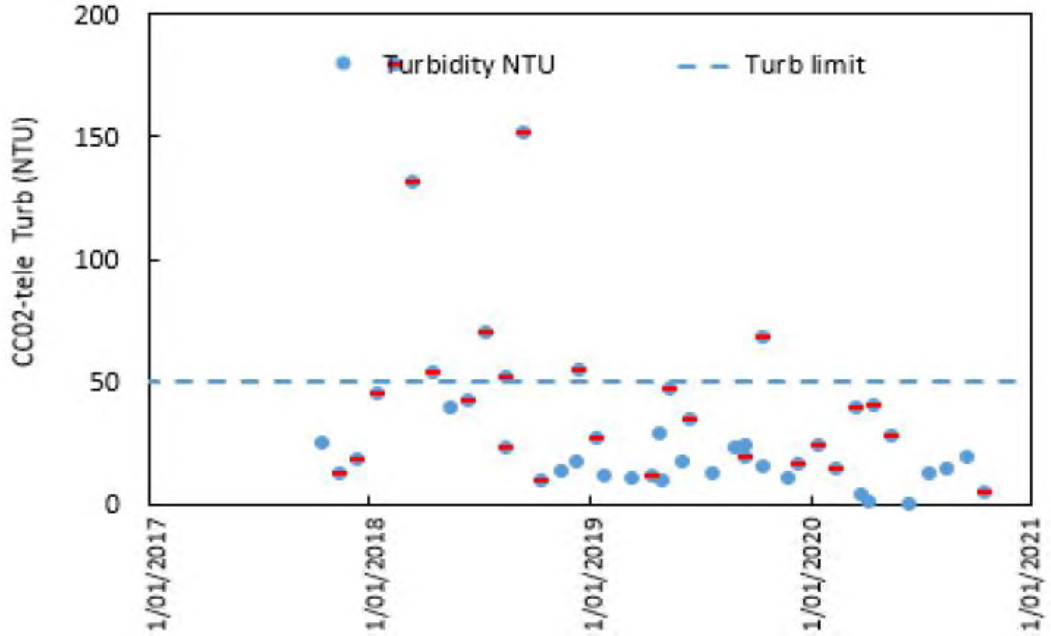
2018-2019 Annual Water Monitoring Report



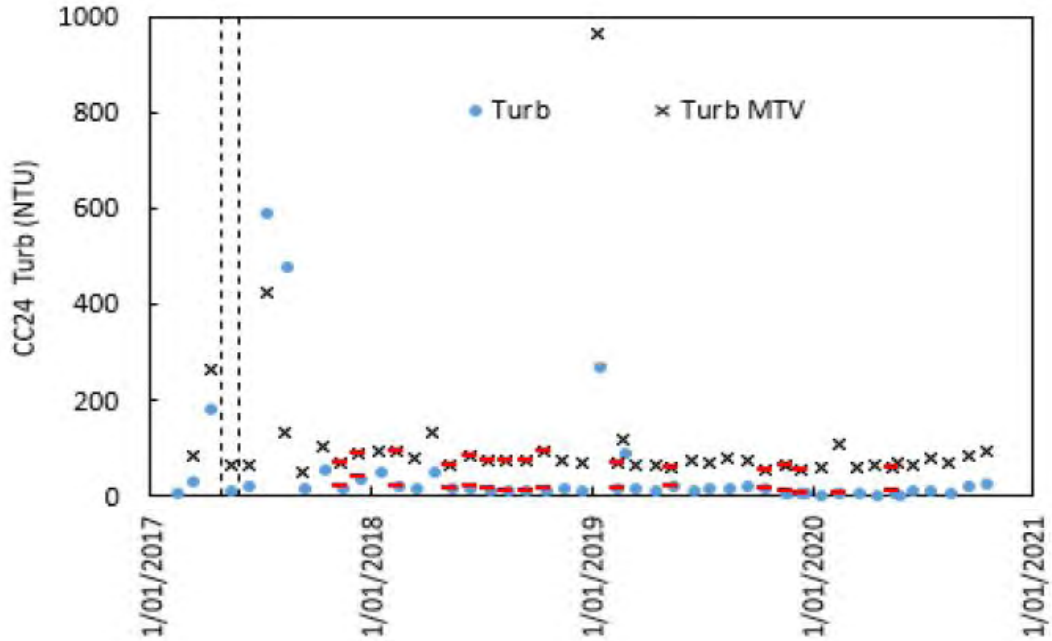
CC02_tele Turbidity Monitoring Data (2018-2019)



CC24_turb Turbidity Monitoring Data (2018-2019)



CC02_tele Turbidity Monitoring Data (2019-2020)



CC24_turb Turbidity Monitoring Data (2019-2020)

APPENDIX 3

FIGURE 2 – COMPLIANCE MONITORING LOCATIONS

FIGURE 3 – PROPOSED FINAL DRAINS

Figure 2 – Compliance Monitoring Locations

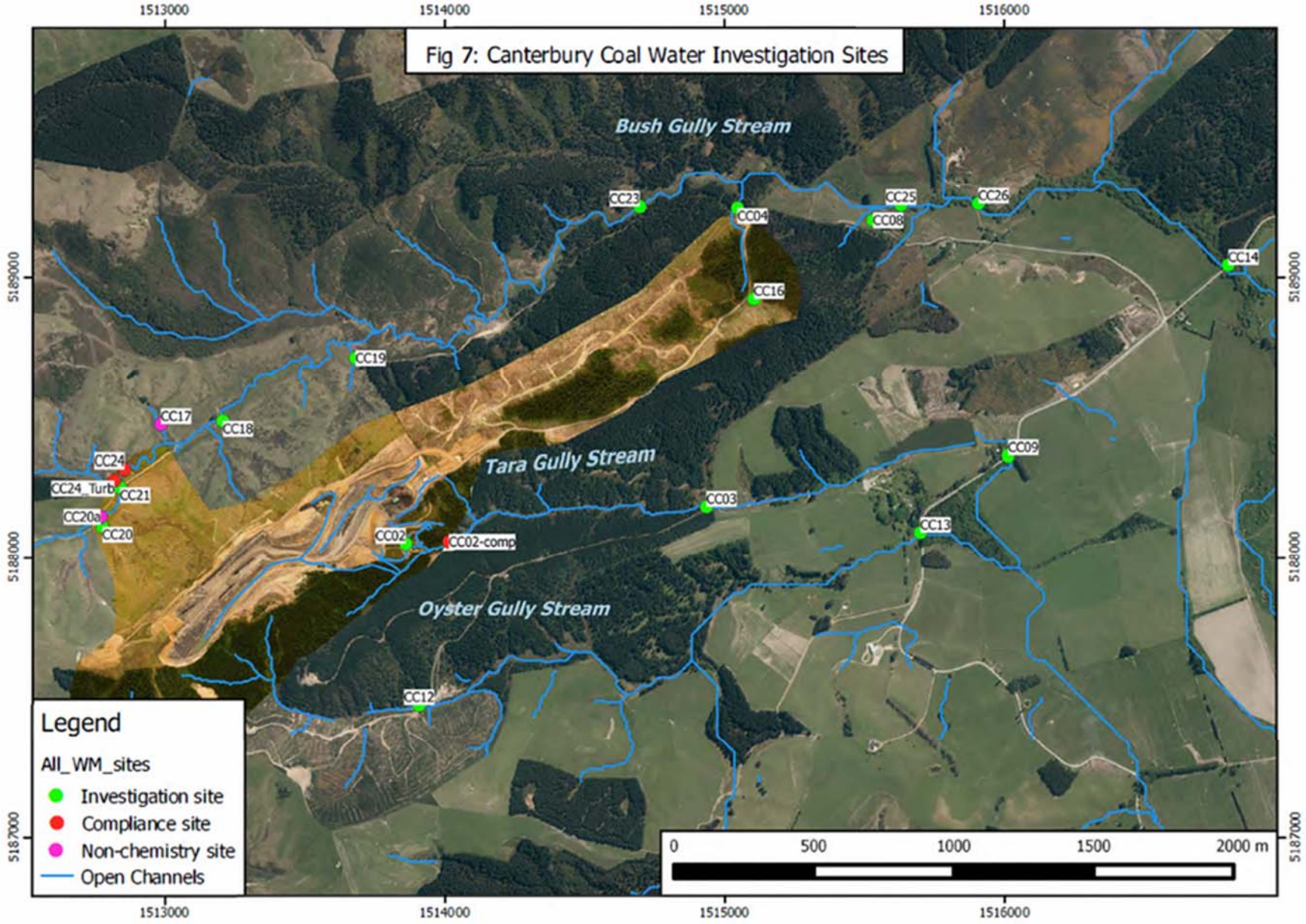


Figure 3 - Proposed Final Drains