

16 July 2021

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CC: Rose-Anne Hawkeswood

Dear Stephen,

Dendrobium Mine – Wongawilli Creek Performance Measure

I refer to the Longwall 18 Subsidence Management Plan (SMP) Approval Condition 10(a) of Schedule 4 requiring IMC to demonstrate the relevant watercourse performance measure for Wongawilli Creek (i.e. minor environmental consequences) has not been exceeded by longwall extraction and would not be exceeded by extraction of Longwall 17, before the longwall can continue with the final 200 m of extraction (or within 600 m but no closer than 400 m of Wongawilli Creek).

The SMP Approval defines minor environmental consequences as:

- *minor fracturing, gas release and iron staining; and*
- *minor impacts on water flows, water levels and water quality.*

Monitoring of Wongawilli Creek has been undertaken in accordance with the *Area 3B Watercourse Impact Monitoring, Management and Contingency Plan* and the *Wongawilli Creek and Waterfall 54 Management Strategy*. Table 1 provides a summary of the monitoring that has been undertaken on Wongawilli Creek during the extraction of Longwall 17 to date and indicates the current trigger level in accordance with the Trigger Action Response Plan.

Table 1 Wongawilli Creek Monitoring and Assessment

Monitoring	Sites	Date of Assessment	Comments	Trigger Level
Observational (visible fractures, gas releases and iron staining)	WC_Prop1, WC_Prop2, WC_Prop3, WC_Prop4, WC_Prop5, WC_Prop6 WC_Pool39, WC_Pool51	15 July 2021	No fracturing, gas releases or iron staining observed on Wongawilli Creek	Not triggered
Water Quality	WC_Pool49, WC_Rockbar39	15 July 2021	No water quality impacts observed on Wongawilli Creek	Not triggered
Pool Water Level	WC_Prop1, WC_Prop2, WC_Prop3, WC_Prop4, WC_Prop5, WC_Prop6 WC_Pool39, WC_Pool51	15 July 2021	No pool water level impacts observed on Wongawilli Creek	Not triggered

Table 1 (continued) Wongawilli Creek Monitoring and Assessment

Monitoring	Sites	Date of Assessment	Comments	Trigger Level
Surface Water Flow Assessments A - C	WWL	01 July 2021	No water flow impacts observed on Wongawilli Creek	Not triggered
Surface Water Flow Assessment D	Pools on Wongawilli Creek downstream of WWU1	07 July 2021	No water flow impacts observed on Wongawilli Creek	Not triggered

The TARP assessments detailed above were undertaken to demonstrate IMC meeting the Wongawilli Creek performance measure of minor environmental consequences, were undertaken at the point where Longwall 17 had approximately 600 m of extraction remaining.

As agreed in previous discussions with the Department, this distance was selected to allow for IMC to undertake the surface water flow assessments A – D (which is provided in Attachment A) and also to allow sufficient time for the Department to undertake their assessment without risking halting the extraction of the longwall. Watershed Hydrogeo's assessment (Attachment A) reached the conclusion *"The watercourse Performance Measure for Wongawilli Creek of no more than minor environmental consequences (including minor impacts on water flows, water levels and water quality) has not been exceeded to date. Given the previous extraction of 11 longwalls in Areas 3A and 3B, the Performance Measure is not likely to be exceeded by the extraction of Longwall 17"*. Given this conclusion and IMC's experience in Dendrobium Areas 3A and 3B, it is considered the Wongawilli Creek Performance Measure of "minor consequence" has been met and is not likely to be exceeded by extraction of Longwall 17.

As of 16 July 2021, Longwall 17 has extracted 1,466 m with 538 m remaining. Production modelling predicts that **Longwall 17 will reach 200 m remaining on 20 August 2021**.

IMC is seeking the Departments concurrence that the performance measure for Wongawilli Creek has not been exceeded and is not likely to be exceeded by the extraction of Longwall 17.

If you have any queries, please do not hesitate to contact myself or Gary Brassington.

Sincerely



Cody Brady
Principal Approvals

Attachment A

16 July 2021

Watershed HydroGeo

ABN: 95 615 827 499

81 North St, Nowra N.S.W.

AUSTRALIA 2541

To: Cody Brady
Principal Mining Approvals
Illawarra Metallurgical Coal

will.minchin@watershedhg.com

cc: Josh Carlon

From: Will Minchin

Memorandum: Analysis of Waterfall WF54 and Wongawilli Creek hydrology - 20210712

Your Ref: Request by IMC, 29/06/2021

Our Ref: IMC110-M030

1 Introduction

Waterfall WC-WF54 is a waterfall that is approximately 20 metres (m) high and located on the upper reaches of Wongawilli Creek. WC-WF54 is located adjacent to the Dendrobium Area 3B mining domain. The centreline of the waterfall is 440 m from the approved finishing end of Longwall 17 and over 1 kilometre (km) from the finishing end of Longwall 18.

Performance Measures n set by NSW Department of Planning, Industry and Environment (DPIE) related to the waterfall and Wongawilli Creek hydrology are:

- **Waterfall WC-WF54:** Negligible environmental consequences including: ...negligible diversion of water from the lip of the waterfall.
- **Wongawilli Creek:** Minor environmental consequences including: ...minor impacts on water flows, water levels and water quality.

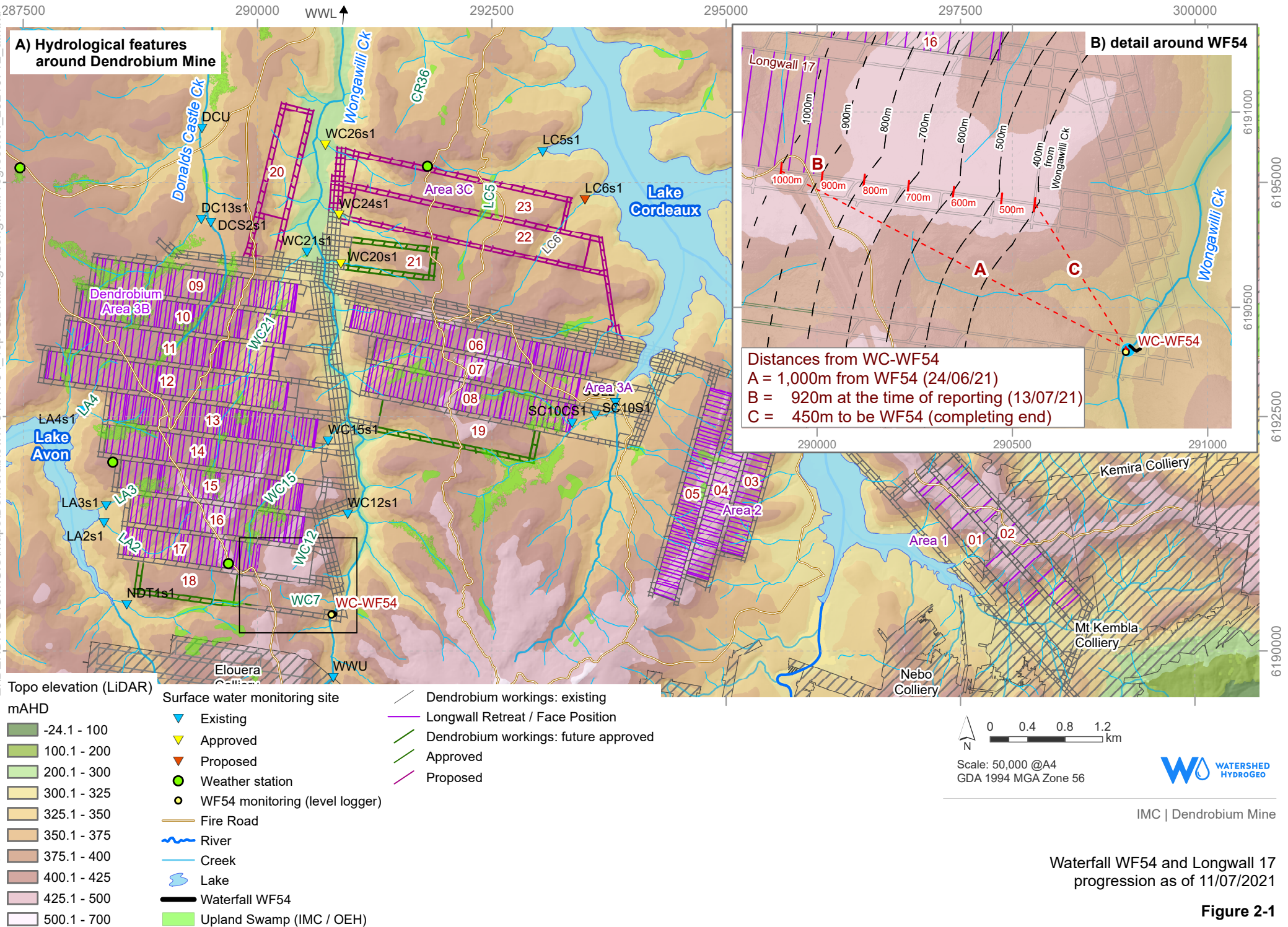
The Wongawilli Creek and WC-WF54 Management Strategy (IMC, 2021) has been approved to monitor and manage the extraction of Longwall 17 and Longwall 18 and to ensure that the relevant DA3B performance measures are met. This memorandum presents WatershedHG's analysis of hydrology at Waterfall WF54 and along the upper or mid-reach of Wongawilli Creek, as required by that management plan (IMC, 2021). These assessments are documented in Section 3, based on the progressive extraction of Longwall 17 which is documented in Section 2 and Figure 2-1.

2 Longwall 17 progression and proximity

Longwall 17 is currently being extracted. The details of this longwall, including details at the time of reporting, are outlined in Table 2-1. As noted, at the time of reporting, the face of Longwall 17 is currently approximately 920 m from the waterfall and Wongawilli Creek. Based on current progression rates, Longwall 17 is expected to be completed in early November 2021.

Table 2-1 Longwall 17 details (as of 11/07/2021)

Date	Progression from start (m)	Face distance from Wongawilli Ck (m)	Face distance from WC-WF54 (m)	Distance from Finishing End (m)
12/12/2020	0 (start)	2315	2315	2005
23/06/2021	1345	1000	1000	660
11/07/2021	1431	923	923	574



3 Assessment of hydrology

The assessments of hydrological behaviour, based on existing and dedicated monitoring are summarised in Table 3-1. For future assessments, the date at which Longwall 17 first approaches to a distance of 800 m of WF54 (Section 2) will be used as the cut-off between “pre-mining” and subsequent “post-mining” conditions. **For this preliminary assessment only, a distance of 1100 m from WC-WF54 is used. That was reached by Longwall 17 on 06/06/2021 and selected because it provides 1 month of data as a proxy for “post-mining”.**

Table 3-1 Assessments of Wongawilli Creek (WWL) and WF54 hydrology

Assessment	Parameter or behaviour	Basis for assessment
SW flow TARP Assessment A	Flow percentiles; as an indication of any changes to ‘general’ hydrological behaviour.	Comparison against flow statistics from agreed Reference Sites.
SW flow TARP Assessment B	Cease-to-flow frequency; changes to this can be important to ecological values.	Comparison against flow statistics from agreed Reference Sites.
SW flow TARP Assessment C	Median flow (Q50); changes to which are relevant to the available water resource.	Comparison against flow statistics from agreed Reference Sites.
SW flow TARP Assessment D	Observations of no flow at pools along the ‘middle’ reach of Wongawilli Creek, as an indicator of low flow and reduced connectivity.	Visual observations by IMCEFT of flow/no flow at pools, and comparison against model estimates of flow reduction
Pool 54 hydrology	Pool levels (stage) at the top of WF54.	Comparison against pool levels measured upstream at WWU.

Of the analyses in the table above, the first three are broader in their scope, assessing effects along Wongawilli Creek at the downstream gauge WWL.

The fourth (Assessment D) is focussed on the ‘middle’ reach of Wongawilli Creek, downstream of WWU to the confluence with WC21 (near Longwall 9).

The fifth assessment focusses on water level (stage) measured at or just above the lip of WF54. The relationship of levels in the WF54 pool and that measured using the same type of Orpheus pressure sensor in the upstream WWU pool is used as a proxy for the relationship of stream flow at the two sites (IMC, 2021).

The analysis for each assessment is provided in the subsections below. Details of the methods for TARP Assessments A-D, as used in End of Panel reports, are documented in the WIMMCP (IMC, 2020) and Watershed HydroGeo (2019).

3.1 Data

Hydrological data has been supplied by IMC and hydrographic consultants ALS. Mine plan data was supplied by IMC. Daily flow and stage data for O’Hares Creek @ Wedderburn (GS 213200), which is used as a Reference site, was obtained from WaterNSW.

Flow data for the gauging stations is currently available as outlined in Table 3-2.

Table 3-2 Data availability of key gauging stations

Gauging station	Purpose	Data source	Last day of flow data available
O’Hares Creek @ Wedderburn	Reference site	WaterNSW	29/06/2021
Wongawilli Creek Upper	Reference site	ALS	1/07/2021
Wongawilli Creek Lower	Assessment site	ALS	1/07/2021

3.2 Flow TARP Assessments A – C

Wongawilli Creek lies between Areas 3A and 3B. The watercourse is not directly mined under by longwalls, but some tributaries (e.g. WC21, WC15, WC12) have been mined near or under by longwalls, including by Longwall 16. Landscape impacts, e.g. cracking at Pool 43a (now re-named to be “WC_Pool50”), have been identified in the past, but no such effects recently.

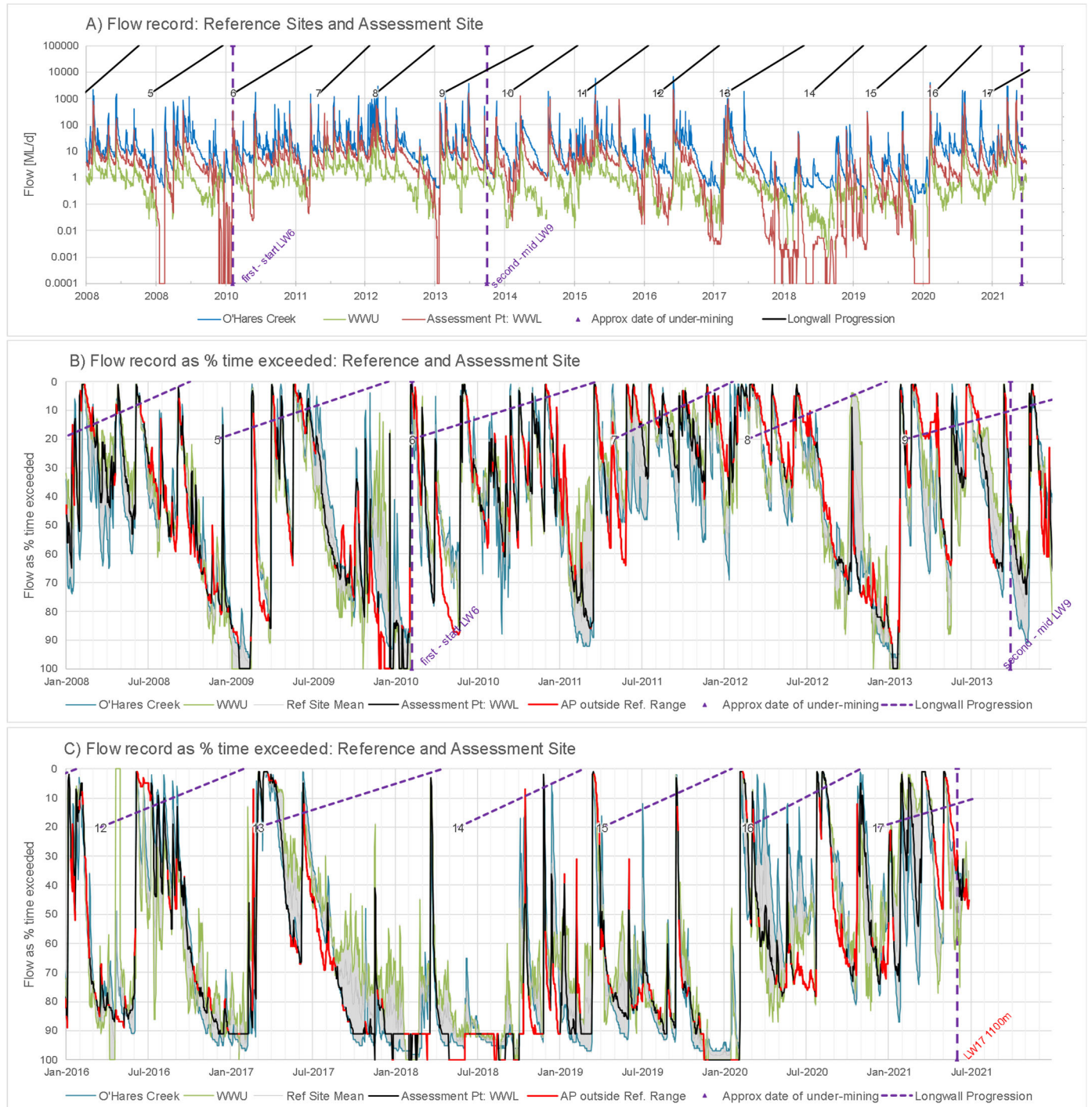


Figure 3-1 Comparison of WWL against Reference Sites A) flows; B) and C) flow duration statistics [Q%iles]

Figures B and C show the Q%ile hydrograph for the WWL Assessment Point versus the Q%ile hydrographs for the Reference Sites, O'Hares Creek and WWU. For this assessment

'natural variability' is defined as the range between the Q%ile for the Reference Sites on each day.

Table 3-3 Flow assessments A, B and C for the sub-catchment to WWL

WWL		Pre-mining	Post-mining	
		to start LW6 (Area 3A)	LW17 (approx. 1390 m extracted)	
		1/01/2008	10/02/2010	
		9/02/2010	01/07/2021	
Method A: Assessment of flow variability				
Period	Compared to Reference Sites, gauge is at:	lower flow (higher Q%ile)	higher flow (lower Q%ile)	
Pre-mining		22%	23%	of the time
Post-mining		21%	29%	of the time
Change		-1%	7%	of the time
Assessment A:				Not triggered
Method B: Change in cease-to-flow frequency				
Cease to flow as % of daily record during		pre- and post- mining periods		
Site	Pre-mining	Post-mining	Change	
O'Hares Creek	0.0%	0.0%	0.0%	
WWU	9.7%	4.3%	-5.4%	
Bomaderry Creek	10.9%	n/a	n/a	
Average Ref Site change, inc. Bomaderry Creek:			n/a%	
Average Ref. Site change ex. Bomaderry Creek (= natural variability):			-2.6%	
WWL	8.3%	4.1%	-4.2%	
	no. of cease-to-flow days increased: (inc. Bomaderry Creek):		n/a %	
	no. of cease-to-flow days increased: (ex. Bomaderry Creek):		-1.5%	
Assessment B:				Not triggered
Method C: Change to median flow (Q50)				
Reference Site Q50 [ML/d]	Q50 (pre-)	Q50 (post-)	% Change	
O'Hares Creek	9.50	8.61	-9%	
WWU	0.75	0.58	-22%	
Bomaderry Creek	5.29	n/a	n/a	
Natural variability	Min	Mean	Max	
including Bomaderry Ck	n/a	n/a	n/a	
excluding Bomaderry Ck	-22%	-16%	-9%	
Assessment Site Q50 [ML/d]	Q50 (pre-)	Q50 (post-)	% Change	
WWL	3.37	3.06	-9%	
Change beyond natural	Min	Mean	Max	
% change, including Bomaderry.	n/a	n/a	n/a	
% change, excluding Bomaderry	+12.9%	+6.9%	0.0%	
ML/d change, excl. Bomaderry	+ 0.434	+ 0.22	0.00	
Assessment C:				Not triggered

3.3 Flow TARP Assessment D

Surface water flow observations made by IMCEFT are recorded in a semi-quantitative fashion. At each field site (such as at the upstream or downstream end of a pool), an observation of flow conditions is made as follows:

0	No flow visible
1	Subsurface flow observed
2	Surface seepage observed
3	Surface trickle observed
4	Surface flow observed

Field surveys typically make an observation at each of the nominated sites around Area 3A and 3B over the period of a month. The “Outflow” results of IMCEFT’s surveys are plotted on the maps in Appendix A for June-2021 and July-2021. As far as possible, individual weeks have been plotted and reviewed, but this is not always possible and some weeks are combined, as shown in Appendix A. The symbology applied meaning that any ‘No Flow’ observations would be highlighted in the mapping.

Of the completed surveys along the main trunk of Wongawilli Creek (which is the watercourse that is subject of Assessment D), all surveys in the assessment period are “Not triggered”. This indicates that flow conditions along the middle reach of Wongawilli Creek are not clearly affected by mining (and/or weather) effects, and means that the further calculations for Assessment D are not required.

3.4 Pool 54 hydrology (water levels)

An Orpheus sensor and logger measure water levels at the WF54 pool (above the waterfall) at five-minute intervals, and has been recorded since 25/03/2020. The same type of equipment is used to measure pool levels upstream at WWU at the same interval (since 23/10/2020). This data is compared in a form of before-after-control-impact (BACI) assessment. Data is also recorded at WWU using a Diver sensor and logger, and that record is longer, but the Diver is not as accurate as the Orpheus, so the data from the Orpheus equipment is relied on. Manual water level measurements are taken regularly by IMCEFT staff at both sites to allow conversion from a measured water depth above each sensor to a mAHD and a water level above the benchmark and above the cease-to-flow control. We note that there is some inaccuracy in the manual measurements used to set the datum. During the first 7 months to November 2020, the error was up to 11 mm = 0.011 m, but procedures have improved since and the residual error is approximately 3 mm = 0.003 m.

The “pre-mining” period used for this assessment is from the beginning of the common data period (23/10/2020). The “post-mining” test period used for this preliminary analysis is 06/06/2021, as shown on Figure 3-2. The last data available for the analysis in this report is from 07/07/2021.

Figure 3-2 shows that water level in both pools (WF54 – green; WWU – dark blue) respond to rainfall and recede in a similar manner in the pre-mining period, with a consistent difference in depth of during drier periods of approximately 0.02 m (greater difference at high flows).

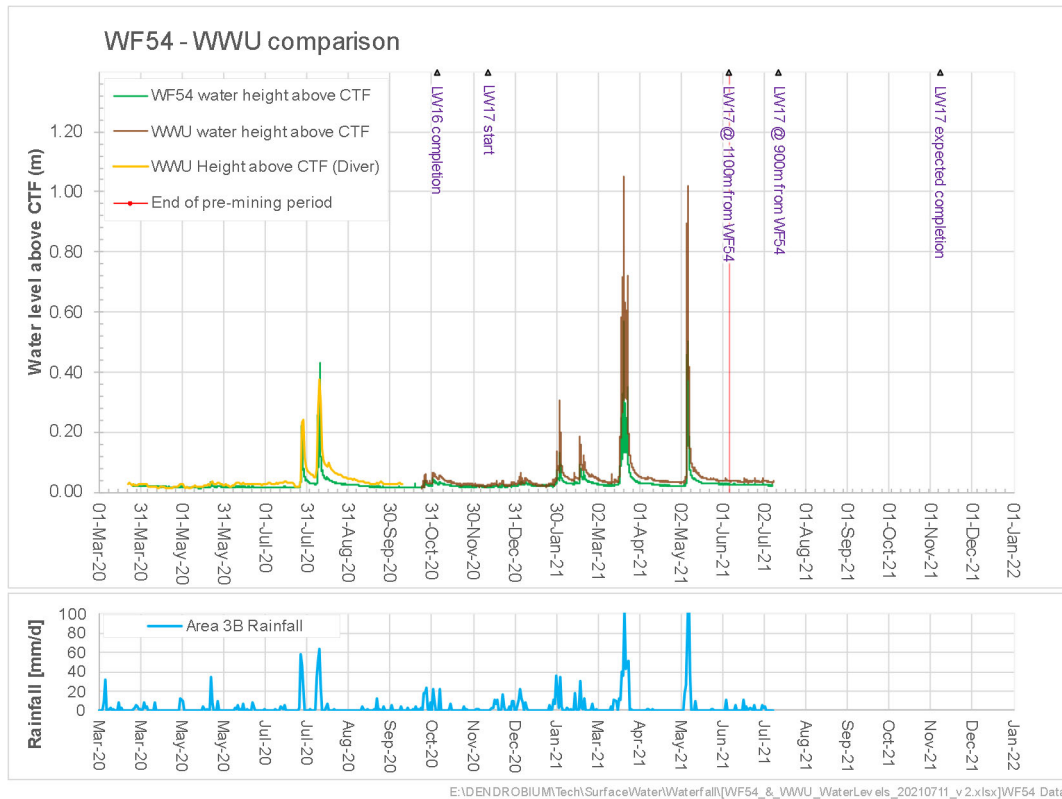


Figure 3-2 Comparison of water level (stage) data from WWU and WF54

A relationship in water levels at the two sites has been developed by plotting the data against one another for the pre-mining period. This is shown on Figure 3-3 (one linear, one logarithmic plot of the same data), where the solid blue lines represent a moving 5%/95th percentile, and the dashed blue lines shown the minimum/maximum bounds on this relationship. These ranges do not consider the error in the manual measurements noted earlier. The pre-mining data falls outside the solid blue lines 4.3% of the time (2,522 of 59,126 readings).

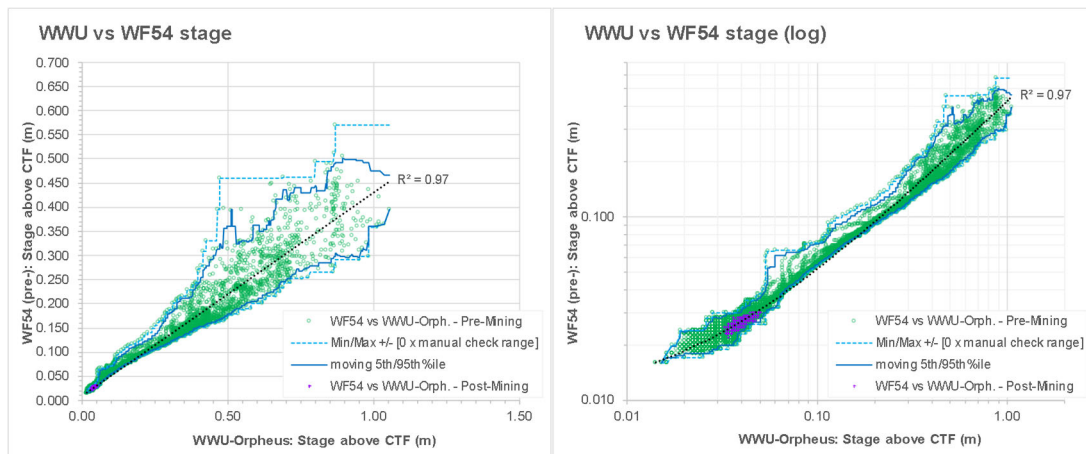


Figure 3-3 Relationship between water level (stage) at WWU and WF54

The “post-mining” data is plotted in purple on the charts in Figure 3-3. Currently, the post-mining data is in good agreement with the pre-mining relationship. It falls outside the solid blue lines 0% of the time (0 out of 9,055 readings).

An alternative method of presenting the data above is in a timeseries, where the upper and lower bounds of the “expected” WF54 stage are calculated from the upstream WWU stage, using the scatter or noise in the pre-mining data (i.e. the 5%-95%ile plotted on Figure 3-3).

This timeseries of the range in expected WF54 stage is shown on Figure 3-4. This shows the pre-mining data (green) is generally within the orange lines but occasionally strays to or outside the orange line as expected. The post-mining data is currently tracking within the expected range (orange series). This suggests no mining effect beyond natural variability.

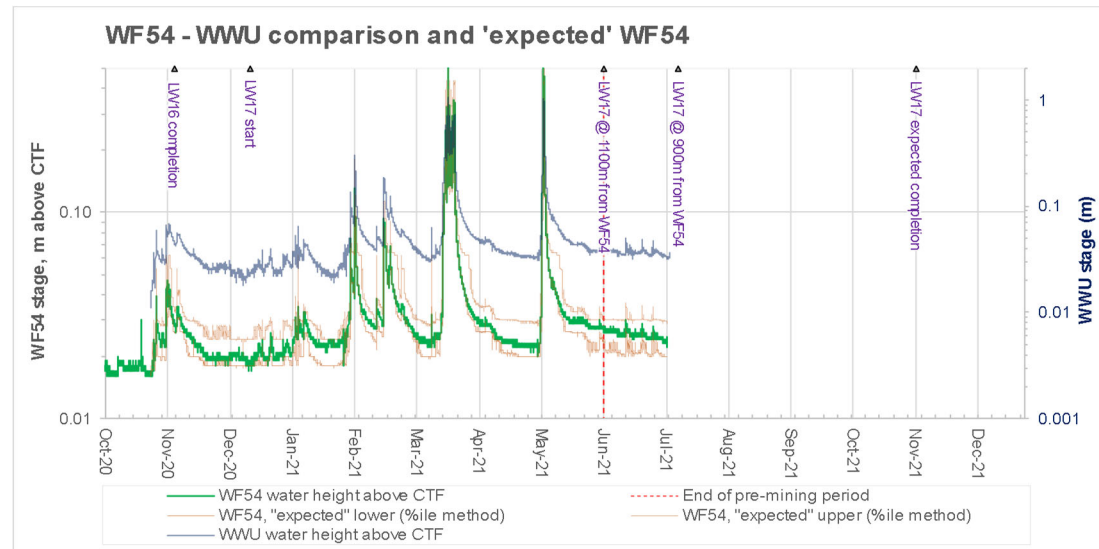


Figure 3-4 Comparison of WF54 stage with range in “expected” stage

4 Conclusions

Based on the analysis presented in this document, and the data available to date, with regard to hydrological effects of Longwall 17 (and mining in Area 3B in general):

- As of 01/07/2021 – there are no impacts, or none detected beyond natural variability, on surface water flows at the WWL gauging station on Wongawilli Creek.
- As of 07/07/2021 – there are no pools along the middle reach of Wongawilli Creek where an observation of ‘no flow’ from the pool suggests an effect on flow connectivity.
- As of 07/07/2021 – there are no impacts, or none detected beyond natural variability, on the hydrology of the pool at (above) Waterfall WC-WF54.

The watercourse Performance Measure for Wongawilli Creek of no more than minor environmental consequences (including minor impacts on water flows, water levels and water quality) has not been exceeded to date. Given the previous extraction of 11 longwalls in Areas 3A and 3B, the Performance Measure is not likely to be exceeded by the extraction of Longwall 17.

Your sincerely,

Will Minchin

will.minchin@watershedhg.com

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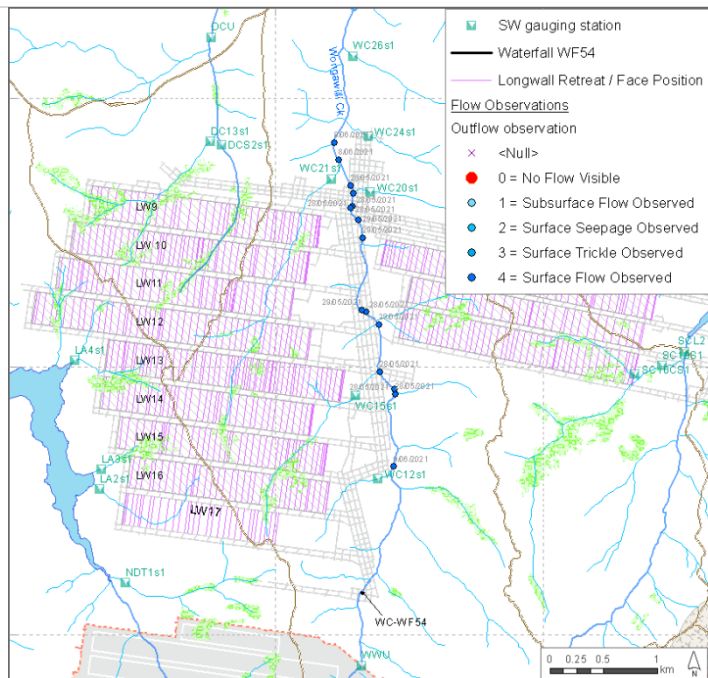
5 References

- IEPMC, 2019. Part 1 - Review of specific mining activities at the Metropolitan and Dendrobium coal mines. https://www.chiefscientist.nsw.gov.au/___data/assets/pdf_file/0004/281731/IEPMC-Part-1-Report.pdf
- IMC, 2020. Area 3B Watercourse Impact Monitoring, Management and Contingency Plan. August 2020.
- IMC, 2021. Wongawilli Creek and Waterfall 54 Management Strategy. Rev E, May 2021.
- Watershed HydroGeo, 2019. Dendrobium Area 3B: Discussion of Surface Water Flow TARPs. Report r011i5, December 2019.
- Watershed HydroGeo, 2020b. Dendrobium Area 3B: Longwall 18 Groundwater Assessment. Report r014i4, August 2020.

Appendix A – Surface water flow observations

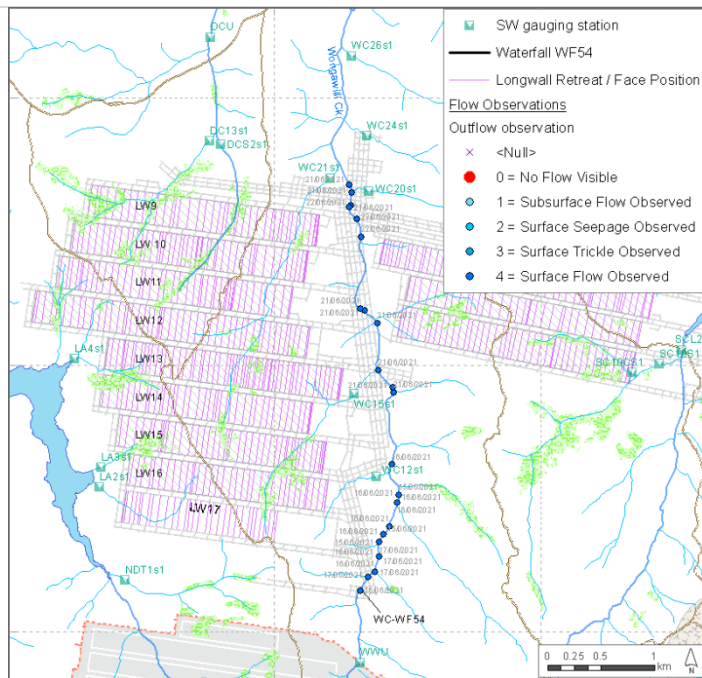
For the periods:

Early June 2021	First two weeks of June-2021 (plus last week May for completeness)	'SAMPLEWEEK' = '20210607' OR 'SAMPLEWEEK' = '20210614' OR 'SAMPLEWEEK' = '20210528'
3rd week of June 2021	third week of June-2021	'SAMPLEWEEK' = '20210621'
Last week of June 2021	last week of June-2021	'SAMPLEWEEK' = '20210628'
First week of July 2021	first week of July-2021	



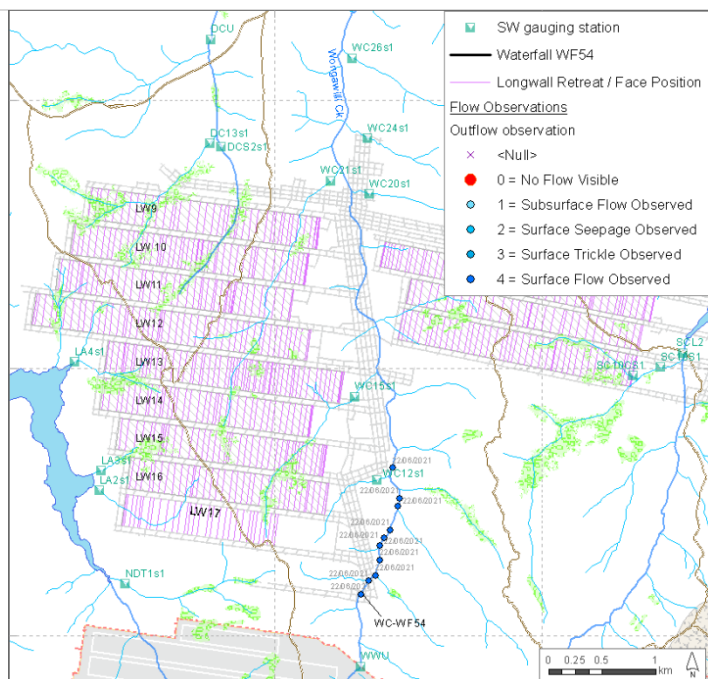
Observations: early June 2021

Assessment D not triggered



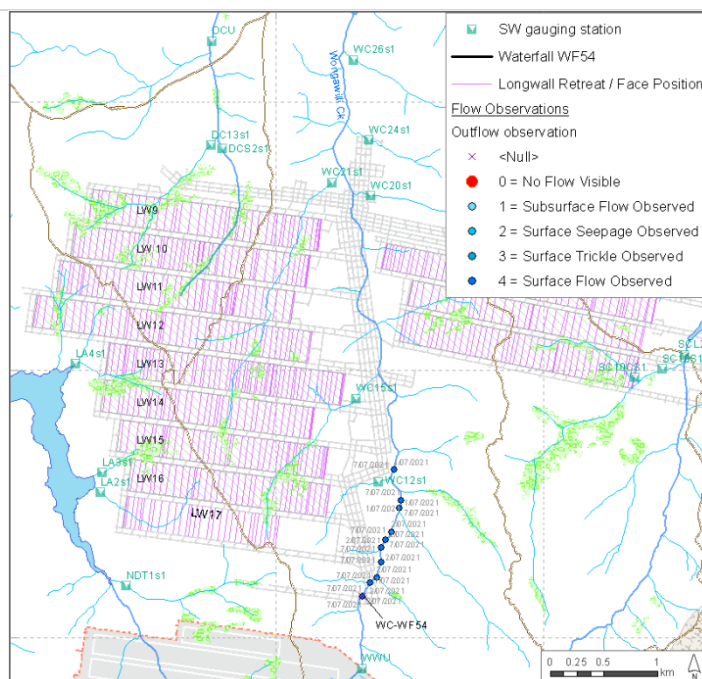
Observations: 3rd week June2020

Assessment D not triggered



Observations: last week June 2021

Assessment D not triggered



Observations: first week July 2021

Assessment D not triggered

Flow Observations

Outflow observation

- ✖ <Null>
- 0 = No Flow Visible
- 1 = Subsurface Flow Observed
- 2 = Surface Seepage Observed
- 3 = Surface Trickle Observed
- 4 = Surface Flow Observed

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Wongawilli Creek surveys