Memo

From	**James Griffiths, NIWA**
To	**Campbell Robertson, Bathurst Resources Ltd**
CC	**Eden Sinclair**
Date	**16 March 2021**
Subject	**Canterbury Coal Mine Closure – hydrology**
Client Report No:	*2021053CH*

1 Background

During 2018–2020, Bathurst Resources Limited (Bathurst) applied for resource consent for retrospective and future activities at the Canterbury Coal Mine (CCM), and the bundled consent applications were publicly notified in 2020. Bathurst is now proceeding with mine closure at CCM and has received several queries from Environment Canterbury (ECan) and Selwyn District Council (SDC) pertaining to the hydrology of the draft project description (for mine closure). This memo provides a response to those queries based on information held within the water management sections of the CCM Closure Project Description and associated documents (see Documents Reviewed Table at end of report).

2 Effects of final landform on NW seepages and spring

2.1 Query

ECan: Under the new mine closure consent proposal, the quarried ridge on the northern margin of the mine operational area (MOA) will now not be reinstated (a change from previous proposal). How does the proposed final landform influence the hydrology of the seepages and spring on the NW slopes outside of the MOA? The previous assessment by "Jens Rekker", in his "December 2019 Response on Hydrological Matters", stated that 'The rehabilitated final landform will restore the pre-existing shallow, downslope seepage'.

As pointed out at meeting last week by Ecan groundwater hydrologist Fouad Alkhaier, this will have implications for hydrology (water supply) to springs and seepage wetlands on the hillslope north of the current MOA. Hydrological impacts will have flow-on effects on seepage wetland ecology. These hydrological and ecological effects need to be assessed, and measures proposed to manage impacts on affected wetland areas.

2.2 Response

As part of the mine closure planning, the quarried ridge on the northern margin of the mine operational area (MOA) will not be reinstated. As a result, surface water run-off that previously would have drained north into the Bush Gully, will now drain towards the proposed No. 2 pit pond to the south of the original catchment divide. Figure 1 illustrates the quarried area (2.16 Ha) that used to contribute runoff to the wīwī rushland on the north slope (shown by solid black line). Figure 2 (top) illustrates the cross-section location of a seepage wetland relative to the original catchment divide and associated north running surface runoff. Figure 2 (lower) illustrates the proposed areas of infill and No.2 pit pond. Infill landscaping up-gradient of the wetland will continue to allow infiltration of rainfall up-gradient of the seepage wetland.

The extent to which the seepage wetland to the north of the current MOA will be impacted by the proposed landscaping will depend on the extent to which the wetland is dependent on surface-water runoff, the contributing area of which has been reduced. If the wetland is predominantly dependent on surface water runoff, the impact of the proposed closure plan will be proportionate to the change in the surface-water catchment area. However, if the wetland is predominantly dependent on groundwater and infiltrated water, there will be less impact.

Jens Rekker (16-12-2019) indicated that the seepage wetlands are most likely sustained by shallow or superficial groundwater movement in a downslope direction. In addition, he indicates that deeper groundwater movement is controlled by preferential permeability along the strike of the strata (i.e., in the east-west) direction rather than the dip (south-north) direction. It is also understood that the seepages are promoted by hydrostatic pressure within the bedded Broken Rover Coal measure formation which would not be impacted by changing surface water catchments (Bathurst Resources Ltd, 16-12-2019). This suggests that in addition to shallow sub-surface seepage from up-slope infiltration, there may be lateral seepage of groundwater in the gulley.

In Figure 1, the line of surface water flow convergence (shown as blue line) has be derived from surface topographic contours. The raised spring area (purple), lies just outside this line. The surface water contributing area itself is seen to be relatively small (shown as yellow line). This suggests that the raised spring is fed by predominantly sub-surface rather than surface water drainage.

Recent inspection of the site (see photos in Figure 3) indicate that seepage to the raised spring area has not been severely impacted during the current mining operations. This suggests that there is sufficient sub-surface drainage to this area to maintain the raised spring.

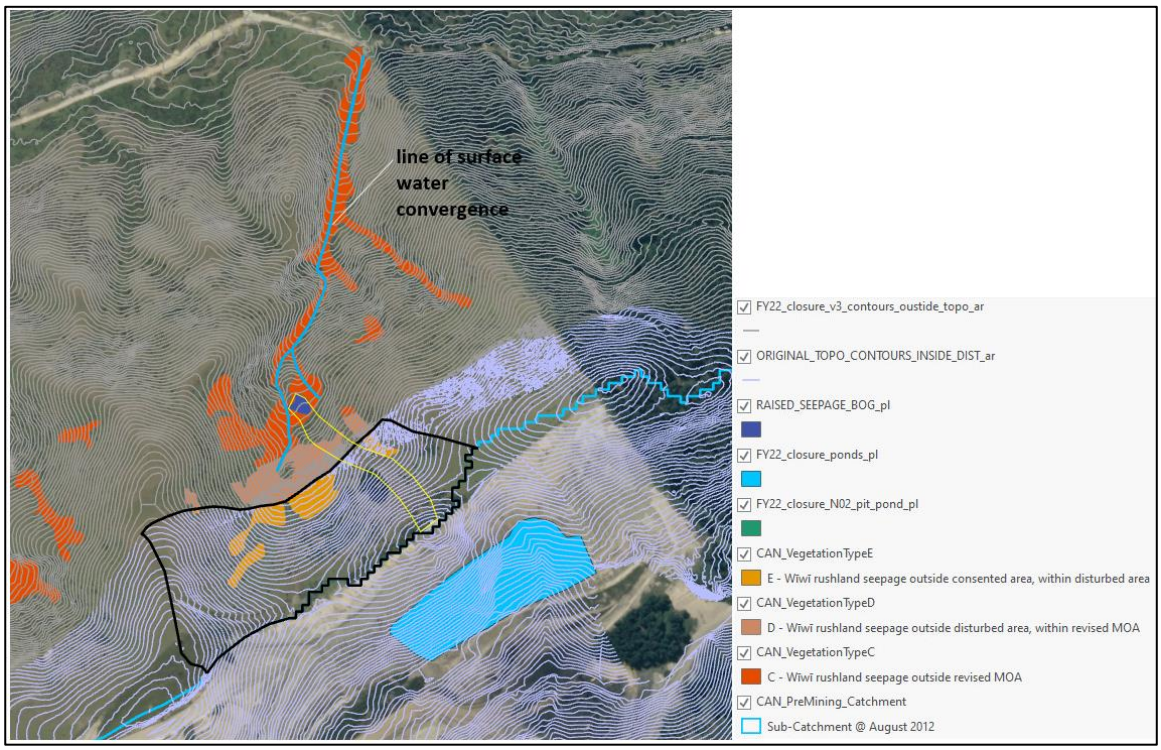


Figure 1: Quarried ridge on northern margin of MOA illustrating area of reduced surface runoff (solid black line). Original land surface colour contours are coloured to indicate area within (blue contour) and outside (red contour) final MOA. Blue line indicates contour line convergence areas and thus main drainage line. Yellow line indicates surface water contributing area to the raised seepage area.

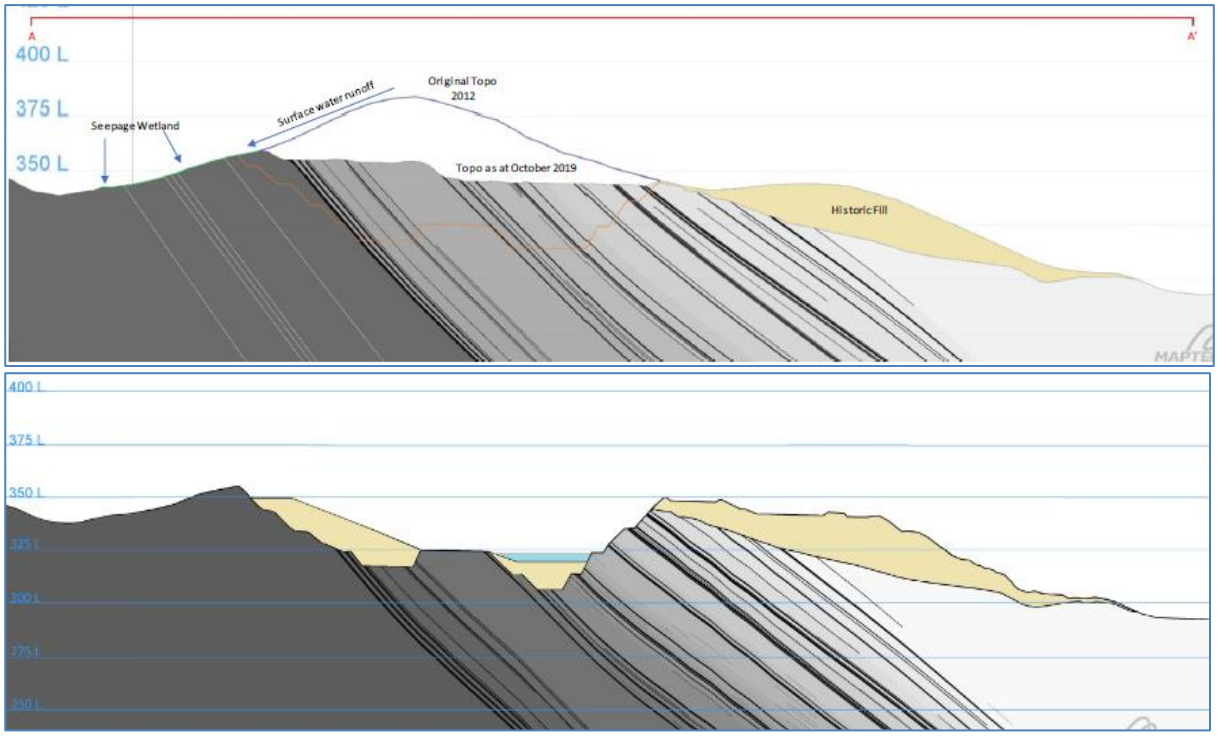


Figure 2: Profile through section A-A' (running north-south). Showing current topography and location of seepage wetland north of the MOA (top); and proposed closure landform (lower).

3 Surface water flows at closure in relation to proposed landforms

3.1 Query

In addition to the overall changes in sub-catchment areas, the final landform will include a new pond feature which will capture some water, rather than the slope being reinstated to shed water. Some assessment of how this influences the hydrology of the Tara wetland/stream is necessary.

3.2 Response

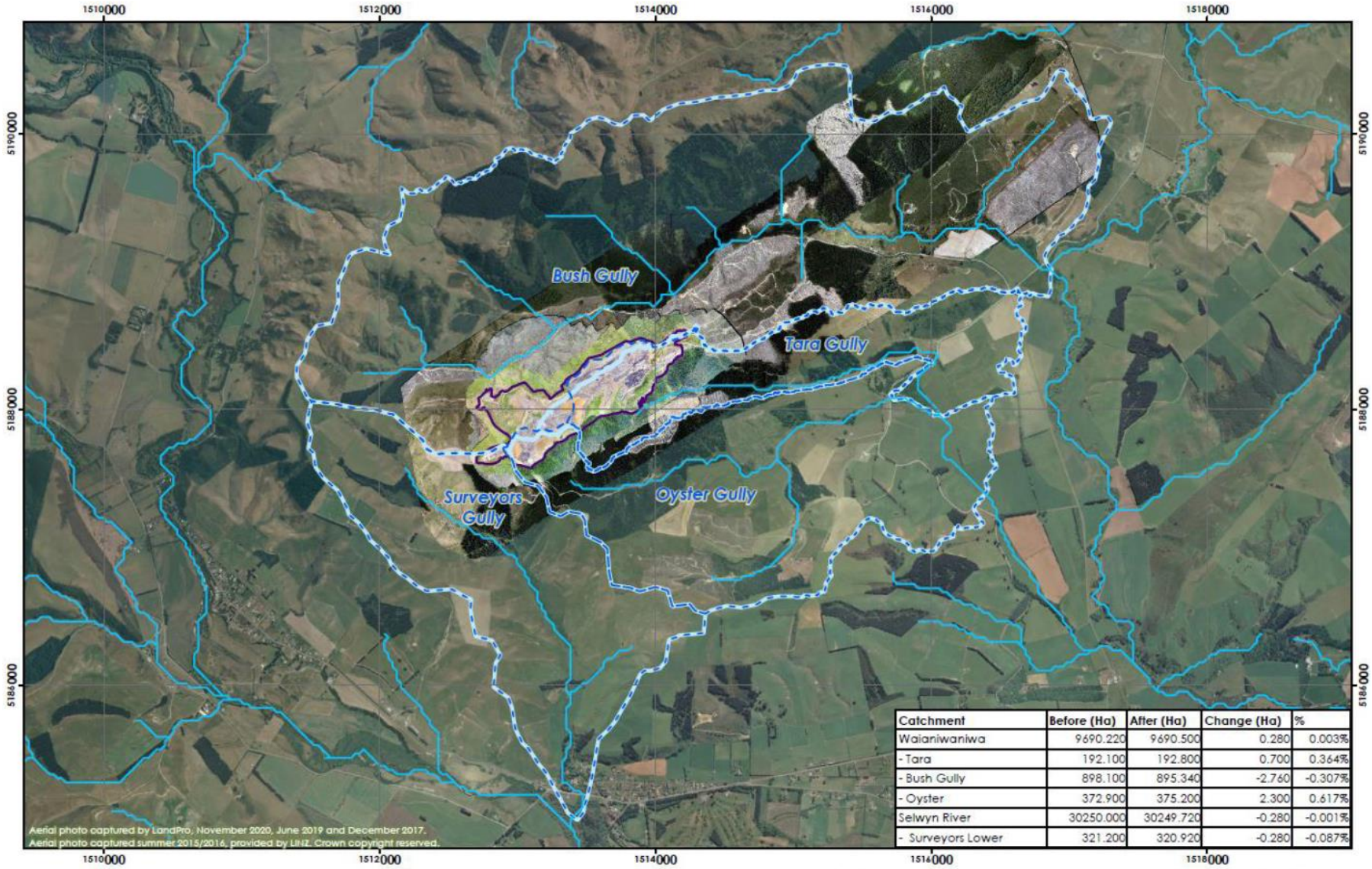
Changes to sub-catchment boundaries on mine closure, compared to before mining, are shown in Figure 3. Changes to all sub-catchment areas are relatively small, ranging from 0.617% (Oyster catchment) to -0.307% (Bush Gulley). It is noted from Figure 4 that whilst a section of the Tara catchment is lost (west side of MOA) a similar-sized section in gained (north of MOA).

The impact of the No2 pit pond, spillway and drainage channel (shown in Figure 5) will be to buffer surface water runoff, i.e., reduce peak runoff but sustain low flows (to an extent determined by the spillway threshold). It is envisaged that the spill level of the No2 pond could be managed with the lower Tara pond to ensure minimum low flows to the Tara catchment are sustained.

Documents reviewed

Date	Item
15-02-2021	Canterbury Coal Mine, Resource/LUC Consent Project Description, Bathurst Resources Limited. [*Can-Mine-Closure-2021.02.15-V5.3*]
16-12-2019	Jens Rekker, JH Rekker Consulting Ltd – 'Attachment 4' Response on Hydrological matters.
16-12-2019	Bathurst Resources Ltd – Further Information Response. [*03_01 Final Bathurst RFI 19Dec19_SUBMITTED.pdf*]

Figure 3: **Photos of raised spring (top left) and surrounding rushland north of the MOA.**



Catchment	Before (Ha)	After (Ha)	Change (Ha)	%
Waianiwaniwa	9690.220	9690.500	0.280	0.003%
- Tara	192.100	192.800	0.700	0.364%
- Bush Gully	898.100	895.340	-2.760	-0.307%
- Oyster	372.900	375.200	2.300	0.617%
Selwyn River	30250.000	30249.720	-0.280	-0.001%
- Surveyors Lower	321.200	320.920	-0.280	-0.087%

Figure 4: Catchment areas at Canterbury Coal Mine – table indicates surface catchment area before and after closure (map provided by Bathurst)..

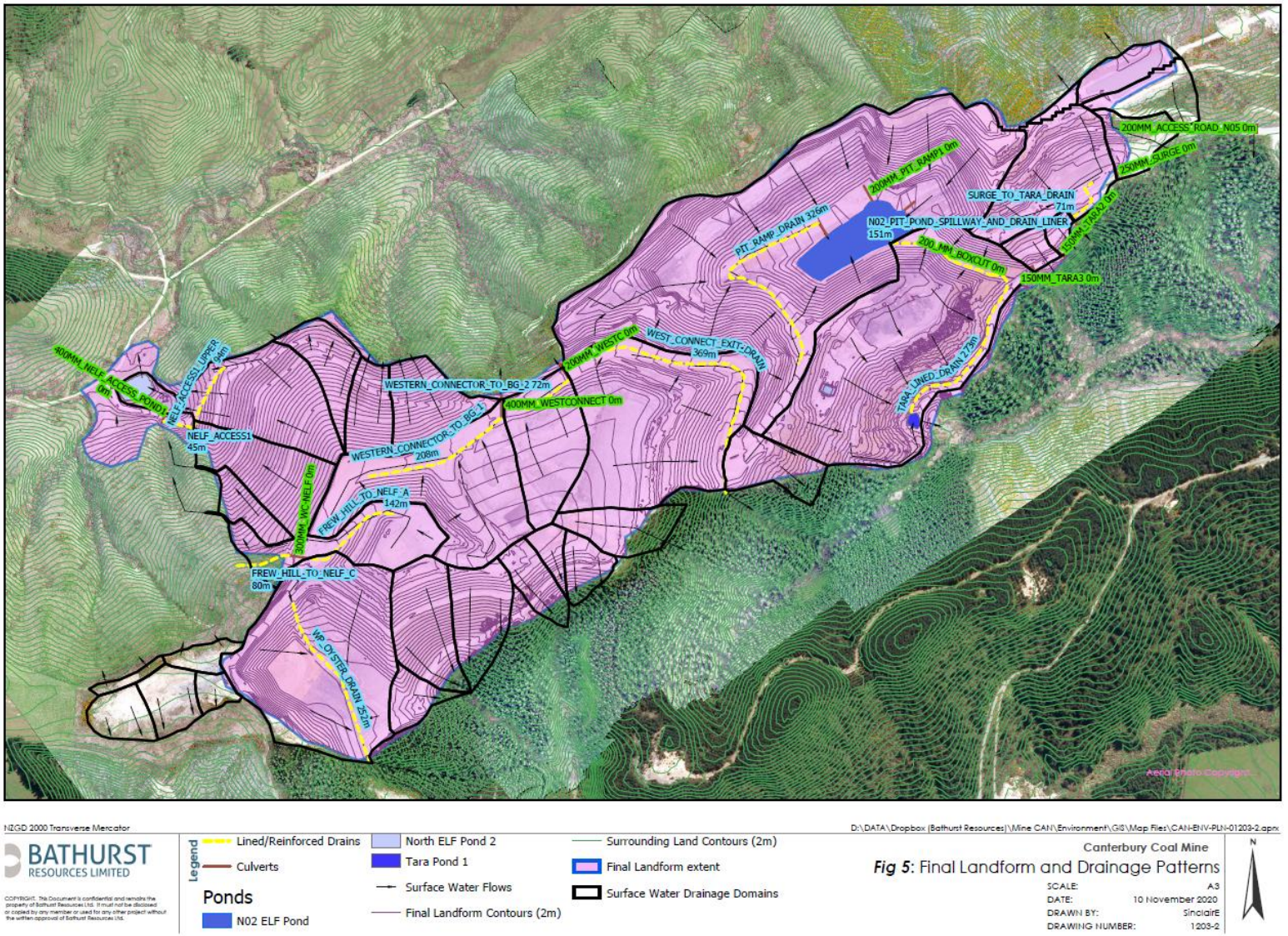


Figure 5: Final landform drainage patterns (map provided by Bathurst).