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SCT Operations Pty Ltd
ABN 23 078 328 953
www.sct.gs

HEAD OFFICE
Cnr Kembla & Beach Streets Wollongong NSW 2500 Australia
PO Box 824 Wollongong NSW 2520 Australia
Telephone +61 2 4222 2777 Fax: +61 2 4226 4884
Email: sctnsw@sct.gs

BRISBANE OFFICE
Telephone 0428 318 009 (international +61 428 318 009)
Email: p.cartwright@sct.gs

BENDIGO OFFICE
Telephone: +61 3 5443 5941
Email: s.macgregor@sct.gs

Devendra Vyas
Project Manager
Wollongong Coal Ltd
PO Box 281
FAIRY MEADOW NSW 2519

**WCWO5306**

Dear Devendra

**RESPONSE TO SUBSIDENCE RELATED SUBMISSIONS FOR MOD2 AT WONGAWILLI COLLIERY**

Wollongong Coal Limited (WCL) has applied to modify the Nebo Area Project Approval 09_0161 (MOD2) to include continuation of development of the main headings known as the Western Driveages or NW Mains in a similar layout to that currently approved. WCL has received submissions from government agencies relating to this proposed modification. WCL commissioned SCT Operations Pty Ltd (SCT) to prepare a response to subsidence-related issues raised in these submissions. This letter report presents our response.

The four issues raised in the submissions and addressed in this letter report are:

- proximity of the mining below the base of Avon Reservoir
- the potential for water inflows associated with mining through the Wongawilli Fault and the dyke projected to extend below Avon Reservoir
- the potential for increased stresses in the vicinity of these geological structures associated with previous mining in the Wongawilli Seam
- potential interaction with the proposed Burrawang to Avon tunnel (Illawarra Spur pipeline).

The first three of these issues are addressed in SCT (2020). References to this earlier report are provided, but the issues are re-examined in response to the submissions. SCT was not aware of the proposed Burrawang to Avon tunnel during preparation of SCT (2020). The potential for interaction is discussed and there is found to be no potential for interaction.

Figure 1 shows the location of the proposed Illawarra Spur pipeline and the Avon- Illawarra Tunnel relative to proposed mining of MOD2, existing workings and geological structures.

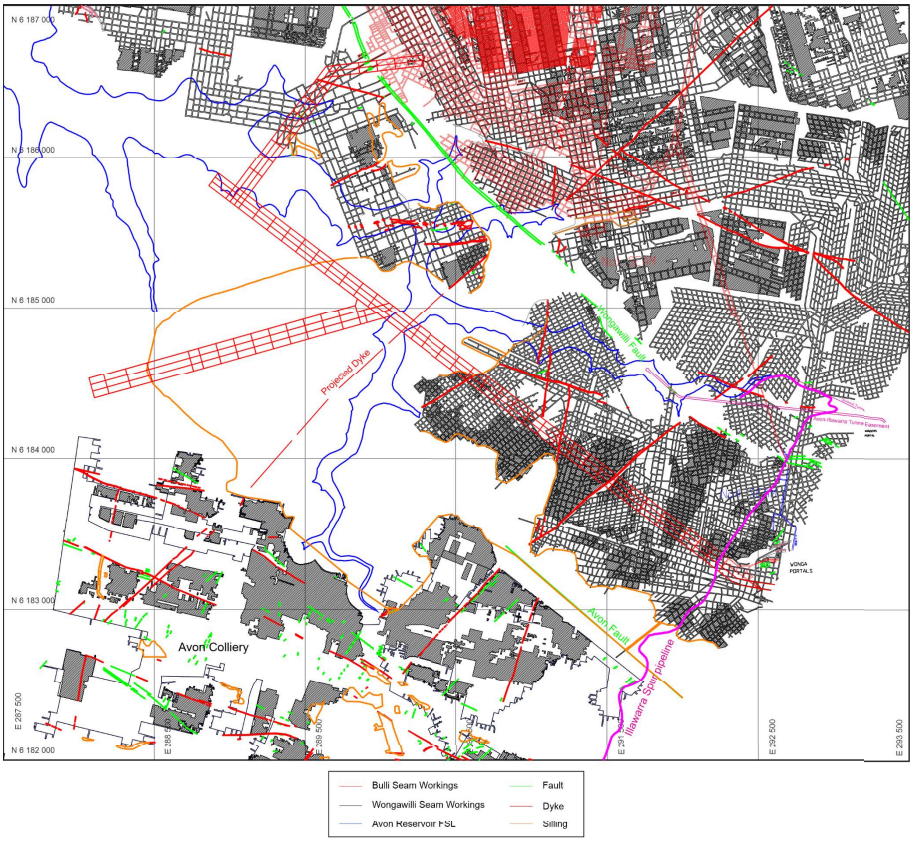


**Figure 1: Plan of Proposed MOD2 Layout relative to geological structure, existing mine workings and existing and proposed water infrastructure.**

The key point is that there is no potential for the underground developments to cause surface subsidence movements of any consequence. The proposed mining are development roadways separated by long-term stable pillars. There is no secondary extraction proposed with this modification and therefore no potential for surface ground movements of any consequence.

## 1. Proximity of Mining to Base of Avon Reservoir

The proposed mining passes below the base of Avon Reservoir at three locations at depths below surface of 60m, 113m and 134m (SCT 2020). In the Dams Safety NSW submission (DSNSW 2021), it is recognised that the proposed main heading developments with no extraction would normally not be expected to cause concern. The concern expressed related to the low depths of mining below reservoirs in the Southern Coalfield.

SCT is aware of previous mining at Huntley Colliery and Elouera (Wongawilli) Colliery where main headings were developed below the Full Supply Level (FSL) of Avon Reservoir at depths of 65m and 55m, respectively.

At Huntley Colliery, two headings were mined in the Wongawilli Seam at a depth of 65m below Avon Reservoir. Reynolds (1977) reported inflows from the general area in the range 0.1-0.3Ml/day but notes that some of these inflows are from headings located outside the FSL.

At Elouera Colliery, a heading was developed in the Bulli Seam in 1997 at a depth of approximately 55m below the Flying Fox No3 Creek arm of Avon Reservoir. This heading was driven as the main access roadway for daily use in an area above first workings in the Wongawilli Seam and passed through two dykes that intersect the reservoir at 110 and 170m from this mining. This mining was approved by the Dams Safety Committee in 1993 (DSC consent reference Wongawilli-6). No perceptible inflow was observed in this heading at the time of development and the 22 years until the mine was abandoned in 2019 (Wilson 2021).

At Elouera Colliery, the heading was developed in the Bulli Seam, so the Wombarra Shales are present in the 55m overburden section. The Wombarra Shales are absent in the overburden section at Huntley Mine because the Wongawilli Seam is approximately 30-35m lower in the stratigraphic section. The absence of the Wombarra Shales at Huntley Colliery is likely to be the reason inflows were observed in the headings mined below the reservoir.

The DSC guidelines (DSC 2010) indicate that while each application is assessed on its merits and there are no pre-determined limits, mining below stored waters at depths less than 60m is unlikely to be approved.

SCT understands that WCL intends to implement the DSNSW recommendations to:

- undertake inseam drilling ahead of mining
- undertake water monitoring of volume and hydrochemistry
- develop emergency TARPS to notify relevant organisations

- develop a Contingency Plan to prevent or halt inrush prior to developing roadways beneath the reservoir.

WaterNSW (2021) seeks clarification as to how close cracking from the roadway voids would come to the base of Avon Reservoir. There is not expected to be any significant cracking of the overburden strata associated with the proposed mining because this mining is only first workings.

The individual roadways are less than 5.5m wide. At 60m deep, the weight of overburden strata (1.5MPa) plus water (0.5MPa) is much lower than the nominal strength of the coal (6MPa) and the ribs are likely to remain in their as-cut condition without significant overbreak or rib spall.

The height of roof fracturing depends on the magnitude of horizontal stresses relative to the strength of the immediate roof strata. The Coal Cliff Sandstone that forms the immediate roof strata above the coal seam is expected to be much stronger than the horizontal stresses at 60m deep. Significant roof fracturing is therefore not expected. If the immediate roof strata were to become overloaded, the height of fracturing would not be expected to extend above the bolted horizon of the roof of the roadways i.e. above 2-2.5m. This height of fracturing is small by comparison to the full 60m overburden depth.

## 2. POTENTIAL INFLOWS THROUGH WONGAWILLI FAULT AND DYKE

WaterNSW (2021) has requested further consideration of the impact of mining through the Wongawilli Fault and the dyke located below Avon Reservoir. The potential for inflow through these structures is discussed in Section 6 of SCT (2020).

### 2.1 Wongawilli Fault

Historical mining at Wongawilli and Elouera Colliery has driven ten cross-measures drifts through the Wongawilli Fault. Figure 2 shows an exposure of the Wongawilli Fault plane at the start of one of these driveages where the downthrow of the fault is approximately 12m.

There are also many intersections of the fault plane(s) or steeper ground associated with the fault from everyday driveages in both the Wongawilli and Bulli Seams. Some of these intersections are in close proximity to where the Wongawilli Fault crosses the reservoir in the Flying Fox No1, No2 and No3 arms of the storage. No significant inflows have been observed from the drifts or other intersections of the Wongawilli Fault.

Sydney Water's Upper Talus Tunnel (Avon-Illawarra Tunnel) constructed in the early 1990's also crosses the Wongawilli Fault in proximity to Wongawilli Seam workings that intersect the fault plane. This tunnel intersects the fault at an acute angle at a location approximately 30m from the FSL of Avon Reservoir and 115m below the floor of the reservoir. Immediately to the west of where the tunnel crosses the fault, the reservoir appears to be located in the surface expression of the fault.

**Figure 2: Exposure of the Wongawilli Fault Plane at start of drift driveage.**

SCT understands that the ground conditions in the tunnel were successfully managed during construction using steel support without any significant difficulty and there was no significant inflow recorded (Wilson 2021). The tunnel remains operational.

The proposed MOD2 roadways are designed to cross the Wongawilli Fault above existing Bulli to Wongawilli Seam cross-measures drifts driven in 1975-77 to service the mine operations until this section of the mine was sealed in 1999.

It is anticipated that the ground conditions where the proposed headings cross the Wongawilli Fault will be able to be managed without undue difficulty. The coal mining and Avon-Illawarra Tunnel driveage experience supports this expectation. The crossing point for the proposed headings is approximately 400m from the FSL of Avon Reservoir. No interaction effects with the reservoir are expected.

## 2.2 Dykes

Dykes encountered in the Southern Coalfield are typically found to be dry when mined through. It is anticipated that the dyke located below Avon Reservoir will also be dry. Nevertheless, inflows of up to approximately 0.2Ml/day are anticipated at the first crossing below Avon Reservoir based on the pre-extraction inflows measured in nearby Blue Panel at Wongawilli Colliery. Inflows in the range 0.1-0.3Ml/day were also reported by Reynolds (1977) for headings at Huntley Colliery located 65m below the reservoir where there was no dyke present. No inflows were observed at Elouera Colliery where main headings passed 55m below the reservoir. It is not clear whether the inflows observed prior to extraction in Blue Panel were due to the shallow depth or the presence of dykes and other geological features. In any case, a precautionary approach is recommended.

SCT understands that WCL intends to implement a program to drill ahead to confirm the absence of zones of elevated hydraulic conductivity below the reservoir and to develop a management strategy consistent with the expectations of DSNSW.

# 3. Increased stresses associated with Wongawilli Seam mining

WaterNSW (2021) requests consideration of the potential for increased stresses above the previously extracted Wongawilli Seam goaf areas. This issue is discussed in this section.

The proposed main headings are to be mined in the Bulli Seam. The Bulli Seam is located 30-35m above the Wongawilli Seam. There has been previous mining activity in the Wongawilli Seam below where the main headings are planned. This mining includes some pillar extraction remote from the reservoir and some first workings directly under the reservoir at the third crossing point where the minimum overburden to the Bulli Seam is 134m.

There is some potential for increased vertical stresses around the edges of areas of pillar extraction and reduced vertical stressed directly above the pillar extraction. These changing vertical stresses are likely to locally impact mining conditions and require additional support to maintain serviceable roadway conditions. However, any impacts are limited to underground. There is no potential for there to be additional surface subsidence or other perceptible impacts due to this previous mining.

The pillars in the Wongawilli Seam below the third crossing point are developed at 40m centres with a roadway height of 2.8m. They thus have a nominal width to height ratio of greater than 12. There is no potential for these pillars to become overloaded. The existence of these pillars causes slight variations in vertical stress at the level of the proposed Bulli Seam workings, but these variations are much less than the variations that occur elsewhere because of topography-related changes in overburden depth.

## 4. Proposed Burrawang to Avon Tunnel

WaterNSW (2021) requested the potential for impacts to future water infrastructure, specifically the Burrawang to Avon tunnel, be considered. The only component of this proposed water security project, in the vicinity of the proposed MOD2 mining, is the Illawarra Spur pipeline from the upper reaches of Avon River to the Flying Fox No3 arm of the reservoir storage. This pipeline is design to traverse the surface along the route of existing fire roads, including Fire Road 15a, adjacent to the Moss Vale – Unanderra Railway.

Figure 1 shows the location of the proposed Illawarra Spur pipeline relative to proposed mining of MOD2.

Two headings of the MOD2 proposed layout would mine below where the pipeline would be constructed. Two headings of the NW Mains already exist at this location at a depth of 170m below the proposed pipeline route.

No impacts to this proposed pipeline are expected from the mining proposed in MOD2.

If you have any queries or require further clarification of any of the issues raised, please don't hesitate to contact me.

Yours sincerely

Ken Mills
Principal Geotechnical Engineer

## 5. References

DSC 2010 Guideline DSC4B "Mining Near Prescribed Dams Mining Applications" – NSW Dams Safety Committee - June 2010.

DSNSW 2021 "Wongawilli Colliery North West Mains Development (SSD: PA09_0161-Mod-2)" - DSNSW Reference 10.121.046 – 8 March 2021.

Reynolds R.G. 1977 "Coal Mining Under Stored Water" Reynolds Inquiry Report of the Commissioner on an inquiry into coal mining under or in the vicinity of the stored waters of the Nepean, Avon, Cordeaux, Cataract and Woronora Reservoirs, NSW, Australia.

SCT 2020 "Wongawilli Colliery: Subsidence and Geotechnical Assessment for Application to Modify Project Approval 09_0161" SCT Report WCW05136 to Wollongong Coal Limited – 10 November 2020.

WaterNSW 2021 "WaterNSW submission to Environmental Impact Statement – Wongawilli Mine Modification 2 (MP 09_06161 MOD 2)" WaterNSW Ref. D2021/21308 – 10 March 2021.

Wilson S.J. 2021 Personal Communication: Observations from inspections of the tunnel during construction in his capacity as mine surveyor at Wongawilli Colliery.