



DENDROBIUM AREA 3A LONGWALL 19 SUBSIDENCE MANAGEMENT PLAN Reasons for Approval

1. DEVELOPMENT CONSENT

- South32 Pty Ltd's (South32's) Dendrobium Coal Mine was approved by the then Minister for Planning in 2001 following a Commission of Inquiry and was subsequently modified by a later Minister for Planning in December 2008 (Mod 6). The 2008 modification significantly reduced the potential water impacts of the approved mine by removing longwall mining from under large sections of Wongawilli Creek and Sandy Creek.
- The existing development consent, as modified, expressly allows longwall coal mining in mining Areas 1, 2, 3A, 3B and 3C. Longwall mining has already occurred in Areas 1 and 2, the remainder of Area 3A and most of Area 3B.
- While the mining in Area 3A (including the area covered by Longwall 19) is already approved, the development consent requires a Subsidence Management Plan (SMP) for progressive longwalls to be approved before any mining can occur.
- The preparation of a SMP allows the assessment of impacts on all built and natural features to be focused at the local level, ensuring that impacts are appropriately monitored, and impact management regimes are further refined during the life of the project in response to subsidence monitoring and recorded impacts. SMPs may cover a group of longwalls, or in this case a single longwall (ie Longwall 19). Each SMP is prepared in consultation with relevant NSW Government agencies.
- The existing consent expressly notes that, in approving an SMP, the Secretary may "*impose conditions containing subsidence impact limits, subsidence management mechanisms or other conditions*" (condition 8 of Schedule 3). SMPs, including performance measures and monitoring requirements, provide a framework to avoid, minimise and mitigate subsidence impacts and maintain a robust adaptive management framework.

2. BACKGROUND

- Area 3A was originally proposed by South32's subsidiary Illawarra Coal to contain five longwall (LW) panels (at that time termed as LW6 to LW10). However, detailed geological mapping demonstrated that a known major underground igneous intrusion, the Dendrobium Nepheline Syenite, was more extensive than originally thought. This led South32 to decide not to extract its proposed LW10 and instead to widen the proposed longwall void widths of LW8 and LW9 from 249 metres (m) to 305 m. In addition, because LW9 was shortened substantially at its eastern end (to avoid the intrusion), South32 decided to extract it from east to west (ie towards the main headings developed to extract Area 3B), rather than from west to east (ie towards main headings developed to extract LW6 to LW8). Because the proposed LW9 would have to be extracted following extraction of LW18 in Area 3B, it was renumbered as LW19.
- An SMP covering all of Area 3A (ie LW6 to LW8 and LW19) was conditionally approved by the Department on 28 June 2010. Following finalisation of a Sandy Creek Waterfall Management Plan (as required by that conditional approval), the SMP was unconditionally approved on 18 November 2010. That is, there is already an existing SMP approval covering the proposed extraction of LW19.
- LW6 to LW8 were extracted between February 2010 and December 2012.

3. SMP APPLICATION

- On 18 March 2020, South32 lodged an application on the Department of Planning, Industry and Environment's (the Department's) Planning Portal, on behalf of South32's subsidiary Illawarra Metallurgical Coal, for a fresh approval of a revised and updated SMP for the extraction of LW19. LW19 is proposed to be extracted between April and December 2022, following extraction of LW18 between October 2021 and March 2022.
- The draft SMP comprised a number of documents. In addition to the SMP itself (which is somewhat of a summary document), conditions of consent require that the SMP integrates two other, more detailed plans, being the Watercourse Impact Monitoring, Management and Contingency Plan (WIMMCP) and the Swamp Impact Monitoring, Management and Contingency Plan (SIMMCP). Each of these two plans also contains a Trigger, Action, Response Plan (TARP). Most of the detailed monitoring, management, remediation and contingency measures applicable under the SMP are contained within the WIMMCP and SIMMCP and their associated TARPs.
- South32's draft SMP was also supported by seven specialist assessments and a peer review addressing subsidence effects, impacts and consequences, but these do not comprise part of the SMP itself.
- On 15 January 2021, South32 submitted a revised Sandy Creek Waterfall Management Plan (SCWMP) as part of its response to the Mining Panel (see Section 6 below). On 18 February 2021, South32 submitted a revised WIMMCP and revised SIMMCP. The amendments addressed the need for these documents (substantially revised since their 2010 equivalents) to refer to LW19 alone, rather than all of Area 3A. On 5 March 2021, South32 submitted a revised SMP which contained minor amendments to reflect the revised WIMMCP and SIMMCP and the newly applicable SCWMP.
- South32 is therefore seeking approval for its SMP dated March 2021, which includes the WIMMCP and SIMMCP dated February 2021 and the SCWMP dated January 2021.

4. KEY MINING PARAMETERS

- The SMP shows that LW19 would be the last and most southerly longwall proposed to be extracted from the Wongawilli Seam in Area 3A. LW19 is proposed to be located to the south of the extracted LW8 and east of Wongawilli Creek and to be oriented generally east-west. The extraction direction is from east to west.
- The proposed total void length for LW19 is 1760 metres (m) and the proposed total void width (ie including first workings) is 305 m. The maximum mining height would not exceed 3.9 m, but is more likely to be 3.5 to 3.7 m due to seam thickness constraints.
- The depth of cover from LW19 to the surface varies between 280 m and 370 m.
- The SMP's Study Area is defined by the outermost of any of three variables – the 35° angle of draw, the predicted 20 millimetre (mm) vertical subsidence contour, and all sensitive natural features located laterally within 600 m of the proposed void area.
- South32 has designed the mining layout of LW19 to avoid Wongawilli Creek to the west, the major igneous intrusion and a number of significant geological faults.

5. CONSIDERATION BY AGENCIES

- On 17 April 2020, the Department sought comments on South32's draft SMP from WaterNSW, the Department's Biodiversity Conservation Division (now the Biodiversity, Conservation and Science Directorate (BCS)) and Water Group (including the Natural Resource Access Regulator), the Department of Regional NSW's Division of Mining, Exploration and Geoscience (MEG), Dams Safety NSW (DSN), the NSW Resources Regulator and Subsidence Advisory NSW. Advice was received from each of these agencies.
- South32 provided the Department with a response (RTS) to the issues raised by agencies (principally BCS, the Resources Regulator and WaterNSW) on 16 July 2020. South32 provided a response to the issues raised by the Water Group on 23 November 2020. These responses were forwarded to the affected agencies for further comment.
- Additional comments were received from BCS, the Resources Regulator and WaterNSW. These comments have been carefully considered by the Department.

6. CONSIDERATION BY INDEPENDENT ADVISORY PANEL FOR UNDERGROUND MINING (THE MINING PANEL)

- Following the Government's adoption of the recommendations of the Independent Expert Panel on Mining in the Catchment (the Catchment Panel), a new independent subsidence advisory panel was established in August 2020. The new Independent Advisory Panel for Underground Mining (the Mining Panel) is chaired by Emeritus Professor Jim Galvin, who also chaired the Catchment Panel.
- On 28 October 2020, the Department wrote to Prof Galvin seeking advice on the draft SMP. This request for advice focussed on the following:

"The Department requests advice from the Panel as to the:

- *likely impacts on Swamp 15a and whether the proposed longwall panel design would meet the performance measure required under Schedule 3 Condition 5, and performance indicators outlined in the SMP – Area 3A Swamp Impact Monitoring, Management and Contingency Plan;*
- *feasibility and potential environmental benefits of the option of mining west to east with an adaptive management approach to manage impacts on Swamp 15a; and*
- *appropriateness of the proposed 175 m setback distance from Wongawilli Creek in relation to the performance measure of "minor impacts" as required by Schedule 3 Condition 2 of the consent and proposed performance indicators outlined in the SMP – Area 3A Watercourse Impact Monitoring, Management and Contingency Plan.*

The Panel should also feel free to provide any other advice it considers would assist the Department in reviewing the Extraction Plan."

- The Mining Panel provided the Department with its advice on 24 February 2021. The Panel's four conclusions and five recommendations regarding the draft SMP are as follows:

"Conclusions

- *The options for adaptive management for the Sandy Creek Waterfall, Wongawilli Creek and Swamp 15a are restricted basically to the selection of appropriate setback distances.*
- *Because of the potential to increment existing valley closure, the proposed 175 m setback from Wongawilli Creek does not provide a high level of confidence that impacts on Wongawilli Creek will be contained to "minor impacts" In determining an appropriate setback, the potential for further reducing impact likelihood by small margins (up to another 3 %) needs to be judged against the required reduction in longwall length to deliver this reduced risk.*
- *As a matter of due diligence, the Technical Committee formed under the Sandy Creek Waterfall Management Plan should be engaged in determining the setback distance of LW19 from the waterfall and the appropriateness and robustness of the monitoring plan and associated trigger levels and responses.*
- *LW19 would need to be setback at least 60 m from the edges of Swamp 15a in order to satisfy Condition 5 regarding change in ecosystem functionality of this swamp.*

Recommendations

1. *The Department should embrace the proposal of South32, dated 15/1/2021, that the Sandy Creek Waterfall Management Plan be re-established and applied to the extraction of LW19.*
2. *The starting location of LW19 and the proposed monitoring plan and its associated triggers and responses should take into account the latest field survey results and be endorsed by the Technical Committee previously constituted for the Sandy Creek Waterfall.*
3. *As a minimum requirement for meeting Condition 5 regarding no change in ecosystem functionality of Swamp 15a, LW19 should be set back at least 60 m from all edges of Swamp 15a.*
4. *To avoid inadvertently approving a mine layout that could result in a breach of the Consent Conditions relating to Swamp 15a, the Department's assessment should include careful*

consideration of the environmental impacts on that portion of Swamp 15a which lies at the headwaters of SC10B, over the main gate chain pillars of LW19.

5. An additional chemistry site should be added adjacent to the proposed water level site behind the Swamp 15a controlling rockbar.”

- The Mining Panel’s advice was provided to South32 for review on 25 February. South32 provided the Department with its response on 3 March 2021.

7. KEY ISSUES

Possible Reversal of Mining Direction

- South32 has planned to extract LW19 from east to west, in the opposite direction to LW6 - LW8. The primary reason why this configuration was chosen was the time and cost involved in constructing main headings and driveages south of LW8, because they would have had to be driven through the major igneous intrusion. It was therefore preferable for South32 to extract the panel towards Area 3B’s main headings located to the west. The reasons for this mining layout were clearly set out in South32’s RTS.
- However, because this would mean that extraction would commence nearer to sensitive features such as Swamp 15a and Sandy Creek Waterfall and at the request of WaterNSW, the Department sought advice from the Mining Panel on the *“feasibility and potential environmental benefits of the option of mining west to east with an adaptive management approach to manage impacts on Swamp 15a”*.
- The Mining Panel advised that *“South32 has provided compelling reasons why it is too late to change this mining direction.”* The Mining Panel’s 1st conclusion also noted that, as a consequence, *“The options for adaptive management for the Sandy Creek Waterfall, Wongawilli Creek and Swamp 15a are restricted basically to the selection of appropriate setback distances.”*
- The Department accepts this advice and agrees with the Mining Panel’s conclusion.

Sandy Creek Waterfall

- Sandy Creek Waterfall (denominated as SW-WF1 in South32 documents) is perhaps the most sensitive natural environmental feature anywhere within or close to Area 3A, 3B or 3C. For this reason, protection of the waterfall was given particular consideration in the Department’s 2008 assessment of Mod 6. The consent contains a detailed performance measure that specifically relates to the waterfall, as follows:

“The Applicant must ensure that, as a result of the development:

(a) no rock fall occurs at Sandy Creek Waterfall or from its overhang;

(b) the structural integrity of the waterfall, its overhang and its pool are not impacted;

(c) cracking in Sandy Creek within 30 m of the waterfall is of negligible environmental and hydrological consequence; and

(d) negligible diversion of water occurs from the lip of the waterfall

to the satisfaction of the Secretary.”

- South32’s draft SMP took the view that extraction of LW19 posed little risk to the waterfall, since the longwall’s eastern end would be located 900 m from the waterfall’s centreline. However, the Mining Panel was concerned that the longwall’s extraction posed a risk of increased compressive strain and valley closure at the feature (ie, while the impacts of LW19 were expected to be minor in themselves, when considered together with those of LW6 – LW8 they may pose a significant cumulative risk). The Mining Panel posed a series of questions to South32, which provided an extensive response on 15 January 2021. *Inter alia*, South32 advised that:
 - *One of the six high-resolution survey lines used for previous monitoring of the waterfall was resurveyed on 8 January 2021 and approximately 4 mm of additional closure was measured since 18 September 2014;*
 - *The predicted closure at the waterfall due to extraction of LW19 has been revised from < 2 mm to < 5 mm;*

- *Weekly surveys (rather than monthly as originally proposed) will be carried out for the first 600 m of mining of LW19;*
- *[On the basis of the Mining Panel's concerns and the new survey results,] South32 has reactivated and updated its 2012 Sandy Creek Water Management Plan (SCWMP) developed for the extraction of LW6 to LW8;*
- *Under the updated SCWMP, a Technical Committee will (as previously) review monitoring data during the mining of LW19 and advise a Steering Committee on interpreting the monitoring results with respect to the status of the waterfall. The Steering Committee will review and assess this information, assess the acceptability of any ongoing level of risk to the waterfall and implement management actions as required; and*
- *It is extremely difficult to quantify the additional closure capacity of the waterfall as it is dependent on many factors that themselves are difficult to fully quantify....Even if these factors could be quantified, it would still be difficult to quantify the extent to which these factors influence the stability of the waterfall in its natural state or when subjected to mine subsidence effects.*
- The Mining Panel supported South32's proposals regarding reactivating the SCWMP and its Technical and Steering Committees (see its 3rd conclusion and 1st and 2nd recommendations). The Department accepts this advice and the Panel's recommendations. Conditions of approval to this effect for the SMP have been proposed.

Wongawilli Creek

- At its closest, the centreline of Wongawilli Creek is located 175 m south-west of the proposed finishing end of LW19. This proposed 175 m setback was determined by South32's subsidence consultant MSEC, using its rockbar impact model, with the aim of limiting predicted valley closure to 200 mm across any rockbar in Wongawilli Creek. However, there is only one such rockbar, which lies to the west of the centreline of LW8, some 475 m north-west of LW19. Of the total predicted closure at this rockbar (190 mm) only 20 mm is expected to result from LW19.
- The remainder of the 1.4 km length of Wongawilli Creek within the SMP's Study Area (ie that might be affected by extraction of LW19) is not characterised by rockbars. Instead, this section of the creek is a long series of shallow pools developed on bedrock, separated by shallow riffle zones, log jams and short channels. For this reason, the prediction of highest impact on these sections of the stream is more significant than the prediction of impacts on a relatively distant rockbar.
- The maximum predicted total valley-related effects for Wongawilli Creek after mining both Area 3A and Area 3B are 150 mm upsidence and 210 mm closure. The maximum predicted incremental valley-related effects due to the mining of LW19 are 50 mm upsidence and 70 mm closure. The location of the highest predicted effects from LW19 is a large pool to the southwest of the proposed finishing line.
- The Mining Panel's advice noted that the previous Catchment Panel took the view that *"a Type 3 impact should constitute an exceedance of a performance measure of minor environmental consequence"* and, further, that there is no basis for assuming that a low rate of predicted Type 3 impacts (eg < 10%) meets the condition of "minor impacts".¹ On this basis, the Mining Panel concluded:
"Because of the potential to increment existing valley closure, the proposed 175 m setback from Wongawilli Creek does not provide a high level of confidence that impacts on Wongawilli Creek will be contained to "minor impacts". In determining an appropriate setback, the potential for further reducing impact likelihood by small margins (up to another 3 %) needs to be judged against the required reduction in longwall length to deliver this reduced risk."
- However, the Mining Panel made no specific recommendation regarding Wongawilli Creek or a more appropriate setback from LW19. The Department has considered this matter carefully.
- South32's response to the Mining Panel's advice reported that it had undertaken further analysis of setback distances. Apart from the proposed 175 m setback distance, it reviewed potential reductions in subsidence risk and impacts for six additional 50 m increments in setback. The results are shown in **Table 1** below.

¹ These views did not lead to any formal conclusions or recommendations in the Catchment Panel's final report.

Table 1: Sensitivity analysis of impact risk at Wongawilli Creek with increased longwall setbacks

Description	Length of LW19 (relative to that adopted in MSEC1082)						
	Base case	Shortened 50 m	Shortened 100 m	Shortened 150 m	Shortened 200 m	Shortened 250 m	Shortened 300 m
Overall void length of LW19 (m)	1760	1710	1660	1610	1560	1510	1460
Minimum distance between LW19 and the centreline of Wongawilli Creek (m)	175	215	255	300	350	395	440
Maximum predicted total closure anywhere along Wongawilli Creek (mm)	212	212	211	211	211	211	211
Maximum predicted total closure along Wongawilli Creek within the Study Area (600m boundary) for LW19 (mm)	207	201	196	191	188	185	183
Maximum predicted total closure at Rockbar A (mm)	190	187	184	182	180	179	178
Maximum predicted total closure at the Riffle Zones (mm)	207	201	196	191	188	185	183
Assessed rate of Type 3 impacts (%)	8	7	6	6	6	5	5

- The key outcomes from this analysis are that:
 - maximum predicted total closure along Wongawilli Creek (including the riffle zones) within MSEC's Study Area (ie the 600 m boundary) would reduce by just 6 mm (<3%) for a 50 m increase in setback and by just 11 mm for a 100 m (>5%) increase in setback. As setbacks increase to 325 m or greater, the rate of reduction in predicted total closure reduces to 3 mm or 2 mm per additional 50 m increment;
 - maximum predicted total closure at the rockbar opposite LW8 would reduce by just 3 mm (1.6%) for a 50 m increase in setback and by just 6 mm (3.2%) for a 100 m increase in setback. As setbacks increase to 325 m or greater, the rate of reduction in predicted total closure reduces to 2 mm or 1 mm per additional 50 m increment; and
 - the maximum predicted risk of Type 3 impacts occurring in Wongawilli Creek (8%, with half of that arising from previous longwall extraction) would reduce by just 1% for a 50 m increase in setback and by 2% for a 100 m increase in setback. A 6% chance of Type 3 impacts in Wongawilli Creek persists until (roughly) an additional 225 m setback, or a setback of 400 m in total.
- These small reductions in risk lead to the critical question of whether they warrant an additional setback. For many years, 200 mm of predicted valley closure was used by both industry and regulators as the likely threshold for Type 3 impacts on rockbars in the Southern Coalfield. However, more recent empirical data shows that there is a measurable risk of Type 3 impacts to at least as low as 80 mm of valley closure (the lowest such recorded event). The Mining Panel includes a graph from a report prepared by MSEC in 2019 which shows that all then-available data indicates there is a:
 - 22% chance of such impacts where closure is predicted to be 300 mm;
 - 7% chance where closure is predicted to be 200 mm;
 - 4% chance where closure is predicted to be 160 mm; and
 - 2% chance where closure is predicted to be 100 mm.
- The table above supports the view that the risk of impact at the Creek is relatively insensitive to the longwall setback. That is, a group of large longwall voids would lead to significant compressive and tensile strains and valley closure effects even if those voids are a considerable distance from an incised valley profile. Those strains will only begin to increase markedly once the longwall voids get quite close to the valley.
- Mining elsewhere in Area 3A (ie LW6 and LW8) has also already encroached substantially closer to Wongawilli Creek than is proposed for LW19. However, only one potential Type 3 impact has previously been reported in the full two-kilometre length of Wongawilli Creek located within 400 m of mining at Dendrobium, this being at Pool 43a, located 200 m from LW6 in Area 3A and 410 m from LW9 in Area 3B. South32 reports that reduced water levels in Pool 43a were not apparent when the crack in the creek bed was first observed, and only became noticeable during "low flow" conditions

that resulted from low regional rainfall. South32 has reported that, since the end of the drought in February 2020, Pool 43a has been holding water. Nonetheless, it is defined as a Type 3 impact.

- The Catchment Panel suggested in 2019 that any such Type 3 impact is not a “minor impact”. The Department considers that the performance measure in the development consent applies to the whole affected length of Wongawilli Creek, rather than individually and separately to each single pool, rockbar or riffle zone. It holds this view based on both the intention of the consent (as shown by the content of the Assessment Report) and also the construction of the condition.
- The Department also considers that subsidence management should proceed on the basis of reducing the risk of Type 3 impacts to <2% (based on MSEC’s current database) or even <5%. The particular local geology and geomorphology will always lead to variability and unpredictability in the risk of such impacts, as may have been the case for the site at Metropolitan Mine which developed a Type 3 impact where valley closure was predicted to be just 80 mm.
- In any case, it is South32’s responsibility to achieve the performance measures in the consent, rather than the Department’s. If South32 causes greater than “minor impacts (such as minor fracturing, gas release, iron staining and minor impacts on water flows, water levels and water quality)” on Wongawilli Creek, then this would be a breach of its consent and would be subject to appropriate enforcement action by the Department. The risk, and the responsibility for appropriate risk mitigation and avoidance, lies solely with South32.
- As proposed by the Mining Panel, the Department has given careful consideration to the potential reduction in risk of Type 3 impacts within Wongawilli Creek by imposing an increase on South32’s planned 175 m setback. It considers that the risk of such impacts is already low (c.8%, based on MSEC’s existing database of similar impacts). It considers that the available reductions in risk (ie 1% or 2%) are not significant in themselves. Most significantly, it considers that the existing rate of Type 3 impacts in Wongawilli Creek (which has been affected by the extraction of ten longwalls, two of which were closer to Wongawilli Creek than is proposed for LW19) is very low. On this basis, the Department accepts South32’s proposed setback of LW19 from Wongawilli Creek of 175 m. No additional conditions are required.

Swamp 15a

Extent of the Swamp

- The upland coastal swamp denominated as Swamp 15a within South32 documents is a large swamp (about 1,330 m in length and 17.38 ha in area) located to the east, southeast and south of the starting end of the proposed LW19. This swamp received particular consideration in the Department’s assessment of Mod 6. As a result, the consent contains a detailed performance measure that specifically relates to the swamp, as follows:

“The Applicant must ensure that subsidence does not cause erosion of the surface or changes in ecosystem functionality of Swamp 15a and that the structural integrity of its controlling rockbar is maintained or restored, to the satisfaction of the Secretary.”

- It must be noted that this performance measure was not imposed in order to prevent *any* impact on Swamp 15a. Pages 22-24 of the Department’s Assessment Report for Mod 6 make this quite clear. South32’s then-proposed mine plan for Area 3A included two longwalls (then termed LW9 and LW10) that would directly undermine Swamp 15a. This proposal was not limited by the consent in any way. Later, South32 decided to not mine LW10, due to the existence of the major igneous intrusion. LW19 is in large measure a shortened version of the previously proposed LW9.
- Instead, the intention of the consent condition was to prevent *major* impacts (“*erosion of the surface or changes in ecosystem functionality*”) in Swamp 15a. The perceived importance of the rockbar at the north-eastern (ie downstream) end of the swamp (which is a 12 m waterfall) was also recognised, albeit that the consent allowed the possibility of restoring the rockbar’s integrity through grouting.
- Nonetheless, because of its size and value and because it is located quite close to the proposed footprint of LW19, the Department specifically sought advice from the Mining Panel regarding impacts on Swamp 15a, in the following terms:
 - *likely impacts on Swamp 15a and whether the proposed longwall panel design would meet the performance measure required under [the consent] and performance indicators outlined in the SIMMCP;*

- The Mining Panel gave careful consideration to LW19's potential impacts on Swamps 15a, which led to three recommendations, as follows:
 3. *As a minimum requirement for meeting Condition 5 regarding no change in ecosystem functionality of Swamp 15a, LW19 should be set back at least 60 m from all edges of Swamp 15a.*
 4. *To avoid inadvertently approving a mine layout that could result in a breach of the Consent Conditions relating to Swamp 15a, the Department's assessment should include careful consideration of the environmental impacts on that portion of Swamp 15a which lies at the headwaters of SC10B, over the maingate chain pillars of LW19.*
 5. *An additional chemistry site should be added adjacent to the proposed water level site behind the Swamp 15a controlling rockbar.*
- The Mining Panel's analysis of potential impacts on Swamp 15a proceeded on the basis of mapping undertaken by South32's ecological consultant in 2020 and provided in the draft SMP. This mapping was much refined over that included in the Environmental Assessment (EA) for Mod 6, on which the consent's performance measure for Swamp 15a was based. That mapping was undertaken in the early 2000s by the then Office of Environment and Heritage (OEH) on the basis of air photo interpretation. The more recent mapping not only refined swamp boundaries but also identified through ground truthing and LiDAR a number of smaller swamps not included in OEH's original mapping. This included a small satellite swamp at the headwaters of SC10B, which is the subject of the Mining Panel's 4th recommendation.
- However, this minor satellite swamp is not directly connected with Swamp 15a and was not included in the EA for Mod 6 nor considered in any way in the Department's assessment at that time, and should therefore be excluded from the application of the consent condition. Notwithstanding, the Department has considered the boundary of Swamp 15a defined in 2020 as the basis of its consideration in this report.
- The Mining Panel and South32 have diverging views as to how to apply the consent condition regarding "*no changes in ecosystem functionality of Swamp 15a*". In essence, South32 considers that the basis for measurement of compliance with this condition relates to the *entirety* of Swamp 15a, whereas the Mining Panel's analysis proceeds on the basis of avoiding change to ecosystem functionality *at any point* within the swamp.
- The Department has had regard to the discussion on Swamp 15a within its Assessment Report for Mod 6. It is clear that that report was considering Swamp 15a as a totality, most obviously because it gave approval to South32's then intention to directly undermine the swamp with two 249 m longwall panels (the then LW9 and LW10).
- South32's response to the Mining Panel's advice indicates that it now considers that 4.09% of Swamp 15a is within 60 m of the proposed footprint of LW19 (see **Table 2**) and that none of the swamp is situated above the proposed longwall void (only the panel's maingates, see **Figure 1**). Because the current mine plan for LW19 does not include any direct undermining of Swamp 15a, it could be said that the consent condition has given greater protection to this swamp than originally envisaged.

Table 2: Old and recent mapping of Swamp 15a

	Approved OEH Mapping	Niche 2020 Mapping
Swamp 15a total	20.39 ha	17.38 ha
Within 60 m buffer	1.06 ha	0.71 ha
% within buffer	5.18	4.09

- On this basis, the Department considers that South32's proposed mine plan is not likely to lead to any significant changes in ecosystem functionality in Swamp 15a. In addition, the consent condition remains in effect and it is South32's responsibility to ensure that it achieves it. Again, the risk lies with South32.
- Notwithstanding, given the recommendations of the Mining Panel, the Department considers that additional protection measures for Swamp 15a are appropriate in this case and would reduce uncertainty about the ability of South32 to comply with the performance measures. These measures are described below.

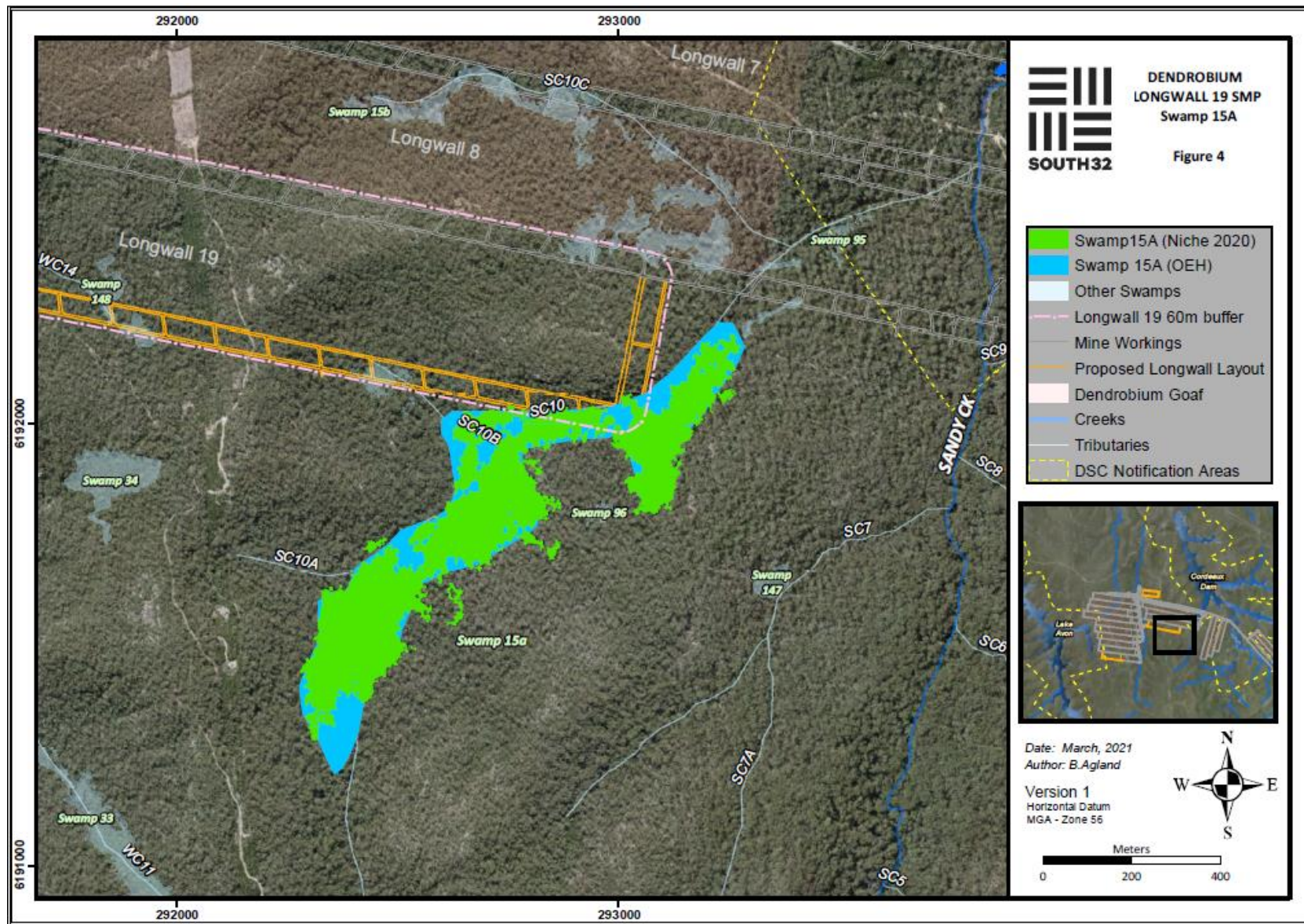


Figure 1: Previously mapped and currently mapped extent of Swamps 15a

NB: The small "satellite swamp" is shown in grey over the LW19 main gates, in the headwaters of watercourse SC10b.

Rockbar SC10-RB15A

- The Mining Panel made no formal conclusion or recommendations regarding the rockbar immediately downstream of Swamp 15a, ie the 12 m waterfall denominated as SC10-RB15A. However, the advice did state that *“The Panel thus concludes that there is low to moderate likelihood of Condition 5 not being met in regard to the Swamp 15a controlling rockbar SC10-RB15A.”* The key basis underpinning this view was MSEC’s advice in the draft SMP that it considered that there was a 13% chance of a Type 3 impact at this location.
- South32 gave further consideration to these risks in its response to the Panel’s advice. South32 first reported on the currently understood nature of Swamp 15a. At the time when the EA for Mod 6 was prepared, this swamp was considered to be a “valley infill” swamp, with reasonably deep sediments held back by a “controlling rockbar”, which acted much like a dam. However, more recent mapping of the actual alignment of watercourse SC10 (which is now known to be almost entirely outside and to the north of Swamp 15a) has led to a change in this view. Swamp 15a is now understood to have developed mostly on the southeastern side of the valley containing SC10. Thus any damage to the rockbar would be of less consequence to the swamp because it is not a “controlling” rockbar.
- South32’s additional consideration was undertaken on a similar basis to that applied to the setback from Wongawilli Creek, with additional 50 m incremental setbacks up to a maximum of 300 m (see **Table 3**).

Table 3: Sensitivity analysis of impact risk at Rockbar SC10-RB15A with increased longwall setbacks

Description	Length of LW19 (relative to that adopted in MSEC1082)						
	Base case	Shortened 50 m	Shortened 100 m	Shortened 150 m	Shortened 200 m	Shortened 250 m	Shortened 300 m
Overall void length of LW19 (m)	1760	1710	1660	1610	1560	1510	1460
Minimum distance between LW19 and Rockbar 15A (m)	150	200	250	300	350	400	450
Minimum distance between mining area (LW6 to LW19) and Rockbar 15A (m)	150	170	170	170	170	170	170
Maximum predicted total closure anywhere along Stream SC10 (mm)	208	193	181	172	163	153	145
Maximum predicted total closure at Rockbar 15A (mm)	135	128	121	116	111	106	102
Assessed rate of Type 3 impact for Rockbar 15A (%)	13	8	6	4	3	2	2

- However, while similar, it was not identical. Firstly, MSEC’s originally assessed 13% risk of a Type 3 impact did not arise from its rockbar model, because watercourse SC10 has previously been directly undermined. Instead, an analysis of other impacts on rockbars solely within Area 3B was undertaken to derive the 13% risk of impact. As the incremental setbacks of LW19 from the rockbar were increased, results from the rockbar model were blended (or “transitioned”) in. MSEC and South32 are convinced that this approach is the best available in the circumstances. The Mining Panel accepted MSEC’s previous evaluation of risk as being 13% and the Department accepts this baseline and the added influence of the rockbar model as the setback is increased.
- **Table 3** clearly indicates a step change in the risk of Type 3 impacts at the waterfall. A 50 m setback reduce MSEC’s assessed risk of such an impact from 13% to 8%, which is the same level of risk arising at the finishing end of LW19. A 100 m setback reduces MSEC’s assessed risk to 6%.
- South32 has advised that every 50 m reduction in the length of LW19 would be at the cost of production of 81,000 tonnes of ROM coal, and income to the State of about \$1.1 million in coal royalties. The Department considers that the reduction in risk of impact at this significant waterfall outweighs the cost of lost coal production. It also shares the Mining Panel’s concerns that, notwithstanding that the consent permits “restoration” of any loss of structural integrity in the waterfall, the necessary remediation strategy of drilling and cementiferous or polyurethane grouting may prove impractical.
- The Department therefore recommends that the starting gate of LW19 (ie the eastern end of the longwall) is set back an additional 100 m, in order to significantly reduce the risk of impact at SC10-RB15A. It is noted that such a setback would also significantly reduce the risk of any broader impacts

in Swamp 15a, in that the proportion of the swamp located within 60 m of the longwall footprint would be more than halved and represent just 1.84% of the overall extent of the swamp (see **Figure 2** below). The proposed setback would also significantly reduce the overlap of the first workings for the longwall overlapping the narrow part of the swamp near SC10 and hence the potential for any impacts on the ecological functioning of the swamp identified in the performance measure and in the advice from the Mining Panel.

- Conditions of approval to this effect have been recommended.

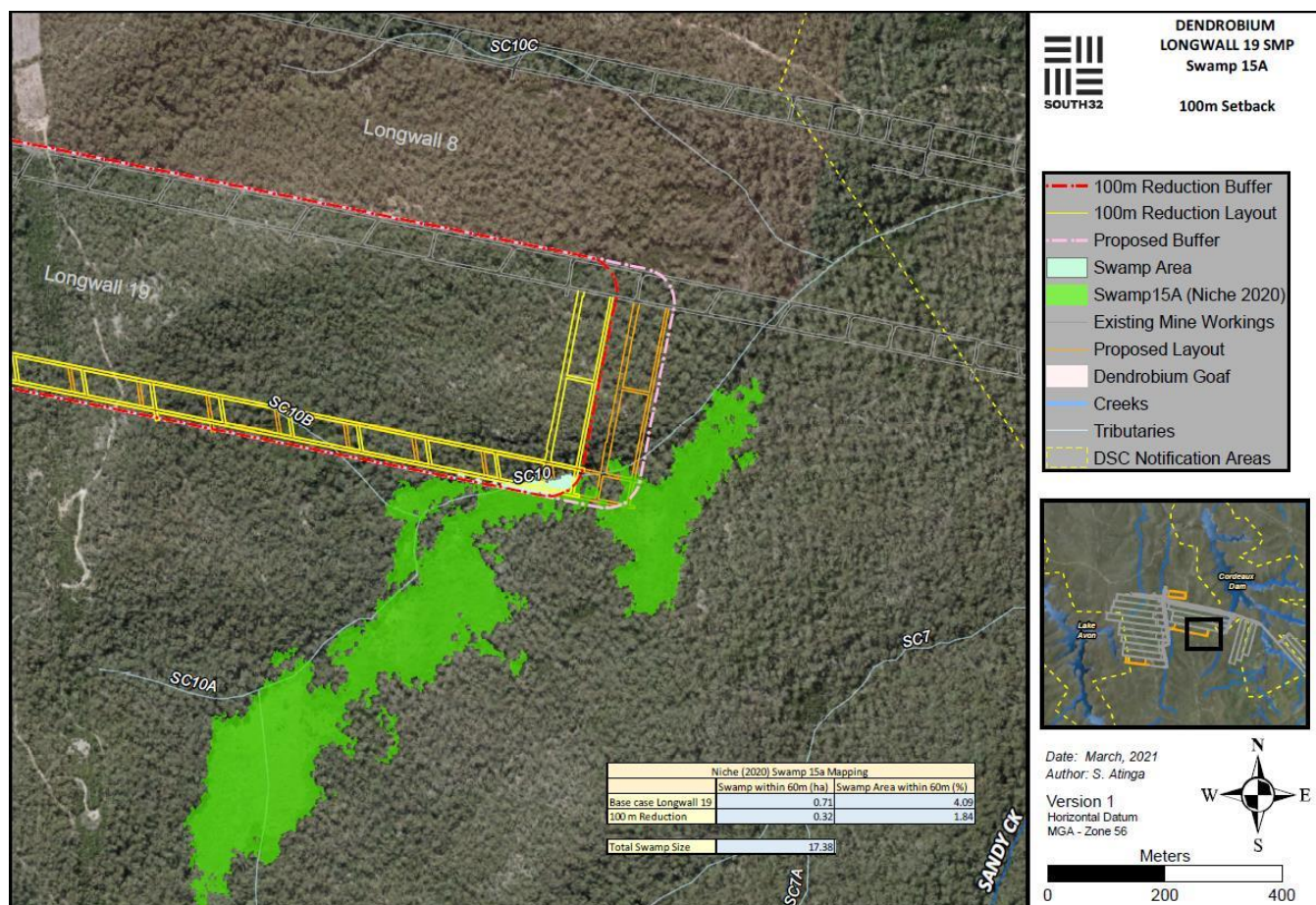


Figure 2: Extent of swamp within 60 m buffer – 100 m offset to starting point

Swamp Offsets

- In April 2015, the Dendrobium consent was modified by adding a new condition (condition 15 of Schedule 2) to enable South32 to provide a land through a Strategic Biodiversity Offset (SBO) having conservation values exceeding those required to meet immediate offsetting requirements prescribed in a condition of an approval (such as an SMP). Further, that any excess conservation values beyond those required for current offsets could be relied upon to meet future offsetting requirements under the mine's consent. In 2016, South32 provided an SBO in the form of 598 ha of land at Maddens Plains to satisfy existing and future offsetting requirements required under the consents for both Dendrobium Mine and its Bulli Seam Operations mines. This large parcel of land contained 140 ha of coastal upland swamp equivalent to those being impacted at Dendrobium. The SBO was to be secured in perpetuity by transfer to the National Parks Estate.
- South32 wrote to the Department on 4 March 2020 requesting confirmation that the residual conservation values associated with the SBO can be relied upon to offset impacts associated with the Area 3A SMP, ie that no further offset would be required for any impacts on swamps caused by LW19.
- Neither BCS nor WaterNSW supported this approach. Both were concerned that the SBO had been drafted in terms that limited its current and future effect to Areas 3B and 3C, rather than also covering Area 3A. The Mining Panel was not requested to provide advice on this issue.

- The Department has given careful consideration to the specific terms of the SBO, as well as to the terms of condition 15 of Schedule 2. It is correct (as agencies have pointed out) that the SBO's text and tables contain no specific mention of Area 3A, nor the swamps within it. However, the SBO's Figure 1 is labelled "Dendrobium Area 3 Swamps" and clearly shows Area 3A as well as Areas 3B and 3C. It includes all the then mapped swamps within Area 3A, including Swamp 15a. It also shows the proposed footprint of LW19. Section 3.1 of the SBO also states that *"The proposed Strategic Offset at Maddens Plains satisfies all the swamp biodiversity offsetting requirements for Dendrobium Mine as currently approved by DA 60-03-2001 by protecting in perpetuity, through reservation as National Park, 140 ha of 'like-for-like' upland swamp."* (emphasis added).
- While the clarity of the SBO with respect to its coverage of the swamps affected by LW19 could have been improved, in the Department's opinion its terms cover LW19, since this longwall falls within the coverage of the term "Dendrobium Mine as currently approved". In addition, LW19 appears in the SBO's Figure 1.
- The Department is also satisfied that the provisions of condition 15 of Schedule 2 do not prevent any residual conservation values associated with the SBO from being used to satisfy offset requirements associated with LW19.
- Consequently, the Department agrees that the residual conservation values within the SBO can be used to offset any impacts on upland swamps caused by LW19.
- However, this offset does not extend to impacts which would cause a breach of condition 3 of Schedule 3 of the consent (ie *"The Applicant must ensure that subsidence does not cause erosion of the surface or changes in ecosystem functionality of Swamp 15a and that the structural integrity of its controlling rockbar is maintained or restored, to the satisfaction of the Secretary."*). This condition provides a strict performance measure and cannot be satisfied via offsets. Nonetheless, impacts on Swamp 15a which do not exceed this standard can be offset via the SBO.
- Conditions of approval to this effect have been recommended.

Additional Monitoring

- The Mining Panel's 5th recommendation relates to additional monitoring of potential surface water quality impacts from subsidence at the downstream end of Swamp 15a. The Department supports this recommendation and South32 has not raised any concerns over it.
- A condition of approval to this effect has been recommended.

8. OTHER FACTORS

- The Dendrobium mine remains a significant contributor to regional employment in the Illawarra, with around 400 people working at the mine, and a further 600 people indirectly reliant on the mine.
- The coal extracted from the mine is a key component in the production of a premium coal blend that is used in steel production at the BlueScope Steelworks in Port Kembla, which employs 3,000 people.
- The coal proposed to be recovered from LW19 (1.9 Mt) is estimated to provide approximately \$25 million in State Government revenue through royalties, levies and payroll tax.

9. EVALUATION AND CONCLUSIONS

- The Department has assessed the application for approval of the SMP in accordance with the relevant requirements of the approved consent and has carefully considered the potential impacts of the extraction of LW19 on the surrounding environment. The Department has carefully considered the matters summarised in the foregoing sections of this report.
- Extraction of coal in LW19 using longwall methods is already approved under the existing development consent, as modified in 2008. This extraction is subject to the performance measures listed in the consent and to the preparation and approval of an SMP.
- The key matters for consideration by the Department in determining whether to approve the SMP application are whether South32 can meet the three relevant performance measures contained in the development consent. These are that South32 must ensure, to the satisfaction of the Secretary, that:

1. *(a) no rock fall occurs at Sandy Creek Waterfall or from its overhang;*
(b) the structural integrity of the waterfall, its overhang and its pool are not impacted;
(c) cracking in Sandy Creek within 30 m of the waterfall is of negligible environmental and hydrological consequence; and
(d) negligible diversion of water occurs from the lip of the waterfall;
 2. *underground mining operations do not cause subsidence impacts at Sandy Creek and Wongawilli Creek other than “minor impacts” (such as minor fracturing, gas release, iron staining and minor impacts on water flows, water levels and water quality); and*
 3. *subsidence does not cause erosion of the surface or changes in ecosystem functionality of Swamp 15a and that the structural integrity of its controlling rockbar is maintained or restored.²*
- The Department is satisfied that LW19 can be extracted, as proposed under the SMP, with a low risk of exceedance of these performance measures.
 - Extraction of LW19 would allow the recovery of valuable coal resources, using existing infrastructure and without significantly increasing the existing disturbance footprint within the approved project boundary.
 - Extraction of LW19 would continue to underpin the wide-ranging benefits for the local and State economies that derive from the continued operation of the Dendrobium Mine and the part that it plays in supporting the wider coal mining and preparation operations of South32 in the Illawarra Region and the coking coal which it provides for consumption at BlueScope's Port Kembla Steelworks and for export.
 - On balance, the Department considers that the extraction of LW19 is in the public interest and that the SMP application should be approved, subject to strict conditions as discussed below.

10. RECOMMENDED CONDITIONS

- The development consent and previous SMP approvals have established a strict regulatory framework, including stringent performance measures, and comprehensive monitoring requirements.
- The Department's recommended conditions of approval for the Longwall 19 SMP include:
 - requiring an additional 100 m setback from Rockbar SC10-RB15A, which would also lead to a substantial reduction in the risk of environmental consequences on Swamp 15a;
 - confirming and clarifying the consent's performance measures for Sandy Creek Waterfall, Swamp 15a, Rockbar SC10-RB15A and Wongawilli Creek;
 - requiring a biodiversity offset (expected to be satisfied by the SBO) for all environmental consequences on upland swamps;
 - confirming that enforcement action can be taken for any breach of the performance measure for Swamp 15a, even if the environmental consequence is offset;
 - confirming the application of the revised Sandy Creek Waterfall Management Plan, including the roles of the Technical Committee and Steering Committee;
 - requiring regular provision of environmental reporting of subsidence impacts and that the extraction of LW19 is subject to the consent's 3-yearly independent auditing process; and
 - maintaining the previous approval for the Area 3A SMP in respect of its application to LW6 – LW8.

11. ONGOING MANAGEMENT

- The Department considers that the additional conditions to be imposed through the SMP approval provide effective safeguards against any significant impacts as a result of the extraction of LW19 and would also provide additional information to inform decision-making about any future mining at the Dendrobium Coal Mine.

² See conditions 2, 3 and 5 of Schedule 3 of consent DA-60-03-2001, as modified.

- This SMP approval continues the Department's precautionary approach by requiring sufficient setbacks from key features (ie Wongawilli Creek, Swamp 15a and Rockbar SC10-RB15A).
- The Department also has a role under the *Environmental Planning and Assessment Act 1979* (EP&A Act) to ensure compliance with the existing development consent and subsequent approvals under the consent.
- In undertaking this role, the Department has a range of enforcement powers available to it if it considers that there may have been or may potentially be a breach of the development consent or subsequent approvals under the consent, including but not limited to, requiring further setbacks from key features or the cessation of mining operations if considered necessary.



11 March 2021

Mike Young
Executive Director
Energy, Resources and Compliance
as nominee of the Secretary