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Subsidence Advisory NSW (letter dated 1 December 2021)		
1	Clarification on whether the estimated number of homes that will be damaged is inclusive of non-conventional subsidence risks from mining under steep “Wianamatta Shale” slopes and previous slope failures.	<p>The estimated number of houses assessed to be damaged considers the potential for non-conventional subsidence due to mining beneath steep slopes with Wianamatta Group shales. The ACARP method (Waddington, 2009) for assessing potential impacts on houses was developed based on experience of mining at several collieries including Appin, West Cliff and Tahmoor. These collieries include areas with steep slopes comprising of Wianamatta Group shales.</p> <p>Some areas of the topography associated with Razorback Range are more incised than these previous mining areas. However, the majority of the houses within the Study Area are located on Razorback Range. There are only eight houses (5 % of the total) located on the top of Razorback Range and above the longwall mining area; however, these houses are setback from the more incised areas (i.e. grades greater than 1 in 2) of the range. There are no houses located on the incised slopes associated with Razorback Range.</p> <p>The subsidence report (MSEC, 2021) states that “The natural grades in close proximity to the houses within the Study Area are reasonably similar to those where houses have been directly mined beneath elsewhere in the Southern Coalfield. The ACARP method for assessing impacts on houses should therefore provide a reasonable indication of the overall levels of potential impact for the houses within the Study Area”.</p> <p>The mining beneath Razorback Range could cause higher tensile strains to develop on the sides and top of the range. The eight houses located at the top of Razorback Range could therefore experience higher tensile strains compared with other houses located below the range. However, severe impacts to houses are predominately caused by compressive strain rather than tensile strain. The Property Subsidence Management Plans for these eight houses will include a framework for the implementation of monitoring and management measures for these potential higher tensile strains.</p> <p>Previous slope failures will be identified, monitored and managed in accordance with the framework provided by the Property Subsidence Management Plans for the eight houses located at the top of Razorback Range. Additional geotechnical assessment would be carried out based on site-specific conditions, allowing monitoring and management measures to be developed and implemented in a timely fashion prior to the first potentially influencing longwall.</p> <p>As the majority of houses are located near slopes with natural grades similar to previous mining areas with Wianamatta Shale, it is considered that the ACARP method should provide a reasonable assessment of the overall potential damage on the houses within the Study Area.</p> <p>These risks are further assessed and managed for the extraction of each longwall through the Structures Management Plan and the activities of the Structures Response Group (SRG) to the satisfaction of the NSW Resources Regulator under Workplace Health and Safety (WHS) legislation. This process has been successfully implemented for Longwall 904, with current arrangements expected to be continued to be applied throughout the mining of the longwalls outlined in this Extraction Plan Application.</p>
2	That a full appraisal of the risk of landslides and slope stability impacting homes and other	The Land Management Plan includes a Landslide Risk Assessment appraised by two senior geotechnical engineers at GHD, who are industry leading experts with extensive experience in landside risk management and longwall mining (and associated subsidence management activities) in the NSW Southern Coalfield.

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	<p>infrastructure be provided by a suitable industry leading expert.</p>	<p>The study was completed by Andrew Leventhal, Senior Technical Director – Geotechnics (Project Director) and Jon Thompson, Technical Director – Geotechnics (Project Manager). Refer to attached Confirmation Letter dated 29 December 2021 for further details.</p> <p>Andrew has been an instrumental contributor to the introduction of Landslide Risk Management (LRM) in Australia since 1985. This has included involvement in the development of risk assessment guidelines and the introduction of the three seminal papers on LRM (1985, 2000 & 2007). He was the instigator and chair of the Australian Geomechanics Society’s Landslide Taskforce that developed the suite of guidelines (AGS 2007) that are now recognised LRM standard across Australia.</p> <p>Andrew’s experience over the past decade has extended to being a major contributor to subsidence management activities across the Southern Coalfield for both Illawarra Metallurgical Coal and Tahmoor Coking Coal Operations.</p> <p>Jon has over 40-years’ experience in geotechnical engineering within the Illawarra and Wollondilly regions, with a special focus on land risk management, providing technical advice to land developers, local councils, infrastructure / asset owners and other government agencies.</p> <p>Jon has extensive experience in residential development in hillside areas, including subsidence management activities in relation to private properties in the Douglas Park, Menangle and Razorback area. This work also includes baseline assessments of the Razorback Range across both the Appin Area 7 and Area 9 mining domains in collaboration with Dr Phil Flentje, Senior Research Fellow at the University of Wollongong.</p> <p>In relation to the Appin Mine, Jon and Andrew’s recent work has included the following mine subsidence management projects:</p> <ul style="list-style-type: none"> • The Razorback Range for Longwall 904, • The Nepean River gorges for Longwall 708B, and • Harris Creek Cliff Line for Longwalls 901 to 903. <p>Jon and Andrew have completed the full appraisal (LRM attached to the Land Management Plan) of the Extraction Plan Application Study Area at a regional level forming the framework, context and methodology for detailed property specific assessments. These detailed property specific assessments will be completed on a longwall-by-longwall basis in accordance with the Structures Management Plan covering the extraction of each longwall.</p> <p>This staged approach for property specific assessments is required to ensure detailed site assessments remain relevant and up-to date accounting for the current condition of the properties including naturally occurring and/or mining induced changes, updated for observations and experiences to-date as well as any new property developments landholders have undertaken.</p>

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		<p>To-date this process has been successfully implemented with detailed assessments being completed for Gibraltar Drive properties ahead of Longwall 904 and the Menangle area for Longwall 709; whilst the assessments for Hawkey Road properties are currently underway for Longwall 905.</p> <p>Jon and Andrew will continue to contribute to subsidence management activities, through the development of the Structures Management Plan for each longwall and the actions of the SRG to the satisfaction of the NSW Resources Regulator under WHS legislation.</p>
3	<p>The provision of copies of existing PSMP's for all homes located within the extraction plan study area and confirmation that the PSMP's comply with both the Coal Mine Subsidence Compensation Act 2017 and SA NSW's approved procedures.</p>	<p>Property Subsidence Management Plans (PSMPs) are completed in accordance with WHS legislation, the BSO Project Approval and Extraction Plan Application approvals. IMC develop the PSMP documents prior to the impact of the first longwall and includes landholder participation (where the landholder agrees to participate).</p> <p>The primary intent of the PSMP and its development process is to provide for two-way engagement and the development of a framework for the management of landholder safety and property during the mining process. Typically, this will include:</p> <ul style="list-style-type: none"> • Complimentary information to our landholder subsidence engagement campaigns; • Offers to complete Pre-Mining Structural and Geotechnical Inspections; • Implementation of identified mitigatory measures; • Offers to complete survey monitoring of private properties; • Offers to complete active mining monitoring and inspections when deemed required by the SRG; • Management details of other infrastructure and/or other natural features as required; • Process of reporting impacts and other landholder concerns to IMC through our 24-hour Community Call Line; and, • Details of the compensation processes once subsidence is complete for both built (with input from SA NSW) and natural features (managed by IMC in consultation with landholders and Government Agencies). <p>We note the Coal Mine Subsidence Compensation Act 2017, the SA NSW Claim Guidelines (Guidelines - Process for Claiming Mine Subsidence Compensation) and the recently introduced SA NSW Early Claim Settlement Policy are primarily concerned with effective claim management to ensure the fair, efficient and pragmatic provision of compensation to landholders whose properties' improvements (built features) are adversely impacted by mine subsidence.</p>
4	<p>Details of the proposed survey type and frequency used to monitor subsidence contained in each PSMP. It is recommended that SA NSW be consulted when these survey plans are developed, and this survey data is provided to SA NSW as it is obtained in order to support the claims process.</p>	<p>Monitoring requirements for properties are risk-based determinations, governed by the Structures Management Plan and the activities of the SRG technical committee. This may include visual inspections and a variety of geotechnical and survey monitoring, determined on a risk-basis, to the satisfaction of the NSW Resources Regulator under WHS legislation.</p> <p>Site specific survey plans are typically governed by site specific constraints such as survey lines of sight and landholder preferences. Accordingly, survey plans typically cannot be finalised until the day of base survey and installation.</p>

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		Relevant data will be compiled and provided to SA NSW upon request under current arrangements to ensure all available data is considered as part of the SA NSW managed claim assessment process.
5	The provision of a list and a plan identifying homes within the extraction plan study where a PSMP does not exist and the provision of documentation outlining timeframes for PSMP development that includes a summary of the type and frequency of monitoring proposed for each home.	PSMP's are completed prior to the first impacting longwall, subject to landholder participation.
6	<p>Subsidence damage may cause considerable stress and anxiety for homeowners who may be required to live in damaged houses for a number of years before their claims can be resolved. In situations where a house has sustained significant damage, these effects on homeowners are exacerbated. SA NSW recommends that IMC include within their extraction plan, the following requirements:</p> <ul style="list-style-type: none"> • Offer property acquisition when the house reaches damage category R4 or R5 and/or • Offer property acquisition when the house reaches damage category R3 or more and has/will be impacted by more than two longwalls as outlined in both the extraction plan for LWs 709 to 711 and 905. This should be inclusive of previously approved and planned longwall panels as outlined in IMC's project approval. 	<p>IMC acknowledges the impact of our operations upon communities in which we operate and aim to minimise this as far as reasonably practical. In relation to subsidence management above the Appin Mine we have implemented a community engagement campaign consisting of landholder meetings, information packs, routine and regular correspondence, phone calls at the commencement of active subsidence and provision of the 24-hour Community Call Line to report landholder concerns. In our experience, by providing upfront subsidence education, building on-going relationships and keeping landholders informed with regular updates assists in minimising the effect of subsidence impacts to effected landholders.</p> <p>Landholders are not required to live with property damage for a number of years before resolving their impacts or claims. IMC has a track record of proactively working with effected landholders to progressively resolve impacts to properties, including:</p> <ul style="list-style-type: none"> • Four (4x) claims settled early; • One (1x) claim settlement being brought forward; • Two (2x) additional requests for early settlement to SA NSW; and, • Completion of fifteen (15x) sets of repair projects. <p>Additionally, in 2019, IMC hosted a workshop with SA NSW where we requested 'early' settlement of a further seven (7x) claims under the former Mine Subsidence Compensation Act 1961 due to the nominal gap of approximately two-years between the discrete subsidence events associated with Longwalls 708A and 709, with IMC assuming direct financial liability for any future impacts under the Coal Mine Subsidence Compensation Act 2017.</p> <p>As such, IMC has a demonstrated responsible management of subsidence impacts to private properties, including minimising the effect of our operations on landholders and the wider Douglas Park community.</p> <p>In this context, IMC considers property acquisition on a case-by-case basis in consultation with effected landholders as appropriate to their personal circumstances, extraction timeframes, subsidence impacts and any likely future impacts.</p> <p>We note R3 impacts include the loss of bearing in isolated walls, piers, columns or other load-bearing elements, or loss of stability of isolated structural elements. Under application of SA NSW's requested acquisition rights, an R3 impact such as a settled pier (or "dropped stump") would be eligible for property acquisition despite having repair cost of less than \$5k.</p>

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		Ultimately, we do not consider the provision of arbitrary acquisition rights to be an effective or reasonable subsidence management tool for effected landholders, nor an economically viable impact settlement strategy.
7	<p>Proposed mining sequence and claim timeframes</p> <p>SA NSW notes there are properties that will be impacted by Longwalls 709, 710A and 711. This will result in active subsidence periods of approximately three and half years. Therefore, it is likely several homeowners will be living in damaged properties for a number of years. Others may require relocation where their properties require extensive repairs or rebuilding.</p> <p>Due to the significant period of time between the extraction of these longwalls, SA NSW would anticipate progressing claims for subsidence damage resulting from Longwall 710A at the completion of this longwall. The owners of properties impacted by subsidence from subsequent longwalls would then be eligible to lodge further claims under the Coal Mine Subsidence Compensation Act 2017.</p>	<p>Clarification of Extraction Sequencing</p> <p>IMC would like to take the opportunity to clarify extraction sequencing and IMC’s proposed subsidence management strategy that was discussed at the most recent meeting with SA NSW on 14 October 2021.</p> <p>Extraction sequencing is planned to occur in the following order:</p> <ol style="list-style-type: none"> 1. Longwall 904 & Longwall 709 extracted concurrently. 2. Longwall 905 & Longwall 709 extracted concurrently. 3. Longwall 709 remaining extraction to be completed. 4. Longwall 710A – located to the west of the Douglas Mains, with extraction focused in the Razorback area. 5. Longwall 710B – located to the east of the Douglas Mains, with extraction focused in the Menangle area. 6. Longwall 711 – marking the commencement of the consolidated Appin Area 7 mining domain. <p>We note extraction and associated subsidence within the Appin Area 9 mining domain will conclude within the next 12-months, representing a relatively short remaining impact timeframe.</p> <p>In the assessment of acceptable impact timeframes, the total subsidence timeframe should be used for background context only, in accordance with section 3.1.4 of SA NSW’s Early Settlement Policy which references typical timeframes for subsidence to cease in an active mining area of three to five years, beyond which alternative measures, such as an early settlement should be considered.</p> <p>IMC Requested Settlement Point Following LW709</p> <p>In application to the proposed extraction sequencing timeframes referenced by SA NSW, Longwall 709 (located to the east of the Douglas Mains) will commence in December 2021. However, Longwall 710B (located to the east of the Douglas Mains) will not commence until March 2024, representing a forecast delay in the commencement of discrete incremental subsidence events of 28 months.</p> <p>Accordingly, as consistent with the discussion at the 14 October 2021 meeting, IMC will be requesting SA NSW facilitate the settlement of any claims that arise from the extraction of Longwall 709 accounting for the delay between subsidence events of over 2-years. Any future impacts from Longwall 710B (or subsequent longwalls) will be managed as new claims under the Act.</p> <p>This approach is consistent with section 3.1.4 of SA NSW’s Early Settlement Policy, accounting for the non-sequential extraction (i.e. LW709 > LW710A (West of Douglas Mains) > LW710B) to the east of the Douglas Mains until the consolidated Appin Area 7 mining domain is embedded.</p>

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		<p>SA NSW Proposal</p> <p>SA NSW's proposal of settling Longwall 709 claims after Longwall 710B is not supported due to the return to a conventional extraction sequence, with an estimated timeframe in the order of 12-months between the conclusion of the Longwall 710B subsidence event and the commencement of the Longwall 711 subsidence event.</p> <p>IMC raises concern this timeframe is inadequate to reasonably have completed any repair works. For example, based on SA NSW's Claim Guidelines & Early Settlement Policy, out of the 12-month period up to 346 days are consumed:</p> <ul style="list-style-type: none"> • 90x days – SA NSW to manage the claim assessments to allow IMC to determine the claim. This does not include additional steps such as a peer review or the inclusion of engineering design work. • 3x days – SA NSW to forward determination to landholder. • 3-months – landholder review period to obtain independent legal advice and accept or dispute (request Secretary Review) the determination. • 90x days – Secretary of Customer Service to provide a determination. • 42x days – IMC to provide finalised settlement documentation based on Secretary's Determination to SA NSW. • 3x days – SA NSW to forward documentation to landholder. • 3-months – landholder to lodge appeal to Land & Environment Court (if applicable). • 7x days – assumed landholder acceptance, returning the settlement documentation and EFT form within 7-days. • 21x days – IMC to pay landholder. <p>In IMC's experience over 50% (7 of 13 to-date) of landholders, with claims for damages to their dwellings, request a Secretary Review. Assuming the landholder accepts the Secretary's Determination within 7x days, a nominal timeframe of just 20x days would be left to allow the landholder to coordinate repairs prior to the Longwall 711 subsidence event.</p> <p>As such, IMC considers SA NSW's proposal to be impractical and ultimately, unviable without impinging on landholders' rights of review.</p> <p>IMC Requested Workshop</p> <p>In relation to the consolidated Appin Area 7 mining domain, each longwall is forecast to take 18-months to extract, with a nominal period of 12-months between cessation of and the commencement of the next discrete active subsidence event. As illustrated by the timeframes above, this represents an inadequate timeframe to practically and fairly settle any impact claims and allow the landholder to coordinate repairs.</p> <p>As the Appin Mine moves further to the north-west within Area 7, the depth of cover increases, resulting in a wider influence area (angle of draw effects). It is expected that dwellings may be subject to subsidence movements of up to ~five longwalls, resulting in nominal start to finish timeframes of up to ~7.5 years.</p> <p>This exceeds the "acceptable" 3 to 5-year on-hold limit referred to under section 3.1.4 of SA NSW's Early Settlement Policy.</p>

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		Accordingly, as per our request at the most recent meeting on 14 October 2021, IMC reinforces the request to SA NSW for a workshop (or other meeting) to consider alternative measures to minimise our impact on the communities in which we operate.
Heritage NSW (letter dated 11 November 2021)		
1	Prior HNSW comments included expanding the table under Appendix 6 in the prior version of the HMP. This table has been removed from the submitted document. It is recommended that this table is reintroduced and extended to clarify any potential impacts and proposed mitigation measures (including protection and monitoring, dilapidation surveys, subsidence monitoring) to these heritage items.	<p>The Table under Appendix 6 in the Heritage Management Plan for the Appin Mine refers to Non-Aboriginal Heritage Sites located in the BSO Project Area.</p> <p>It is noted that there are no identified Non-Aboriginal Heritage Sites within the Longwalls 709 to 711 and 905 Extraction Plan Area.</p>
2	Table 6 of the TARP (Trigger Action Response Plan) within the HMP includes actions for three subsidence levels (negligible, major and severe). It is recommended that monitoring and remediation actions be incorporated into the HMP, particularly at the major and severe levels. Heritage NSW recommends the following actions in case of vibration and subsidence within any SHR curtilage: stop activity in surrounding area, followed by urgent rehabilitation of the area and submission of a report to Heritage NSW outlining the actions taken.	<p>The predicted impacts to Aboriginal objects are negligible and no mitigation measures are currently required or proposed.</p> <p>IMC will review the need to implement management or mitigation strategies if additional Aboriginal sites and/or items are located within the Study Area.</p> <p>The proposed TARP includes the following actions in response to major or severe impacts:</p> <p>Major Impact</p> <ul style="list-style-type: none"> • Review monitoring program and modify if necessary. • Report to key stakeholders as required. • Condition assessment and photographic record. • Consider development of site management plan to mitigate effects. • Continue with monitoring program (as reviewed) if safe to do so. • Notify relevant specialists. • Notify registered Aboriginal parties. <p>Severe Impact</p> <ul style="list-style-type: none"> • Review monitoring program and modify if necessary. • Report to key stakeholders • Site visit and discussions with Heritage NSW. • Condition assessment and photographic record. • Develop site management plan to mitigate effects. • Continue with monitoring program (as reviewed) if safe to do so. • Notify relevant specialists. • Notify registered Aboriginal parties.

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		A search of the SHR and Wollondilly LEP 2011 was completed in order to identify any non-Aboriginal heritage located within the study area. There were no records identified by these searches.
3	HNSW observes that the HMP subject to this referral covers the Appin Mine Areas 7 and 9, Longwalls 709 to 711 and 905, which are located within the greater Appin Way BSO Project study area. The greater study area is subject to another HMP– Appin Mine: Heritage Management Plan (South32 Illawarra Metallurgical Coal, August 2021)– for which HNSW has previously provided comment (our correspondence ref: DOC21/720490).	Noted
4	HNSW notes that the assessment Appin Area 7-9 Longwalls 709 to 711 and 905: Heritage Impact Assessment (Biosis Research, 2021), provided in Appendix B of the HMP subject to this referral, does not identify any non-Aboriginal heritage sites within the Appin Mine Areas 7 and 9, Longwalls 709 to 711 and 905 that require management.	Noted
5	Given that no non-Aboriginal heritage items have been identified, no further comments concerning historical archaeology are applicable to this HMP referral.	Noted
Environment, Energy and Science Group – Biodiversity, Conservation and Science Division (letter dated 24/11/2021)		
<i>...the current water monitoring program is considered highly deficient because:</i>		
1	There are no locations where water levels in pools, alluvium or hard rock aquifers are monitored directly above the proposed longwalls (see Figure 1).	<p><i>Figures referred to in this section of the Response are from the updated Groundwater Impact Assessment (SLR 2022, v6.0), which will be made available once finalised.</i></p> <p>As stated previously in Table 7 of the Longwalls 709 to 711 and 905 Extraction Plan (EP), potential sites directly above the proposed longwalls would be located on private property. Installing pool water monitoring equipment or boreholes with piezometers is subject to landholder agreement.</p> <p>As shown in Figure 54 of the updated Groundwater Impact Assessment (SLR 2022), a new bore was recently installed in the Alluvium (S2536) along Navigation Creek to the north of Longwall 711. Once the groundwater level measurements from this bore are available, they will be used to refine the model calibration and predictions.</p> <p>The minimal impact on the lower order streams has been inferred from the model prediction, which showed that the alluvium (Figure 47; SLR 2022) and Wianamatta Group (Figure 48; SLR 2022) do not show any cumulative groundwater level drawdown, and hence would not result in a change in surface water. In the Upper HBSS, there is cumulative drawdown of up to 30 m (Figure 49; SLR 2022), however this is more likely to be attributed to the extraction at landholder bores (Figure 50; SLR 2022 for Lower HBSS shows steep cones of depression around the registered bores).</p>

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2	<p>Many of hard rock piezometers are already impacted or are not recording at all.</p> <p>The majority of bores close to the extraction area do not have an appropriate baseline to assess change.</p>	<p>Refer to Table 7 in the Longwalls 709 to 711 and 905 EP. New borehole sites have been established and have been incorporated into the Water Management Plan.</p> <p>Several monitoring bores and their measurements were not included in the previous Groundwater Impact Assessment (SLR 2021, v5.0). These are now included in the Groundwater Impact Assessment (Section 3.2; SLR 2022 v6.0) and were used for the calibration process.</p> <p>As shown in Figure 9 of the Groundwater Impact Assessment (SLR 2022), there are 9 monitoring bores close to Longwalls 709, 711 and 905. These include S1954, S1936, S2080, S2282, S2283, S1941, S2280, S2281, S1913. Bore S1936 has only one remaining piezometer operational (65 m) as all other piezometers have sheared. The rest of the sensors in the bores are functional and the recorded water levels from these bores are now included in Section 3.2 (SLR 2022).</p> <p>Furthermore, as shown in Figure 54 (SLR 2022), 4 new monitoring bores are installed near Longwalls 709, 711 and 905 (S2536, S2536A, S2537, S2538). Once the groundwater measurements from these new bores are available, they will be assessed and added to the calibration dataset in future revisions of the model.</p>
3	<p>The quality of the data is considered highly suspect for some piezometers.</p> <p>S1913, S1941, S2060, S2281, S2282, S2283, S2080, S2315 and S2308 are included in Appendix C.</p> <p>Reference to one of these (S2308) suggests that water levels in the HBSS at 70 m have potentially risen by 40 m, without any explanation or validation.</p> <p>Many other piezometers in the area and cited to be part of an 'extensive' groundwater monitoring program but are not included in the assessment or have any appropriate impact assessment (eg a rigorous and objective BACI assessment) applied.</p>	<p>SLR has reassessed all groundwater data available from the monitoring bores and included the latest data for the bores in the data set as shown in Section 3.2 of the Groundwater Impact Assessment (SLR 2022). The groundwater calibration data set was also updated using the updated groundwater data set.</p> <p>A summary of groundwater calibration data is provided below:</p> <p>S1913 – the sensors are still working. In the updated report (V6.0), the hydrograph for S1913 has been updated using the latest data for this bore. The model calibration data set has also been updated to include the missing measurements for S1913.</p> <p>S1936 –all sensors except the shallowest one (65m) are no longer working. This is likely due to the loggers being damaged by mining.</p> <p>S1941 – latest data for S1941 indicates gradual decline in groundwater level in lower HBSS, lower BGSS, SBSS and significant decline (>200m) in groundwater level in the Bulli Coal Seam (Figure 12 in the update report). The decline in the observed groundwater levels is a result of the longwall mining approaching this bore.</p> <p>S2060- The hydrograph for this bore is shown in Figure 25 in the updated report. As shown in the figure, the decline in groundwater levels in the Bulli Coal Seam and Balgownie Seam due to the longwall mining is evident.</p> <p>S2281, S2282 and S2283- The bores are located close to Harris Creek and LW901 and monitor the HBSS. The hydrographs for these bores are shown in the updated report (Figure 15, Figure 16, and Figure 17). The data shows there is a decline of between 5 to 7 m recorded in the lower sensor in HBSS in S2281, S2282 and S2283 between 2016 to 2017. These changes in groundwater levels correlate with the cumulative rainfall departure (CRD) but also the timing of the longwall mining. Therefore, it is likely the groundwater levels in HBSS were both impacted by mining and climate. The</p>

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		<p>groundwater levels in HBSS in these bores show steady groundwater levels between 2017 to 2020 (during the drought period in NSW). However, since 2020 the bores are showing signs of recovery with gradual increase in groundwater levels.</p> <p>S2080 – The hydrograph for the bore is updated using the latest data and is shown in Figure 14 of the updated Groundwater Impact Assessment (SLR 2022). The hydrograph for the bore shows decline in groundwater levels in HBSS is consistent with the timing of the longwall panels but also correlates with the CRD. Therefore, it is likely the groundwater level in HBSS in S2281 are a response to more than one stress (i.e. mining and climate).</p> <p>Alluvium Bores: A review of the NSW GW registered bores database showed there are no alluvium bores available to be used in the model calibration. Most of the groundwater bores in the NSW database monitor the HBSS. South32 has installed a monitoring bore in the alluvium to the north of Longwall 711. Once data is available, the measurements from this new bore will be used in future revision of the model to better inform the model calibration in matching the alluvium groundwater levels.</p> <p>Additional hydrographs: SLR has plotted data from two additional bores (S2315 and S2308) to be presented in the updated groundwater report (V6.0). The hydrograph for S2315 (Figure 23) shows significant decline in groundwater levels in the Bulli Coal Seam in response to longwall mining. However, S2308 located 1.8 km to the west of S2315 has recorded stable groundwater level due to further distance from the current mining works (Figure 13).</p>
4	SLR (2021a) predicted 3 m and 4 m depressurisation of landholder bores GW072874 and GW105534 in the lower HBSS due to mining at Longwalls 709 to 711 and 905. These bores are not instrumented/monitored and nor are landholder bores GW101986, GW105388, GW106574, GW105376, GW112381 and GW105574 (likely to experience similar drawdown to that of GW105534).	<p>A conservative approach was taken where the predicted depressurisation at landholder bores was calculated based on maximum depressurisation across all layers representing the HBSS and Bulgo Sandstone.</p> <p>The incremental depressurisation for privately owned bores due to Appin Mine was predicted by subtracting the Approved plus Project Appin Mine water levels from the NULL Appin Mine Run water levels (shown in Table 15; SLR 2022). Negligible depressurisation (less than 1 m) at all identified landholder bores is due to Appin Mine.</p>
5	Local geological structures such as fracturing and shearing could cause significantly greater depressurisation at individual bores (SLR 2021a).	<p>There are two NNW-SSE orientated zones of geological structure that span Appin Areas 7 and 9. These zones comprise a series of dykes with thicknesses up to approximately 3.5 m and minor faults with displacements up to approximately 3 m. Longwalls 707 and 708 have been split into four shorter panels (i.e. LW707A, LW707B, LW708A and LW708B) to avoid this zone.</p> <p>The proposed LW709, LW710B and LW711 cross one of the zones of geological structure; LW905 is located on the eastern side of the other zone. Increased vertical subsidence is not anticipated in these locations, as it was not observed when LW703 to LW706 and LW901 to LW903 were previously mined through these zones. Localised irregular surface movements (i.e. compressive strain and heaving) were observed near these zones; however, these are likely due to surface topography (i.e. drainage lines and cuttings) rather than the geological structures. In any case, the surface features located above and near the zones of geological structure have been assessed for potential localised irregular ground movements.</p>

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		<p>Elsewhere, minor faults with displacements up to approximately 1 m, span the proposed LW709 to LW711 and LW905. Increased subsidence or localised irregular movements are not anticipated in these locations, compared to when longwalls previously mined through similar geological structures in Appin Areas 7 and 9. Surface features have been assessed for potential anomalous irregular movements, as the predicted strains are based on statistical analyses of monitoring data that include these effects.</p>
6	<p>MSEC (2021) predict that fracturing of shallow (10 m to 20 m depth) bedrock for the creeks could develop due to the Project, particularly in areas immediately above the longwall panels. Surface tension cracks are also likely to occur, typically with widths in the order of 25 mm to 50 mm.</p>	<p>The mining-induced compression due to valley closure effects can also result in dilation and the development of bed separation in the topmost bedrock, as it is less confined. This additional dilation due to valley closure is expected to develop predominately within the top 10 m to 20 m of the bedrock. Compression can also result in buckling of the topmost bedrock resulting in heaving in the overlying surface soils.</p> <p>Surface water flow diversions could occur along the creeks and tributaries that are located directly above the mining area. In times of heavy rainfall, the majority of the runoff would flow over the fractured bedrock and soil beds and would not be diverted into the dilated strata below. In times of low flow, however, surface water flows can be diverted into the dilated strata below the beds. These creeks and tributaries are ephemeral and, therefore, surface water flows only occur during and for relatively short periods after rain events.</p> <p>As stated above (item #1), potential watercourse monitoring sites above longwall panels are located on private property. Installing pool water monitoring equipment or boreholes with piezometers is subject to landholder approval.</p>
7	<p>Use of Tammetta's equation suggests a height of connective fracturing of 338-360 m for a panel width of 324 m and extraction height of 3.3 m. Such a height of connective fracturing would likely take it up into the Bulgo Sandstone and Hawkesbury Sandstone.</p>	<p>The existing Appin Model fracture heights are determined using the Ditton algorithm. The Ditton algorithm is preferred over the Tammetta method at Appin Mine for the following reasons:</p> <ol style="list-style-type: none"> 1. There is no evidence (e.g. site measurements) that favours the Tammetta formula over the Ditton formula at Appin Mine. 2. Tammetta algorithm is highly sensitive to extraction height (T) and therefore, overestimates fracture zone height with increase in extraction height. This is due to the nature of the Tammetta algorithm which uses a power law (exponent of 1.4). As shown in Figure 8 below, the power law causes large increases in fracture zone height for small increases in extraction height. The Ditton method uses an exponent of 0.5 which is consistent with laboratory evidence (Whittaker and Reddish, 1989).

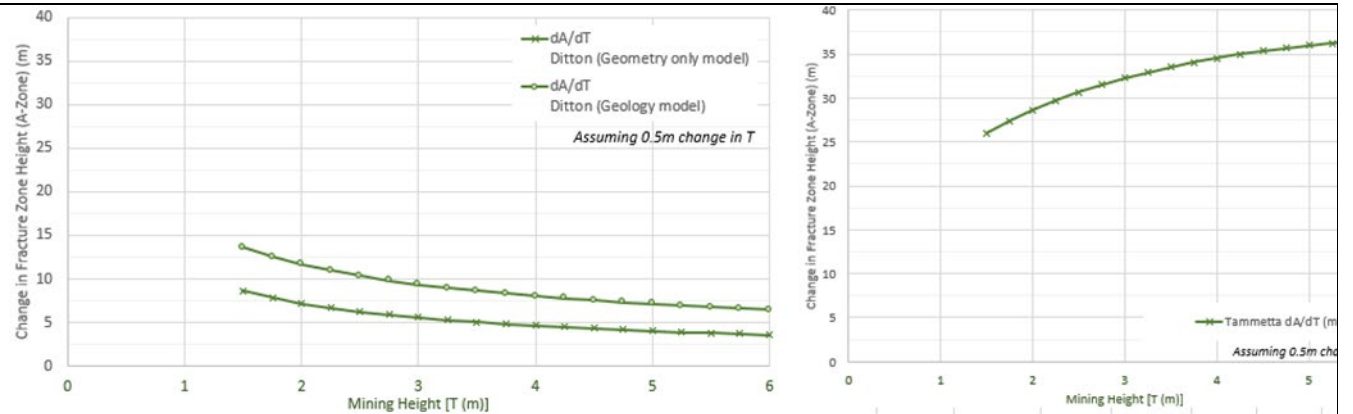


Figure 1 Sensitivity to extraction height (T), Ditton method and Tammetta method

3. Effective thickness of the strata (t') which supports the larger mining height is not included in the Tammetta algorithm. Therefore, the algorithm disregards this parameter and tends to overestimate the fracture height. A sensitivity analysis was carried out with the aim of comparing the fracture zone height using different approaches. The sensitivity analysis included the following methods:
 - Ditton method with $t'=20$ m [base case];
 - Ditton method with $t'=15$ m;
 - Ditton method with $t'=10$ m; and
 - Tammetta method.

The results of the sensitivity analysis are presented in Table 8 below. As it can be seen in the table, Ditton with $t'=10$ m results in fracture height values consistent with the Tammetta method. A study by Ditton and Merrick (2014) on longwall mines in the NSW coalfields indicated that $t'=15$ m to 20 m is considered appropriate for the Southern Coalfield (Figure 9). The 2014 study considered $t'=10$ as an extreme value (i.e., worst case scenario).

Given that the depth of cover above the Appin longwalls varies between 530 m and 750 m, the exiting Appin groundwater model uses Ditton calculation with $t'=20$ for the longwalls simulated in the model. However, as a part of the new round of updates to the groundwater model, SLR suggests a Ditton method with a variable t' (between 15 to 20) be used in calculation of fracture height for different depth of cover areas above the Appin longwalls.

Table 1 Calculated Ditton and Tammetta Methods Average Heights, Vertical Buffer Depths (m) and extent of fracturing

Methods	Average Height (m)	Average Vertical Buffer (m)	Fractured into Model Layers
Ditton A $t'=20$ m [base case]	198 – 286	306 – 536	7 [BGSS]

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		<table><tr><td>Ditton A t'=15m</td><td>223 – 321</td><td>280 – 501</td><td>6 [BACS]</td></tr><tr><td>Ditton A t'=10m</td><td>262 – 378</td><td>239 – 448</td><td>5 [Lower HBSS]</td></tr></table> <div><h3>Minimum t' with non-spanning strata</h3><p>From subsidence data in the coalfields: Strain E = (mm/m) Curvature C = km⁻¹</p><div><p>$E = C \times d_n$ $d_n = \text{Depth of Cracking}$ $2 \times d_n = t'_{\min}$ $R = \text{Radius of curvature or the curvature, } C = 1/R \text{ (km}^{-1}\text{)}$</p></div><table><thead><tr><th>Coalfield</th><th>Normal Condition* t'min (m)</th><th>Adverse Condition t'min</th></tr></thead><tbody><tr><td>Southern</td><td>40 – 20</td><td>15</td></tr><tr><td>Western</td><td>30 – 20</td><td>10</td></tr><tr><td>Newcastle</td><td>20 – 15</td><td>10</td></tr><tr><td>Hunter</td><td>20 – 15</td><td>10</td></tr><tr><td>Gunnedah</td><td>20 – 15</td><td>10</td></tr></tbody></table><p>* - Southern to Hunter Valley</p><table><thead><tr><th>Cover Depth H (m)</th><th>Normal Condition* t'min (m)</th><th>Adverse Condition t'min</th></tr></thead><tbody><tr><td>>450</td><td>40 – 20</td><td>15</td></tr><tr><td>350 – 450</td><td>30 – 20</td><td>15</td></tr><tr><td>250 – 350</td><td>20 – 20</td><td>10</td></tr><tr><td>150 – 250</td><td>20 – 15</td><td>10</td></tr><tr><td><150</td><td>20 – 15</td><td>10</td></tr></tbody></table><p>* - Southern to Hunter Valley</p><p>Ditton & Merrick, 2014</p><p>Figure 2 Recommended values for effective thickness of the strata (t') for different depth covers in longwall mines in the NSW coalfields (Ditton and Merrick, 2014)</p></div>	Ditton A t'=15m	223 – 321	280 – 501	6 [BACS]	Ditton A t'=10m	262 – 378	239 – 448	5 [Lower HBSS]	Coalfield	Normal Condition* t'min (m)	Adverse Condition t'min	Southern	40 – 20	15	Western	30 – 20	10	Newcastle	20 – 15	10	Hunter	20 – 15	10	Gunnedah	20 – 15	10	Cover Depth H (m)	Normal Condition* t'min (m)	Adverse Condition t'min	>450	40 – 20	15	350 – 450	30 – 20	15	250 – 350	20 – 20	10	150 – 250	20 – 15	10	<150	20 – 15	10
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DPI – Agriculture (letter dated 8 November 2021)																																														
1	<p>It is noted that the extraction plan has included details of the proposed management, mitigation, monitoring and reporting of potential impacts and environmental consequences of the approved underground mining operations at Appin Mine. This process will include the preparation of a Property Subsidence Management Plan (PSMP) for individual landowners.</p> <p>The PSMPs will be developed in consultation with the individual property owners prior to subsidence effects at the property and will address the management of all surface infrastructure including rural buildings and farm dams and development of any mitigation measures.</p> <p>DPI Agriculture has no further requirements for the extraction plan.</p>	Noted																																												

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DPI - Fisheries (letter dated 11 November 2021)		
1	<p>DPI Fisheries has reviewed the proposal in light of these provisions and has no objections to the proposed works, and makes the following comments:</p> <ul style="list-style-type: none"> • Negligible environmental consequences to threatened species, threatened populations, or endangered ecological communities listed under Part 7A of the Fisheries Management Act (1994). • Nepean River is expected to experience negligible environmental consequences. This includes negligible diversion of flows or changes in the natural drainage behaviour of pools, negligible gas releases and iron staining and negligible increase in water cloudiness (p.31, Biodiversity Management Plan, October 2021). • Other watercourses are expected to experience no greater subsidence impact or environmental consequences than approved in the Bulli Seam Operations original environmental assessment (2009). 	Noted
Office of the National Rail Safety Regulator (email dated 3 December 2021)		
1	In this instance the longwalls as proposed will not undermine the Main South Railway (MSR),	Noted
2	LW#709 will approach the railway at its eastern corner, but is not expected to have significant subsidence impact on the railway,	Noted
3	Both the rail safety regulator (ONRSR) and the mine regulator (DRE) will have on-going oversight during extraction of subsidence monitoring and mitigation controls as outlined in the mine subsidence management plans. Both regulators will require the mine to ensure that the critical rail infrastructure can continue to operate safely during coal extraction and until subsidence stabilises.	Noted
4	At this stage ONRSR has no additional requirements with regard to planning approvals, but ONRSR will continue to receive regular subsidence reports from the mine and will request additional mitigative	Noted

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	actions if the planned subsidence management is not adequately effective.	
5	We understand that ARTC as the rail operator of the MSR has also been approached for comment, ONRSR will continue to oversee ARTC's role in maintaining the safety of the rail operations especially during the period of active subsidence.	Noted
Resources Regulator (letter dated 12 November 2021)		
1	Based on the review of the modification report, the Resources Regulator advises that the holder of relevant mining leases is required to ensure that the rehabilitation commitments outlined in any approved Extraction Plan are included in the Mining Operations Plan / Rehabilitation Management Plan regulated by the Resources Regulator pursuant to the conditions of the mining leases under the Mining Act 1992. The holder of the mining leases must ensure the Mining Operations Plan / Rehabilitation Management Plan for the area covered by this APPIN MINE AREAS 7 AND 9 LONGWALLS 709 TO 711 AND 905 EXTRACTION PLAN is updated where necessary.	Noted.
Wollondilly Shire Council (letter dated 1 December 2021)		
1	Layout of the longwalls in regard to watercourses Council's preferred position is that a precautionary approach be adopted and DPIE require adjustment to minimise the extent of impacts to third order watercourses, or require scientific based demonstration from South32 reasons this cannot be achieved on operational grounds	Several layout alternatives for Longwalls 709 to 710 and 905 were assessed by South32 using a multi-disciplinary team including environment, community, mining and exploration expertise. These included variations in the number of longwalls and orientations, lengths, and setbacks of the longwalls from key surface features. These options were reviewed, analysed and modified until an optimised longwall layout was achieved. Condition 1, Schedule 3 of the BSO Approval states that impacts to watercourses (other than the Nepean River) are "no greater subsidence impact or environmental consequences than those predicted in the EA and PPR". The impacts to third order watercourses are consistent with those predicted in the BSO EA.
2	Potential impacts to the ecological health of waterways An assessment of likely impacts to the ecological health of watercourses within and downstream of the Study Area be required as part of the additional assessment sought by this submission.	Potential impacts to aquatic ecology have been assessed as part of the BSO Environmental Assessment (Bioanalysis 2009). In support of the Longwalls 709 to 710 and 905 EP, potential impacts to aquatic ecology have been further assessed for proposed longwalls (Cardno 2021). These assessments consider the following factors for the Nepean River and watercourses within the study area: aquatic habitat, riparian vegetation, aquatic macrophytes, fish and threatened species. Table 8 within the Biodiversity Management Plan for Appin Mine Areas 7 and 9, compares the assessed potential impacts for the proposed longwalls against the predicted and approved impacts for the BSO Project. The potential impacts from the extraction of the proposed longwalls are consistent with the approved predicted impacts from the BSO

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		<p>Environmental Assessment.</p> <p>The potential impacts from Longwalls 709 to 711 and 905 on aquatic habitats and biota in the Nepean River will be minimised by:</p> <ul style="list-style-type: none"> • Adopting a mine layout that does not involve mining under the Nepean River. • Identifying triggers that would prompt surveys to assess any impacts on aquatic habitats and their biota identified during and after extraction of the longwalls. • Identifying physical and water quality impacts that occur during the extraction of Longwalls 709 to 711 and 905 through ongoing monitoring and timely implementation of appropriate CMAs. <p>DPI Fisheries provided comment on the EP on 11 November 2021. DPI Fisheries is responsible for ensuring that fish stocks are conserved and that there is no net loss of key fish habitats upon which they depend.</p> <p>DPI Fisheries made the following comments on the EP:</p> <ul style="list-style-type: none"> • Negligible environmental consequences to threatened species, threatened populations, or endangered ecological communities listed under Part 7A of the Fisheries Management Act (1994). • Nepean River is expected to experience negligible environmental consequences. This includes negligible diversion of flows or changes in the natural drainage behaviour of pools, negligible gas releases and iron staining and negligible increase in water cloudiness (p.31, Biodiversity Management Plan, October 2021). • Other watercourses are expected to experience no greater subsidence impact or environmental consequences than approved in the Bulli Seam Operations original environmental assessment (Bioanalysis 2009).
3	<p>Identification of potential impacts to surface and groundwaters</p> <p>The statements regarding potential impacts to water quality within the EIS are in large part generic and with insufficient scientific basis.</p> <p>There is considered insufficient detailed analysis of the interaction of existing and potentially created fractures resulting from mine induced subsidence with groundwater sources within the EIS.</p> <p>There is concern over the adequacy of analysis in identifying long-terms impacts to quality and quantity of groundwaters given viewed shortcomings in the adequacy of the groundwater properties and its movement within the EIS.</p>	<p>Based on predictions of subsidence, changes to water quality and observations from previous aquatic ecology monitoring in the Nepean River, impacts to aquatic habitat and biota are not expected to occur in the Nepean River due to extraction of Longwalls 709 to 711 and 905 (Cardno 2021).</p> <p>Localised and minor changes in habitat availability and connectivity may occur along the first, second and third order drainage lines due to tilt but these effects will be difficult to detect due the high variability in natural flows within these ephemeral watercourses. The impacts resulting from the changes in surface water flows are expected to be small in comparison with those which occur during natural flooding conditions. Consequently, impacts to aquatic habitat and biota due to tilt, if any, are expected to be minor and localised in drainage lines located directly above and within 400 m of the proposed longwalls (Cardno 2021).</p> <p>The Project does not include any surface activities or direct abstraction or interaction with the HBSS groundwater source. Therefore, impacts on the water quality within the HBSS are unlikely. A more detailed description of potential impacts to the deeper Bulgo Sandstone is provided in Section 4.3.6 (SLR 2022).</p>
4	Risk assessment of potential impacts to waterways	The Extraction Plan application has been prepared in accordance with the BSO Approval, specifically Condition 5,

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	<p>The Extraction Plan be amended to contain an enhanced assessment and modelling of likely subsidence induced impacts (including potential gas emissions) on watercourses (including aquatic ecology), to a similar level that would be required for Environmental Impact Statements for mining applications.</p> <p>The DPIE require that the detailed assessment be required by a Water Plan (or equivalent) for all sections of third order streams directly undermined in the approved layout in the event of this modification not occurring. First and second order watercourses: A site specific assessment that identifies significant features warranting protection through provision of an appropriate setback be required for first and second order streams.</p>	<p>Schedule 3. The supporting specialist assessments have been developed by suitably qualified experts in their respective fields. Mine Subsidence Engineering Consultants (MSEC) are the same consultants who undertook the subsidence modelling and assessment for the BSO EA.</p> <p>MSEC (2021) state that further gas release zones could develop along the Nepean River, which has been observed due to the mining of previous longwalls in AA7 and 9.</p> <p>Cardno (2021) provide assessment and previous observations of potential aquatic ecology impacts “It is possible that gas releases may result in localised changes in water quality, such as reductions in Dissolved Oxygen, though localised changes are not expected to result in significant impacts to aquatic biota. No impacts to aquatic biota have been observed in the Nepean River associated with gas releases observed during extraction of previous Appin Area 7 and 9 longwalls (Cardno 2020 and references therein).”</p>
5	<p>Monitoring post Determination</p> <p>The Surface Water Quality Indicator be required to be updated to include inspections for the presence of any re-emergence of water to the surface from mine induced fractures and that any such identified re- emergence be monitored as part of the implementation of the Plan.</p>	<p>Fracturing of the uppermost bedrock can occur along the streams that are located directly above or adjacent to the proposed mining area. Surface water flow diversions could occur along the creeks and tributaries that are located directly above the mining area. It is unlikely, however, that there would be a net loss of water from the catchment.</p> <p>The IMCEFT undertake visual inspections as part of routine monitoring across the Longwalls 709 to 711 and 905 Study Area. If mining induced fractures were observed to be diverting water from a watercourse, this would be recorded and investigated by a suitability qualified expert. This would be reported in the End of Panel Report and Annual Review.</p>
6	<p>Impacts to terrestrial biodiversity</p> <p>The inclusion of a consideration of the State Environmental Planning Policy (Koala Habitat Protection) 2021 within the EIS be required.</p> <p>The EIS be amended to include a specific criteria within the Trigger Action Response Plan that would trigger assessment of impacts and/or rehabilitation for both these communities given their threatened ecological community status be required.</p>	<p>The potential for subsidence impacts to the Koala are remote as the Project is unlikely to affect the trees that this species utilises and forages in. Impact likely to be insignificant. Predicted impacts for the current proposal is consistent with predicted impacts in BSO EA (Niche 2021).</p> <p>The terrestrial ecology monitoring program for the Project includes visual inspections as part of landscape and water monitoring programs in active mining areas, which are subject to access agreement from relevant landholders.</p> <p>Results from the monitoring program will be reported annually in the Annual Review. This report will:</p> <ul style="list-style-type: none"> • Detail the outcomes of monitoring undertaken; • Provide results of visual inspections; • Determine whether performance indicators have been exceeded; and • Make recommendations in relation to any CMAs required. <p>Monitoring results will be reviewed monthly by the IMC Subsidence Management Committee. However, if the findings of monitoring are deemed to warrant an immediate response, the Principal Approvals will initiate the requirements of the Trigger Action Response Plan (TARP) (Table 11 in the Biodiversity Management Plan – AA7 and 9).</p>

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7	<p>Impacts to aquatic biodiversity</p> <p>The (requested by Council's submission), enhanced assessment of likely impacts of the longwalls on the condition of water sources based on current scientific research and guidelines be required to also consider impacts to aquatic biodiversity.</p>	<p>Predictions indicate impacts to aquatic habitat and biota would be comparable to or of lesser magnitude and / or extent than those predicted by Bioanalysis (2009). Impacts to aquatic habitat, riparian vegetation, macrophytes, macroinvertebrates and fish in the Nepean River are generally less likely to occur and are less than predicted previously. This is due to the absence of adverse physical impacts predicted to occur due to extraction of Longwalls 709, 710A, 710B, 711 and 905.</p> <p>Impacts to threatened species (i.e. unlikely to occur) are comparable, primarily because Macquarie perch and Sydney hawk dragonfly have not been detected and are unlikely to be located within the Study Area. Predictions for drainage lines are comparable, with the potential for fracturing, flow diversions and localised impacts to aquatic biota expected to occur in the BSO AEA and the current assessment.</p>
Transport for NSW (letter dated 23 December 2021)		
1.	The study area extends underneath a Declared Freeway (Hume Highway) as shown by blue colour and green hatching on attached Aerial – "X". Access is denied across this boundary.	Addressed below
2	<p>The developer is to submit design drawings and documents relating to the excavation and the impacts resulting from the extraction of the vertical and horizontal longwalls to the Hume Motorway to TfNSW for assessment, in accordance with Technical Direction GTD2012/001.</p> <p>The developer is to submit all documentation at least six (6) weeks prior to commencement of construction and is to meet the full cost of the assessment by TfNSW. Please send all documentation to development.sydney@transport.nsw.gov.au.</p> <p>If it is necessary to excavate below the level of the base of the footings of the adjoining roadways, the person acting on the consent shall ensure that the owner/s of the roadway is/are given at least seven (7) day notice of the intention to excavate below the base of the footings. The notice is to include complete details of the work.</p>	<p>IMC's Appin Mine has been successfully undertaking longwall extraction directly beneath the M31 Hume Motorway over the past 10-years with the completion to-date of Longwalls 703 to 708B at depths of approximately 520 to 560 m below the corridor.</p> <p>IMC routinely consults with TfNSW in relation to IMC's mining operations and the M31 Hume Motorway through the established Technical Committee in accordance with the approved Management Plan.</p> <p>In relation to the Extraction Plan Application, the approved Management Plan incorporates the extraction of Longwalls 709 and 710B; and is regularly reviewed and updated as required in consultation with the Technical Committee, TfNSW and the NSW Resources Regulator.</p> <p>Accordingly, IMC considers the requested details to be addressed by existing arrangements.</p>
3	It is noted that the Menangle Road is directly within the study area. Menangle Road is a Classified Regional Road under the care and control of Wollondilly Shire Council. Council are to be	<p>IMC regularly consults with WSC in relation to IMC's mining operations and their local road assets, in accordance with the approved Public Road Management Plan (Rev 12, March 2019).</p> <p>This Public Road Management Plan will be revised in a timely fashion accounting for the proposed extraction outlined by</p>

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	consulted and satisfied that any possible impacts to this corridor are adequately addressed and mitigated.	this Extraction Plan Application.
4	TfNSW also advises that The Outer Sydney Orbital (OSO) Project is currently investigating the proposed Outer Sydney Orbital corridor. Further information in regard to the OSO corridor can be obtained at https://www.transport.nsw.gov.au/corridors/oso or by contacting the project team on our free call information line: 1800 837 511 or via email: corridors@transport.nsw.gov.au .	IMC notes that the forecast completion of mining associated with this Extraction Plan is May 2026. We understand subsidence will be completed in this area prior to the commencement of construction of any potential future OSO Project. Accordingly, there will be no interaction between these two projects.