Appendices

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Appendix 1

Updated Project Description

(Total No. of pages = 3)

Component	Original Application (RWC 2010a & RWC 2010b)	MOD 1 – July 2012 (RWC 2012a & RWC 2012b)	MOD 2 – October 2013 (RWC 2013a and 2013b)	MOD 3 – August 2016 (RWC 2015a and RWC 2015b)	MOD 4 – May 2019 (RWC 2018 and RWC 2019)	MOD 5 – Proposed Modification (This document)
Limits on Approval	• Life of the Mine – 31 August 2018	• No change	• No change	• Life of the Mine – 30 June 2025	• No change	• No change
	• Processing rate: – 355 000tpa – 1.2Mt over the life of the Project • No use of tailings to backfill completed slopes • No use of cyanide or mercury to process or extract gold • No processing or smelting of any ore other than extracted from site	• Use of tailings to backfill permitted	• No change	• Processing rate: – 1.6Mt over the life of the Project • Concentrate stored within a covered, concrete-sealed and bunded area within the processing plant. • No other changes	• No change	• Processing rate: – 415 000tpa • No other changes
Mining Operations	• Underground sublevel open stope with suitable crown pillar, internal pillars and sill	• No change	• No change	• No change	• No change	• No change
Waste Rock Management	• Use of ROM pad/temporary waste rock emplacement prior to use in infrastructure establishment and/or rehabilitation	• No change	• Adjustment to ROM pad shape • No other changes	• Construction and use of Eastern Waste Rock Emplacement • No other changes	• No change	• No change
Processing Operations	• Ore stockpiling at the ROM pad/temporary waste rock emplacement • Crushing and screening within enclosed Processing Plant • Concentrate production via gravity and flotation circuit	• Construction and use of a paste plant within the Processing Plant • No other changes	• Relocation of the Processing Plant • No other changes	• No change	• No change	• No change – increase in processing rate achieved through efficient operations
Tailings Harvesting and Pastefill Operations	• Construction and use of a Tailings Storage Facility with a capacity of approximately 900 000t	• No change	• No change	• Removal of an internal Tailings Storage Facility access road • Submission of the TSF *Final Design Report*. • No other changes	• Reinstatement of the internal Tailings Storage Facility access road. • No other changes	• Amendment to the Project Site layout to show the maximum TSF embankment height of 712m AHD as per the *Final Design Report* submitted as Appendix 1 to RWC (2015b) • No change
Water Management	• Eight harvestable rights dams and associated water reticulation system with a total capacity of 34.5ML for the harvesting and supply of environmental flows • Harvesting/extracting a maximum of 79ML per year of groundwater from the following historic workings – Snobs (approximately 39ML/year – Stewart and Mertons (16ML/year) – United Miners (24ML/year) • Treatment of raw, dirty and contaminated water through the use of a Mine Water Settlement Dam, Raw Water Pond and Process Water Pond • Use of sediment basins with a total capacity of 6000m^3	• No change	• No change	• Increased harvestable right capacity to 37ML as a result of purchasing adjacent property • Removal of two harvestable rights dams (HRD-E and HRD-F) to allow for construction of the Eastern Waste Rock Emplacement and increase to the Tailings Storage Facility • No other changes	• Construction of four sediment basins – SCCSB1 and SCCSB2 north of Spring Creek – SCCSB3 and SCCSB4 south of Spring Creek • No other changes	• Construction and use of a turkey's nest style Water Storage Dam with a capacity of 180ML • No other changes

<table>
<tr><th>Component</th><th colspan="2">Original Application
(RWC 2010a & RWC 2010b)</th><th>MOD 1 –
July 2012
(RWC 2012a & RWC 2012b)</th><th>MOD 2 –
October 2013
(RWC 2013a and 2013b)</th><th>MOD 3 – August 2016
(RWC 2015a and RWC 2015b)</th><th>MOD 4 – May 2019
(RWC 2018 and RWC 2019)</th><th>MOD 5 – Proposed Modification
(This document)</th></tr>
<tr><td>Transportation Operations</td><td colspan="2">• Site access: Dedicated Site Access Road via Majors Creek Road
• Transportation of sulphide concentrate via Site Access Road, Majors Creek Road, Araluen Road, Captains Flat Road, Coghill Street and Kings Highway
• Transportation of sulphide concentrate using covered semi-trailers
• Concentrate laden truck movement limits:
– Maximum 4 concentrate trucks exit the site per hour
– Dispatch of concentrate limited to between the hours of 7am to 10pm Monday to Saturday and 8am – 10pm Sundays and Public Holidays
– All heavy vehicle movements to or from the site are prohibited between 7am – 8.30am and 3pm – 5pm on school days
• 26 light vehicle movements per day
• 18 heavy vehicle movements per day</td><td>• 20 heavy vehicle movements per day (increased from 18)
• No other changes</td><td>• No change</td><td>• Construction and use of an internal heavy vehicle crossing across Spring Creek
• No other changes</td><td>• Relocation of the Spring Creek crossing approximately 400m north
• No other changes</td><td>• Inclusion of emergency transportation of water within approved transportation limits for concentrate trucks (no change to maximum transport rates)
• No other changes</td></tr>
<tr><td>Supporting Infrastructure</td><td colspan="2">• Electricity transmission line consisting of approximately 16 treated timber power poles
• Mine operations associated infrastructure:
– box cut
– portal
– settling pond
– decline approximately 3 640m long at a maximum depth of 520m
– vent fan with a capacity of approximately 150m³/second
– ventilation drives and ventilation rises approximately every 25m vertically as the mine increases with depth
• Office area and carpark
• Workshop, hardstand and laydown area
• Drill core storage and processing facility
• Explosives storage area</td><td>• No change</td><td>• Changes to the box cut layout
• Replacement of the Office and core yard area with a series of demountable buildings, a drill core storage and processing facility
• No other changes</td><td>• No change</td><td>• No change</td><td>• No change</td></tr>
<tr><td rowspan="6">Hours of Operation</td><td>Activity</td><td>Approved Hours</td><td rowspan="6">• Inclusion of paste filling with mining, maintenance and processing operations</td><td rowspan="6">• No change</td><td rowspan="6">• No change</td><td rowspan="6">• No change</td><td rowspan="6">• No change</td></tr>
<tr><td>Vegetation clearing, topsoil stripping, construction of the box cut and rehabilitation</td><td>7am – 6pm Monday to Saturday
8am to 6pm on Sundays and public holidays</td></tr>
<tr><td>Remainder of construction operations</td><td>24 hours per day, 7 days a week</td></tr>
<tr><td>Mining, maintenance and processing operations</td><td>24 hours per day, 7 days a week</td></tr>
<tr><td>Crushing operations (including operation of front-end loader)</td><td>7am – 7pm, 7 days per week</td></tr>
<tr><td>Transportation</td><td>7am – 6pm Monday to Saturday
8am to 6pm on Sundays and public holidays
6pm – 10pm any day</td></tr>
<tr><td>Biodiversity Offset Area</td><td colspan="2">• On site Biodiversity Offset Area located south of the operational areas covering a total area of approximately 272ha</td><td>• No change</td><td>• No change</td><td>• No change</td><td>• No change</td><td>• No change</td></tr>
</table>

Appendix 2

Updated Management and Mitigation Measures

(Total No. of pages = 15)

Table A2.1
Updated Management and Mitigation Measures

Environmental Setting	Management and Mitigation Measure
Noise and Blasting	Ensure all bulk earthworks strictly adhere to standard construction hours of operation, namely 7:00am to 6:00pm.
	Maintain the on-site road network to limit body noise from empty trucks travelling on internal roads.
	Maintain an open dialogue with the surrounding community and neighbours to ensure any concerns over noise or vibration are addressed.
	Place and operate the crusher within an enclosure engineered to achieve a noise reduction of at least 12dB.
	Ensure that the grinding circuit is rubber lined.
	Place and operate the final ventilation fan at least 10m below ground level rather than at the surface. The interim ventilation fan would be placed within the deepest section of the box cut until the final fan is commissioned. The interim fan may be retained as a backup ventilation system in the event of failure of the final fan.
	Construct a noise bund of at least 5m high along the southern and western edges of the ROM pad.
	Undertake attended noise monitoring at the residences most likely to be affected by noise generated by the Project.
	Prepare a *Noise Management Plan* prior to the commencement of mining activities which would incorporate the specific details of all noise controls and provide measures to address noise criteria exceedances and/or complaints should they occur.
	Ensure that frequency modulated reversing alarms are fitted to all mobile equipment that require such alarms.
	Ensure strict adherence to hours of operation, identified in Table 2.6 in RWC (2010a).
	Ensure, where practicable, that all project employees and contractors enter and exit the Project Site in a courteous manner and without causing undue traffic noise.
	Prepare and implement a Drivers Code of Conduct and ensure that all drivers of heavy vehicles that regularly access the Project Site sign and comply with the code.
	Ensure that all blasts are designed by a suitably qualified and experienced blasting engineer or shotfirer and that each blast has an MIC of no greater than 105kg (until such time that a site law is developed which will allow for more precise predictions of blast emissions).
	Ensure that equipment with lower sound power levels is used in preference to more noisy equipment and that frequency modulated reversing alarms are installed on all mobile equipment operating on the surface.
	Maintain an open dialogue with the surrounding community and neighbours to ensure any concerns over noise or vibration are addressed.

Black Text = Original EIS (RWC 2010a) – including revisions under the Response to Submissions (RWC 2010b)
Blue Text = MOD 1 (RWC 2012a) – including revisions under the Response to Submissions (RWC (2012b)
Red Text = MOD 2 (RWC 2013a) – including revisions under the Response to Submissions (RWC 2013b)
Green Text = MOD 3 (RWC 2015a) – including revisions under the Response to Submissions (RWC 2015b)
Orange Text = MOD 4 (RWC 2018) – including revisions under the Response to Submissions (RWC 2019)
Purple Text = MOD 5 (the Proposed Modification)

Table A2.1 (Cont'd)
Updated Management and Mitigation Measures

Environmental Setting	Management and Mitigation Measure
Ecology	Ensure that no ground disturbing activities, with the exception of the Return Air Rise, Fresh Air Rise and associated infrastructure are undertaken within areas of identified Ribbon Gum Forest and Fragmented Ribbon Gum Forest. No vegetation over 3m high would be removed.
	Avoid the use of phosphate-based fertiliser in pasture areas to encourage the regeneration of native grasses.
	Manage grazing operations, including stocking rates and fencing, in a manner to sustain and facilitate the spread of native grass species.
	Fence all areas of Ribbon Gum Forest and Fragmented Ribbon Gum Forest and exclude stock from those areas.
	Manage all areas of Ribbon Gum Forest and Fragmented Ribbon Gun Forest to maintain and improve biodiversity values.
	Ensure that areas of habitat suitable for the Majors Creek Leek Orchid are appropriately identified and fenced with a 20m buffer and access restricted. Ensure no disturbance occurs within the fenced areas.
	Prepare a management plan to ensure that Common Wombat are not harmed during establishment of the tailings storage facility. This plan may include the following. • Mark all wombat burrows prior to the commencement of ground disturbing activities. • Commence ground disturbing activities on the upper slopes of creek banks a few days before disturbing the identified hollows to allow individual wombats time to vacate their burrows at night when equipment is not operating. • Inspect all burrows to ensure that common wombats have vacated the proposed area of disturbance. • Any remaining wombats would be relocated in consultation with a suitably qualified and experienced wildlife carer, fauna ecologist and/or local wombat expert.
	Continue the existing weed and pest control program, with particular focus on managing Broom and Blackberry within the southern section of the Project Site.
	Ensure that dead fallen and standing timber are not removed or disturbed to preserve fauna habitat.
	Implement fully the Biodiversity Strategy described in Section 2.15, including ensuring that the strategy would be implemented in perpetuity.
	Prepare a *Biodiversity Management Plan* in consultation with the relevant government agencies and surrounding community within 12 months of receipt of the project approval. That plan would: • specify biodiversity-related actions to be undertaken during the life of the Project and for several years after the site has been decommissioned; • incorporate the above commitments; • describe management of the proposed biodiversity area; • describe the proposed revegetation and amelioration program, including identification of areas to be revegetated/ameliorated and the species to be used; and • involve, where practicable, local community groups in management of biodiversity with in the Project Site.

Table A2.1 (Cont'd)
Updated Management and Mitigation Measures

Environmental Setting	Management and Mitigation Measure
Ecology (Cont'd)	Implement reasonable and feasible measures to ensure that fauna, including birds, do not enter the Tailings Storage Facility and monitor the facility for such use.
	Conduct annual late winter surveys for the presence of active Little Eagle nests within the project site for the life of the Project. In the event that one or more nests are identified, prepare and implement an appropriate management plan in consultation with OEH.
	Prepare and implement a *Construction Environmental Management Plan* which covers disturbance associated with the WSD, pipelines and associated infrastructure.
	Update the existing *Environmental Management Strategy* for the Project to include any changes to existing environmental management measures required as a result of the proposed construction of the WSD, pipeline and associated infrastructure.
	Update the existing *Biodiversity Management Plan* for the Project to include any changes to existing biodiversity management measures required as a result of the proposed construction of the WSD, pipeline and associated infrastructure.
	Delineate the assessed Study Area and communicate to personnel involved in construction of the proposed WSD, pipeline and associated infrastructure that clearing of vegetation outside of this area is not permitted.
	Provide construction personnel with a map of the Study Area detailing sensitive biodiversity areas, clearing boundaries, and any biodiversity exclusion zones, and provide briefings to communicate the significance of these features prior to commencement of clearing works for the proposed construction of the WSD, pipeline and associated infrastructure.
	Locate areas of disturbance within areas of limited biodiversity value (e.g. exotic dominated grassland, disturbed areas, existing tracks) preferentially during the detailed design of the proposed WSD and during construction.
	Use existing tracks, roads, and cleared areas, where possible, to avoid unnecessary disturbance.
	Engage a suitably qualified ecologist to complete pre-clearing surveys of potential habitat prior to vegetation clearing works for the proposed construction of the WSD, pipeline and associated infrastructure. • Clearing protocols, including pre-clearing surveys, daily surveys and staged clearing, would be implemented under the supervision of a trained ecologist or licensed wildlife handler during clearing events, where required. • Biodiversity exclusion zones (temporary fencing) for retained vegetation would be clearly identified by a suitably qualified ecologist prior to the commencement of construction.
	Implement a threatened species unexpected finds protocol if threatened flora and fauna species, not assessed in the biodiversity assessment, are identified in the disturbance area for the proposed construction of the WSD, pipeline and associated infrastructure.
	Relocate habitat features (e.g. surface rock, fallen timber) from the development footprint of the proposed construction of the WSD, pipeline and associated infrastructure.to adjacent retained vegetation, where practicable.

Table A2.1 (Cont'd)
Updated Management and Mitigation Measures

Environmental Setting	Management and Mitigation Measure
Ecology (Cont'd)	Implement hygiene protocols to prevent the introduction and/or spread of weeds or pathogens during construction of the WSD.
	Ensure that rehabilitation and/or ongoing maintenance of retained native vegetation and habitat on, or adjacent to, disturbance areas for the proposed construction of the WSD, pipeline and associated infrastructure are undertaken as soon as possible.
Groundwater	Undertake consultation with the owners of bores or users of springs that are predicted to be adversely impacted by the Project or have been determined by an independent hydrologist to have been adversely impacted by the Project. The consultation would be directed at seeking to adequately mitigate or compensate the owners or users for the identified adverse impacts. Options include deepening or redrilling and re-equipping the existing bores or providing additional water from another source to compensate for the reduced groundwater supply.
	Release water sourced primarily from the harvestable rights dams at the rates identified in Table 4.20 in RWC (2010a) into Majors Creek at the confluence of Majors and Spring Creeks. These environmental discharges are to continue from the commencement of mining operations until 2 years after the cessation of dewatering operations.
	Negotiate an appropriate arrangement with the owners of Lot 210, DP755934 to allow construction or equipping of a bore to access groundwater within the Snobs workings prior to construction of that bore and extraction of water.
	Monitor groundwater levels in surrounding, privately-owned bores on request. The Proponent would ensure that all landholders in the vicinity of the anticipated zone of groundwater drawdown are briefed on the anticipated impacts and that an appropriate monitoring program is negotiated. In addition, a similar offer would be made to all other land owners with bores in the vicinity of the Project Site. Monitoring frequency would be reviewed at least annually and adjusted as required. This may include removing some monitoring locations in consultation with the relevant government agencies.
	Undertake preliminary groundwater monitoring within and surrounding the Project Site during preparation of the *Water Management Plan* and adjust the monitoring to be consistent with that plan once it has been approved by the relevant government agencies.
	Undertake, in consultation with NOW, a pump test to confirm the assumed hydrological parameters used in the groundwater model.
	Undertake a review of the numerical groundwater model based on the above. In the event that the actual impacts are significantly greater than those presented in AGE (2010), then the Proponent would consult with NOW in relation the revised modelling results and would develop appropriate management and mitigation measures to address those impacts.
	Present the results of the review of the numerical groundwater model to the relevant government agencies.
	Store all hydrocarbon and chemical products within a bunded area complying with the relevant Australian Standard.
	Refuel all equipment within designated, sealed areas of the Project Site, where practicable.

Table A2.1 (Cont'd)
Updated Management and Mitigation Measures

Environmental Setting	Management and Mitigation Measure
Groundwater (Cont'd)	Undertake all maintenance works involving hydrocarbons, where practicable, within designated areas of the Project Site such as the maintenance workshop.
	Direct all water from wash-down areas and workshops to oil/water separators and containment systems.
	Ensure all hydrocarbon and chemical storage tanks are either self-bunded or bunded with an impermeable surface and a capacity to contain a minimum 110% of the largest storage tank capacity.
	Design and construct the tailings storage facility as described in Section 2.7 of RWC (2010a) and in accordance with the requirements of the relevant government agencies. Key design parameters would be as follows. • Construct the floor and walls of the tailings storage facility in a manner that would achieve a permeability of less than $1x10^{-9}$m/sec. • Ensure that the tailings storage facility embankment is keyed into the underlying material in a manner that would prevent down slope migration of potentially contaminated groundwater from the facility. • Place residue uniformly around the perimeter of the tailings storage facility via several slurry spigots. • Construct seepage collection structures at the foot of the tailings storage facility embankment and ensure that any captured seepage is automatically pumped back to the tailings storage facility. • Install piezometers at appropriate intervals at the base of the tailings storage facility embankment and monitor these regularly to assess the integrity of the facility.
	Cap the tailings storage facility during final shaping and rehabilitation to minimise the potential for infiltration of surface water into the facility. The nature of the cap is to be determined in consultation with the relevant government agencies during preparation of the *Closure Plan*.
	Undertake further testing of the tailings material to confirm the results of test work undertaken prior to the commencement of mining operations and the proposed paste fill operational, management and mitigation measures.
	Construct two additional groundwater monitoring bores (WSDB01 and WSDB02) located southwest of the proposed WSD.
	Incorporate the additional groundwater monitoring bores into the existing *Water Management Plan* to monitor for any potential impacts to the local groundwater system.
Surface Water	Prepare a detailed *Surface Water, Sediment and Erosion Control Plan,* including a description of surface water management structures and procedures to ensure that the criteria identified in Section 4.4.3 and any additional criteria included in the Environment Protection Licence or project approval, assuming that they are granted, are achieved. This would include a description of how all potentially chemical-laden or contaminated water would be retained within the Project Site and returned to the process water system for re-use within the processing plant.
	Ensure that the site access road is treated using chemical dust suppressants or similar to ensure that regular watering is not required.

Table A2.1 (Cont'd)
Updated Management and Mitigation Measures

Environmental Setting	Management and Mitigation Measure
Surface Water (Cont'd)	Ensure that best-practice erosion and sediment control measures as identified in Landcom (2004) *Managing Urban Stormwater: Soils and Construction, 4th ed*, Landcom, NSW, Sydney and *Department of Environment and Climate Change* (DECC) (2008a). *Managing Urban Stormwater: Soils and Construction. Volume 2E Mines and Quarries*. NSW Department of Environment and Climate Change, Sydney (DECC) (2008b). *Managing Urban Stormwater: Soils and Construction. Volume 2C Unsealed Roads* NSW Department of Environment and Climate Change, Sydney are implemented during both the construction and operational stages of the Project.
	Construct appropriate sediment basins of sufficient size to contain a five day, 75^{th} percentile rain depth of 18mm during construction of the Project and a 20-day, 90^{th} percentile rain depth of 73.7mm during operation of the Project.
	Ensure that sediment basins have a minimum of 0.6m of freeboard and a spillway that is sized and lined for stability in a 100-year annual recurrence interval (ARI) rain event.
	Ensure that water discharged from the sediment basins has a total suspended sediment concentration of less than 50mg/L. SEEC (2010a) notes that achieving this commitment may require flocculation.
	Ensure that accumulated water within sediment basins is removed from the basins within 5 days of the end of a rain event.
	Ensure that water within the sediment basins is not used for mining-related activities unless the volume of the sediment basins have been included in the harvestable right calculations.
	Ensure that the upper limit of the Sediment Storage Zone, as defined in Landcom (2004) *Managing Urban Stormwater: Soils and Construction*, 4^{th} ed, Landcom, NSW, Sydney, is identified with a peg and accumulated sediment removed as required.
	Ensure that surface water flows are diverted away from disturbed areas and that potentially sediment-laden flows from disturbed areas are diverted to sediment basins. All diversion structures would be sized and lined for stability in a 10-year ARI time-of-concentration rain event during construction of the Project and the 20-year ARI time-of-concentration rain event during operation of the Project.
	Ensure that disturbed areas are stabilised through the use of vegetation or artificial covers to achieve a long-term C-factor of 0.05 (equivalent to 70% grass cover). Where such areas are to be subjected to channelized water flows, they should be stabilised within 10 days of completion of construction and before they convey any flows.
	Inspect all surface water control structures at least quarterly and following any rainfall event of more than 10mm in 24-hours to ensure their adequacy and identify where remedial action is required.
	Ensure that all roads within the Project Site are constructed in accordance with DECC (2008b).
	Construct table drains along the sides of roads within the Project Site, with regular turn-out drains constructed at-grade approximately every 50m.
	Continue to maintain and upgrade, as required, the existing soil conservation measures in areas of active and stabilised gullying.

Table A2.1 (Cont'd)
Updated Management and Mitigation Measures

Environmental Setting	Management and Mitigation Measure
Surface Water (Cont'd)	Ensure that the tailings storage facility is effectively sealed to prevent leakage.
	Ensure that potential surface water run on onto the tailings storage facility is diverted around the facility using a surface water diversion structured designed to effectively convey the 100-year ARI, time-of-concentration flow from the upstream catchment.
	Ensure that all fuel and chemical storage, delivery and handling areas are appropriately sealed and bunded and that overflow pipes are installed in a manner that would minimise the potential for pollution in the event of overfilling.
	Ensure that no low grade ore material is used to construct the ROM Pad or is stored in areas where potentially low-pH leachate may flow to natural drainage
	Ensure waste rock material to be used during site establishment operations is tested for acid generation potential and any potentially acid generating material is appropriately managed.
	Ensure that all water with the potential to contain processing reagents, hydrocarbons, other chemicals or lowered pH is contained within a bunded Contaminated Water Management Area and that all surface waters within the that area retained and pumped to the Process Water Tank for use within the processing plant.
	Ensure that best-practice erosion and sediment control measures as identified in Landcom (2004) and DECC (2008a and 2008b) are implemented during the construction and operation of the Spring Creek Crossing, the Eastern Waste Rock Emplacement and the Tailings Storage Facility. In particular, ensure that the detailed management and mitigation measures identified in **Appendix 2** of RWC (2015a) and Appendix 2 of RWC (2018) are fully implemented.
	Ensure that water accumulated within sediment basins is treated and tested prior to discharge within the timeframes identified in in Appendix 2 of RWC (2015a) and **Appendix 2** of RWC (2018).
	Ensure that topsoil is shallow ripped with gypsum (at a rate of 5t/ha) prior to stripping and stockpiling to limit dispersion once stockpiled.
	Ensure stabilisation of exposed surfaces occurs progressively through the use of the following methods. • Shallow ripping of surfaces with gypsum at a rate of 5t/ha. • Placement of treated topsoil over subsoil stockpiles. • Seeding, hydromulching (with seed), placement of locally sourced native mulch over soil and/or spraying with a polymer soil binder.
	Ensure that in the event that rainfall is forecast during construction (more than 50% probability of more than 5mm of rain), measures are implemented to "bed down" disturbed areas as described in in Appendix 2 of RWC (2015a) and Appendix 2 of RWC (2018).
	Implement a self-auditing program at least weekly and retain a log of inspections identifying the performance of design features, general erosion and drainage conditions.
	Ensure that adaptive environmental management practices are implemented in the event that monitoring or site inspections identify potential or actual impacts to the surrounding surface water environment.

Table A2.1 (Cont'd)
Updated Management and Mitigation Measures

Environmental Setting	Management and Mitigation Measure
Surface Water (Cont'd)	Ensure that the WSD spillway and any other surface water diversion structures are constructed to ensure that any potential discharge from the WSD is directed away from the Shoalhaven Catchment and into the Moruya Catchment.
	Update the *Water Management Plan*, including the Project water balance, to include any changes to water management practices required as a result of the Proposed Modification.
	Update the *Erosion and Sediment Control Plan* to incorporate any additional management measures required during the construction and operation of the proposed WSD and water pipelines.
Aboriginal Heritage	Sites GT OS1 & GT OS2 would be re-identified in the field with the assistance of a suitably qualified archaeologist and community representative(s). An appropriate fence on all sides of the site would be erected, access to the fenced area would be restricted and appropriate signage would be displayed.
	All other sites would be identified on plans held by the Environmental Manager and Mine Surveyor and activities in the vicinity of those sites would be prohibited. Those sites would not be fenced to limit the potential for inappropriate identification and disturbance of the sites.
	If items of suspected Aboriginal heritage significance are identified throughout the life of the Project, the following procedures would be implemented. • **Step 1** - No further earth disturbing works would be undertaken in the vicinity of the suspected item of Aboriginal heritage significance. • **Step 2** - A buffer of 20m x 20m would be established around the suspected item of Aboriginal heritage significance. No unauthorised entry or earth disturbance would be allowed with this buffer zone until the area has been assessed. • **Step 3** - A qualified archaeologist or the DECCW would be contacted to make an assessment of the discovery. Mitigation procedures would then be developed and implemented based on the assessment.
	If, throughout the life of the Project, suspected human remains are identified, the following procedures would be implemented. • **Step 1** - the suspected skeletal remains would not be touched or disturbed. • **Step 2** - A buffer zone of 50m x 50m would be established around the suspected remains and all work in the vicinity of the suspected remains would be suspended until the area has been assessed. • **Step 3** - The NSW Police and the DECCW would be contacted to make an assessment of the discovery. If appropriate, mitigation procedures would then be developed in consultation with the registered stakeholders.
	Artefacts located at Sites GT OS1 and GT OS2 would be salvaged, in consultation with and under the supervision of the registered Aboriginal parties and the Office of Environment and Heritage, from their existing location and reburied in natural fibres in a suitable location that is not proposed to be impacted by mining or associated activities.

Table A2.1 (Cont'd)
Updated Management and Mitigation Measures

Environmental Setting	Management and Mitigation Measure
Aboriginal Heritage (Cont'd)	Site impact forms would be completed for both Site GT OS1 and Site GT OS2 and submitted to the Office of Environment and Heritage notifying them of the destruction of these sites.
	The new locations of the reburied artefacts would be registered within the Aboriginal Heritage Management Plan and with the AHIMS.
	Protocols implemented to protect previously identified sites would be extended to include the newly located site.
	Undertake a program of test excavation to determine the nature and extent of archaeological deposits within DGM PAD 22-1 (AHIMS # TBC) prior to any ground surface disturbance.
Historic Heritage	Identify on plans held by the Environmental Manager and Mine Surveyor, where relevant, all identified sites and ensure that activities in the vicinity of those sites are appropriately managed.
	If items of suspected non-Aboriginal heritage significance are identified throughout the life of the Project, the following procedures would be implemented. • **Step 1** - No further earth disturbing works would be undertaken in the vicinity of the suspected item of non-Aboriginal heritage significance. • **Step 2** - A buffer of 20m x 20m would be established around the suspected artefact. No unauthorised entry or earth disturbance would be allowed with this buffer zone until the area has been assessed. • **Step 3** - A qualified archaeologist would be contacted to make an assessment of the discovery. Mitigation procedures would then be developed and implemented based on the assessment.
Bushfire Hazard	Refuelling undertaken within designated fuel bays or within cleared area of the Project Site.
	Vehicles to be turned off during refuelling.
	No smoking policy to be enforced in designated areas of the Project Site.
	Fire extinguishers maintained within site vehicles and refuelling areas.
	No smoking policy to be enforced in designated areas of the Project Site.
	Focus on housekeeping to be maintained by mine management.
	Water cart available to assist in extinguishing any fire ignited.
	Site vehicles to carry a fire extinguisher.
Traffic and Transportation	The Site Access Road will have horizontal alignment complying with the maximum grades and changes of grade outlined in the *Australian Standards for Off-Street Commercial Vehicle Facilities*. Maximum vertical grades would be approximately 10%.
	The gravel surface of the Site Access Road would be graded treated with chemical suppressants to minimise dust generation.
	The Site Access Road layout would ensure that all vehicles would enter and exit the site in a forward direction.
	All heavy vehicles transporting concentrate would be loaded using a front-end loader fitted with a bucket load indicator. All vehicles would be loaded in a manner that would ensure that they were not overloaded.
	A speed limit of 40km/hr on the site access road and 20km/hr in the operational sections of the Project Site.

Table A2.1 (Cont'd)
Updated Management and Mitigation Measures

Environmental Setting	Management and Mitigation Measure
Traffic and Transportation (Cont'd)	All regular heavy vehicle movements associated with the Project would be scheduled for between 7:00am and 6:00pm, where practicable. Furthermore, the movement of heavy vehicles to and from the Project Site would, where practicable be avoided during the hours of 7.00am to 8.30am and 3.00pm to 5.00pm on school days to avoid potential conflict with the local school bus services.
	Require, where practicable, that all non-Proponent-controlled heavy vehicle movements are scheduled for between 7:00am and 6:00pm. Furthermore, request that the movement of such heavy vehicles to and from the Project Site be avoided during the hours of 7:00am to 8:30am and 3:00pm to 5:00pm on school days to avoid potential conflict with the local school bus services.
	A Code of Conduct for all drivers would be developed and enforced for all heavy vehicles that travel to and from the Project Site regularly. The Code of Conduct would stipulate safe driving practices must be maintained at all times and nominate the maximum vehicle speed on Majors Creek Road of 80km/hr for heavy vehicles travelling to and from the Project Site. The code would also include specific requirements for practices to be adopted during periods of fog, such as the use of headlights / fog lights and adopting vehicle speeds appropriate to the conditions as required.
	Approach Palerang Council with a view to erecting signs in appropriate locations requesting heavy vehicles to consider residents and limit noisy driving practices.
	Any complaints received would be immediately investigated and substantiated incidents acted on decisively, which could include the banning the offending driver(s) from the Project Site.
	Provide centreline road marking along the full length of Majors Creek Road between the Araluen Road and Majors Creek immediately, irrespective of whether project approval is granted. This will assist drivers using Majors Creek Road to drive on the left of the centreline at all times, particularly those times of low visibility, and will assist in maintaining road safety.
	Provide signage/delineation and appropriate barriers such as guardrails at the culverts on Majors Creek Road at 4.4km and 4.9km from the intersection of Majors Creek Road and Araluen Road, as well as at the bridge structure over Honeysuckle Creek. The Proponent has committed to completing this road upgrade prior to the commencement of the operational phase of transport operations.
	Provide pavement widening on curves and crests on Majors Creek Road at the following chainages, as measured from the intersection of Majors Creek road and Araluen Road. • Reverse curve between 2.4km and 2.7km • Curve at 3.25km • Crest at 3.8km • Curve at 4.3km • Curve at 4.5km • Curve and crest near Morgans Lane at 5.3km and 5.5km • Crest at 6.9km • Crest at 7.75km • Crest at 8.2km

Table A2.1 (Cont'd)
Updated Management and Mitigation Measures

Environmental Setting	**Management and Mitigation Measure**
Traffic and Transportation (Cont'd)	The noted road pavement widening would be undertaken in lieu of Section 94 Contributions during the initial 12 months of the operations phase of transport operations. No significant environmental impacts associated with these works are anticipated.
	Formalise a Section 94 Contributions arrangement or Planning Agreement with Palerang Council.
	Road pavement widening works would be undertaken in lieu of Section 94 contributions during the initial 12 months of the operations phase of transport operations.
Energy Reduction	Optimise the underground mine design to minimise: • development metres; • travel distances for mining equipment; and • rehandle of waste and ore material.
	Use mining equipment which is regularly maintained and serviced to maximise efficiency.
	Use Euro 4 compliant engines wherever practicable.
	Minimise the mine footprint to reduce land disturbance and travel distances for mobile plant.
	Optimise the design Process Plant to: • maximise the use of gravity to move material through the Process Plant reducing the need for pumping; and • maximise the use of energy efficient motors in major pieces of plant.
Air Quality	Operate the largest practical truck size to reduce the number of movements necessary to transport ore.
	Use the shortest internal haulage route possible.
	Use conveyors within the processing plant.
	Establish and use water sprays on key transfer points within the processing plant.
	Orient the Waste Rock Emplacement to minimise profile exposure to receptors.
	Profile all surfaces to reduce velocity of overland winds.
	Contour the final landform shape to avoid strong wind flows and smooth gradients to reduce turbulence at surface.
	When undertaking progressive rehabilitation, apply vegetative cover as wide as possible to non-operational exposed surfaces, e.g. tailings storage facility Wall, ROM pad batters, as soon as practical after disturbance.
	Limit disturbance to the minimum area necessary for mining and associated activities.
	Reshape, topsoil and rehabilitate completed waste rock emplacement areas as soon as practicable after the completion of waste rock tipping. (As the Waste Rock Emplacement of the Project is to be a temporary structure, reshaping, topsoiling and rehabilitation activities of the remaining structure (ROM pad batter) would be undertaken as soon as practical after the excavation and haulage of the waste rock is complete.)

Table A2.1 (Cont'd)
Updated Management and Mitigation Measures

Environmental Setting	Management and Mitigation Measure
Air Quality (Cont'd)	Maintain ore handling areas / stockpiles in a moist condition by using water carts to water down areas affected by wind-blown and traffic-generated dust.
	Water stockpiles to maintain moisture content and minimise the generation of dust.
	Apply water to all roads and trafficked areas using water trucks to minimise the generation of dust.
	Clearly define all haul roads edges with marker posts or equivalent to control their locations, especially when crossing large areas of non-descript disturbance.
	Close, rip and revegetate all obsolete roads.
	Limit the development of minor roads and clearly define the locations of these.
	Apply water to all minor roads used regularly for access.
	Close, rip and revegetate all obsolete roads.
	Apply water to all access tracks used by topsoil stripping equipment during their loading and unloading cycle.
	Establish vegetative cover over all long term topsoil stockpiles not regularly used.
	Establish and use water sprays on key transfer points within the processing plant.
	Minimise drop heights from the ROM bin to the primary crusher.
	Maximise the recovery of recyclable materials where practicable, including: • waste hydrocarbons; • polyethylene; and • scrap metals.
	Minimise waste sent to landfill through the development of appropriate purchasing and waste management plans.
	Progressively review and implement energy efficiency measures during the life of the Project.
Visual Amenity	Construct and revegetate a 5m high bund on the southern and western edge of the ROM pad as soon as practicable after the commencement of mining operations. This bund, together with the southern and western faces of the ROM pad, would be temporarily covered with soil material and revegetated with appropriate species as soon as practicable after completion to ensure that the visual impact of the ROM pad and bund is minimised to the greatest extent practicable.
	Progressive reshaping and rehabilitation of areas that are no longer required for mining related purposes.
	Continuation of the existing tree planting program to limit views of the Project Site from areas to the southwest, south and southeast of the Project Site.
	Construction of the processing plant and other infrastructure within the Project Site from non-reflective, neutral-coloured material.
	Selection and placement of permanent and temporary lights such that the lights: • do not point towards surrounding residences; or • minimise the 'loom' created by the lights.

Table A2.1 (Cont'd)
Updated Management and Mitigation Measures

Page 13 of 14

Environmental Setting	**Management and Mitigation Measure**
Visual Amenity (Cont'd)	Consider any reasonable request by a potentially affected resident for assistance to create a visual screen adjacent to their residence through planting of fast-growing vegetation and/or landscaping where such a screen would effectively reduce the visual impact of the Proponent's activities during the life of the Project.
	Strip soil materials to the depths identified in Table 2.2 in RWC (2010a).
	Strip soil materials only when they are moderately moist to preserve soil structure.
	Stockpile topsoil and subsoil materials separately.
	Construct soil stockpiles as low, flat, elongated mounds on slopes of less than 1:10 (V:H). Topsoil stockpiles would be less than 2m high and subsoil stockpiles would be less than 3m high.
	Ensure that soil stockpiles achieve a 70% vegetative cover within 10 days of formation.
	For areas that would be disturbed and have slopes of more than 13% or approximately 1:7.5 (V:H): • Place soil material in areas to be rehabilitated in the same stratigraphic order in which they were removed. SEEC (2010b) note that topsoils of one soil landscape unit may be mixed with topsoils soils of the other landscape unit. Similarly, subsoils of one soil landscape unit may be mixed with subsoils soils of the other landscape unit. • Ensure that ground disturbing activities are limited to the period from 1 March to 30 November, unless measures identified in Landcom (2004) and DECC (2008) are implemented, including ensuring that soils are not exposed during any period when the three-day weather forecast suggests rain is likely. • Ensure that slope lengths are no longer than 80m. • Ensure that run-on from upslope is diverted away from disturbed areas.
Socio-Economic	Engage each of the communities surrounding the Project Site in regular dialogue in relation to the proposed and ongoing operation of the Project and maintain an "open door" policy for any member of those communities who wishes to discuss any aspect of the Project.
	Proactively and regularly consult with those residents most likely to be adversely impacted by the Project, particularly those within the Majors Creek Community.
	Continue to support community organisations, groups, and events, as appropriate, and review any request by a community organisation for support or assistance throughout the life of the Project. Particular emphasis would be placed on providing support to those organisations, groups or events that service the communities in Majors Creek, Araluen or Braidwood.
	Form and maintain a Community Consultative Committee (CCC), including representative members of the surrounding community and Palerang Council. It is noted that the Proponent has previously consulted with the Majors Creek Community Liaison Committee. The Proponent would continue to do so, either as part of the CCC or separately.

Table A2.1 (Cont'd)
Updated Management and Mitigation Measures

Environmental Setting	Management and Mitigation Measure
Socio-Economic (Cont'd)	Regularly brief the CCC and wider community on activities within the Project Site and seek feedback in relation to Project-related impacts whether actual or perceived. In addition, seek advice in relation to the most appropriate manner to provide assistance to the community in an effective, fair and equitable manner.
	Advertise and maintain a community complaints telephone line.
	Give preference when engaging new employees, where practicable, to candidates who are part of the Majors Creek, Araluen or Braidwood communities over candidates with equivalent experience and qualifications based elsewhere and ensure that the mining and other contractors do so as well.
	Encourage the involvement of the local Aboriginal community in the workforce.
	Encourage and support participation of locally based employees and contractors in appropriate training or education programs that would provide skills and qualifications that may be of use to encourage and further develop economic activity within the surrounding communities following completion of the Project.
	Give preference, where practicable, to suppliers of equipment, services or consumables located within the Palerang LGA.
	Assist community members and others, as appropriate, to establish complimentary businesses within the Palerang LGA where those businesses would provide a benefit to the community through increased economic activity or development.
	Assist Palerang Council to promote and encourage economic development that would continue beyond the life of the Project.
	Ensure that infrastructure and services installed for the Project, including the electricity transmission facilities, road improvements and water supply bores, remain available for alternative uses during and/or following completion of the Project.
	Encourage and support, in consultation with the local community, the provision of services to the community. These may include health, education, transportation and other services.
	Prepare and implement a *Property Vegetation Plan* as described in Section 2.15 of RWC (2010a), including continued management of weeds, pests and bushfire risks on land held by the Proponent in consultation with surrounding landowners.
	Ensure that the land capability of those sections of the final landform to be used for agricultural purposes is similar to the current land capability.

Black Text = Original EIS (RWC 2010a) – including revisions under the Response to Submissions (RWC 2010b)
Blue Text = MOD 1 (RWC 2012a) – including revisions under the Response to Submissions (RWC (2012b)
Red Text = MOD 2 (RWC 2013a) – including revisions under the Response to Submissions (RWC 2013b)
Green Text = MOD 3 (RWC 2015a) – including revisions under the Response to Submissions (RWC 2015b)
Orange Text = MOD 4 (RWC 2018) – including revisions under the Response to Submissions (RWC 2019)
Purple Text = MOD 5 (the Proposed Modification)

Appendix 3

HVAS and TSF Correspondence

(Total No. of pages = 9)

Our reference: DOC22/125037
Date: 23 February 2022

Aurelia Metals Pty Ltd
Dargues Gold Mine
Majors Creek NSW 2622
Attention: Mr Chase Dingle
Sustainability Manager

Sent by email: Chase.Dingle@aureliametals.com.au

Dear Mr Chase Dingle

Dargues Gold Mine – Monitoring point enquiries

I refer to Environment Protection Licence (EPL) 20095 held by Aurelia Metals Pty Ltd (the Licensee) for the Dargues Gold Mine (the premises). I also refer to correspondence from the licensee provided to the NSW Environment Protection Authority (EPA) regarding the High Volume Air Sampling (HVAS) sample site dated 11 February 2022 and correspondence regarding water flow monitoring site locations dated 15 February 2022.

As discussed, the EPA has reviewed the information provided in the Licensee's respective proposals to:

- Decommission or move the HVAS monitoring site: HVAS-1 (EPA monitoring point 77), the EPA considers that it is appropriate to decommission the HVAS as proposed.

- Move the water flow monitoring sites: SW4 (EPA monitoring point 56) and SW2 (EPA monitoring point 54), the EPA considers that it is appropriate move these locations as proposed.

Considering the above, the EPA considers that the Licensee should submit a licence variation application that incorporates the proposed changes via the EPA's licence management tool 'eConnect':https://apps.epa.nsw.gov.au/profileapp/auth?_ga=2.124789897.260043648.1645393127-2127803106.1645393127

If you have any questions and would like to discuss the matter further, please Andreas Stricker on 02 6229 7002 or at info@epa.nsw.gov.au.

Yours sincerely

Matthew Rizzuto
Unit Head
Regulatory Operations – Regional South

Mr Chase Dingle
Sustainability Manager - Aurelia Metals Ltd
MAJORS CREEK ROAD
MAJORS CREEK NSW 2622

Via email: Chase.Dingle@aureliametals.com.au

17/03/2022

Dear Mr Dingle

Dargues Gold Project (MP10_0054)
Request for decommissioning a high volume sampler

I refer to your letters dated 22 December 2021 and 14 March 2022 with regards to decommissioning a high volume sampler (HVAS-1 /EPA Identification Number 77) from the project's air quality monitoring program, as part of the project's Air Quality and Greenhouse Gas Management Plan, required under condition 17 of schedule 3 of the project approval (MP10_0054).

The Department has carefully reviewed the information that you provided, including the EPA's advice dated 23 February 2022, confirming that the proposed decommissioning and variation to the project's EPL would be appropriate.

Consequently, the Planning Secretary has approved the requested decommissioning and recommends relocation of the HVAS-1 and/or co-location of the HVAS-1 with another operating depositional dust gauge.

If you have any questions, please contact Mandana Mazaheri on 02 9995 5093.

Yours sincerely

Stephen O'Donoghue
Director
Resource Assessments
As nominee of the Secretary

NEW SOUTH WALES

Dams Safety Committee

ABN 55 079 703 705

RECEIVED
DATE 16.02 BY K.G

3 February, 2012

Big Island Mining Pty Ltd
Ground Floor, 22 Oxford Close
West Leederville WA 6007

Our ref: DarguesTSF

Your ref:

Att: Ajanth Saverimutto

Dear Mr. Saverimutto,

Re: Dargues Reef Gold Project Tailings Dam – Design Report

The Committee wishes to thank Knight Piesold Pty Ltd for providing the design report for the proposed Dargues Reef Gold Project Tailings Dam, near Braidwood for consideration.

The Design Report, received on 19th December 2011, has been reviewed by the Committee at its February 2012 meeting. The overall design conforms to the Committee requirements. Dam owners and their engineers remain at all times responsible for the safe design and construction of a dam. The Committee wishes to clearly state that it does not have a role of approving designs, but is required to assess the safety of a dam or proposed dam. In this regard its interest is primarily confined to major aspects of the design concept, such as the flood security level and the structural stability criteria. On these matters the Committee has developed requirements by which it makes its assessment.

The Committee is willing to comment on whether a design or constructed dam accords with Committee safety requirements. Such advice must not be construed or relied upon as anything more than such a comment – it must not, for example, be construed as an approval that the dam or design for a dam is safe or effective.

You should also understand that the Committee does not undertake detailed design checks and its advice that a proposal accords with Committee requirements is not to be construed as endorsement of design calculations or details. The Committee relies in its assessment on the knowledge, experience and diligence of the dam owner's engineer for the correctness of design work and for construction of the works in accordance with design requirements.

You should also be aware that while the Committee does not have a role in approving a design for a dam, that pursuant to section 18 of the Dams Safety Act, 1978 the Committee may issue a notice to a dam owner to ensure the safety of a dam where the Committee is of the view that a prescribed dam is unsafe or is in danger of becoming unsafe.

Postal: NSW Dams Safety Committee
PO Box 3720
Parramatta NSW 2124
Australia

Address: Level 3
10 Valentine Avenue
Parramatta NSW 2150
Australia

Phone: +61 (02) 9895 7363
Fax: +61 (02) 9895 7354
http: www.damsafety.nsw.gov.au
email: dsc@damsafety.nsw.gov.au

If the project proceeds the Committee requires you to provide the Engineer's "Dam Construction Certificate" to the plans and specifications, as varied if appropriate, and the relevant construction standards. Any inspection by the Committee staff or members must be seen in the same context as the review of plans and documents; that is a general overview, reliant on the owner's arranging of the appropriate inspections and controls. In addition, a Construction Report containing Work-As-Executed drawings and construction photos is to be submitted to the Committee as soon as practicable after completion of construction. The Committee wishes to emphasise on need for appropriate construction supervision.

The Committee advises that it does require a modified Dam Safety Emergency Plan (DSEP) to be prepared and a copy submitted to the Committee prior to commencement of tailings deposition. Similarly, an Operation & Maintenance Manual is required to be prepared for use by the owner, specifying strict emplacement protocols are in place as to ensure that intended design functions are met.

The Committee also requires owners of all prescribed dams in NSW to organise the preparation and submission of surveillance reports in respect of their dams at the completion of the dam's first substantial filling (or one year after completion of dam construction) and thereafter at annual intervals. In this regard, given the hazard category is at Significant, the Committee requests that a Type 2 Surveillance Report be prepared for your dam at yearly intervals to summarise progress with the dam, until decommissioning.

Although the Committee requires these yearly reports, it is emphasized that surveillance activities (i.e. weekly inspections and monthly survey and piezometer monitoring of the dam), should be undertaken regularly, and at times of unusual events (e.g. flooding, earthquakes). In this regard the Committee has endorsed the publication "Guidelines on Dam Safety Management 2003", prepared by the Australian National Committee on Large Dams (ANCOLD) and your attention is drawn to that publication for more information on the surveillance of dams.

A decommissioning report prior to completion of the project needs to be submitted to the Committee.

Your continuing cooperation is appreciated. If there are any queries in regard to the above please do not hesitate to contact the undersigned.

Yours sincerely,

EZiegler

for Bill Ziegler
A/Executive Engineer

cc. Simon Smith
Knight Piesold Pty Ltd
P O Box 6837
East Perth WA 6892

U:\EH\Design Report Letters\Dargues.doc, New South Wales Government

Dams Safety Committee

D9 form

DAM CONSTRUCTION CERTIFICATE

For .... **Dam**

I hereby certify that the works associated with .... Dam have been constructed in accordance with the design drawings and specifications (including any amendments) all of which have been authorised by the designer.

Name of Owner's Engineer

Signature of Owner's Engineer

Date

Dams Safety Committee

NSW GOVERNMENT

9th December, 2016

Big Island Mining Pty Ltd
Level 10, 56 Pitt Street
Sydney NSW 2000

Our ref: DarguesTSF

Your ref:

Att: Nick Woolrych

Dear Mr. Woolyrch,

Re: Dargues Reef Gold Project Tailings Dam – Design Report

The Committee wishes to thank Knight Piesold Pty Ltd for providing the Design Report for the proposed Dargues Reef Gold Project Tailings Dam for consideration. The Design Report received on 9th November 2016, has been reviewed by the Committee at its December 2016 meeting. The overall design conforms to the Committee requirements. Please note that design reports are required to be prepared and submitted to the DSC for consideration prior to each future raising of the embankment. Dam owners and their engineers remain at all times responsible for the safe design and construction of a dam.

The Committee wishes to clearly state that it does not have a role of approving designs, but is required to assess the safety of a dam or proposed dam. In this regard its interest is primarily confined to major aspects of the design concept, such as the flood security level and the structural stability criteria. On these matters the Committee has developed requirements by which it makes its assessment.

The Committee is willing to comment on whether a design or constructed dam accords with Committee safety requirements. Such advice must not be construed or relied upon as anything more than such a comment – it must not, for example, be construed as an approval that the dam or design for a dam is safe or effective.

You should also understand that the Committee does not undertake detailed design checks and its advice that a proposal accords with Committee requirements is not to be construed as endorsement of design calculations or details. The Committee relies in its assessment on the knowledge, experience and diligence of the dam owner's engineer for the correctness of design work and for construction of the works in accordance with design requirements.

You should also be aware that while the Committee does not have a role in approving a design for a dam, that pursuant to section 18 of the Dams Safety Act, 1978 the Committee may issue a notice to a dam owner to ensure the safety of a dam where the Committee is of the view that a prescribed dam is unsafe or is in danger of becoming unsafe.

Postal: NSW Dams Safety Committee
Locked Bag 5123
Parramatta NSW 2124
Australia

Address: Level 3
10 Valentine Avenue
Parramatta NSW 2150

Phone: (02) 9842 8073
Fax: (02) 9842 8071
http: www.damsafety.nsw.gov.au
email: dsc@damsafety.nsw.gov.au

ABN 55 079 703 705

If the project proceeds the Committee requires you to provide the Engineer's "Dam Construction Certificate" (copy attached) to the plans and specifications, as varied if appropriate, and the relevant construction standards. Any inspection by the Committee staff or members must be seen in the same context as the review of plans and documents; that is a general overview, reliant on the owner's arranging of the appropriate inspections and controls. In addition, a Construction Report containing Work-As-Executed drawings and construction photos is to be submitted to the Committee as soon as practicable after completion of construction.

The Committee wishes to emphasise on need for appropriate construction supervision.

The Committee advises that it does require a modified Dam Safety Emergency Plan (DSEP) to be updated and a copy submitted to the Committee prior to commencement of tailings deposition. Similarly, an Operation & Maintenance Manual is required to be updated for use by the owner, specifying strict emplacement protocols are in place as to ensure that intended design functions are met.

The Committee also requires owners of all prescribed dams in NSW to organise the preparation and submission of surveillance reports in respect of their dams at the completion of the dam's first substantial filling (or one year after completion of dam construction) and thereafter at annual intervals. In this regard, given the dam life has short term and hazard category is at High C, the Committee requests that a Type 2 Surveillance Report be prepared for your dam at 2 yearly intervals and Intermediate Surveillance Report on annual basis to summarise progress with the dam, until decommissioning.

Although the Committee requires these yearly reports, it is emphasised that surveillance activities (i.e. tri-weekly inspections and monthly piezometer monitoring of the dam), should be undertaken regularly, and at times of unusual events (e.g. flooding, earthquakes). In this regard the Committee has endorsed the publication "Guidelines on Dam Safety Management 2003", prepared by the Australian National Committee on Large Dams (ANCOLD) and your attention is drawn to that publication for more information on the surveillance of dams.

Your continuing cooperation is appreciated. If there are any queries in regard to the above please do not hesitate to contact the undersigned.

Yours faithfully,

Steve Knight
Executive Engineer

cc. Simon Smith
Knight Piesold Pty Ltd
Level 1, 184 Adelaide Terrace
East Perth WA 6004

New South Wales Government

Dams Safety Committee

D9 form

DAM CONSTRUCTION CERTIFICATE

For .... **Dam**

I hereby certify that the works associated with .... Dam have been constructed in accordance with the design drawings and specifications (including any amendments) all of which have been authorised by the designer.

____

Name of Owner's Engineer

____

Signature of Owner's Engineer

____

Date

Appendix 4

Pre-conditions to the Granting of Approval and Mandatory Matters for Consideration

(Total No. of pages = 15)

Table A4.1
Pre-conditions to the Granting of Approval

Section/ Clause	Precondition	Relevance
Environmental Planning and Assessment Act 1979		
4.56(1)	A consent authority may, on application being made by the applicant or any other person entitled to act on a consent granted by the Court and subject to and in accordance with the regulations, modify the development consent if—	
	(a) it is satisfied that the development to which the consent as modified relates is substantially the same development as the development for which the consent was originally granted and before that consent as originally granted was modified (if at all), and	The Proposed Modification would be substantially the same as the modified consent as of 10 August 2016 for the following reasons. • The Project would continue to be an underground mine with a processing plant producing a gold-rich concentrate. • The construction and use of the proposed Water Supply Dam would not be a significant alteration to the approved on-site water management practices. • The proposed increase in processing rate would not result in an intensification of the approved activities. • The proposed emergency trucking of water would not result in a significant increase in heavy vehicle movements generated by the Project.
	(b) it has notified the application in accordance with— i) the regulations, if the regulations so require, and ii) [not relevant]	This is a matter for the Department of Planning and Environment.
	(c) it has notified, or made reasonable attempts to notify, each person who made a submission in respect of the relevant development application of the proposed modification by sending written notice to the last address known to the consent authority of the objector or other person, and	This is a matter for the Department of Planning and Environment.
	(d) it has considered any submissions made concerning the proposed modification within any period prescribed by the regulations or provided by the development control plan, as the case may be	This is a matter for the Department of Planning and Environment, however, the Applicant anticipates preparing a Submissions Report to provide a response to any submissions received.

Table A4.2
Mandatory Matters for Consideration

Section/ Clause	Precondition	Relevance
Environmental Planning and Assessment Act 1979		
1.3	Relevant objects of the Act • to promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources,	Section 8.6 addresses matters relevant to Socio-Economic Considerations.
	• to facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment,	Section 8.1 addresses matters relevant to Ecologically Sustainable Development.
	• to promote the orderly and economic use and development of land,	The Proposed Modification would be undertaken in an orderly way to maximise the economic benefit to the community while minimising other adverse outcomes.
	• to protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats,	The Proposed Modification would not result in significant adverse environmental outcomes. Section 7 presents a detailed analysis of the key environmental aspects that may be affected by the Proposed Modification.
	• to promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage),	Section 7.3 addresses matters relevant to historic and Aboriginal heritage.
4.15	Relevant environmental planning instruments	See Resources and Energy SEPP, Palerang LEP below
	Relevant development control plans	In accordance with Clause 2.10(a) of the *State Environmental Planning Policy (Planning Systems) 2021*, development control plans are not relevant to SSD applications.
	Any planning agreement	A Planning Agreement exists between the Applicant and Queanbeyan-Palerang Regional Council, including the following terms. • (A) Road upgrades .... PAID • (B) Road maintenance .... $92 820 per annum • (C) Community contribution .... $446 250 • (D) Waste disposal .... $120 per tonne

Table A4.2 (Cont'd)
Mandatory Matters for Consideration

Section/ Clause	Precondition	Relevance
Environmental Planning and Assessment Act 1979 (Cont'd)		
4.15 (Cont'd)		Item B is to be paid annually on 1 July thereafter or until completion of concentrate shipment from the Project. Item B is subject to CPI increases from September 2019. Item C represents a one time payment which has been paid. Item D is no longer applicable as of 1 July 2020.
	The regulations	The Regulations have been considered throughout this document.
	The likely impacts of that development, including environmental impacts on both the natural and built environments, and social and economic impacts in the locality,	Section 7 presents an assessment of relevant impacts on the natural and built environment and social and economic impacts.
	The suitability of the site for the development,	The Project Site is an approved Mine and is suitable for the development.
	Any submissions made in accordance with this Act or the regulations,	This is a matter for Department of Planning and Environment, however, the Applicant anticipates preparing a *Submissions Report* following completion of the exhibition period.
	The public interest.	This is addressed in Section 8.7. In summary, however, the Applicant contends that the Proposed Modification is in the public interest
State Environmental Planning Policy (Resources and Energy) 2021		
2.16	**Non-discretionary development standards for mining** Cumulative noise level. The development does not result in a cumulative amenity noise level greater than the acceptable noise levels, as determined in accordance with Table 2.1 of the Industrial Noise Policy, for residences that are private dwellings	The Noise Assessment (see Section 7.5) determined that anticipated noise emissions would be less than the relevant criterion.
	Cumulative air quality level. The development does not result in a cumulative annual average level greater than 25µg/m^3 of PM_{10} or 8µg/m^3 of $PM_{2.5}$ for private dwellings.	The Air Quality Assessment (see Section 7.6) notes that the annual average $PM_{2.5}$ criteria is predicted to be exceeded at all receiver locations, however, these exceedances are a result of background $PM_{2.5}$ concentrations exceeding the relevant criteria without the addition of any incremental impact.

Table A4.2 (Cont'd)
Mandatory Matters for Consideration

Section/ Clause	Precondition	Relevance
State Environmental Planning Policy (Resources and Energy) 2021 (Cont'd)		
2.16 (Cont'd)		Likewise, cumulative impacts are predicted result in 5 days that exceed the 24-hour $PM_{2.5}$ criterion and 10 days that exceed the PM_{10} criterion. As above, these exceedances are a result of background concentrations which exceed the relevant criteria.
	Airblast overpressure. Airblast overpressure caused by the development does not exceed: (a) 120 dB (Lin Peak) at any time, and (b) 115 dB (Lin Peak) for more than 5% of the total number of blasts over any period of 12 months, measured at any private dwelling or sensitive receiver.	The Proposed Modification would not alter blasting operations.
	Ground vibration. Ground vibration caused by the development does not exceed: (a) 10mm/sec (peak particle velocity) at any time, and (b) 5mm/sec (peak particle velocity) for more than 5% of the total number of blasts over any period of 12 months, measured at any private dwelling or sensitive receiver.	The Proposed Modification would not alter blasting operations.
	Aquifer interference. Any interference with an aquifer caused by the development does not exceed the respective water table, water pressure and water quality requirements specified for item 1 in columns 2, 3 and 4 of Table 1 of the Aquifer Interference Policy for each relevant water source listed in column 1 of that Table.	No significant changes to the approved groundwater and aquifer interference impacts are anticipated.

Table A4.2 (Cont'd)
Mandatory Matters for Consideration

Section/ Clause	Precondition	Relevance
State Environmental Planning Policy (Resources and Energy) 2021 (Cont'd)		
2.17	Consideration is given to: • the existing uses and approved uses of land in the vicinity of the development;	The existing and approved use of the Project is mining and rural land use. The Proposed Modification is consistent with that use. Surrounding land uses include residential and rural land uses and the Mine has co-existed with those uses through regular community updates prior to, and since approval in 2012.
	• the potential impact on the preferred land uses (as considered by the consent authority) in the vicinity of the development; and	Section 7 presents an assessment of relevant impacts on the natural and built environment and social and economic impacts surrounding the Project. The Proposed Modification would not significantly impact on those land uses.
	• any ways in which the development may be incompatible with any of those existing, approved or preferred land uses.	The Proposed Modification would not be inconsistent with existing approved land use within the Project Site and would therefore not be incompatible with surrounding land uses.
	The respective public benefits of the development and the existing, approved or preferred land uses are evaluated and compared.	The Proposed Modification would maximise the efficiency of mining activities and tailings residue management and clarify permissible transportation operations, resulting in public benefit arising from the development. The Proposed Modification not adversely impact on the public benefit associated with the surrounding uses.
	Measures proposed to avoid or minimise any incompatibility are considered.	The Proposed Modification would result in no incompatibility with approved land uses.
2.19	Consideration is given to whether the development is likely to have a significant impact on current or future mining, petroleum production or extractive industry and ways in which the development may be incompatible. Measures taken by the Applicant to avoid or minimise any incompatibility are considered. The public benefits of the development and any existing or approved mining, petroleum production or extractive industry must be evaluated and compared.	Clause 2.19 is not considered relevant on the basis that the Project has already been approved, therefore, the compatibility of the Project with other mining, petroleum production or extractive industry has already been considered.

Table A4.2 (Cont'd)
Mandatory Matters for Consideration

Section/ Clause	Precondition	Relevance
State Environmental Planning Policy (Resources and Energy) 2021 (Cont'd)		
2.20	Consideration is given to ensuring that the development is undertaken in an environmentally responsible manner, including conditions to ensure: • impacts on significant water resources, including surface and groundwater resources, are avoided or minimised;	Sections 7.7 and 7.8 address matters related to surface water and groundwater respectively.
	• impacts on threatened species and biodiversity are avoided or minimised; and	Section 7.2 addresses matters related to biodiversity.
	• greenhouse gas emissions are minimised and an assessment of the greenhouse gas emissions (including downstream emissions) of the development is provided.	The Proposed Modification would not materially alter the Project's greenhouse gas emissions.
2.22	The following transport-related issues are considered. • The transport of some or all of the materials from the site by means other than public road. • Limitation of the number of truck movements that occur on roads within residential areas or roads near to schools. • The preparation of a code of conduct for the transportation of materials on public roads.	Section 7.4 addresses matters related to transport.
2.23	The rehabilitation of the land affected by the development is considered including: • the preparation of a plan that identifies the proposed end use and landform of the land once rehabilitated; • the appropriate management of development generated waste; • remediation of any soil contaminated by the development; and • require steps to be taken to ensure that the state of the land, while being rehabilitated and at the completion of rehabilitation, does not jeopardize public safety.	Rehabilitation of the proposed WSD is discussed in Section 4.2.8. Surplus materials generated by cut and fill operations during construction of the proposed WSD would be hauled and placed within the WRE. The Proposed Modification would not require remediation of contaminated soil or jeopardise public safety.

Table A4.2 (Cont'd)
Mandatory Matters for Consideration

Section/ Clause	Precondition	Relevance
Biodiversity Conservation Act 2016		
7.14(2)	The Minister for Planning, when determining in accordance with the *Environmental Planning and Assessment Act 1979* any such application, is to take into consideration under that Act the likely impact of the proposed development on biodiversity values as assessed in the biodiversity development assessment report. The Minister for Planning may (but is not required to) further consider under that Act the likely impact of the proposed development on biodiversity values	An assessment of Biodiversity impacts is presented in Section 7.2.
State Environmental Planning Policy (Biodiversity and Conservation) 2021		
8.10	**Neutral or beneficial effect on water quality – continuing development** (1) This section applies for the purposes of determining under this Chapter whether the carrying out of continuing development on land in the Sydney drinking water catchment would have a neutral or beneficial effect on water quality. (2) ***Continuing development*** is any development (such as mining) for which development consent was limited to the carrying out of the development for a particular time or to a particular area or intensity, but which was likely to be the subject for future applications for consent for its extension or expansion. (3) If-- a) development consent was granted for continuing development ("the existing development consent"), and b) a development application is made for consent to extend or expand the carrying out of the development ("the proposed development"), and	The Project is considered a "continuing development" for the purposes of Clause 8.10. An assessment of potential impacts to water quality within the Sydney drinking water catchment is presented in Section 7.7.

Table A4.2 (Cont'd)
Mandatory Matters for Consideration

Section/ Clause	Precondition	Relevance
State Environmental Planning Policy (Biodiversity and Conservation) 2021 (Cont'd)		
8.10 (Cont'd)	c) the development application is made before the authority conferred by the existing development consent expires or is exhausted, the carrying out of the proposed development will have a neutral or beneficial effect on water quality if it will have the same or a lesser adverse impact on water quality when compared to the adverse impact that the continuing development would have if it were extended or expanded under similar conditions as the existing development consent. (4) Subsection (3) extends to an existing development consent that is to be surrendered if consent is granted on the determination of the development application. (5) In this section, a reference to an existing development consent includes a reference to a project approved under Part 3A of the Act before its repeal (or granted after its repeal pursuant to Schedule 6A to the Act).	
Palerang Local Environmental Plan 2014		
5.10	**Heritage Conservation** (1) The objectives of this clause are as follows – a) to conserve the environmental heritage of Palerang, b) to conserve the heritage significance of heritage items and heritage conservation areas, including associated fabric, settings and views, c) to conserve archaeological sites, d) to conserve Aboriginal objects and Aboriginal places of heritage significance.	Section 7.3 addresses matters relevant to historic and Aboriginal heritage.

Table A4.2 (Cont'd)
Mandatory Matters for Consideration

Section/ Clause	Precondition	Relevance
Palerang Local Environmental Plan 2014 (Cont'd)		
5.10 (Cont'd)	(2) Development consent is required for any of the following a) – b) [not relevant] c) disturbing or excavating an archaeological site while knowing, or having reasonable cause to suspect, that the disturbance or excavation will or is likely to result in a relic being discovered, exposed, moved, damaged or destroyed, d) disturbing or excavating an Aboriginal place of heritage significance, e) – f) [not relevant] (3) [not relevant]	
	(4) The consent authority must, before granting consent under this clause in respect of a heritage item or heritage conservation area, consider the effect of the proposed development on the heritage significance of the item or area concerned. This subclause applies regardless of whether a heritage management document is prepared under subclause (5) or a heritage conservation management plan is submitted under subclause (6).	Section 7.3 addresses matters relevant to historic and Aboriginal heritage. This is a matter for the Department of Planning and Environment.
	(5) The consent authority may, before granting consent to any development – a) on land on which a heritage item is located, or b) on land that is within a heritage conservation area, or c) on land that is within the vicinity of land referred to in paragraph (a) or (b), require a heritage management document to be prepared that assesses the extent to which the carrying out of the proposed development would affect the heritage significance of the heritage item or heritage conservation area concerned.	An *Aboriginal and Historic Heritage Assessment Report* has been prepared by Lantern Heritage Pty Ltd as a matter of due diligence. The report is summarised in Section 7.3 and provided in full as **Appendix 6**.

Table A4.2 (Cont'd)
Mandatory Matters for Consideration

Section/ Clause	Precondition	Relevance
Palerang Local Environmental Plan 2014 (Cont'd)		
6.3	**Terrestrial Biodiversity** (1) The objective of this clause is to maintain terrestrial biodiversity by – a) protecting native fauna and flora, and b) protecting the ecological processes necessary for their continued existence, and c) encouraging the conservation and recovery of native fauna and flora and their habitats. (2) This clause applies to land identified as "Biodiversity" on the Terrestrial Biodiversity Map.	Section 7.2 addresses matters related to biodiversity. Areas within the Project Site are identified as "Biodiversity" on the Terrestrial Biodiversity Map associated with the *Palerang Local Environmental Plan 2014*.
	(3) In deciding whether to grant development consent for development on land to which this clause applies, the consent authority must consider – a) whether the development is likely to have – i) any adverse impact on the condition, ecological value and significance of the fauna and flora on the land, and ii) any adverse impact on the importance of the vegetation on the land to the habitat and survival of native fauna, and iii) any potential to fragment, disturb or diminish the biodiversity structure, function and composition of the land, and iv) any adverse impact on the habitat elements providing connectivity on the land, and b) any appropriate measures proposed to avoid, minimise, or mitigate the impacts of the development.	This is a matter for the Department of Planning and Environment. Section 7.2 addresses matters related to biodiversity.

Table A4.2 (Cont'd)
Mandatory Matters for Consideration

Section/ Clause	Precondition	Relevance
Palerang Local Environmental Plan 2014 (Cont'd)		
6.3 (Cont'd)	(4) Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that – a) the development is designed, sited and will be managed to avoid any significant adverse environmental impact, or b) if that impact cannot be reasonably avoided by adopting feasible alternatives – the development is designed, sited and will be managed to minimise that impact, or c) if that impact cannot be minimised – the development will be managed to mitigate that impact.	
6.4	**Drinking Water Catchments** (1) The objectives of this clause are as follows – a) to protect drinking water catchments by minimising the adverse impacts of development on the quality and quantity of water entering drinking water storages, b) to maintain water quality and the natural environment in the Sydney, Googong and Captains Flat drinking water catchments. (2) This clause applies to land identified as "Drinking water catchment" on the Drinking Water Catchment Map.	Section 7.7 addresses matters related to surface water. The location of the proposed Water Supply Dam is identified as the "Sydney drinking water catchment" on the Drinking Water Catchment Map associated with the *Palerang Local Environmental Plan 2014*. The Proposed Water Supply Dam would actually be located on the border of the Shoalhaven Catchment (part of the Sydney Drinking Water Catchment) and the Moruya Catchment, with any uncontrolled discharge to be directed into the Moruya Catchment.

Table A4.2 (Cont'd)
Mandatory Matters for Consideration

Section/ Clause	Precondition	Relevance
Palerang Local Environmental Plan 2014 (Cont'd)		
6.4 (Cont'd)	(3) In deciding whether to grant development consent for development on land to which this clause applies, the consent authority must consider the following – a) whether or not the development is likely to have any adverse impact on the quality and quantity of water entering the drinking water storage, having regard to the following – i) the distance between the development and any waterway that feeds into the drinking water storage, ii) the on-site use, storage and disposal for any chemicals on the land, iii) the treatment, storage and disposal of waste water and solid waste generated or used by the development. b) any appropriate measures proposed to avoid, minimise or mitigate the impacts of the development. (4) Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that – a) the development is designed, sited and will be managed to avoid any significant adverse impact on water quality and flows, or b) if that impact cannot be reasonably avoided – the development is designed, sited and will be managed to minimise that impact, or c) if that impact cannot be minimised – the development will be managed to mitigate that impact.	This is a matter for the Department of Planning and Environment. Section 7.7 addresses matters related to surface water.

Table A4.2 (Cont'd)
Mandatory Matters for Consideration

Section/ Clause	Precondition	Relevance
Palerang Local Environmental Plan 2014 (Cont'd)		
6.5	**Riparian land and watercourses** (1) The objective of this clause is to protect and maintain the following – a) water quality within watercourses, b) the stability of the bed and banks of watercourses, c) aquatic and riparian habitats, d) ecological processes within watercourses and riparian areas. (2) This clause applies to all of the following – a) land identified as "Riparian land" on the Riparian Lands and Watercourses Map, b) land identified as "Watercourse" on that map, c) all land that is within 40 metres of the top of the bank of each watercourse on land identified as "Watercourse" on that map.	Section 7.7 addresses matters related to surface water. The location of the proposed Water Supply Dam is identified as within 40 metres of the top of the bank of a watercourse on the Riparian Lands and Watercourses Map associated with the *Palerang Local Environmental Plan 2014*.
	(3) In deciding whether to grant development consent for development on land to which this clause applies, the consent authority must consider – a) whether or not the development is likely to have any adverse impact on the following – i) the water quality and flows within the watercourse, ii) aquatic and riparian species, habitats and ecosystems of the watercourse, iii) the stability of the bed and banks of the watercourse,	This is a matter for the Department of Planning and Environment. Section 7.7 addresses matters related to surface water.

Table A4.2 (Cont'd)
Mandatory Matters for Consideration

Section/ Clause	Precondition	Relevance
Palerang Local Environmental Plan 2014 (Cont'd)		
6.5	iv) the free passage of fish and other aquatic organisms within or along the watercourse, v) any future rehabilitation of the watercourse and riparian areas, and b) whether or not the development is likely to increase water extraction from the watercourse, c) any appropriate measures proposed to avoid, minimise or mitigate the impacts of the development. (4) Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that – a) the development is designed, sited and will be managed to avoid any significant adverse environmental impact, or b) if that impact cannot be reasonably avoided – the development is designed, sited and will be managed to minimise that impact, or c) if that impact cannot be minimised – the development will be managed to mitigate that impact.	

Appendix 5

Biodiversity Development Assessment Report

prepared by

WSP Australia Pty Limited

(Total No. of pages = 147)

Big Island Mining Pty Ltd

Biodiversity Development Assessment Report

Dargues Gold Mine - Mod 5

JUNE 2022

Question today
Imagine tomorrow
Create for the future

Biodiversity Development Assessment Report
Dargues Gold Mine - Mod 5

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REV	DATE	DETAILS
A	22/10/2021	Draft 1
B	3/3/2022	Draft 2
C	16/5/2022	Draft 3 new dam location
D	10/6/2022	Final

	NAME	DATE	SIGNATURE
Prepared by:	Liza Hill	1/3/2022	
Reviewed by:	Alex Cockerill	10/6/2022	
Approved by:	Alex Cockerill	10/6/2022	

WSP acknowledges that every project we work on takes place on First Peoples lands.
We recognise Aboriginal and Torres Strait Islander Peoples as the first scientists and engineers and pay our respects to Elders past and present.

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Glossary

Affected species	A species that is likely to be affected through by direct and/or indirect impacts as a result of the proposal.
Assessment area	An area created in accordance with BAM 2020 (s3.1) by applying a 1500m buffer surrounding the outside edge of the boundary of the subject land.
Avoid	Measures taken by a proponent such as careful site selection or actions taken through the design, planning, construction and operational phases of the development to completely avoid impacts on biodiversity values, or certain areas of biodiversity.
Biodiversity	The biological diversity of life is commonly regarded as being made up of the following three components: — genetic diversity – the variety of genes (or units of heredity) in any population — species diversity – the variety of species — ecosystem diversity – the variety of communities or ecosystems.
Biodiversity Assessment Method (BAM 2020)	The Biodiversity Assessment Method 2020
Biodiversity Assessment Method Calculator (BAM-C)	The web application that provides decision support to assessors and proponents by applying the BAM, and which calculates the number and class of biodiversity credits required to offset the impacts of a development or created at a biodiversity stewardship site.
Biodiversity Credit Report	The report produced by the Biodiversity Assessment Method Calculator (BAM-C) that sets out the number and class of biodiversity credits required to offset the remaining adverse impacts on biodiversity values at a development site, or on land to be biodiversity certified, or that sets out the number and class of biodiversity credits that are created at a biodiversity stewardship site.
Biodiversity credits	Ecosystem credits or species credits
Biodiversity offsets	Management actions that are undertaken to achieve a gain in biodiversity values on areas of land to compensate for losses to biodiversity values from the impacts of development.
Biodiversity value	Are the following values: — vegetation integrity – being the degree to which the composition, structure and function of vegetation at a particular site and the surrounding landscape has been altered from a near natural state — habitat suitability – being the degree to which the habitat needs of threatened species are present at a particular site — biodiversity values, or biodiversity-related values, prescribed by the regulations under the BC Act.
Candidate species	A species credit species that is likely to have suitable habitat on the subject land. Referred to as 'candidate species credit species' in the BAM-C and require further assessment in accordance with subsection 5.2.3 of the BAM.

Construction footprint	The area that would be used for the construction of the proposal.
Disturbance area	The area that would be impacted by both construction and operation of the project including all project infrastructure elements. This is equivalent to the Subject land in this BDAR.
Ecosystem credit	A measurement of the value of threatened species habitat for species that can be reliably predicted to occur with a PCT.
Ecosystem credit species	Ecosystem credit species are threatened species whose occurrence can generally be predicted by vegetation surrogates and/or landscape features, or that have a low probability of detection using targeted surveys.
Groundwater	Water found in the subsurface in the saturated zone below the water table or piezometric surface i.e. the water table marks the upper surface of groundwater systems.
Hollow bearing tree (HBT)	A living or dead tree that has at least one hollow. A tree is considered to contain a hollow if: (a) the entrance can be seen; (b) the entrance width is at least 5 cm; (c) the hollow appears to have depth (i.e. you cannot see solid wood beyond the entrance); (d) the hollow is at least 1m above the ground. Trees must be examined from all angles.
IBRA region	A bioregion identified under the Interim Biogeographic Regionalisation for Australia (IBRA) system, which divides Australia into bioregions on the basis of their dominant landscape-scale attributes.
IBRA subregion	A subregion of a bioregion identified under the IBRA system.
Indirect impact	An impact on biodiversity values that occurs when development related activities affect threatened species, threatened species habitat, or ecological communities in a manner other than direct impact.
Local population	The population that occurs in the locality of the subject land. In cases where multiple populations occur in the locality or a population occupies part of the subject land, impacts on each subpopulation must be assessed separately.
Locality	The area within 10 kilometres of the subject land.
Minimise	A process applied throughout the development planning and design life cycle which seeks to reduce the residual impacts of the proposal on biodiversity values.
Mitchell landscape	Landscapes with relatively homogeneous geomorphology, soils and broad vegetation types, mapped at a scale of 1:250,000.
Mitigation	Action to reduce the severity of an impact.
Mitigation measure	Any measure that facilitates the safe movement of wildlife and/or prevents wildlife mortality.
Native vegetation	Means any of the following types of plants native to New South Wales: — trees (including any sapling or shrub or any scrub) — understorey plants — groundcover (being any type of herbaceous vegetation) — plants occurring in a wetland.

Patch size	An area of intact native vegetation that: — occurs on the subject land or biodiversity stewardship site — includes native vegetation that has a gap of less than 100m from the next area of moderate to good condition native vegetation (or ≤30m for non-woody ecosystems). Patch size may extend onto adjoining land that is not part of the subject land or biodiversity stewardship site.
PCT classification system	The system of classifying native vegetation approved by the NSW Plant Community Type Control Panel and described in the BioNet Vegetation Classification.
Plant community type	A NSW plant community type identified using the PCT classification system.
Population	A group of organisms, all of the same species, occupying a particular area.
Project, the	Proposed modification (MOD 5) to the Dargues Gold Mine including a water management dam (WMD) and associated infrastructure.
Proposal, the	The proposal is the proposed construction of a water management dam (WMD) and associated infrastructure described in Section 1.2.1.
Species credit species	Threatened species that are assessed in accordance with section 6.4 of the BAM. Species credit species are threatened species for which vegetation surrogates and/or landscape features cannot reliably predict the likelihood of their occurrence or components of their habitat. A targeted survey or an expert report is required to confirm the presence of these species on the subject land. Alternatively, a species may be assumed present within subject land.
Species credits	The class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Species that require species credits are listed in the Threatened Biodiversity Data Collection.
Stage 1: Biodiversity Assessment	Stage 1 of the Biodiversity Assessment Method. It establishes a single consistent approach to assessing the biodiversity values on land subject to the proposal.
Stage 2: Impact Assessment	Stage 2 of the Biodiversity Assessment Method. It provides for an impact assessment on biodiversity values on land subject to the proposal.
Subject land	The area that will be directly impacted by both construction and operations including the areas that will be impacted by maintenance activities. Equivalent to the Disturbance area. For this report the subject land is an area comprised of two design options, option A and B. However, only one is likely to impact the site.
Threatened Biodiversity Data Collection (TBDC)	Part of the BioNet database, published by EES and accessible from the BioNet website at www.bionet.nsw.gov.au.
Threatened ecological community	Means a critically endangered ecological community, an endangered ecological community or a vulnerable ecological community listed in Schedule 2 of the BC Act or any additional ecological community listed under Part 13 of the EPBC Act as critically endangered, endangered or vulnerable.

Threatened species	Critically endangered, endangered or vulnerable threatened species as defined by Schedule 1 of the BC Act, or any additional threatened species listed under Part 13 of the EPBC Act as critically endangered, endangered or vulnerable.
Vegetation class	A level of classification of vegetation communities defined in Keith (2004). There are 99 vegetation classes in NSW.
Vegetation formation	A broad level of vegetation classification as defined in Keith (2004). There are 16 vegetation formations and sub-formations in NSW.
Vegetation integrity	The condition of native vegetation assessed for each vegetation zone against the benchmark for the PCT.
Vegetation integrity score (VI)	The quantitative measure of vegetation condition of a vegetation, calculated by BAM-C using BAM vegetation integrity plot data.
Vegetation type	A NSW plant community type (PCT)
Vegetation zone	A relatively homogenous area of native vegetation that is the same PCT and broad condition state.

Abbreviations

BAM	Biodiversity Assessment Method 2020
BAM-C	Biodiversity Assessment Method Calculator
BC Act	NSW *Biodiversity Conservation Act 2016*
BDAR	Biodiversity Development Assessment Report
BMP	Biodiversity Management Plan
BOS	NSW Biodiversity Offset Scheme
CSSI	Critical State Significant Infrastructure
DNG	Derived native grassland
EEC	Endangered Ecological Community
CEEC	Critically Endangered Ecological Community
EES	Environment, Energy and Science Group – a division of the Department of Planning Industry and Environment (DPIE) (formerly NSW Office of Environment and Heritage)
EIS	Environmental impact statement
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EPL	Environment protection licence
HBT	Hollow bearing tree
HTW	High threat weed listed under BAM 2020
IBRA	Interim Biogeographic Regionalisation of Australia
LGA	Local Government Area
MNES	Matters of National Environment and Significance
NSW	New South Wales
PCT	Plant Community Type
SSI	State Significant Infrastructure
TBCD	Threatened Biodiversity Data Collection: part of the BioNet database, published by the Department and accessible from the BioNet website at www.bionet.nsw.gov.au
TEC	Threatened Ecological Community
TSF	Tailings storage facility
VIS	Vegetation information system (BioNet Vegetation Classification)
WMD	Water management dam

Executive summary

The proposal

Dargues Gold Mine is a State Significant Development that operates under Modified Project Approval (MP) 10_0054. The mine has had four modifications since it began operations in February 2012. This report documents the biodiversity development assessment report (BDAR) for the proposed fifth modification (MOD 5).

This BDAR responds directly to the NSW Biodiversity Assessment Method 2020 (BAM).

The proposal is for a fifth modification to MP 10_0054 (MOD 5), which includes construction of a 180ML Water Storage Dam and ancillary infrastructure. For this report the proposed disturbance footprint is an area comprised of two design options, option A and B, only one is likely to impact the site. These proposed disturbance footprints will include the water management dam, access road, pump stand, laydown area, pipelines and surface water diversion bunds.

The subject land for the proposal would encompass all construction and operational activities and components of the proposal (including access tracks). The subject land would encompass all disturbance required for the activities and components of the proposal.

Landscape features overview

The subject land occurs in the South East Corner bioregion, within the South East Coastal Ranges subregion.

The important landscape features of the subject land are as follows:

- occurs within Braidwood Granites Mitchell landscape
- occurs in the Queanbeyan-Palerang LGA
- no streams have been identified in the subject land
- there is limited connectivity due to the cleared agricultural land within and surrounding the subject land. The closest wooded area occurs along Spring Creek, with which the subject land adjoins but does not intersect
- no geological significance and soil hazard features have been identified that relates to biodiversity
- no karst, caves, crevices, cliffs within the subject land. Gold geological deposits occur in the area
- no high hazard soil areas occur in the area

Native vegetation cover for BAM landscape calculation purposes has been estimated as 11 per cent within a 1500 m buffer area. The majority of the native vegetation cover is represented by woodland and open forest. Derived grasslands are treated as exotic pasture for the BAM landscape calculation purposes as there is no mapping of native grasslands in the 1500m buffer assessment area.

Native vegetation overview

Native vegetation recorded within the subject area are derived grasslands. These have been derived from wooded parent units that were cleared of almost all woody vegetation to create grassland for pastoral land practices, which have been ongoing for decades.

One plant community type (PCT) was mapped in the subject land occurring in a single disturbed condition class, forming one vegetation zone in low condition, which is:

- PCT 1100 Ribbon Gum - Snow Gum grassy forest on damp flats, eastern South Eastern Highlands Bioregion (Low)

Threatened species overview

In accordance with the BAM threatened species have been assessed as predicted species (ecosystem credit species) and species credit species.

Predicted species (ecosystem credit species)

A total of 23 threatened fauna species were identified by BAM-C as predicted or ecosystem credit species within the subject land. Of these 22 were retained as candidate ecosystem credit species. One was excluded as a predicted ecosystem credit species due to the lack of required habitat in the subject land, which was Glossy black-cockatoo (*Calyptorhynchus lathami*).

No threatened fauna species (species) were recorded in the subject land during field survey except for the gang-gang cockatoo (*Callocephalon fimbriatum*), which was seen flying over the site during field survey on 31 January 2022; however, no individuals on the gang-gang cockatoo were seen foraging on the subject land.

Threatened flora (species credit species)

A total of seven threatened flora species were identified by BAM-C as candidate threatened flora species within the subject land. Of these, one was retained as candidate species credit species, being:

- Hoary sunray (*Leucochrysum albicans* subsp. *tricolor*) which was assessed as having the potential to occur in the subject land based on the presence of suitable habitat.

The remainder were excluded as species credit species in BAM-C based on the high level of degradation of habitat in the subject land and the lack of suitable habitat in the subject land.

No additional flora species were included as candidate threatened flora species with a moderate likelihood of occurrence in the subject land based on as the presence of potential suitable habitat.

No threatened flora species were recorded in the subject land during field survey. Based on this, *Leucochrysum albicans* subsp. *tricolor* was removed from BAM-C as a candidate species.

Threatened fauna (species credit species)

A total of 16 candidate threatened fauna species were identified by BAM-C as potential candidate threatened fauna species. All 16 species were excluded as candidate species based on the lack of suitable habitat or on the high level of degradation of habitat in the subject land.

No threatened fauna species were recorded in the subject land during field survey.

Avoidance and design refinements

The proposal has been refined to avoid and minimise potential impacts on biodiversity values by reducing the development footprint in areas of higher biodiversity value. This was achieved through relocating the proposed water transfer pipeline from an area of native vegetation on Spring Creek to an area of disturbed land with little biodiversity values.

Where practical, the disturbance footprint will be sited in areas of poor condition vegetation, such as exotic pasture (i.e. areas with a low vegetation integrity score).

Impact summary

Impacts unable to be avoided by the proposal have been assessed in accordance with Stage 2 of the BAM (DPIE 2019) and Matters of National Environmental Significance – Significant impact guidelines 1.1 (2013) EPBC Act.

Direct impacts on biodiversity values resulting from the proposal and the revised disturbance footprint are:

- 2.82 ha of native vegetation (PCT 1100 in low condition). This does not meet the characteristics of any listed TECs under the BC Act or EPBC Ac.

Indirect impacts on biodiversity resulting from the proposal are likely to be low to negligible, which may include the following:

- Impact on adjacent habitat and vegetation impact by sedimentation and erosion from construction activities will be controlled during construction by mitigation measures and sediment containment measures.
- Connectivity and habitat fragmentation in the local landscape is unlikely to increase, as the subject land occurs within an already highly fragmented landscape with few remnant trees or other woody vegetation. The proposal would largely involve small areas of disturbance of PCT 1100 (low) which is a derived grassland with low (about 30 percent) native species cover, and exotic grassland, which would not result in significant habitat fragmentation. Mitigation measure would further minimise any residual indirect impact to native vegetation is managed during both the construction and operational phases of the proposal.
- Reduced viability of adjacent habitat due to edge effects, noise, dust or light spill is likely to be low or negligible as the subject land occurs within a rural landscape currently impacted by agricultural activities (ploughing, cropping and stock grazing), and related issues of weed invasion, soil erosion, dust, vegetation fragmentation and edge effects.
- Loss of breeding habitat is likely to be negligible as none occur on the subject land and all such loss will be restricted to the subject land.
- The proposal would not impact on surface or groundwater and is considered unlikely to lead to any adverse impact on the water availability or status for groundwater dependent ecosystems.

There are no prescribed impacts from the proposal on threatened entities.

In conclusion, the proposal is considered unlikely to lead to a significant impact on any threatened species, ecological communities or their habitats.

In terms of impacts on Matters of National Environmental Significance (MNES) the proposal will not directly impact on any MNES.

Mitigation and management

The specific performance outcomes for the proposal regarding biodiversity include as a minimum:

- measures to minimise impacts to biodiversity, including measures to reduce disturbance to sensitive flora and fauna
- procedures for clearing of vegetation, including pre-clearing inspections and procedures for the relocation of flora and fauna
- procedures for the demarcation and protection of retained vegetation, including vegetation adjacent to construction areas (no go zones)
- weed and pathogen management
- rehabilitation strategies including progressive rehabilitation, and measures for the management and maintenance of rehabilitated areas (including duration)
- procedures for unexpected, threatened flora and fauna species finds during construction, including stop work procedures
- monitoring requirements and compliance management

Offsetting biodiversity impacts

This BAM assessment found that the proposal will not have an residual impacts that are not able to be managed through mitigation; therefore, the proposal will not generate any ecosystem or species credit requirements. The project's nil offset obligation based on the disturbance area has been calculated to require the following biodiversity credits:

- nil ecosystem credits due to the low vegetation integrity score (0.4) for PCT 1100 (low) on the subject land
- nil species credits as no species credit species or their habitats were recorded on the subject land, and none were assessed as likely to occur on the subject land

Since the proposal will not generate any biodiversity offset requirements, an offset approach is not needed.

STAGE 1–BIODIVERSITY ASSESSMENT

1 Introduction

1.1 Certification

As required under *Section 6.15 Currency of biodiversity assessment report* of the NSW *Biodiversity Conservation Act 2016* (BC Act) I Alex Cockerill (BAM Accredited Assessor BAAS17020) certify that this BDAR has been prepared on the basis of the requirements of (and information provided under) the current biodiversity assessment method (2020) as at 10/6/2021

Name of Assessor

1.2 Background

Dargues Gold Mine (the mine) is owned by Big Island Mining Pty Ltd and located about 60km southeast of Canberra and 13km south of Braidwood. The mine is immediately north of the village of Majors Creek. The location of the mine is shown in Figure 1.1. Mining includes extraction of waste rock and ore from the Dargues Gold Deposit using underground sublevel open slope mining methods, with up to 355,000 tonnes of ore processed per year (R.W. Corkery & Co 2021).

Dargues Gold Mine is a State Significant Development that operates under Modified Project Approval (MP) 10_0054. The mine has had four modifications since it began operations in February 2012. This report documents the biodiversity development assessment report (BDAR) for the proposed fifth modification (MOD 5).

Existing biodiversity offsetting requirements for the mine are outlined in MP 10_0054, two approvals under the Environmental Protection and Biodiversity Conservation Act 1999 (EPBC 2015/7538 and EPBC 2010/5770) and the Biodiversity Management Plan for the Mine (Big Island Mining Limited 2016).

Vegetation survey and mapping of the subject land undertaken by Gaia Research (2010) as part of the Dargues Reef Gold Mine Environmental Assessment, supported the application for planning approval for the mine under the EP&A Act. The vegetation in the location of the subject land for the proposal was mapped as native pasture by Gaia Research (2010), which was subsequently included in the on-site biodiversity offsetting requirements (refer Big Island Mining Limited 2016). Contemporary survey by WSP for the proposed MOD 5 provides updated vegetation mapping for the subject land (refer Section 4.3.2).

1.2.1 The project proposal

The proposal is for a fifth modification to MP 10_0054 (MOD 5), which includes construction of a 180ML Water Storage Dam and ancillary infrastructure. For this report the proposed disturbance footprint is an area comprised of two design options, option A and B, only one is likely to impact the site. These proposed disturbance footprints will include the water management dam, access road, pump stand, laydown area, pipelines and surface water diversion bunds.

The water storage dam is proposed to be constructed using cut-and-fill to build a turkey-nest style, having no natural catchment, for the receipt and storage of supernatant water from the tailings storage facility (TSF), water pumped from underground workings and raw water from other on-site sources. This will increase on-site water storage, which is required to ensure that excess water generated at the mine can be safely and effectively managed. The water storage dam is also required for storage of water needed for use during dry weather periods (Big Island Mining Limited 2016).

The subject land includes the disturbance footprint associated with the Water Storage Dam, ancillary infrastructure (e.g. construction laydown yard, bunds) and pipeline routes for raw Water and TSF Water.

The key components of the project are summarised in Table 1.1 and the construction footprint is shown in Figure 1.1.

Table 1.1 Summary of key components of the project

PROJECT COMPONENT	DESCRIPTION
WMD	— Water management dam. — Turkey nest-style design with no natural catchment; constructed using cut-and-fill methods, with embankment construction materials sourced from the WMD footprint. — Constructed in accordance with NSW EPA Tailings Dam Policy. — 180ML capacity. — For receipt and storage of supernatant water from tailings storage facility (TSF), underground workings, and raw water from other on-site sources. — Will provide additional storage of water for use during periods of reduced rainfall or drought.
Ancillary infrastructure	— Access road — Pump stand — Pipelines — Laydown area — Surface water diversion bunds

1.2.2 Subject land location

Combined both subject lands option A and option B comprises 15.17 hectares that is subject to the proposed development including its construction and operation. It comprises the proposed water management dam (WMD) and ancillary infrastructure, shown in Figure 1.1.

The subject land is in the Queanbeyan-Palerang Regional Council Local Government Area (LGA) approximately three kilometres north of the township of Majors Creek.

Table 1.2 Subject land address and lot details

SUBJECT LAND	LOT/DP	ADDRESS
Big Island Mining Pty Ltd, Dargues Gold Mine	Lot 102/DP1170553	920 Majors Creek Road, Major Creek NSW 2622

1.3 Sources of information

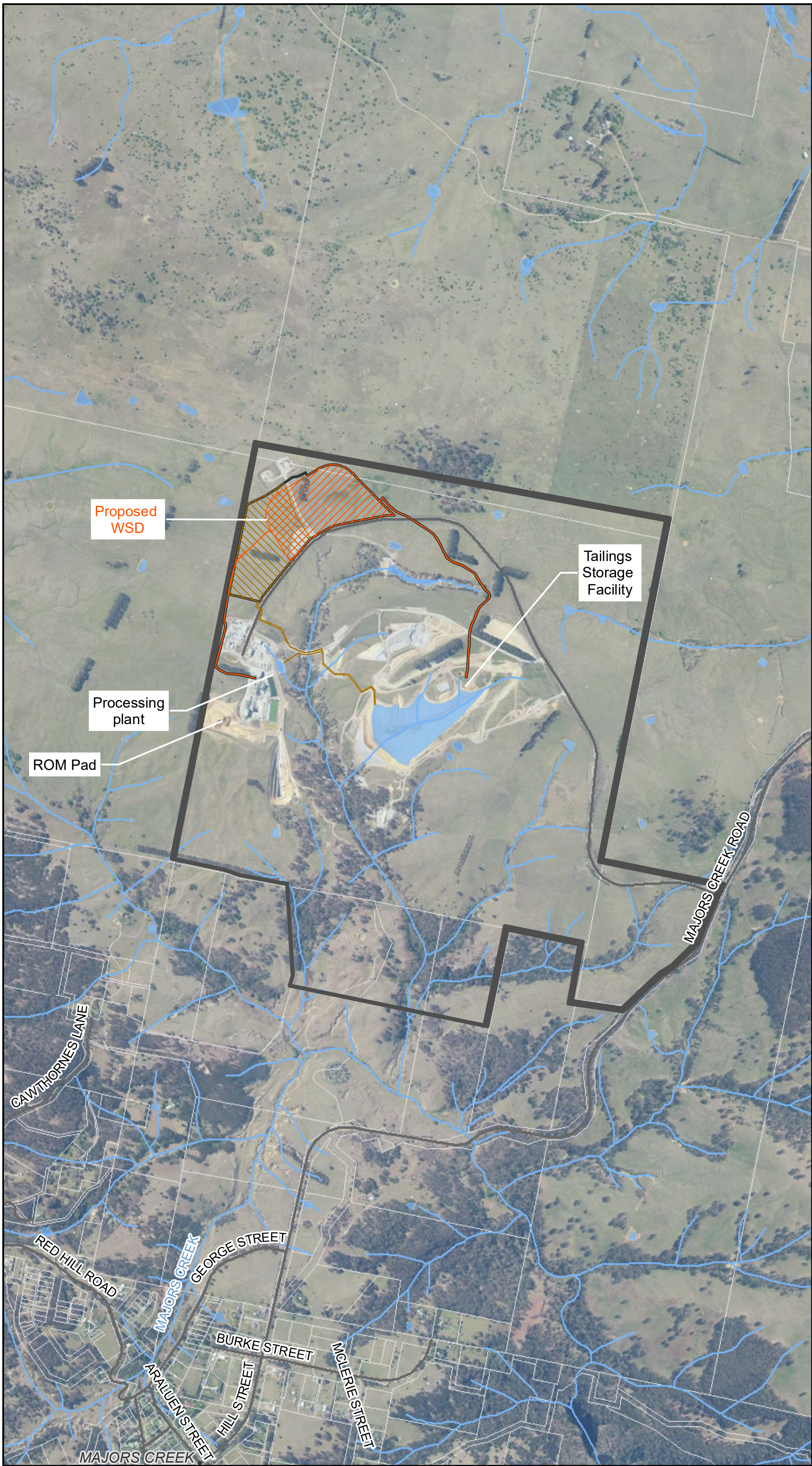
Information used in this BDAR includes the following sources:

- Dargues Reef Gold Project Ecology Assessment (Gaia Research 2010)
- State vegetation type map (SVTM): Southeast NSW Native Vegetation Classification and Mapping (DPIE 2010)
- Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions Final Determination (NSW TSSC 2011)
- Monaro Tablelands Cool Temperate Grassy Woodland in the South Eastern Highlands Bioregion Final Determination (NSW TSSC 2019a)
- Werriwa Tablelands Cool Temperate Grassy Woodland in the South Eastern Highlands and South East Corner Bioregions Final Determination (NSW TSSC 2019b)

- Approved Conservation Advice (including listing advice) for Natural Temperate Grassland of the South Eastern Highlands (TSSC 2016)
- NSW BioNet Atlas and Vegetation Classification (EES 2021a, 2021b and 2021c).
- PlantNet (Royal Botanic Gardens 2021)
- Protected Matters Search Tool (DAWE 2021a)

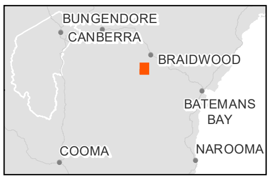
Dargues Gold Mine, Jembaicumbene

Figure 1 - 1
Location & Key Features of the Proposal



Legend

- Subject Lot (Option A)
- Subject Lot (Option B)
- Study Area
- Cadastre
- Waterbody
- Watercourse
- Project Site Boundary (ML 1675)
- Road



0 0.2 0.4
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Coordinate system: GDA2020 MGA Zone 55

Scale ratio correct when printed at A3

1:20,000 Date: 16/06/2022

Data sources: - NSWSS, Geoscience Australia, RWC, Metromap 2019

1.4 Scope and purpose of the report

This report has been prepared by the WSP Australia Pty Ltd as part of the Modification 5 (MOD 5) application for the proposed construction of a Water Storage Dam to assess the impacts to terrestrial biodiversity.

This report presents the Biodiversity Development Assessment Report (BDAR) for the proposal in accordance with section 6 of the NSW *Biodiversity Conservation Act 2016* (BC Act) and the NSW Biodiversity Assessment Methodology (BAM 2020) (EES 2020). This BDAR has been prepared by the WSP Australia Pty Ltd using data collected by WSP for this assessment. This BDAR addresses matters outlined in Stage 1 and Stage 2 of the BAM and has been prepared in accordance with the reporting requirements set out in Appendix 10 and 12 of the methodology in BAM 2020.

Impacts to relevant Matters of National Environmental Significance (MNES) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) are addressed as part of this assessment.

1.5 Structure of this report

The structure and content of this report is as follows:

Stage 1–Biodiversity assessment

- ***Chapter 1–Introduction:*** Outlines the background and need for the proposal, and the purpose of this report.
- ***Chapter 2–Legislation and policy context:*** Provides an outline of the key legislative requirements and policy guidelines relating to the proposal.
- ***Chapter 3–Landscape context:*** Provides information on a range of landscape features in accordance with section 3 of the BAM that occur on the subject land and broader locality.
- ***Chapter 4–Native vegetation:*** Provides information on native vegetation in accordance with section 4 of the BAM and matters relating to the BC Act.
- ***Chapter 5–Threatened species:*** Provides information on threatened species in accordance with section 5 of the BAM and matters relating to the BC Act.
- ***Chapter 6–Prescribed impacts:*** Identifies potential prescribed biodiversity impacts on threatened entities in accordance with section 6 of the BAM and matters relating to the BC Act.
- ***Chapter 7–Matters on national environmental significance:*** Describes biodiversity matters relating to Commonwealth legislation under the EPBC Act.

Stage 2–Impact assessment

- ***Chapter 8–Avoid and minimise:*** Provides information on avoiding and minimising impacts on biodiversity values through the planning and design phase of the proposal in accordance with section 7 of the BAM.
- ***Chapter 9 Assessment of impacts:*** Describes the potential impacts associated with the proposal in accordance with section 8 of the BAM.
- ***Chapter 10–Mitigation and management:*** Outlines the proposed mitigation measures for the proposal on biodiversity matters.
- ***Chapter 11–Impact summary – thresholds for assessment and offsetting impacts:*** Outlines the impact thresholds and offset requirements for residual impacts to biodiversity values after the avoid, minimise and mitigate hierarchy has been applied as required under section 9 of the BAM.
- ***Chapter 12 – Impact summary – no net loss standard:*** Applies the no net loss biodiversity standard as required under section 10 of the BAM.

- ***Chapter 13 – Conclusion:*** Provides a conclusion of the potential impacts of the proposal on biodiversity.
- ***Chapter 14 – Limitations:*** Identifies the permitted purpose and limitations of this report.

Appendices to this report includes:

- **Appendix A** – BAM data
- **Appendix B** – Matters of national environmental significance
- **Appendix C** – Biodiversity credit report.

1.6 Report terminology

The following terms are discussed throughout this report and are defined as:

- **Proposal** – The proposed activities that includes construction of the 180 Mega Litre water storage dam and ancillary infrastructure (construction laydown yard, bunds), a raw water pipeline and TSF water pipeline, as described in Section 1.2.
- **Subject land** – The disturbance area that would be used for the construction and operation of the proposal and includes the location of construction activities and operational infrastructure. Stage 2 (Impact Assessment) of the BAM has been applied to the subject land for this report. This definition is consistent with the BAM definition of development footprint.

1.7 Personnel

The contributors to the preparation of this paper, their qualifications and roles are listed in Table 1.3.

Table 1.3 Personnel

NAME	ROLE	QUALIFICATIONS
Alex Cockerill	Ecology National Team Executive– Project Director, field survey and technical review	Bachelor of Science (Hons), BAM Accredited Assessor (BAAS17020)
Toby Lambert	Principal Ecologist Technical review	Bachelor of Environmental Science, BAM Accredited Assessor (BAAS17046)
Liza Hill	Principal Ecologist – Report preparation	Bachelor of Applied Science (Environmental Analysis), BAM Accredited Assessor (BAAS17071)
Alicia Palmer	Graduate Ecologist– Field survey and report preparation	Bachelor of Science (Hons)
Emma Buxton	GIS Consultant	Bachelor Science (Environmental Science) Graduate Certificate in Bushfire Protection, Western Sydney Uni

Specific methodologies used for the assessment of native vegetation and threatened species are detailed in Chapter 4 (Native vegetation) and Chapter 5 (Threatened species) of this report respectively.

All work was carried out under the appropriate licences, including scientific licences as required under Part 2 of the BC Act (License Number: SL100630) and an Animal Research Authority issued by the DPI (Agriculture).

2 Legislation and policy context

2.1 Commonwealth legislation

2.1.1 *Environment Protection and Biodiversity Conservation Act 1999* (Australian)

The objective of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is to protect and manage prescribed Matters of National Environmental Significance (MNES). Under the EPBC Act, proposed 'actions' that have the potential to significantly impact on MNES, the environment of Commonwealth land, or that are being carried out by a Federal Government agency, must be referred to the Federal Minister for the Environment for assessment.

Under the EPBC Act, an action includes a project, a development, an undertaking, an activity or a series of activities, or an alteration of any of these things. The nine MNES protected under the EPBC Act are:

- listed threatened species and ecological communities
- listed migratory species
- wetlands of international importance (listed under the Ramsar Convention)
- Commonwealth marine areas
- world heritage properties
- national heritage places
- the Great Barrier Reef Marine Park
- nuclear actions (including uranium mines)
- a water resource, in relation to coal seam gas development and large coal mining development.

Matters relating to biodiversity values under the EPBC Act have been considered in this assessment through:

- desktop review to determine the listed biodiversity matters that are predicted to occur within the locality of the proposal and hence could occur, subject to the habitats present
- targeted field surveys for listed threatened biota and migratory species
- assessment of potential impacts on threatened and migratory biota. Assessments of significance in accordance with the EPBC Act significant impact guidelines (Department of the Environment 2013) were not required as no threatened fauna or flora species are identified as having a moderate or better likelihood of occurring in the subject land
- identification of suitable impact mitigation and environmental management measures for threatened and migratory biota, where required.

2.2 NSW legislation

2.2.1 *Environmental Planning and Assessment Act* 1979

The Environmental Planning and Assessment Act 1979 (EP&A Act) and Environmental Planning and Assessment Regulation 2000 (EP&A Regulation) establish a framework for the assessment and approval of developments in NSW. They also provide for the making of environmental planning instruments, including state environmental planning policies (SEPPs) and local environmental plans (LEPs), which determine the permissibility and approval pathway for development proposals and form a part of the environmental assessment process. In accordance with the provisions of the EP&A Act, the proposal is State Significant Development (SSD).

The proposal is for a modification (MOD 5) to existing approval MP10_0054.

2.2.2 Biodiversity Conservation Act 2016 (NSW)

The *Biodiversity Conservation Act 2016* (BC Act) came into effect on the 25 August 2017, repealing the *Threatened Species and Conservation Act 1995* (TSC Act), *Native Vegetation Act 2003* and parts of the *National Parks and Wildlife Act 1974*. All threatened entities previously listed under the TSC Act have now been listed under the schedules of the BC Act.

The BC Act outlines the framework for addressing impacts on biodiversity from development and clearing. It establishes a framework to avoid, minimise and offset impacts on biodiversity from development through the Biodiversity Offsets Scheme (BOS). The BOS creates a transparent, consistent and scientifically based approach to biodiversity assessment and offsetting for all types of development that are likely to have a significant impact on biodiversity (Office of Environment and Heritage, 2017).

The Biodiversity Assessment Method (BAM) was established by the Office of Environment and Heritage (OEH) as a standard method to implement the aims of the BOS and to address the loss of biodiversity and threatened species. The scheme creates a market framework for the conservation of biodiversity values and the offsetting of development impacts. It also provides the mechanisms to offset impacts of development, clearing or biodiversity certification such that there is no loss of biodiversity values.

In accordance with section 6.8 (3) of the BC Act, the BAM is to exclude the assessment of impacts of any clearing of native vegetation and loss of habitat on category 1-exempt land (within the meaning of Part 5A of the *Local Land Services Act 2013*), other than any impacts prescribed by the regulations under section 6.3.

This BDAR has been prepared in accordance with the BAM (2020) and includes prescribed biodiversity matters under the *Biodiversity Conservation Regulation 2017*.

2.2.3 Biosecurity Act 2015 (NSW)

The *Biosecurity Act 2015* provides for risk-based management of biosecurity in NSW. It provides a statutory framework to protect the NSW economy, environment and community from the negative impact of pests, diseases and weeds.

The primary object of the Act is to provide a framework for the prevention, elimination and minimisation of biosecurity risks posed by biosecurity matter, dealing with biosecurity matter, carriers and potential carriers, and other activities that involve biosecurity matter, carriers or potential carriers.

In NSW, all plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.

Priority weeds recorded in the subject land and their control measures are detailed in Section 4.6.

2.2.4 *Fisheries Management Act 1994*

The FM Act was introduced to conserve, develop and share the fishery resources of the State for the benefit of present and future generations, and applies to all waters within the area occupied by the proposal. Part 7 of the FM Act relates to the protection of fish and aquatic habitats with the objective of conserving the biodiversity of fish and aquatic vegetation. It provides for the management of certain works located on land that is permanently or intermittently submerged by water. Pursuant to sections 201, 205 and 219 of the FM Act, works and activities required for a proposal, may be undertaken under the authority of a permit.

2.2.5 *Local Land Services Act 2013*

The LLS Act was introduced to provide direction around programs and services associated with agricultural production, biosecurity, natural resource management and emergency management. It aims to ensure the proper management of natural resources in the social, economic and environmental interests of the State, consistent with the principles of ecologically sustainable development. One of the ways that it intends to achieve this is through the regulation of clearing of native vegetation.

Part 5A of the LLS Act sets out the ways in which the regulating of activities (in connection with land management) would occur and the areas of the State to which it would apply. Section 60A applies Part 5A to rural area including lands associated with the subject land; however, this section 60O excludes clearing that is authorised under other legislation. Furthermore, under the provisions of section 60O of the LLS Act the clearing of native vegetation is authorised if the clearing was authorised by a State significant development approval under Division 5.2 of the EP&A Act.

Under the BC Act, section 6.8(3) regulates that the BAM is to exclude the assessment of the impacts of any clearing of native vegetation and loss of habitat on category 1-exempt land (within the meaning of Part 5A of LLS Act).

Category 1-exempt land is defined under the LLS Act (Part 5A Division 2 Section 60H) as:

Land is to be designated as category 1-exempt land if the Environment Agency Head reasonably believes that:

- the land was cleared of native vegetation as at 1 January 1990, or
- the land was lawfully cleared of native vegetation between 1 January 1990 and the commencement of this Part.

Land is to be designated as category 1-exempt land if the Environment Agency Head reasonably believes that:

- the land contains low conservation value grasslands, or
- the land contains native vegetation that was identified as regrowth in a property vegetation plan referred to in section 9 (2) (b) of the Native Vegetation Act 2003, or
- the land is of a kind prescribed by the regulations as category 1-exempt land.

All other rural lands that do not meet category 1 definition form part of the assessment area subject to this BDAR. The method for determining category 1-exempt land for this proposal is outlined in Section 4.2.

3 Landscape context

3.1 Landscape features

3.1.1 *Identification of IBRA regions and subregions*

The subject land occurs in the South East Corner bioregion, within the South East Coastal Ranges subregion, which is shown in Figure 3.1.

3.1.2 *Identification of landscape features*

Landscape features have been identified for the IBRA subregion in accordance with Section 3.2 of the BAM. A summary of landscape features is presented in Table 3.1 and figures are provided in Figure 3.1.

Table 3.1 Summary of landscape features

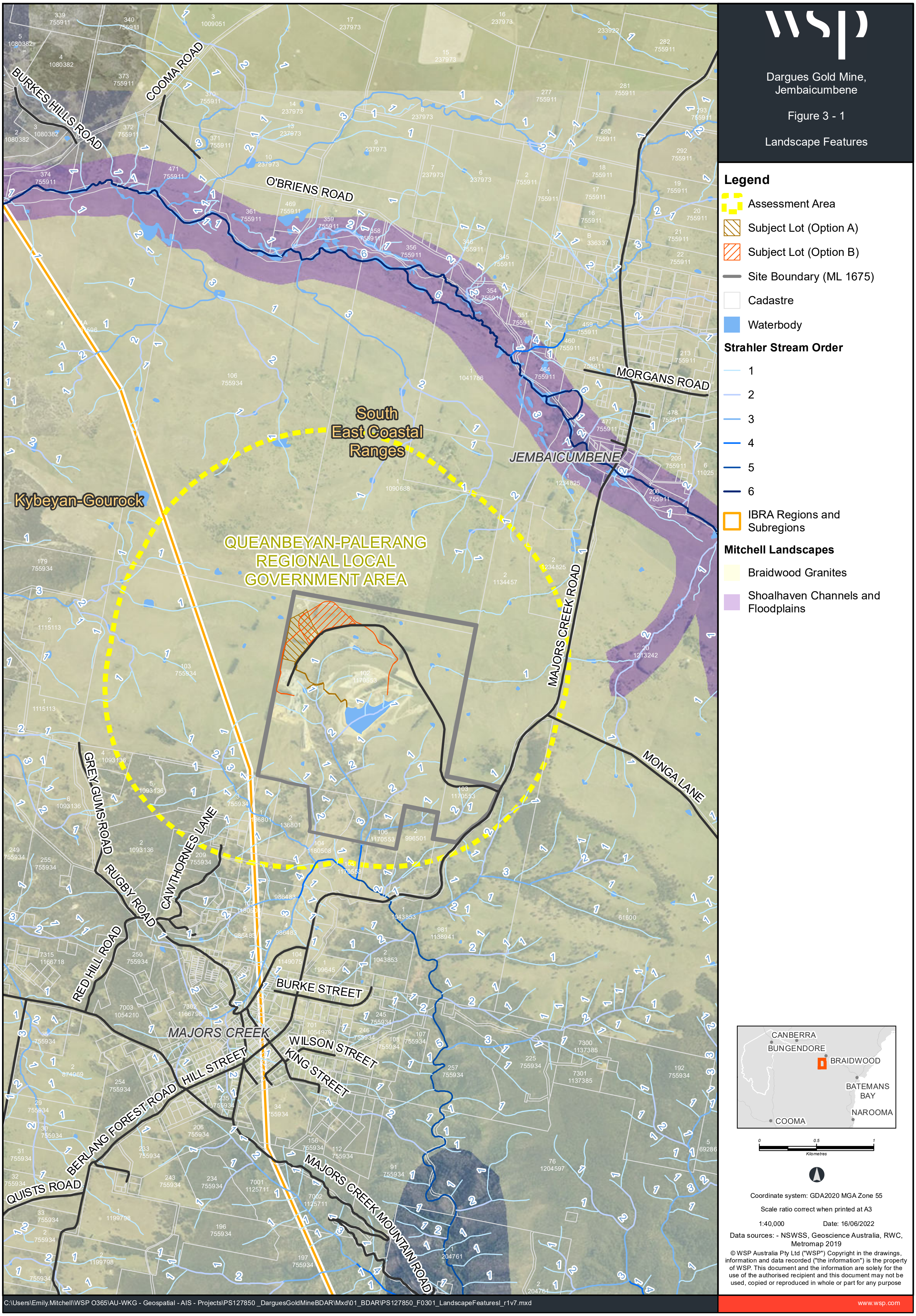
LANDSCAPE FEATURE	OCCURRENCE IN SUBJECT LAND
NSW landscape regions (Mitchell landscapes)	The subject land falls within Braidwood Granites Mitchell Landscape. This landscape comprises rounded and undulating to moderately steep hills on Silurian-Devonian granite and granodiorite, general elevation 800 to 1100m. Includes open grassy valleys with swampy patches surrounded by open woodlands (Mitchell 2002).
Local Government Area (LGA)	Queanbeyan-Palerang LGA
Rivers, streams and estuaries	No streams have been identified in the subject land.
Important and local wetlands	The subject land does not contain any important or other wetland.
Connectivity features	There is limited connectivity due to the cleared agricultural land within and surrounding the subject land. The closest wooded area occurs along Spring Creek, with which the subject land adjoins but does not intersect.
Areas of geological significance and soil hazard features	No geological significance and soil hazard features have been identified that relates to biodiversity. There are no karst, caves, crevices, cliffs within the subject land. Gold geological deposits occur in the area. There are no high hazard soil areas.
Areas of outstanding biodiversity value	No areas of outstanding biodiversity value have been declared for this area.

3.2 Assessing native vegetation cover

The extent and cover of woody and non-woody native vegetation was determined via aerial photography interpretation (API) based on canopy cover, State Vegetation Type Mapping (SVTM) (DPIE 2010) and updated with field survey. Native vegetation cover has been assessed in accordance with Section 3.2 of the BAM.

A 1500 metre buffer was applied to the subject land to create an assessment area for native vegetation cover calculations, resulting in an assessment area of 1076 ha. Wooded vegetation was mapped in the assessment area using API of recent aerial photography (18 October 2019). Native non-woody vegetation could not be mapped in the assessment area as the available SVTM did not map non-woody vegetation types such as grasslands in the area (all non-wooded areas were mapped as cleared land) and native grasslands could not be discerned on aerial photography. An assumption was made that cleared land in the assessment area is likely to be dominated by exotic species. This was based on results of field survey in the subject land and observations of the surrounding landscape made during field work.

A total native vegetation cover of 10.7 per cent was calculated based on the area of woody vegetation cover in the assessment area, which correlates to the cover class of >10-30% in BAM. Native vegetation cover in the assessment area is shown on Figure 3.2.


wsp
Dargues Gold Mine, Jembaicumbene
Figure 3 - 1
Landscape Features
Legend
Assessment Area
Subject Lot (Option A)
Subject Lot (Option B)
Site Boundary (ML 1675)
Cadastre
Waterbody
Strahler Stream Order
1
2
3
4
5
6
IBRA Regions and Subregions
Mitchell Landscapes
Braidwood Granites
Shoalhaven Channels and Floodplains
South East Coastal Ranges
Kybeyan-Gourock
QUEANBEYAN-PALERANG REGIONAL LOCAL GOVERNMENT AREA
JEMBAICUMBENE
MAJORS CREEK
O'BRIENS ROAD
COOMA ROAD
BURKES HILLS ROAD
MORGANS ROAD
MAJORS CREEK ROAD
MONGA LANE
GREY GUMS ROAD
CAWTHORNES LANE
RUGBY ROAD
RED HILL ROAD
BURKE STREET
WILSON STREET
KING STREET
HILL STREET
BERLANG FOREST ROAD
QUISTS ROAD
MAJORS CREEK MOUNTAIN ROAD
CANBERRA
BUNGENDORE
BRAIDWOOD
BATEMANS BAY
NAROOMA
COOMA
Coordinate system: GDA2020 MGA Zone 55
Scale ratio correct when printed at A3
1:40,000
Date: 16/06/2022
Data sources: - NSWSS, Geoscience Australia, RWC, Metromap 2019
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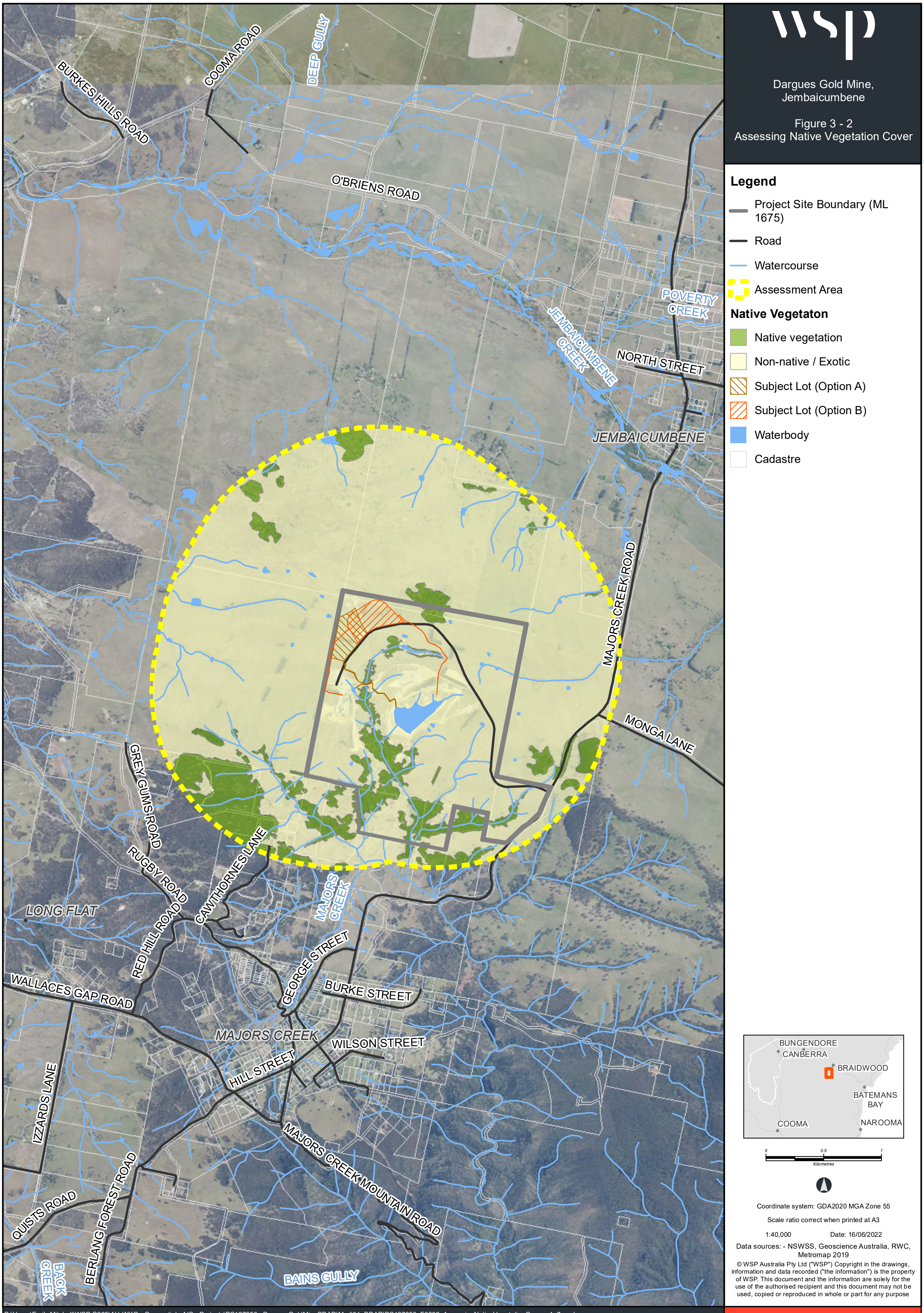

Dargues Gold Mine, Jembaicumbene
Figure 3 - 2
Assessing Native Vegetation Cover
Legend
Project Site Boundary (ML 1675)
Road
Watercourse
Assessment Area
Native Vegetaton
Native vegetation
Non-native / Exotic
Subject Lot (Option A)
Subject Lot (Option B)
Waterbody
Cadastre
BURKES HILLS ROAD
COOMA ROAD
DEEP GULLY
O'BRIENS ROAD
POVERTY CREEK
JEMBAICUMBENE CREEK
NORTH STREET
JEMBAICUMBENE
MAJORS CREEK ROAD
MONGA LANE
GREY GUMS ROAD
RUGBY ROAD
CAWTHORNES LANE
MAJORS CREEK
LONG FLAT
RED HILL ROAD
GEORGE STREET
BURKE STREET
WALLACES GAP ROAD
MAJORS CREEK
WILSON STREET
HILL STREET
IZZARDS LANE
MAJORS CREEK MOUNTAIN ROAD
BERLANG FOREST ROAD
QUISTS ROAD
BACK CREEK
BAINS GULLY
BUNGENDORE
CANBERRA
BRAIDWOOD
BATEMANS BAY
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Coordinate system: GDA2020 MGA Zone 55
Scale ratio correct when printed at A3
1:40,000
Date: 16/06/2022
Data sources: - NSWSS, Geoscience Australia, RWC, Metromap 2019

4 Native vegetation

4.1 Nomenclature

Names of vegetation communities used in this report are based on the Plant Community Type (PCT) used in the NSW BioNet Vegetation Classification Database (Environment Energy and Science, 2021a).

These names are cross-referenced with those used for threatened ecological communities listed under the BC Act final determinations and/or the EPBC Act listing advice.

Names of plants used in this document follow PlantNET (Royal Botanic Gardens, 2021). Scientific names are used in this report for species of plant. The names of introduced species are denoted with an asterisk (*).

4.2 Native vegetation regulatory mapping category 1 'exempt lands'

In accordance with section 6.8 (3) of the BC Act, the BAM excludes the assessment of impacts on category 1-exempt land (within the meaning of Part 5A of the Local Land Services Act 2013), other than any impacts prescribed by the regulations under section 6.3.

The LLS Act defines 'category 1-exempt land' as areas of the State to which Part 5A of the LLS Act applies. These are designated as category 1-exempt land on the 'native vegetation regulatory map', prepared and published under the LLS Act. A native vegetation regulatory map is being developed by DPIE (EES); however, this is currently incomplete and no Category 1 land has been mapped within NSW.

Section 60F of the LLS Act provides transitional requirements which identify how the relevant categorisation of land is to be determined pursuant to section 60H of the LLS Act in the absence of a native vegetation regulatory map. Accredited assessors may determine the categorisation of land during this transitional period in accordance with Section 60F. The method applied to determine the categorisation is provided below.

Native vegetation regulatory mapping has been determined based on an analysis of the following datasets:

- historical and current land use component – NSW Landuse 2017 v1.2 (https://datasets.seed.nsw.gov.au/dataset/nsw-landuse-2017-v1p2-f0ed). This dataset is used to classify areas as either cleared/highly disturbed, affected areas of native vegetation and undisturbed or protected areas of native vegetation
- detectable woody vegetation clearing component – NSW Woody Vegetation Extent 2011 (https://datasets.seed.nsw.gov.au/dataset/nsw-woody-vegetation-extent-2011c0569). This dataset is used to identify areas of extant remnant vegetation and cleared lands/non-woody vegetation
- sensitive regulated and vulnerable regulated lands on the Native Vegetation Regulatory Map portal. This dataset is used to identify areas mapped as category 1, 2 and excluded land.

Initial assessment by WSP of the subject land, suggested that most of the land at the subject land was not likely to be Category 1 - exempt land. This was based on review of the above-listed datasets and historic aerial imagery of the site.

Therefore, the subject land is being treated as Category 2 land.

4.3 Native vegetation survey methods

4.3.1 Native vegetation extent

Mapping of native vegetation extent within the subject land is required under section 4.1 of the BAM with detailed requirements outlined in section 3.2 of the BAM 2020 Operational Manual (EES 2020). The following resources were used for native vegetation mapping in the subject land:

- aerial photographic imagery (Land and Property Information, 2021)
- state vegetation mapping – Central Tablelands Region v1.0, VIS_ID 2230 (DPIE 2010)
- field survey undertaken by WSP on 6 December 2021, including meandering transects, BAM plots and rapid data assessment points.

Data on dominant canopy species, native species richness, vegetation structure and condition was collected during field surveys to validate and refine the native vegetation layer to determine associated PCT in accordance with the BioNet Vegetation Classification System (Environment Energy and Science, 2021a).

4.3.2 Previous vegetation mapping

Vegetation survey and mapping of the subject land has been previously undertaken by Gaia Research (2010) as part of ecological assessment of the Dargues Reef Gold Mine Environmental Assessment to support an application for planning approval for the mine under the EP&A Act. Existing biodiversity offsetting requirements for the mine are outlined in MP 10_0054, two approvals under the Environmental Protection and Biodiversity Conservation Act 1999 (EPBC 2015/7538 and EPBC 2010/5770) and the Biodiversity Management Plan for the Mine (Big Island Mining Limited 2016).

The subject land for the proposal occurs in the existing on-site biodiversity offset (Big Island Mining Limited 2016). Floristic survey that informed development of the exiting on-site biodiversity plan, which is described in Gaia Research (2010), mapped the subject land as native-dominated pasture; however, the location of floristic sampling plots and transects documented in Gaia Research (2010) did not include sampling of vegetation in the subject land or its immediate surrounds.

Field work for this BDAR confirmed the presence of 2.82 hectares of pasture/native grassland in the combined subject lands, comprising a mix of exotic and native species with percentage covers of about 70 and 30 percent, respectively. However, field work found that most of the vegetation in the subject land is exotic-dominated pasture where exotic species occur with over 90 percent cover. Assessment undertaken for this BDAR has relied on the field work that was undertaken by WSP in December 2021 and January, April 2022 specifically for this work, rather than previous vegetation mapping of the subject land which is over 10 years old and did not directly sample vegetation in the subject land (Gaia Research 2010).

4.3.3 Mapping of native vegetation zones

The vegetation within the subject land was firstly assessed to a PCT level and then aligned to a vegetation zone which is defined in the BAM as an area of native vegetation on the proposal site that is the same PCT and has the same broad condition state.

A broad condition state infers that the vegetation has a similar tree cover, shrub cover, ground cover, weediness or combinations of these attributes which determine vegetation condition.

Broad condition state is used for stratifying areas of the same PCT into a vegetation zone for determining the vegetation integrity score. Only one broad condition state was used for this report which is outlined in Table 4.1.

Table 4.1 Native vegetation broad condition states

BROAD CONDITION STATE	DESCRIPTION
Low	For this proposal, it includes a PCT that has been modified because of land management practices over previous decades. In areas of poor condition, the vegetation lacks a native over-storey and mid stratum mostly due to clearing and grazing. All strata have been modified due to weed incursions, clearing, agricultural practises such as cropping or direct seeding. Understorey and groundcover layers are generally dominated or co-dominated by exotic species, and native species diversity is relatively low (30-70%).

4.3.4 *Vegetation integrity plot method*

Vegetation integrity plots were completed in accordance with BAM. A schematic diagram illustrating the layout of each vegetation integrity plot is provided in Figure 4.1.

Figure 4.1 Vegetation integrity plot layout

The following site attributes are recorded at each vegetation integrity plot location:

- **Location:** (easting – northing grid type WGS84, Zone 55).
- **Vegetation structure and dominant species and vegetation condition:** Vegetation structure was recorded through estimates of percentage foliage cover, average height and height range for each vegetation layer.
- **Native and exotic species richness** (within a 400-metre squared quadrat): This consisted of recording all species by systematically walking through each 20 metre x 20 metre plot. The cover and abundance (percentage of area of quadrat covered) of each species was estimated. The growth form, stratum/layer and whether each species was native/exotic/high threat weed was also recorded.
- **Number of trees with hollows** (1000 metre squared quadrat): This was the frequency of hollows within living and dead trees within each 50 metre x 20 metre plot. A hollow was only recorded if (a) the entrance could be seen: (b) the estimated entrance width was at least five centimetres across: (c) the hollow appeared to have depth: (d) the hollow was at least one metre above the ground and the (e) centre of the tree was located within the sampled quadrat.
- **Number of large trees and stem size diversity** (1000 metre squared quadrat): tree stem size diversity was calculated by measuring the diameter at breast height (DBH) (i.e. 1.3 metre from the ground) of all living trees (greater than five centimetre DBH) within each 50 metre x 20 metre plot. For multi-stemmed living trees, only the largest stem was included in the count. Number of large trees was determined by comparing living tree stem DBH against the PCTs benchmarks.
- **Total length of fallen logs** (1000 metre squared quadrat): This was the cumulative total of logs within each 50 metre x 20 metre plot with a diameter of at least 10 centimetres and a length of at least 0.5 metre.

- **Litter cover:** This comprised estimating the average percentage groundcover of litter (i.e. leaves, seeds, twigs, branchlets and branches with a diameter less than 10 centimetre which is detached from a living plant) from within five 1 metre x 1 metre sub-plots spaced evenly either side of the 50-metre central transect.
- **Evaluation of regeneration:** This was estimated as the presence/absence of overstorey species present at the site that was regenerating (i.e. saplings with a diameter at breast height less than or equal to five centimetres).

Prior to establishing plot survey locations, vegetation stratification was undertaken to provide a representative vegetation zone for sampling. Stratification involved marking waypoints and bearings randomly to provide a representative assessment of the vegetation integrity of the vegetation zone in the subject land and establishing the required number of plots at some of these waypoints.

4.3.5 Vegetation integrity plot survey effort

A total of seven vegetation integrity plots were sampled by WSP on 6 December 2021 (5 plots) and 31 January 2022 (one plot) and April 2022 (one Plot) within the subject land and adjacent land. This included five plots within or partially within the subject land, comprising three plots in vegetation that could be attributed to a PCT, and two plots in exotic vegetation that could not be aligned with a PCT due a paucity of native plant species cover.

The three plots located in the native vegetation type that could be attributed to a PCT satisfy the minimum plot requirement under BAM 2020 (EES 2020). Plot Q3 is only partially within the subject land following design refinement of the dam location. This plot has been maintained for the assessment within the BDAR as the vegetation zone is characteristic and contiguous with the vegetation zone within the subject land.

One additional plot (Q4) was located in the native vegetation, however following design refinement of the dam location is no longer within the subject land.

One plot (Q5) was positioned in native vegetation in an area that was originally proposed for a pipeline needed for the proposal. To avoid this area of native vegetation, the proposed pipleline was later relocated (see Table 8.1 for more detail). As a result, plot Q5 is no longer within an area being directly impacted by the proposal.

Survey using transects and meanders were also undertaken for threatened species searches and inform vegetation mapping of the subject land.

Table 4.2 provides details of mapped units in the subject land, including the single PCT mapped (refer to Section 4.5). Plot location details are in Table 4.3. Full vegetation integrity plot data is presented in Appendix A and their locations are shown in Figure 4.2.

Table 4.2 Vegetation zones & other map units in subject land, and vegetation integrity plots

BAM-C VEG ZONE	VEGETATION ZONE NAME (BAM-C) OR OTHER MAP UNITS	SUBJECT LAND (ha)	PLOTS REQUIRED (BAM)	PLOTS SAMPLED
1	PCT 1100 (low)	2.82	1	4
n/a	No PCT - Miscellaneous ecosystem – exotic grassland	10.73	nil	2
n/a	No PCT – Disturbed land (non-vegetation)	1.07	nil	nil
n/a	No PCT – Mixed exotic plantings	0.54	nil	nil

Table 4.3 Details of BAM vegetation integrity plots

PLOT ID	BAM-C VEG ZONE	VEGETATION ZONE NAME (BAM-C) OR OTHER MAP UNITS	MAP ZONE	EASTING	NORTHING
Q1	n/a[a]	Miscellaneous ecosystem - exotic grassland	55	748778	6064003
Q2	n/a[a]	Miscellaneous ecosystem - exotic grassland	55	748720	6064040
Q3	1	PCT 1100 Ribbon Gum - Snow Gum grassy forest on damp flats, eastern South Eastern Highlands Bioregion (Low)	55	748663	6064115
Q4	1	PCT 1100 Ribbon Gum - Snow Gum grassy forest on damp flats, eastern South Eastern Highlands Bioregion (Low) **Note: This unit not in subject land due to avoidance and design refinement of the dam.**	55	748607	6063885
Q5	n/a[b]	PCT 1100 Ribbon Gum - Snow Gum grassy forest on damp flats, eastern South Eastern Highlands Bioregion (Acacia regeneration) **Note: This unit not in subject land due to avoidance measures (refer to** Table 8.1**).**	55	748841	6063472
Q6	1	PCT 1100 Ribbon Gum - Snow Gum grassy forest on damp flats, eastern South Eastern Highlands Bioregion (Low)	55	748832	6064099
Q7	1	PCT 1100 Ribbon Gum - Snow Gum grassy forest on damp flats, eastern South Eastern Highlands Bioregion (Low)	55	748963	6064190

a. Exotic vegetation not entered in BAM-C.

b. Plot does not fall within final subject land/disturbance footprint.

4.4 Native vegetation recorded

Native vegetation has been recorded by vegetation formation, class and associated PCT in accordance with the NSW BioNet Vegetation Classification System (Environment Energy and Science, 2021a). The mapping of vegetation zones was based on the sampling of native vegetation broad conditions states as described in Table 4.1.

The following PCTs were considered as candidates for the native vegetation in the subject land:

- PCT 1100 Ribbon Gum - Snow Gum grassy forest on damp flats in the eastern South Eastern Highlands Bioregion
- PCT 1110 River Tussock - Tall Sedge - Kangaroo Grass moist grasslands of the South Eastern Highlands Bioregion
- PCT 1288 Wallaby Grass - Kangaroo Grass - Rush - Blown Grass Wet Tussock Grassland Moist Grasslands of the South Eastern Highlands Bioregion

Vegetation survey in the subject land found that the grassland that covers most of the area is dominated by exotic species, with a low cover (less than 10 percent) of native species recorded. Furthermore, the grassland vegetation in the subject land is likely to be derived from a woodland or forest parent vegetation type. This likelihood is based on the wooded remnants observed on nearby land occurring in similar a habitat, landscape position, slope and elevation. The assignment of a PCT was complicated by these factors, particularly the low number of native species recorded in the subject land. As a result, available vegetation mapping in nearby remnants that occur in a similar habitat to the subject land was chiefly relied on to inform PCT selection; in particular, ecological assessment for the Dargues Gold Mine carried out in 2010 (Gaia Research 2010) and SVTM (DPIE 2010) were referred to.

Based on this assessment, native vegetation recorded within the subject land has been assigned to PCT 1100 Ribbon Gum - Snow Gum grassy forest on damp flats, eastern South Eastern Highlands Bioregion. One condition class of PCT 1100, was mapped, creating a single vegetation zone in the subject land split into two patches in low condition.

- PCT 1100 Ribbon Gum - Snow Gum grassy forest on damp flats (low)

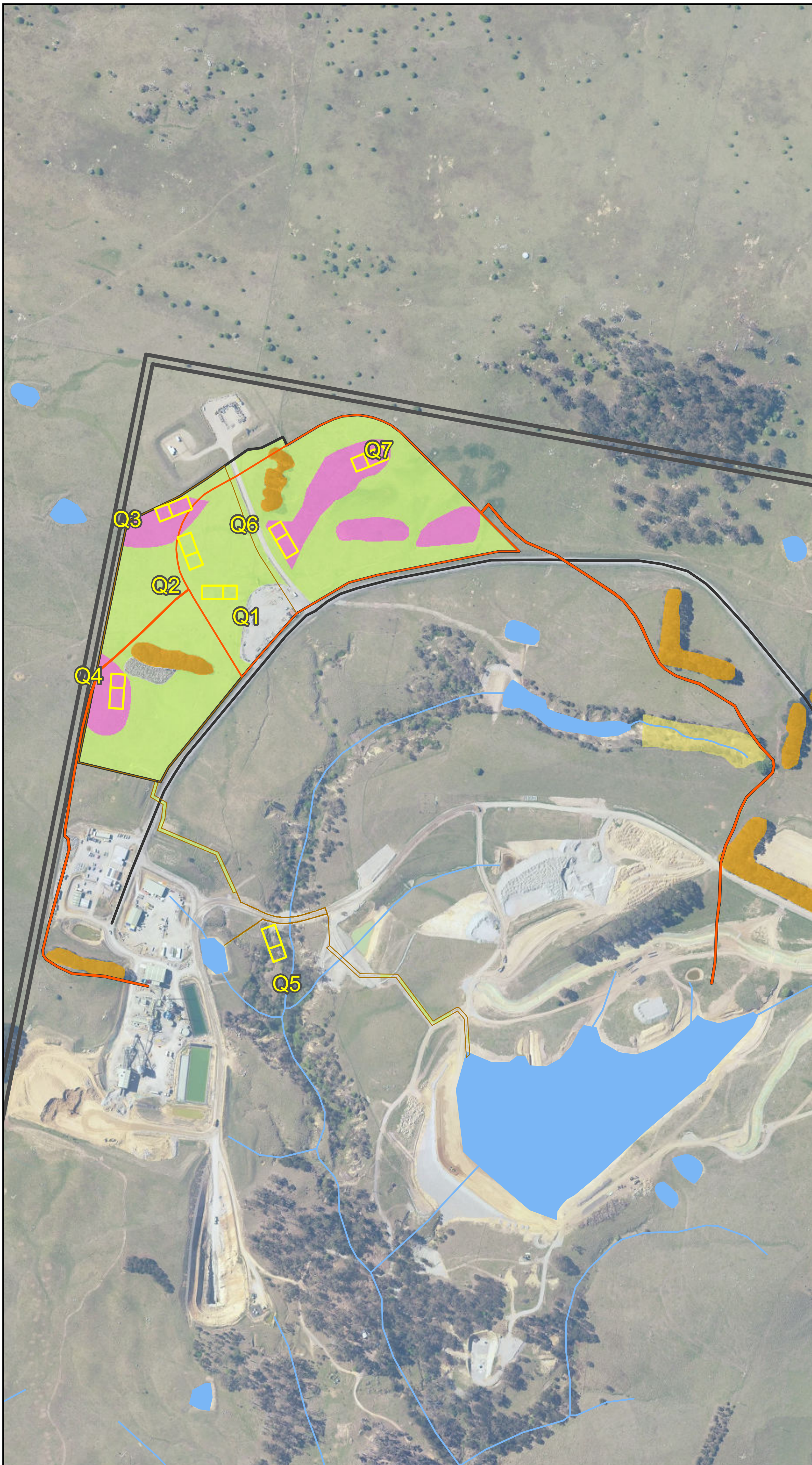
The vegetation integrity score was calculated for this vegetation zone using three vegetation integrity plots for BAM-C calculations. A summary of the vegetation type and zone including the associated vegetation formation, class, vegetation integrity score and extent within the subject land, is presented in Table 4.4.

A detailed description of the PCT is provided in Section 4.5, including selection justification, and floristic and structural composition. Representative photos and summary of BAM plot data against IBRA region benchmarks is also provided.

Table 4.4 Summary of native vegetation type, zone and integrity recorded within the subject land

BAM-C #	VEGETATION TYPE	VEGETATION CLASS	VEGETATION ZONE	PCT % CLEARED	TEC[1]	PATCH SIZE CLASS	COMPOSITION CONDITION SCORE	STRUCTURE CONDITION SCORE	FUNCTION CONDITION SCORE	VEGETATION INTEGRITY SCORE	SUBJECT LAND EXTENT (ha)
NSW Vegetation Formation: Grassy Woodlands											
1	PCT 1100 Ribbon Gum - Snow Gum grassy forest on damp flats, eastern South Eastern Highlands Bioregion (low)	Tableland Clay Grassy Woodlands	1	83	no	2.82 ha	11.9	2.2	0	0.4	2.82
Total extent of native vegetation											**2.82**

(1) Does not meets the final determination criteria for any threatened ecological communities listed under the BC Act or EPBC Act (see Section 4.7).

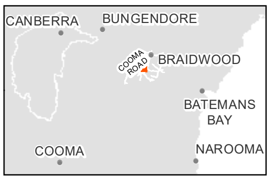


Dargues Gold Mine, Jembaicumbene

Figure 4 - 1
Native Vegetation Types and BAM Vegetation Integrity Plots

Legend

- Subject Lot (Option A)
- Subject Lot (Option B)
- Study Area
- Waterbody
- Watercourse
- Project Site Boundary (ML 1675)
- Road
- BAM Plots
- Disturbed Land
- Miscellaneous Ecosystem Exotic Grassland
- Mixed Exotic Plantings
- Mixed Native Plantings
- PCT 1100 - Low



0 0.09 0.18
Kilometres

Coordinate system: GDA2020 MGA Zone 55

Scale ratio correct when printed at A3

1:7,500 Date: 17/06/2022

Data sources: - NSWSS, Geoscience Australia, RWC, Metromap 2019

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4.5 PCT justification and description

4.5.1 PCT 1100 Ribbon Gum - Snow Gum grassy forest on damp flats, eastern South Eastern Highlands Bioregion (low)

The occurrence of this vegetation type within the subject land is illustrated in Figure 4.2 with photographic representation provided in Photo 4.1.

Other cleared areas in the subject land mapped as Miscellaneous ecosystems – exotic grassland, could not be attributed to a PCT due to the high proportion of exotic species cover (over 90%) and very low proportion of native perennial species cover (less than 10%). An example of Miscellaneous ecosystems – exotic grassland is shown in Photo 6.1. In comparison, areas mapped as PCT 1100 (low) had a relatively higher representation of native species cover (about 30%).

A summary of PCT 1100 is provided in Table 4.5 and a comparison of recorded vegetation integrity data against community condition benchmark data is presented in Table 4.6.

Table 4.5 Summary PCT 1100 Ribbon Gum - Snow Gum grassy forest on damp flats, eastern South Eastern Highlands Bioregion

PCT 1100 RIBBON GUM - SNOW GUM GRASSY FOREST ON DAMP FLATS, EASTERN SOUTH EASTERN HIGHLANDS BIOREGION		
PCT Characteristic (from BioNet Vegetation Classification (EES 2021a))		**Conformation of subject land vegetation**
Vegetation formation	Grassy woodlands	Yes (trees cleared)
Vegetation class	Tableland clay grassy woodlands	Yes (trees cleared)
IBRA Bioregion	Australian Alps, South Eastern Highlands, South East Corner, Sydney Basin	Yes – South East Corner Bioregion
IBRA Subregion	Kybeyan-Gourock, Snowy Mountains, Kanangra, Crookwell, South East Corner Ranges, Burragorang and others	Yes – South East Corner Ranges
Landscape position, Elevation and soils	Flat to gently undulating terrain from 600-1150m ASL largely on granite or acid volcanic soils. Occurs on granite soils in gently undulating to flat terrain at altitudes between 600 and 1100m on the eastern parts of the tablelands.	Yes – gently undulating terrain; c. 715 m ASL; occurs on Braidwood Granites (Mitchell 2002)
Species relied upon for PCT identification	**Species name**	**Recorded average abundance (in 3 plots)**
	Geranium solanderi	47
	Glycine clandestina	10
	Microlaena stipoides var. *stipoides*	12
	Poa labillardierei var. *labillardierei*	73

PCT 1100 RIBBON GUM - SNOW GUM GRASSY FOREST ON DAMP FLATS, EASTERN SOUTH EASTERN HIGHLANDS BIOREGION	
Justification of evidence used to identify the PCT	PCT 1100 is a grassy woodland formation that occurs in several IBRA bioregions, including the South East Corner bioregion in which the subject land occurs. In a more intact form, PCT 1100 is characterised by several *Eucalyptus* species including *E. vimilalis, E. pauciflora, E. radiata subsp. radiata* and *E. stellulata*. It has a diverse herbaceous ground stratum including several species recorded in the subject land. It is known to occur on granite soils in gently undulating to flat terrain at altitudes between 600 and 1100m ASL. Many of these biophysical characteristics are consistent with the subject land, including position in the landscape, soil and altitude. A few characteristic ground cover species were also recorded in the subject land. However, in the subject land, PCT 1100 occurs as a derived grassland due to clearing of trees and shrubs for pastoral uses. PCT 1100 was identified as the most likely vegetation type for the subject land based on the above factors, as well as past vegetation mapping of the site by Gaia Research (2010), which mapped remnant vegetation that occurred within the mine properties as Ribbon Gum – Snow Gum grassy open forest on flats and undulating hills. PCT 1100 is the most likely equivalent of this open forest. Therefore, grasslands in the subject land are likely to be derived from this vegetation unit. Remnant PCT 1100 occurs both upslope and downslope of the subject land Gaia Research (2010).
TEC Status	PCT 1100 (low) in the subject land is not equivalent to any TECs listed on the BC Act or EPBC Act.
Estimate of PCT percent cleared within NSW	83%
Vegetation zone and extent within Subject land	**Low condition** – occurs in 2.82 ha (18.59%) of the subject lands as a derived grassland condition where about 30% of the perennial ground cover is native. Native trees and shrubs have been removed, and the ground cover comprises a mix of exotic and native species of grasses, forbs and subshrubs. Exotic species are more abundant and represent a higher proportion of the ground cover. The soil is disturbed by past and current pastoral activities.

Photo 4.1 Example of PCT 1100 (low)

Table 4.6 Comparison PCT 1100 Name vegetation integrity plot data against PCT condition benchmark data

PLOT	TREE RICHNESS	SHRUB RICHNESS	GRASS RICHNESS	FORB RICHNESS	FERN RICHNESS	OTHER RICHNESS	TREE COVER	SHRUB COVER	GRASS COVER	FORB COVER	FERN COVER	OTHER COVER	LARGE TREE	HBT[2]	LEAF LITTER	LENGTH TIMBER	STEM SIZE CLASS	TREE REGEN[3]	HTW[4] COVER
BM[1]	**4**	**7**	**9**	**16**	**2**	**3**	**17**	**8**	**58**	**11**	**0**	**1**	**3**	**-**	**43**	**41**	**4**	**P**	**0**
3	0	0	6	2	0	1	0	0	3.5	5.1	0	0.1	0	0	1	0	0	nil	0
4[5]	0	0	3	1	0	0	0	0	25.2	0.5	0	0	0	0	0	0	0	nil	0.1
6	0	0	4	6	0	0	0	0	2.4	0.3	0	0	0	0	1	0	0	nil	2
7	0	0	3	1	0	0	0	0	15.6	0.5	0	0	0	0	0	0	0	nil	15

(1) Benchmark data for PCT 1100 in NSW South East Corner IBRA Bioregion; source (NSW BioNet Vegetation Classification database (EES 2021a) and cross referenced with BAM-C)

(2) HBT=Hollow bearing tree

(3) P=present

(4) HTW =High threat weed

(5) No longer used for BAM as it falls outside of subject land.

4.6 Priority weeds and weeds of national significance

Three exotic flora species recorded within the subject land during field surveys are listed under the NSW *Biosecurity Act 2015* (BA Act) as Weeds of National Significance (WONS) (Australian Weeds Committee, 2020). All three weeds are identified as high threat weeds (HTW) under BAM. HTW and WONS recorded in the subject land are listed in Table 4.7.

Table 4.7 High threat weeds (HTW) and weeds of national significance (WONS) recorded within the subject land

SPECIES NAME	WONS[1]	HTW[2]
Rubus fruticosus species aggregate (blackberry)	Yes–General Biosecurity duty (prevent, eliminate or minimise). In NSW, prohibition on certain dealings – must not be imported into the state, sold, bartered, exchanged, or offered for sale.	yes
Crataegus monogyna (Hawthorn)	Yes – General Biosecurity duty (prevent, eliminate or minimise).	yes
Cytisus scoparius subsp. *scoparius* (Scotch broom)	Yes – General Biosecurity duty (prevent, eliminate or minimise). In NSW, prohibition on certain dealings – must not be imported into the state, sold, bartered, exchanged, or offered for sale. Regional recommended measure in south east – land managers should mitigate spread from their land.	yes
Paspalum dilatatum (Paspalum)	No	yes

(1) WONS - Weed of National Significance under the *NSW Biosecurity Act 2015*

(2) HTW – listed as a high threat weed under BAM 2020

A full inventory of weed species recorded within each BAM vegetation integrity plots, is presented in Appendix A.

4.7 Threatened ecological communities

Vegetation in the subject land was analysed to determine if it met the definition of a TEC under the BC Act. Four TECs were considered most likely to be candidates based on vegetation type, habitat and location. The BioNet Vegetation Classification (EES 2021a) was also referred to, which linked PCT 1100 to three TECs, namely:

- Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions EEC (BC Act)
- Monaro Tableland Cool Temperate Grassy Woodland in the South Eastern Highlands Bioregion CEEC (BC Act)
- Werriwa Tablelands Cool Temperate Grassy Woodland CEEC (BC Act)

Natural Temperate Grassland of the South Eastern Highlands, which is listed as critically endangered under the EPBC Act, was also considered as a candidate (see Section 7.1).

The final determinations for the three BC Act-listed TECs were reviewed, and an assessment was made for the conformation of PCT 1100 (low) in the subject land to each. The results of these assessments are provided in Table 4.8.

This assessment found that the PCT 1100 (low) in the subject land does not meet the definition of any listed TECs.

Table 4.8 Comparison of PCT 1100 Ribbon Gum – Snow Gum grassy forest on damp sites, eastern South Eastern Highlands bioregion (low) in the subject land to final determinations of candidate TECs listed on NSW BC Act

CANDIDATE TEC	DETERMINATIVE FACTORS[1]	PCT 1100 (LOW) IN SUBJECT LAND
Tablelands Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions (BC Act)	**Bioregion**: occurs in Sydney Basin, and South Eastern Highlands Bioregions (NSW TSSC 2011)	No – does not occur in the designated bioregions of Sydney Basin or South Eastern Highlands Bioregion
	Assemblage of species: Characterised by an assemblage of 37 species (NSW TSSC 2011).	No – From the total 37 species characteristic of this TEC only **4 species (10.8%**) were recorded in PCT 1100 (low) in the subject land. This is a very low proportion of the characteristic species; therefore, the floristic composition of PCT 1100 (low) in the subject land is not consistent with the final determination of this TEC.
	Vegetation structure: typically, an open eucalypt canopy with sparse shrubs and a dense groundcover of herbs and grass; disturbed stands may lack either or both of the woody strata	Yes – subject land has been cleared of all woody strata and occurs as a disturbed grassland.
Monaro Tableland Cool Temperate Grassy Woodland in the South Eastern Highlands Bioregion	**Bioregion**: occurs in the South Eastern Highlands Bioregion (NSW TSSC 2019a)	No – does not occur in South Eastern Highlands Bioregion
	Assemblage of species: Characterised by an assemblage of 51 species (NSW TSSC 2019a).	No – From the total 51 species characteristic of this TEC only **6 species (11.8%**) were recorded in PCT 1100 (low) in the subject land. This is a very low proportion of the characteristic species; therefore, the floristic composition of PCT 1100 (low) in the subject land is not consistent with the final determination of this TEC.
Werriwa Tablelands Cool Temperate Grassy Woodland in the South Eastern Highlands and South East Corner Bioregions	**Bioregion**: occurs in the South Eastern Highlands Bioregion and South East Corner Bioregion (NSW TSSC 2019b)	Yes – occurs in the South East Corner Bioregion
	Assemblage of species: Characterised by an assemblage of 36 species (NSW TSSC 2019b).	No – From the total 36 species characteristic of this TEC only **4 species (11.1%**) were recorded in PCT 1100 (low) in the subject land. This is a very low proportion of the characteristic species; therefore, the floristic composition of PCT 1100 (low) in the subject land is not consistent with the final determination of this TEC.

5 Threatened species

This chapter assesses the habitat suitability for threatened species in accordance with Chapter 5 of the BAM and has been prepared in accordance with Part 3 of the BAM 2020 Operational Manual (EES 2020).

5.1 Nomenclature

For threatened species of plants, the names used in the BioNet Atlas (Environment Energy and Science, 2021a) and Threatened Biodiversity Data Collection (Environment Energy and Science, 2021b) were used where these differ from the names used in the PlantNET (Royal Botanic Gardens, 2021).

Names of vertebrate fauna follow the Australian Faunal Directory maintained by the Department of Agriculture, Water and Environment (Department of Agriculture Water and the Energy, 2021a).

For threatened species of animals, the names used in the BioNet Atlas (Environment Energy and Science, 2021c) and Threatened Biodiversity Data Collection (TBDC) (Environment Energy and Science, 2021b) and threatened species final determination listing were preferred over Australian Faunal Directory naming.

5.2 Assessing the habitat suitability for threatened species

Under the BAM, threatened species are assessed as either ecosystem credit species, species credit species or a combination of the two (referred to as dual credit species). The BAM defines these threatened species categories as follows:

- **ecosystem credit species (predicted)** are those threatened species where the likelihood of occurrence and/or elements of its habitat can be confidently predicted by vegetation surrogates and landscape features
- **species credit species (candidate)** are those threatened species that cannot be reliably predicted by habitat surrogates
- **dual credit species** are those threatened species where part of the habitat is assessed as an ecosystem credit (e.g. foraging habitat) and part as a species credit (e.g. breeding habitat). In this report, dual credit species will be included in both ecosystem and species credit assessment.

The BAM sets out six steps for assessing habitat suitability for threatened species (ecosystem credit species and species credit species), these are:

- Ecosystem and species credit species (include dual species)
  - Step 1: Identify threatened species for assessment (BAM s. 5.2.1)
  - Step 2: Assess the habitat constraints and vagrant species on the subject land (BAM s. 5.2.2).
- Species credits species only (includes dual species)
  - Step 3: Further assessment of candidate species credit species (BAM s. 5.2.3)
  - Step 4: Determine the presence of a candidate species credit species (BAM s. 5.2.4)
  - Step 5: Determine the area or count, and location of suitable habitat for a species credit species (a species polygon) (BAM s. 5.2.5)
  - Step 6: Determine the habitat condition within the species polygon for species credit species assessed by area (BAM s. 5.2.6).

5.2.1 Threatened database searches

The BAM also requires the assessor to review additional information about threatened species to determining if any predicted or candidate species inclusions are applicable. This involved searches of threatened species databases and likelihood of occurrence assessments. A list of threatened species databases accessed for this report are presented in Table 5.1.

Table 5.1 Threatened species database searches

DATABASE	SEARCH DATE	AREA SEARCHES	REFERENCE
BioNet Atlas	13/12/2021	10 km radius of the subject land	(Environment Energy and Science, 2021c)
EPBC Protected Matters Search Tool	9/12/2021	10 km radius of the subject land	(Department of Agriculture Water and the Energy, 2021b)
PlantNet Search	13/12/2021	10 km radius of subject land	(Royal Botanic Gardens 2021)
Biodiversity Assessment Method Calculator (BAM-C)	16/12/2021	Search of candidate species predicted species using BAM data from vegetation within the subject land	(Environment Energy and Science, 2021d)

5.2.2 Literature review

In addition to threatened species database searches, other relevant documents and literature related to threatened biodiversity was also considered, including:

- NSW Sharing and Enabling Environmental Data (SEED) portal (DPIE 2021)
- NSW BioNet Threatened Biodiversity Data Collection (TBDC) (EES 2021b)
- Dargues Reef Gold Project Ecology Assessment (Gaia Research 2010)
- State vegetation type map (SVTM): Southeast NSW Native Vegetation Classification and Mapping (DPIE 2010)
- Tableland Basalt Forest in the Sydney Basin and South Eastern Highlands Bioregions Final Determination (NSW TSSC 2011)
- Monaro Tablelands Cool Temperate Grassy Woodland in the South Eastern Highlands Bioregion Final Determination (NSW TSSC 2019a)
- Werriwa Tablelands Cool Temperate Grassy Woodland in the South Eastern Highlands and South East Corner Bioregions Final Determination (NSW TSSC 2019b)
- Approved Conservation Advice (including listing advice) for Natural Temperate Grassland of the South Eastern Highlands (TSSC 2016)
- NSW BioNet Atlas and Vegetation Classification (EES 2021a, 2021b and 2021c).

5.2.3 Likelihood of occurrence assessment

Likelihood of occurrence assessments were undertaken for all threatened species, populations and migratory species identified through database searches. These assessments were conducted for both BC Act and EPBC Act listed species. Likelihood of occurrence assessments enabled justification for any identification of species inclusions for both ecosystem and species credit species. They also enabled identification of species considered Matters of National Environmental Significance (MNES) under the EPBC Act for further assessment in Chapter 7 (Matters of National Environmental Significance) of this report.

Criteria used to determine likelihood of occurrence for threatened flora and fauna species are outlined in Table 5.2 and Table 5.3, respectively.

Table 5.2 Likelihood of occurrence criteria for threatened flora species

LIKELIHOOD	CRITERIA
Known	The species was observed in the subject land either during the current survey or during another survey less than one year prior.
High	A species has a high likelihood of occurrence if: — the subject land contains or forms part of a large area of high-quality suitable habitat that has not been subject to recent disturbance (e.g. fire) and the species is known to form a persistent soil seedbank and the species has been recorded recently (within 10 years) in the locality — the species is a cryptic flowering species that has been recorded recently (within 10 years) in the locality and has a large area of high-quality potential habitat within the subject land that was not seasonally targeted by surveys.
Moderate	A species has a moderate likelihood of occurrence if: — the species has a large area of high-quality suitable habitat in the subject land that has not been subject to recent disturbance (e.g. fire) — the species is known to form a persistent soil seedbank — the species has not been recorded recently (within 10 years) in the locality — the species has a small area of high-quality suitable habitat or a large area of marginal habitat in the subject land that has not been subject to recent disturbance (e.g. fire) — the species is known to form a persistent soil seedbank — the species has been recorded recently (within 10 years) in the locality — the species is a cryptic flowering species, with a small area of high-quality potential habitat or a large area of marginal habitat within the subject land, that was not seasonally targeted by surveys.
Low	A species has a low likelihood of occurrence if: — it is not a cryptic species, is not a species known to have a persistent soil seedbank species and was not detected despite targeted searches — the species is a cryptic flowering species, with a small area of high-quality potential habitat or a large area of marginal habitat within the subject land, that was not seasonally targeted by surveys as the species has not been recorded within 50 years in the locality.
None	Suitable habitat is absent from the subject land.

Table 5.3 Likelihood of occurrence criteria for threatened fauna species

LIKELIHOOD	CRITERIA
Known	The species was observed in the subject land either during the current survey or during another survey less than one year prior.
High	A species has a high likelihood of occurrence if: — the subject land contains or forms part of a large area of high-quality suitable habitat — important habitat elements (i.e. for breeding or important life cycle periods such as winter foraging periods) are abundant within the subject land — the species has been recorded recently in similar habitat in the locality — the subject land is likely to support resident populations or to contain habitat that is visited by the species during regular seasonal movements or migration.
Moderate	A species has a moderate likelihood of occurrence if: — the subject land contains or forms part of a small area of high-quality suitable habitat — the subject land contains or forms part of a large area of marginal habitat — important habitat elements (i.e. for breeding or important life cycle periods such as winter foraging periods) are sparse or absent within the subject land — the subject land is unlikely to support resident populations or to contain habitat that is visited by the species during regular seasonal movements or migration but is likely to be used occasionally during seasonal movements and/or dispersal.
Low	A species has a low likelihood of occurrence if: — potentially suitable habitat exists but the species has not been recorded recently (previous 10 years) in the locality despite intensive survey (i.e. the species is considered to be locally extinct) — the species is considered to be a rare vagrant, likely only to visit the subject land very rarely; e.g. during juvenile dispersal or exceptional climatic conditions (e.g. extreme drought conditions in typical habitat of inland birds).
None	Suitable habitat is absent from the subject land.

5.3 Identifying habitat suitability for ecosystem credit species

Ecosystem credit threatened species were assessed using information about subject land context, vegetation types (PCT) and vegetation integrity attributes collected during the field surveys. Data from the Threatened Biodiversity Data Collection (EES 2021b) was also considered, as required by subsections 5.2.1 and 5.2.2 of the BAM and Part 3 of the BAM 2020 Operational Manual–Stage 1 (EES 2020).

Initial desktop assessment to determine ecosystem (predicted) and species (candidate) credit species involved entering the identified vegetation types and zones into BAM-C. This allowed predicted and candidate species reports to be generated for the associated PCTs within the subject land.

5.3.1 Predicted ecosystem credit species generated from BAM-C

A preliminary list of predicted ecosystem credit species was generated from the BAM-C based on associated vegetation types. This preliminary predicted ecosystem credit species list is presented in Table 5.4.

Table 5.4 List of BAM-C generated predicted ecosystem credit species

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	EPBC ACT[1]	SAII	ASSOCIATED NATIVE VEGETATION (PCT)
Birds					
Anthochaera phrygia	Regent Honeyeater (foraging)	CE	E, M	No[2]	1100
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V	-	No	1100
Callocephalon fimbriatum	Gang-gang Cockatoo (foraging)	V	E	No	1100
Calyptorhynchus lathami	Glossy Black-cockatoo (foraging)	V	-	No	1100
Chthonicola sagittata	Speckled Warbler	V	-	No	1100
Daphoenositta chrysoptera	Varied Sittella	V	-	No	1100
Glossopsitta pusilla	Little Lorikeet	V	-	No	1100
Haliaeetus leucogaster	White-bellied Sea-eagle (foraging)	V	-	No	1100
Hieraaetus morphnoides	Little Eagle (foraging)	V	-	No	1100
Hirundapus caudacutus	White-throated Needletail	-	V, M	No	1100
Lathamus discolor	Swift Parrot (foraging)	E	CE	No[2]	1100
Lophoictinia isura	Square-tailed Kite (foraging)	V	-	No	1100
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	-	No	1100
Neophema pulchella	Turquoise Parrot	V	-	No	1100
Ninox connivens	Barking owl (foraging)	V	-	No	1100
Ninox strenua	Powerful owl (foraging)	V	-	No	1100
Petroica boodang	Scarlet Robin	V	-	No	1100
Petroica phoenicea	Flame Robin	V	-	No	1100
Stagonopleura guttata	Diamond Firetail	V	-	No	1100

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	EPBC ACT[1]	SAII	ASSOCIATED NATIVE VEGETATION (PCT)
Tyto novaehollandiae	Masked owl (foraging)	V	-	No	1100
Mammals					
Dasyurus maculatus maculatus	Spotted-tailed Quoll	V	E	No	1100
Miniopterus orianae oceanensis	Large Bent-winged Bat (foraging)	V	-	No	1100
Phascolarctos cinereus	Koala (foraging)	V	E	No	1100
Pteropus poliocephalus	Grey-headed Flying-fox (foraging)	V	V	No	1100

(1) Threat status under the BC & EPBC Act: V = Vulnerable, E = Endangered, CE = Critically Endangered, M=Migratory

(2) Ecosystem credit areas are unlikely to be potential SAII (ref Threatened Biodiversity Data Collection (TDBC))

5.3.2 Justification for exclusion for any predicted ecosystem credit species

In refining the candidate ecosystem species list for further assessment, one ecosystem credit species predicted by the BAM-C were excluded from the BAM-C candidate list based on the habitat present in the subject land. This was the Glossy-black Cockatoo (foraging) (*Calyptorhynchus lathami*).

A summary of the justification for exclusion of this predicted ecosystem credit species from the subject land is provided in Table 5.5.

Table 5.5 Justification for exclusion of any additional predicted ecosystem credit species

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	EPBC ACT[1]	SAII	JUSTIFICATION FOR EXCLUSION FROM PREDICTED SPECIES
Birds					
Calyptorhynchus lathami (foraging)	Glossy black-cockatoo (foraging)	V	-	no	BAM-C Habitat constraints require the presence of *Allocasuarina* or *Casuarina* species. Neither are present in the subject land.

(1) Threat status under the BC & EPBC Act: V = Vulnerable.

5.4 Identifying habitat suitability for species credit species

5.4.1 Threatened flora species

5.4.1.1 Candidate threatened flora species credit species generated from BAM-C

A preliminary list of candidates threatened flora species was generated from the BAM-C based on associated vegetation types. This preliminary candidate threatened flora species list is presented in Table 5.6.

Table 5.6 List of preliminary BAM-C candidate threatened flora species credit species

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	EPBC ACT[1]	SAII	HABITAT FEATURES
Baloskion longipes	Dense Cord-rush	V	V	No	Commonly found in swamps or depressions in sandy alluvium, sometimes growing with sphagnum moss. Also occurs in swails within tall forest, and in Black Gum (*Eucalyptus aggregata*) Woodland.
Caladenia tessellata	Thick-lipped Spider-orchid	E	V	Yes	Grows in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil.
Eucalyptus aggregata	Black Gum	V	V	No	Occurs mainly in the wetter, cooler and higher parts of the tablelands, on alluvial soils, on cold, poorly drained flats and hollows adjacent to creeks and small rivers.
Leucochrysum albicans subsp. *tricolor*	Hoary Sunray	-	E	No	Occurs in grasslands, grassy areas in woodlands and dry open forests, and modified habitats, on a variety of soil types including clays, clay loams, stony and gravely soil.
Thesium australe	Austral Toadflax	V	V	No	Occurs in grassland or grassy woodland. Grows on kangaroo grass tussocks but has also been recorded within the exotic coolatai grass. A root parasite that takes water and some nutrient from other plants, especially Kangaroo Grass.
Pterostylis alpina	Alpine greenhood	V	-	No	Grows in moist forests on foothills and ranges. Often found on sheltered southern slopes near streams in rich loam.
Eucalyptus pulverulenta	Silver-leaved gum	V	V	No	Grows in shallow soils as an understorey plant in open forest, typically dominated by Brittle Gum (*Eucalyptus mannifera*), Red Stringybark (*E. macrorhynca*), Broad-leafed Peppermint (*E. dives*), Silvertop Ash (*E. sieberi*) and Apple Box (*E. bridgesiana*).

(1) Threat status under the BC & EPBC Act: V = Vulnerable, E = Endangered

5.4.1.2 Justification for inclusion of any additional threatened flora species credit species

No additional candidate threatened species credit species were identified to be included to the BAM-C preliminary candidate species credit list for consideration.

5.4.1.3 Justification for exclusion of any threatened flora species credit species

Species that require microhabitats associated with woodland or forest are unlikely to be present in the subject land due to its highly modified condition and long history of cultivation for agriculture. The subject land has been cleared of canopy trees and understory species (trees and shrubs), As a result, the subject area only provides a derived grassland habitat, which has a high proportion of exotic species.

In refining the candidate threatened species list for further assessment, six candidate species generated by the BAM-C were excluded from the BAM-C candidate species credit list. A summary of the justification for these exclusions are provided in Table 5.7.

One BAM-C candidate species credit species was retained (*Leucochrysum albicans* subsp. *tricolor*) based on its habitat requirements and was targeted in field survey (see Section 5.5.2).

Table 5.7 Justification for exclusion of any candidate flora species credit species

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	EPBC ACT[1]	SAII	HABITAT CONSTRAINTS AND GEOGRAPHICAL LIMITATIONS	JUSTIFICATION FOR EXCLUSION
Baloskion longipes	Dense Cord-rush	V	V	No	Commonly found in swamps or depressions in sandy alluvium, sometimes growing with sphagnum moss. Also occurs in swails within tall forest, and in Black Gum (*Eucalyptus aggregata*) Woodland.	Habitat degraded; history of clearing and soil cultivation; no suitable habitat in subject land, including swamps, sphagnum moss, sandy alluvium, swails within tall forest
Caladenia tessellata	Thick-lipped Spider-orchid	E	V	Yes	Grows in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil.	Habitat degraded; history of clearing and soil cultivation in subject land; no suitable habitat in subject land, including grassy sclerophyll woodland.
Eucalyptus aggregata	Black Gum	V	V	No	Occurs mainly in the wetter, cooler and higher parts of the tablelands, on alluvial soils, on cold, poorly drained flats and hollows adjacent to creeks and small rivers.	Habitat degraded; history of clearing and soil cultivation in subject land; no suitable habitat in subject land, including alluvium, or flats and hollows adjacent to streams. Species is conspicuous and was not recorded on site during field survey. No *Eucalyptus* species were found.
Thesium australe	Austral Toadflax	V	V	No	Occurs in grassland or grassy woodland. Grows on kangaroo grass tussocks but has also been recorded within the exotic coolatai grass. A root parasite that takes water and some nutrient from other plants, especially Kangaroo Grass.	Habitat degraded; history of clearing and soil cultivation in subject land; no suitable habitat in subject land, including lack of Kangaroo grass in the subject land.

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	EPBC ACT[1]	SAII	HABITAT CONSTRAINTS AND GEOGRAPHICAL LIMITATIONS	JUSTIFICATION FOR EXCLUSION
Pterostylis alpina	Alpine greenhood	V	-	no	Grows in moist forests on foothills and ranges. Often found on sheltered southern slopes near streams in rich loam.	Habitat degraded; history of clearing and soil cultivation in subject land; no suitable habitat in subject land, including moist forest, or sheltered slopes near streams.
Eucalyptus pulverulenta	Silver-leaved gum	V	V	no	Grows in shallow soils as an understorey plant in open forest, typically dominated by Brittle Gum (*Eucalyptus mannifera*), Red Stringybark (*E. macrorhynca*), Broad-leafed Peppermint (*E. dives*), Silvertop Ash (*E. sieberi*) and Apple Box (*E. bridgesiana*).	Habitat degraded. No suitable habitat (open forest) for this species occurs on subject land. Species is conspicuous and was not recorded on site during field survey. No *Eucalyptus* species were found.

(1) Threat status under the BC and EPBC Act: V = Vulnerable, E = Endangered.

5.4.2 Threatened fauna species

5.4.2.1 Candidate threatened fauna species credit species generated from BAM-C

A preliminary list of candidates threatened fauna species was generated from the BAM-C based on associated vegetation types for each IBRA subregion. This preliminary candidate threatened fauna species list is presented in Table 5.8.

Table 5.8 List of BAM-C generated candidate fauna species credit species

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	EPBC ACT[1]	SAII	HABITAT CONSTRAINTS AND GEOGRAPHICAL LIMITATIONS
Birds					
Anthochaera phrygia	Regent Honeyeater (breeding)	CE	CE, M	yes	There are only three known key breeding areas remaining in NSW: Bundarra-Barraba, Capertee Valley and Hunter Valley districts in New South Wales. BAM-C Habitat Constraints: as per mapped important areas.
Callocephalon fimbriatum	Gang-Gang Cockatoo (Breeding)	V	E	no	Requires tree hollows that are 10cm in diameter in eucalypts for breeding. BAM-C Habitat Constraints: Hollow bearing trees; Eucalypt tree species with hollows greater than 9cm diameter.
Calyptorhynchus lathami	Glossy black-cockatoo (breeding)	V	-	no	Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. Feeds almost exclusively on the seeds of several species of she-oak (*Casuarina* and *Allocasuarina* species), shredding the cones with the massive bill. Dependent on large hollow-bearing eucalypts for nest sites. BAM-C Breeding Habitat Constraints: Hollow bearing

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	EPBC ACT[1]	SAII	HABITAT CONSTRAINTS AND GEOGRAPHICAL LIMITATIONS
					trees; Living or dead tree with hollows greater than 15cm diameter and greater than 8m above ground.
Haliaeetus leucogaster	White-bellied sea-eagle (breeding)	V	-	no	Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea. Occurs at sites near the sea or sea-shore, such as around bays and inlets, beaches, reefs, lagoons, estuaries and mangroves; and at, or in the vicinity of freshwater swamps, lakes, reservoirs, billabongs and saltmarsh. Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, and forest (including rainforest). BAM-C Habitat Constraints: Living or dead mature trees within suitable vegetation within 1km of a river, lakes, large dams or creeks, wetlands and coastlines.
Lathamus discolor	Swift Parrot (breeding)	E	CE, M	yes	The Swift Parrot occurs in woodlands and forests of NSW from May to August, where it feeds on eucalypt nectar, pollen, and associated insects. This species is migratory, breeding in Tasmania and nomadic, moving about in response to changing food availability. The subject land does not occur within important mapped areas. BAM-C Habitat Constraints: As per mapped areas.
Lophoictinia isura	Square-tailed Kite (breeding)	V	-	no	Typically inhabits coastal forested and wooded lands of tropical and temperate Australia. In NSW it is often associated with ridge and gully forests dominated by *Eucalyptus longifolia*, *Corymbia maculata*, *E. elata* or *E. smithii*. Requires large living trees for breeding, particularly near water with surrounding woodland -forest close by for foraging habitat. Nest sites are generally located along or near watercourses, in a tree fork or on large horizontal limbs. BAM-C Habitat Constraints: Nest Trees.
Ninox connivens	Barking owl (breeding)	V		No	Found throughout continental Australia except for the central arid regions. Core populations occur on the western slopes and plains and in some northeast coastal and escarpment forests. Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas. BAM-C Habitat Constraints: Hollow bearing trees; Living or dead trees with hollows greater than 20cm diameter and greater than 4m above the ground.

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	EPBC ACT[1]	SAII	HABITAT CONSTRAINTS AND GEOGRAPHICAL LIMITATIONS
Ninox strenua	Powerful owl (breeding)	V		no	Nest in large tree hollows (at least 0.5 m deep), in large eucalypts (diameter at breast height of 80-240 cm) that are at least 150 years old. While the female and young are in the nest hollow the male Powerful Owl roosts nearby (10-200 m) guarding them, often choosing a dense "grove" of trees that provide concealment from other birds that harass him. BAM-C Habitat Constraints: Hollow bearing trees; Living or dead trees with hollow greater than 20cm diameter.
Petroica rodinogaster	Pink robin	V	-	no	Found in Tasmania and the uplands of eastern Victoria and far south-eastern NSW, almost as far north as Bombala. On the mainland, the species disperses north and west and into more open habitats in winter, regularly as far north as the ACT area, and sometimes being found as far north as the central coast of NSW. Inhabits rainforest and tall, open eucalypt forest, particularly in densely vegetated gullies. BAM-C Habitat Constraints: none
Tyto novaehollandiae	Masked owl (breeding)	V		no	Dead stags are especially popular for roosting/breeding habitat and are a limited resource due to natural attrition. Lives in dry eucalypt forests and woodlands from sea level to 1100 m. Often hunts along the edges of forests, including roadsides. Pairs have a large home-range of 500 to 1000 hectares. BAM-C Habitat Constraints: Hollow bearing tree; Living or dead trees with hollow greater than 20cm diameter.
Mammals					
Cercartetus nanus	Eastern pygmy possum	V	-	no	Found in south-eastern Australia, from southern Queensland to eastern South Australia and in Tasmania. In NSW from the coast inland as far as the Pilliga, Dubbo, Parkes and Wagga Wagga on the western slopes. Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath. May occupy small patches of vegetation in fragmented landscapes and although the species prefers habitat with a rich shrub understory, they are known to occur in grassy woodlands and the presence of Eucalypts alone is sufficient to support populations in low densities. BAM-C Habitat Constraints: none

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	EPBC ACT[1]	SAII	HABITAT CONSTRAINTS AND GEOGRAPHICAL LIMITATIONS
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Yes	Found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes. Potential breeding habitat is PCTs associated with the species within 100m of rocky areas containing caves, or overhangs or crevices, cliffs or escarpments, or old mines, tunnels, culverts, derelict concrete buildings BAM-C Habitat Constraints: Cliffs; within 2km of rocky areas containing caves, overhangs, escarpments, outcrops or crevices, or within 2km of old mines or tunnels. BAM-C Habitat Constraints: none
Miniopterus orianae oceanensis	Large Bentwing-bat (breeding)	V		Yes	Occurs along the east and north-west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings, and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young. BAM-C Habitat Constraints: Caves; Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records with microhabitat code "IC in cave"; Observation type code "E nest-roost"; with numbers of individuals >500.
Myotis macropus	Southern Myotis	V	-	No	Occurs in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. They generally roost in groups of 10–15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, road culverts, buildings, under bridges and in dense foliage. BAM-C Habitat Constraints: Hollow bearing trees; within 200m of riparian zone/other; Bridges, caves or artificial structures within 200m of riparian zone/waterbodies; includes rivers, creeks, billabongs, lagoons, dams and other waterbodies on or within 200m of the site.
Phascolarctos cinereus	Koala (breeding)	V	E	No	Inhabits eucalypt forests and woodlands. The suitability of these forests for habitation depends on the size and species of trees present, soil nutrients, climate and rainfall. Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. BAM-C Breeding Habitat Constraints: Areas identified via survey as important habitat (see comments)
Pteropus poliocephalus	Grey-headed Flying-fox (breeding)	V	V	No	A canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, melaleuca swamps and banksia woodlands. Bats commute daily to foraging

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	EPBC ACT[1]	SAII	HABITAT CONSTRAINTS AND GEOGRAPHICAL LIMITATIONS
					areas, usually within 15 km of the day roost although some individuals may travel up to 70 km. BAM-C Breeding Habitat Constraints: Breeding Camps

(1) Threat status under the BC & EPBC Act: V = Vulnerable, E = Endangered, CE = Critically Endangered, M = migratory

5.4.3 Justification for inclusions of any additional candidate species credit species

No additional candidate threatened species credit species were identified to be included to the BAM-C preliminary candidate species credit list for consideration.

5.4.4 Justification for exclusions of any candidate species credit species

In refining the candidate threatened species list for further assessment, all candidate species generated by the BAM-C were excluded from the BAM-C candidate species credit list. A summary of the justification for this exclusion is provided in Table 5.9.

Table 5.9 Justification for exclusion of any candidate species credit species

SCIENTIFIC NAME COMMON NAME	BC ACT1	EPBC ACT1	SAII	HABITAT CONSTRAINTS AND GEOGRAPHICAL LIMITATIONS	JUSTIFICATION FOR EXCLUSION
Birds					
Anthochaera phrygia Regent Honeyeater (breeding)	CE	CE,M	Yes	There are only three known key breeding areas remaining in NSW: Bundarra-Barraba, Capertee Valley and Hunter Valley districts in New South Wales. BAM-C Habitat Constraints: as per mapped important areas.	Habitat degraded. Lack of suitable breeding habitat (no Eucalypt trees present); subject site not mapped as one of the three known breeding regions in NSW.
Callocephalon fimbriatum Gang-Gang Cockatoo (Breeding)	V	E	No	Requires tree hollows that are 10cm in diameter in eucalypts for breeding. BAM-C Habitat Constraints: Hollow bearing trees; Eucalypt tree species with hollows greater than 9cm diameter.	Habitat degraded. Lack of suitable breeding habitat (no Eucalypt trees present); No tree hollows that are 9cm in diameter in subject land.
Calyptorhynchus lathami Glossy black cockatoo (breeding)	V	-	no	Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of sheoak occur. Feeds almost exclusively on the seeds of several species of she-oak (*Casuarina* and *Allocasuarina* species), shredding the cones with the massive bill. Dependent on large hollow-bearing eucalypts for nest sites. BAM-C Breeding Habitat Constraints: Hollow bearing trees; Living or dead tree with hollows greater than 15cm diameter and greater than 8m above ground.	Habitat degraded. No suitable breeding habitat (hollow-bearing trees) in subject land.

SCIENTIFIC NAME COMMON NAME	BC ACT1	EPBC ACT1	SAII	HABITAT CONSTRAINTS AND GEOGRAPHICAL LIMITATIONS	JUSTIFICATION FOR EXCLUSION
Haliaeetus leucogaster White-bellied sea-eagle (breeding)	V	-	no	Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea. BAM-C Habitat Constraints: Living or dead mature trees within suitable vegetation within 1km of a river, lakes, large dams or creeks, wetlands and coastlines.	Habitat degraded - no living or dead mature trees present on subject land. No stick nests or adult birds observed on or near site during survey.
Lathamus discolor Swift Parrot (breeding)	E	CE	Yes	The Swift Parrot occurs in woodlands and forests of NSW from May to August, where it feeds on eucalypt nectar, pollen, and associated insects. This species is migratory, breeding in Tasmania and nomadic, moving about in response to changing food availability. The subject land does not occur within important mapped areas. BAM-C Habitat Constraints: As per mapped areas.	Habitat degraded. No suitable breeding habitat (Eucalypts/hollow-bearing trees) and site does not occur within mapped breeding areas. Not known to breed in NSW.
Lophoictinia isura Square-tailed Kite (breeding)	V	-	No	Typically inhabits coastal forested and wooded lands of tropical and temperate Australia. In NSW it is often associated with ridge and gully forests dominated by *Eucalyptus longifolia*, *Corymbia maculata*, *E. elata* or *E. smithii*. Requires large living trees for breeding, particularly near water with surrounding woodland - forest close by for foraging habitat. Nest sites are generally located along or near watercourses, in a tree fork or on large horizontal limbs. BAM-C Habitat Constraints: Nest Trees.	Habitat degraded. No suitable nest trees (Eucalypts or similar mature trees near watercourses) present on site.

SCIENTIFIC NAME COMMON NAME	BC ACT1	EPBC ACT1	SAII	HABITAT CONSTRAINTS AND GEOGRAPHICAL LIMITATIONS	JUSTIFICATION FOR EXCLUSION
Ninox connivens Barking owl (breeding)	V		No	Found throughout continental Australia except for the central arid regions. Core populations occur on the western slopes and plains and in some northeast coastal and escarpment forests. Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas. BAM-C Habitat Constraints: Hollow bearing trees; Living or dead trees with hollows greater than 20cm diameter and greater than 4m above the ground.	Habitat degraded. No suitable breeding habitat (hollow-bearing trees with hollows >20cm diameter and over 4m above the ground) present on subject land.
Ninox strenua Powerful owl (breeding)	V		no	Nest in large tree hollows (at least 0.5 m deep), in large eucalypts (diameter at breast height of 80-240 cm) that are at least 150 years old. While the female and young are in the nest hollow the male Powerful Owl roosts nearby (10-200 m) guarding them, often choosing a dense "grove" of trees that provide concealment from other birds that harass him. BAM-C Habitat Constraints: Hollow bearing trees; Living or dead trees with hollow greater than 20cm diameter	Habitat degraded. No hollow bearing trees of any size on subject land, living or dead..
Petroica rodinogaster Pink robin	V	-	no	Found in Tasmania and the uplands of eastern Victoria and far south-eastern NSW, almost as far north as Bombala. On the mainland, the species disperses north and west and into more open habitats in winter, regularly as far north as the ACT area, and sometimes being found as far north as the central coast of NSW.	Habitat degraded. No rainforest or Eucalypt Forest representing potential habitat for this species is present on subject land, which consists primarily of exotic grassland. Trees on site consist of exotic plantings.

SCIENTIFIC NAME COMMON NAME	BC ACT1	EPBC ACT1	SAII	HABITAT CONSTRAINTS AND GEOGRAPHICAL LIMITATIONS	JUSTIFICATION FOR EXCLUSION
				Inhabits rainforest and tall, open eucalypt forest, particularly in densely vegetated gullies. BAM-C Habitat Constraints: none	
Tyto novaehollandiae Masked owl (breeding)	V		no	Dead stags are especially popular for roosting/breeding habitat and are a limited resource due to natural attrition. Lives in dry eucalypt forests and woodlands from sea level to 1100 m. Often hunts along the edges of forests, including roadsides. Pairs have a large home-range of 500 to 1000 hectares. BAM-C Habitat Constraints: Hollow bearing tree; Living or dead trees with hollow greater than 20cm diameter.	Habitat degraded. No hollow bearing trees on subject land, living or dead.
Mammals					
Cercartetus nanus Eastern pygmy possum	V	-	no	Found in south-eastern Australia, from southern Queensland to eastern South Australia and in Tasmania. In NSW from the coast inland as far as the Pilliga, Dubbo, Parkes and Wagga Wagga on the western slopes. Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath. May occupy small patches of vegetation in fragmented landscapes and although the species prefers habitat with a rich shrub understory, they are known to occur in grassy woodlands and the presence of Eucalypts alone is sufficient to support populations in low densities.	Habitat degraded. No suitable nesting habitat or shelters. No Eucalypts or other native shrub or tree species present on site.

SCIENTIFIC NAME COMMON NAME	BC ACT1	EPBC ACT1	SAII	HABITAT CONSTRAINTS AND GEOGRAPHICAL LIMITATIONS	JUSTIFICATION FOR EXCLUSION
				BAM-C Habitat Constraints: none	
Chalinolobus dwyeri Large-eared Pied Bat	V	V	Yes	Found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes. Potential breeding habitat is PCTs associated with the species within 100m of rocky areas containing caves, or overhangs or crevices, cliffs or escarpments, or old mines, tunnels, culverts, derelict concrete buildings BAM-C Habitat Constraints: Cliffs; within 2km of rocky areas containing caves, overhangs, escarpments, outcrops or crevices, or within 2km of old mines or tunnels.	Habitat degraded. No rocky areas or cliffs containing caves, overhangs, outcrops or crevices within 2 km of site.
Miniopterus orianae oceanensis Large Bentwing-bat (breeding)	V		Yes	Occurs along the east and north-west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings, and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young. BAM-C Habitat Constraints: Caves; Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding including species records with	Habitat degraded. No known maternity caves known in vicinity. Observation type code was not "E nest-roost" or numbers of individuals >500.

SCIENTIFIC NAME COMMON NAME	BC ACT1	EPBC ACT1	SAII	HABITAT CONSTRAINTS AND GEOGRAPHICAL LIMITATIONS	JUSTIFICATION FOR EXCLUSION
				microhabitat code "IC in cave"; Observation type code "E nest-roost"; with numbers of individuals >500.	
Myotis Macropus Southern Myotis	V	-	No	Occurs in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. They generally roost in groups of 10–15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, road culverts, buildings, under bridges and in dense foliage. BAM-C Habitat Constraints: Hollow bearing trees; within 200m of riparian zone/other; Bridges, caves or artificial structures within 200m of riparian zone/waterbodies; includes rivers, creeks, billabongs, lagoons, dams and other waterbodies on or within 200m of the site.	Habitat degraded. No hollow bearing tress on subject land.
Phascolarctos cinereus Koala (breeding)	V	E	No	Inhabits eucalypt forests and woodlands. The suitability of these forests for habitation depends on the size and species of trees present, soil nutrients, climate and rainfall. Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. BAM-C Breeding Habitat Constraints: Areas identified via survey as important habitat.	Habitat degraded - no Eucalypt species or other food species present. No important habitat mapped on site.
Pteropus poliocephalus Grey-headed Flying-fox (breeding)	V	V	No	A canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, melaleuca swamps and banksia woodlands. Bats commute daily to foraging areas,	Habitat degraded. No foraging resources on subject land. No known breeding camps occur on site.

SCIENTIFIC NAME COMMON NAME	BC ACT1	EPBC ACT1	SAII	HABITAT CONSTRAINTS AND GEOGRAPHICAL LIMITATIONS	JUSTIFICATION FOR EXCLUSION
				usually within 15 km of the day roost although some individuals may travel up to 70 km. BAM-C Breeding Habitat Constraints: Breeding Camps	

(1) Threat status under the BC Act and EPBC Act: V = Vulnerable, E = Endangered, CE= Critically Endangered

5.5 Species credit species survey methods

5.5.1 Survey dates

In accordance with Part 3 of the BAM 2020 Operational Manual – Stage 1 (EES 2020), further assessment of candidate species credit species includes assessing microhabitats and targeted surveys to determine if a species is absent, or if present, whether a species and/or its habitats are degraded to the point that the species is unlikely to utilise the subject land (or specific vegetation zones).

Details of threatened species surveys methods employed for this assessment are presented below. Detailed locations of field surveys within the subject land in December 2021 and January 2022 and April 2022 are presented in Figure 5.1. Field survey effort carried out in and adjacent to the subject land is summarised in Table 5.10. Unless otherwise indicated, work was carried out by WSP.

Table 5.10 Summary of survey effort

SURVEY TECHNIQUE	DATES OF SURVEY (QUADRATS)
Field traverses, including meanders and opportunistic records	6 December 2021
BAM integrity plots	6 December 2021 (Q1-5) 31 January 2022 (Q6) 20 April 2022 (Q7)

5.5.2 *Threatened flora surveys*

One candidate flora species was selected in the BAM-C as having a moderate or greater likelihood of occurring in the subject land, being hoary sunray (*Leucochrysum albicans* subsp. *tricolor*) (refer to Section 5.4.1). Targeted survey for *Leucochrysum albicans* subsp. *tricolor* was undertaken in accordance with survey guidelines during field work for BAM integrity plots and field traverses on 6 December 2021 and 31 January 2022. However, no individuals of *Leucochrysum albicans* subsp. *tricolor* or other threatened flora species were recorded on the subject land. Survey included the techniques that are summarised in following sections.

5.5.2.1 Field traverses and meanders

The subject land was traversed by foot in a combination of parallel traverses and meanders across all vegetation types generally in accordance with '*Surveying threatened plants and their habitats – NSW survey guide for the Biodiversity Assessment Method*' (2020).

Parallel traverses focused on suitable habitat. Traverses informed vegetation types mapping and facilitated targeted searches for candidate threatened flora species.

5.5.2.2 Vegetation integrity plots

Vegetation integrity plot surveys were carried out in accordance with the BAM. At each vegetation integrity plot survey location, dedicated 20-minute searches were conducted for threatened species assessed as candidate species within each vegetation zone sampled. The number of plots completed for each identified PCT and vegetation zone is provided in Table 4.2 with the location of each vegetation integrity plot identified in Table 4.3.

5.5.2.3 Opportunistic observations

Opportunistic sightings of threatened flora species were recorded during field surveys whilst completing other field surveys such as undertaking BAM vegetation integrity plots, vegetation type/condition validation etc. During these surveys, a hand-held GPS was carried if needed to record the locations of any threatened or important flora species observed; however, no threatened or important species were found.

5.5.2.4 Survey effort summary

The BAM and Threatened Biodiversity Data Collection (TBDC) outlines survey requirements for threatened flora species including requirements for seasonal surveys to maximize the likelihood of recording a species if present.

Targeted surveys were completed for one candidate threatened flora species, *Leucochrysum albicans* subsp. *tricolor* within the required seasonal survey requirements (refer to Table 5.11).

Table 5.11 Survey timing for candidate threatened flora (species credit species)

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	EPBC ACT[1]	SAII	SEASONAL SURVEY REQUIREMENT	SURVEY EFFORT IN SUBJECT LAND
Leucochrysum albicans subsp. *tricolor*	Hoary Sunray	-	E	No	September to April	In accordance with seasonal requirements: Field traverse and plot surveys in December 2021, January 2022 and April 2022.

(1) Threat status under the BC & EPBC Act: E = Endangered.

5.5.3 *Threatened fauna surveys*

No targeted fauna survey was carried out since no candidate species were predicted to have a moderate or higher likelihood of occurrence within the subject land based on database searches (refer to Section 5.2).

5.5.3.1 Fauna habitat assessment

Fauna habitat assessments were undertaken to assess the likelihood of threatened species of animal (candidate species identified in desktop review) occurring within the subject land. Fauna habitat characteristics assessed included the presence and nature of the following:

- structure and floristics of the canopy, understorey and ground vegetation, including the presence of flowering and fruiting trees providing potential foraging resources
- hollow-bearing trees providing roosting and breeding habitat for arboreal mammals, birds and reptiles
- ground cover vegetation, leaf litter, rock outcrops and fallen timber and potential to provide protection for ground-dwelling mammals, reptiles and amphibians
- waterways (ephemeral or permanent) and water bodies.

The following criteria were used to evaluate the condition of habitat values:

- **Good:** A full range of fauna habitat components are usually present (for example, old growth trees, fallen timber, feeding and roosting resources) and habitat linkages to other remnant ecosystems in the landscape are intact.
- **Moderate:** Some fauna habitat components are missing or greatly reduced (for example, old-growth trees and fallen timber), although linkages with other remnant habitats in the landscape are usually intact, but sometimes degraded.
- **Poor:** Many fauna habitat elements in low quality remnants have been lost, including old growth trees (for example, due to past timber harvesting or land clearing) and fallen timber, and tree canopies are often highly fragmented. Habitat linkages with other remnant ecosystems in the landscape have usually been severely compromised by extensive clearing in the past.

5.5.3.2 Opportunistic sightings

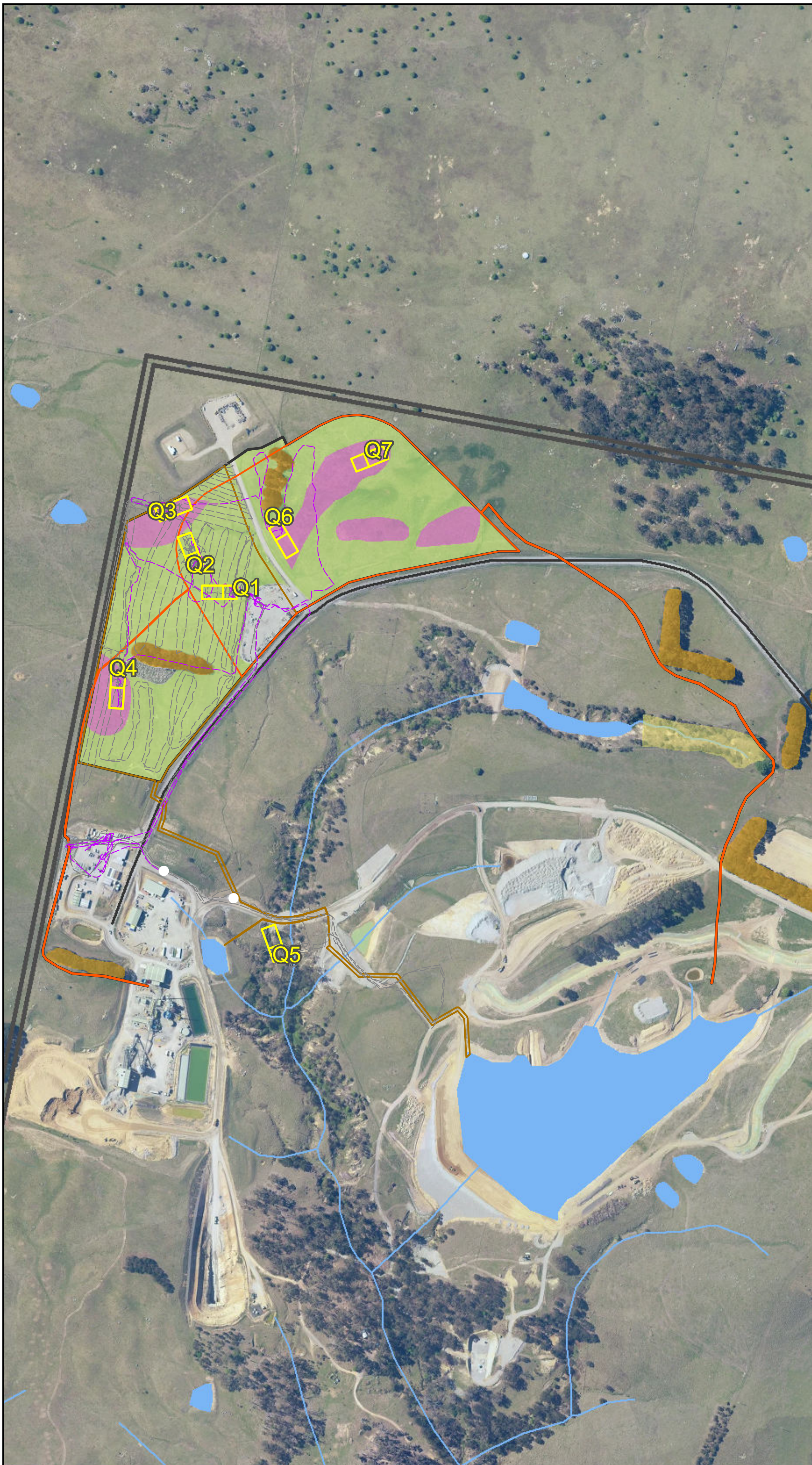
Opportunistic sightings of animals and habitat assessments were undertaken during the field survey to assess the likelihood of threatened species (candidate species identified in desktop review and by BAM-C) to occur within the subject land. Evidence of animal activity, such as scats, diggings, scratch marks, nests/dreys, burrows etc. was recorded along with potential shelter sites for fauna (such as rocky outcrops, woody debris, aquatic habitat or hollow-bearing trees). Diurnal bird surveys were also conducted. Results of the opportunistic sightings are in Table A.2.

Opportunistic survey was also undertaken for threatened grassland fauna with minor potential to occur including Striped Legless Lizard, Pink-tailed Worm Lizard and Golden Sun Moth. Opportunistic surveys for Golden Sun Moths involved walking 10 m transects of the entire site to identify flying males and record any patches of potential habitat (vegetation which includes a known food source, appropriate inter-tussock spacing and/or flying male moths). Opportunistic herpetofauna searches involved looking for active specimens, turning over suitable ground shelters such as surface rock, sheets of iron or rubbish, or woody debris, and identifying any individuals found visually, or via call recognition (for frog species). No threatened fauna species were recorded in the subject land.

One threatened bird species, the gang-gang cockatoo (*Callocephalon fimbriatum*) was seen flying over the subject land during survey on 31 January 2022. However, no individuals were seen foraging on the subject land and no breeding habitat for this species is present on the subject land.

Dargues Gold Mine, Jembaicumbene

Figure 5 - 1
Field Survey Effort



Legend

- Subject Lot (Option A)
- Subject Lot (Option B)
- Study Area
- Waterbody
- Watercourse
- Project Site Boundary (ML 1675)
- Road
- Survey Transects (December 2021)
- Survey Transects (January 2022)
- BAM Plots
- Disturbed Land
- Miscellaneous Ecosystem Exotic Grassland
- Mixed Exotic Plantings
- Mixed Native Plantings
- PCT 1100 - Low

0 0.09 0.18
Kilometres

Coordinate system: GDA2020 MGA Zone 55

Scale ratio correct when printed at A3

1:7,500 Date: 16/06/2022

Data sources: - NSWSS, Geoscience Australia, RWC, Metromap 2019

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5.6 Species credit species survey results

5.6.1 Determining the presence of an affected species credit species

One candidate threatened fauna species, gang-gang cockatoo, was recorded flying over site during 2021 surveys. No suitable foraging or breeding habitat was recorded within the subject site for this species and therefor will not be impacted by the proposed development. No other candidate threatened flora or fauna species were recorded during surveys undertaken for this proposal and none have been assumed present. Therefore, the proposal will not generate and species credit requirements.

6 Prescribed impacts

This chapter identifies potential prescribed biodiversity impacts on threatened entities in accordance with Chapter 6 of the BAM and has been prepared in accordance with Part 4 of the BAM 2020 Operational Manual–Stage 1 (EES 2020).

6.1 Identifying prescribed impacts on threatened entities

Prescribed impacts are those that may affect biodiversity values in addition to, or instead of, impacts from clearing vegetation. These impacts may be difficult to quantify or offset as they often affect biodiversity values that are irreplaceable.

Prescribed additional biodiversity impacts (prescribed impacts) comprise impacts on:

- the habitat of threatened entities including:
  - karst, caves, crevices, cliffs, rocks and other geological features of significance, or
  - human-made structures, or
  - non-native vegetation
- areas connecting threatened species habitat, such as movement corridors
- water quality, water bodies and hydrological processes that sustain threatened entities (including from subsidence or subsidence from underground mining)
- threatened and protected animals from turbine strikes from a wind farm
- threatened species or fauna that are part of a TEC from vehicle strikes.

Table 6.1 lists the potential prescribed impacts associated with the proposal and the threatened species which have the potential to utilise these features within the subject land.

There are no prescribed impact features or movement corridors within the subject land that would be directly or indirectly impacted by the proposal. Given that the subject land is unlikely to provide permanent or optimal habitat for any threatened species, there are unlikely to be prescribed impacts from vehicle strikes.

6.1.1 Non-native vegetation

6.1.1.1 Miscellaneous ecosystems – exotic grassland

This vegetation type does not align to any recognised plant community type in NSW due to the high percentage of exotic perennial plants, which was found through plot survey to be over 95%. Therefore, it has been aligned to miscellaneous ecosystems – exotic grassland, which are shown in Figure 4.2 and an example image is provided in Photo 6.1.

Photo 6.1 Miscellaneous Ecosystems – exotic grassland

Table 6.1 Potential prescribed impacts

FEATURE	DESCRIPTION	IMPACT ASSESSED
Karst, caves, crevices, cliffs, rocks and other geological features of significance	No areas of geological significance are present. No karst, caves, cervices, cliffs or rocks, which may provide potential breeding habitat for threatened fauna (i.e. microchiropteran bats) were recorded.	Not considered further
Occurrences of human-made structures	No human-made structures that potentially provide habitat will be removed by the proposal.	Not considered further
Corridors or other areas of connectivity linking habitat for threatened entities	The habitat present within the landscape has been heavily fragmented due to agricultural practices. Existing connectivity is limited to creek lines and road reserves. The proposal will not impact connectivity.	Not considered further
Proposed development may result in vehicle strike on threatened fauna or on animals that are part of a threatened ecological community	The subject land is unlikely to provide permanent or optimal habitat for any threatened species, and does the subject land does not contain a TEC.	Not considered further

7 Matters of National Environmental Significance

This chapter describes Matters of National Environmental Significance (MNES) relating to Commonwealth legislation under the EPBC Act.

7.1 Threatened species and ecological communities

7.1.1 Threatened ecological communities

The final approved conservation advice for the EPBC Act-listed TEC, were reviewed and an assessment was made for the conformation of PCT 1100 (low) in the subject land to each.

Based on broad-scale state vegetation mapping and database searches, one candidate threatened ecological community (TEC) listed under the EPBC Act was considered as a candidate for native vegetation in the subject land, being:

- Natural Temperate Grassland of the South Eastern Highlands CEEC

A comparative assessment was carried out of native vegetation recorded within the subject land against the Approved Conservation Advice for Natural Temperate Grassland of the South Eastern Highlands EPBC Act (TSSC 2016). This assessment concluded that PCT 1100 (low) in the subject land does not meet several of the key diagnostic characteristics and does not meet the condition threshold for this CEEC. Therefore, it was concluded that Natural Temperate Grassland of the South Eastern Highlands does not occur in the subject land. The results of this comparative assessment are summarised in Table 7.1.

Table 7.1 Comparison of PCT 1100 Ribbon Gum Snow Gum grassy forest on damp sites, eastern South Eastern Highlands bioregion (low) in the subject land to final approved conservation advice for Natural Temperate Grassland of the South Eastern Highlands CEEC (EPBC Act)

DETERMINATIVE FACTORS[1]	PCT 1100 (LOW) IN SUBJECT LAND
Key Diagnostic characteristics	
Bioregion: occurs in South Eastern Highlands Bioregions, although some occurrences are in areas immediately adjacent to the boundary of the South Eastern Highlands Bioregion	Yes – subject site occurs in the South East Corner Bioregion, about 530m from the boundary of the South Eastern Highlands Bioregion
Altitude: typically, 350-1200m ASL	Yes – subject site occurs at about 710m ASL
Native grasses usually are dominant including one or more of the specified species (p 10, TSSC 2016)	Yes – subject site recorded *Poa labillardierei*, *Lachnagrostis filiformis* and *Poa meionectes*.
Native sedges may dominate (note: not an essential characteristic)	No – *Juncus australis* is present but does not dominate
A range of native forb species are typically present, or in recently disturbed sites, components of the indigenous native species (incl plants and propagules) are present that are sufficient to re-establish the characteristic ground cover	No – only 3 native forbs were recorded in low abundance and low cover: (refer to Appendix A for full species list).
A tree, shrub or sub-shrub layer may be present up to 10% projective foilage cover of each. The area is not a derived or secondary grassland as assessed by criteria provided in Final Conservation Advice (TSSC 2016), including the following:	No – although the vegetation in the subject land lacked native tree or shrub or sub-shrub strata, is likely to be a derived grassland. This is based on the presence of woodland remnants adjacent to the site on similar topographical positions and geological substrates.

DETERMINATIVE FACTORS[1]	PCT 1100 (LOW) IN SUBJECT LAND
...there are no trees of woodland or forest tree species in a woodland or forest formation adjacent to or near the site, on similar topographical positions and geological substrates (p11 TSSC 2016).	
Condition Thresholds	
Moderate to high condition threshold (p12 TSSC 2016): *The patch is characterised by at least 50 % foliage cover of the ground of Themeda triandra.* *OR* *The patch is characterised by at least 50 % foliage cover of the ground of Poa labillardierei, generally in flats and drainage lines where this vegetation type naturally occurs* *OR* *The patch is characterised by at least 50 % foliage cover of the ground of Carex bichenoviana, or at least 50 tussocks for every 100 m2*	No–the subject land vegetation does not meet the moderate to high condition threshold category, or better category. *Themeda triandra* was not recorded on the subject land. *Poa labillardierei* was recorded at two plots in PCT 1100 (low) with 2% and 25% cover. *Carex bichenoviana* was not recorded in PCT 1100 (low) on the subject land.

7.1.2 Threatened flora species

A total of 22 EPBC Act listed threatened flora species were generated by the PMDS (see Table 5.1). These were assessed for their likelihood of occurrence in the subject land based on habitat and distribution. This assessment is provided in Appendix B (Table B.1).

Based on this assessment, no threatened flora species are identified as having a moderate or better likelihood of occurring in the subject land. Therefore, no threatened EPBC Act threatened flora will be affected by the proposal.

7.1.3 Threatened fauna species

A total of 34 EPBC Act listed threatened fauna species were generated by the PMDS (see Table 5.1). This comprised four species of amphibian, 17 birds, eight mammals, two reptiles, one invertebrate and two fish. These were assessed for their likelihood of occurrence in the subject land based on habitat and distribution. This assessment is provided in Appendix B (Table B.2).

Based on this assessment, no threatened fauna species are identified as having a moderate or better likelihood of occurring in the subject land. Therefore, no threatened EPBC Act threatened flora will be affected by the proposal.

No fauna species were identified as having a moderate or better likelihood of occurrence based on previous records and availability of potential habitat; therefore, no threatened EPBC Act threatened flora will be affected by the proposal.

7.2 Migratory species

Migratory species are protected under international agreements, to which Australia is a signatory, including JAMBA, CAMBA, RoKAMBA and the Bonn Convention on the Conservation of Migratory species of Wild Animals. Migratory species are considered MNES and are protected under the EPBC Act.

A total of 12 EPBC Act listed migratory species are predicted to occur within the locality of the subject land based on the results of database searches completed (refer to Appendix B, Table B.2).

However, none are considered to have a moderate or better likelihood of occurrence within the subject land. As such, it is not likely that the proposal would significantly affect migratory species and therefore this group has not been considered further.

7.3 Critical habitat

No EPBC Act listed critical habitat has been recorded or is considered likely to occur within the subject land.

7.4 World and national heritage

Based on the PMDS, no World Heritage Properties are located within or nearby the subject land and therefore will not be impacted by the proposal.

7.5 Wetlands of national and international importance

Wetlands are important habitat for a diverse range of animals including waterbirds, amphibians, invertebrates and fish species as well as aquatic and water loving plants such as sedges and rushes. Wetlands provide strategic refuge during drought and frequently support threatened species. Most of the migratory bird species listed under international convention agreements with Australia may be found in these wetlands.

7.5.1 Nationally important wetlands

No nationally important wetlands were identified by the PMST as occurring within or in proximity to the subject land. As such, the proposal is unlikely to impact on nationally important wetlands.

7.5.2 Wetlands of international importance (RAMSAR wetlands)

No RAMSAR wetlands or Wetlands of International importance were identified by database searches. These include:

STAGE 2 IMPACT ASSESSMENT

8 Avoiding or minimising impacts on biodiversity values

The following provides information on avoiding and minimising impacts on biodiversity values through the planning and design phase of the proposal. This information is provided to directly address Section 7 of the BAM.

8.1 Avoid and minimise impacts on native vegetation and associated habitat

In accordance with Section 7.1.1 of the BAM, efforts to avoid and minimise direct impact on native vegetation and habitat through proposal design are further addressed in Table 8.1.

Table 8.1 Efforts to avoid and minimise impacts on native vegetation and habitat during proposal design

PRINCIPLES	PROPOSAL CONSISTENCY
Locating the proposal to avoid and minimise impacts on native vegetation, threatened species, threatened ecological communities and their habitat (section 7.1.1.3 of BAM)	
(a) *Locating the proposal in areas where there are no biodiversity values*	The proposal is mostly located in an area with no biodiversity values: 86.6 percent of the proposed subject land/disturbance footprint is located on disturbed land and in areas of exotic vegetation where there are no biodiversity values.
(b) *Locating the proposal in areas where the native vegetation or threatened species habitat is in the poorest condition (i.e. areas that have a lower vegetation integrity score)*	The results of field survey and vegetation mapping were used to inform the design during preliminary stages. This enabled some areas of the proposal to be located in areas of disturbed land; specifically, the water pipelines were located along already disturbed road corridors rather than through native vegetation adjacent to the road. The majority of the disturbance footprint/subject land (81.4%) is located within areas of disturbed land and exotic vegetation that does not equate to a native PCT, and the remainder of the disturbance footprint (only 15.5%) is located in of native vegetation that has a low condition (VI score of 0.4).
(c) *Locating the proposal in areas that avoid habitat for species with a high biodiversity risk weighting or land mapped on the important habitat map, or native vegetation that is a TEC or a highly cleared PCT.*	The subject land does not include any habitat for species with a high biodiversity risk weighting or TECs. Only 15.5 percent of the subject land contains a PCT.
(d) *Locating the proposal outside of the buffer area around breeding habitat features such as nest trees or caves.*	N/A. The subject land does not have any breeding habitat features.

PRINCIPLES	PROPOSAL CONSISTENCY
Consideration of alternatives (section 7.1.1.4 of the BAM)	
(a) an analysis of alternative modes or technologies that would avoid or minimise impacts on biodiversity values	Three potential locations for the water management dam were considered. All occur within the mine's exiting biodiversity offset areas; and within derived/cleared vegetation. The final location is predominantly within exotic grassland and includes an area of exotic pasture that was mapped by Gaia Research (2010); therefore, minimises impacts on biodiversity. The location of water pipelines from the existing tailings storage facility to the proposed water storage dam were initially impacting on an area of native vegetation along Spring Creek. To avoid this area of native vegetation, the pipeline has been moved so that it lies within a disturbed roadside with no biodiversity values.
(b) an analysis of alternative routes that would avoid or minimise impacts on biodiversity values	
(c) an analysis of alternative locations that would avoid or minimise impacts on biodiversity values	
(d) an analysis of alternative sites within a property on which the proposal is proposed that would avoid or minimise impacts on biodiversity values	
Designing a proposal to avoid and minimise impact on native vegetation, threatened species, threatened ecological communities and their habitat (section 7.1.2.1 of BAM)	
(a) Reducing the proposal's clearing footprint by minimising the number and type of facilities	The final design of the proposal will aim to avoid and minimise impact to areas of native vegetation that have been mapped for this BDAR, within the confines of the design and construction requirements.
(b) Locating ancillary facilities in areas where there are no biodiversity values	
(c) Locating ancillary facilities in areas where the native vegetation or threatened species habitat is in the poorest condition (i.e. areas that have a lower vegetation integrity score)	
(d) Locating ancillary facilities in areas that avoid habitat for species and vegetation in high threat status categories (e.g. an EEC or CEEC or is an entity at risk of a serious and irreversible impact (SAII)	
(e) actions and activities that provide for rehabilitation, ecological restoration and/or ongoing maintenance of retained areas of native vegetation, threatened species, threatened ecological communities and their habitat on the subject land.	Mitigation measures have been developed to address the direct and indirect impacts of the proposal, outlined in Chapter 10.

8.2 Avoid and minimise impacts on prescribed biodiversity

The proposal will not cause any prescribed biodiversity impacts.

9 Assessment of impacts

9.1 Assessment of direct impacts unable to be avoided

Assessment of direct impacts unable to be avoided has been prepared in accordance with Section 9.1 of the BAM.

9.1.1 Impacts on native vegetation

This assessment has assumed that all vegetation in the subject lands will be cleared for this proposal, therefore the proposal will impact on a total of 2.82 hectares of native vegetation. These impacts on native vegetation including the PCT 1100 Ribbon Gum - Snow Gum grassy forest on damp flats, eastern South Eastern Highlands Bioregion (low), the vegetation zones, current and future vegetation integrity within the subject land is detailed in Table 9.1. The locations of direct impacts on native vegetation are shown in Figure 9.1.

Table 9.1 Direct impacts on native vegetation and change in vegetation integrity

BAM-C Veg Zone	VEGETATION TYPE	VEGETATION ZONE	CURRENT VEGETATION INTEGRITY	CHANGE IN VEGETATION INTEGRITY	FUTURE VEGETATION INTEGRITY	DIRECT IMPACT (ha)
1	PCT 1100 Ribbon Gum - Snow Gum grassy forest on damp flats, eastern South Eastern Highlands Bioregion	Low	0.4	-0.4	0	2.82
Total native vegetation impact						**2.82**

9.1.2 Impacts on threatened ecological communities

The proposal will not impact on any threatened ecological community as none are present in the subject land.

9.1.3 Impacts on threatened species

9.1.3.1 Direct impacts on species credit species

No species credit species are considered likely to occur on the site due to lack of suitable habitat and/or high level of habitat degradation on the subject land (refer to Section 5.4).

9.1.4 Injury and mortality

Injury and mortality of fauna could occur during construction activities and during operation and are discussed in this section.

Injury and mortality may occur:

- prior to construction when vegetation and habitat is being cleared
- during construction when machinery and plant is moved to, from and on site
- during operation, as a result of vehicle strike.

All roads have potential to result in the mortality of native animals. The risk is higher where roads:

- traverse areas of substantial animal habitat
- are located near natural or artificial water bodies
- contain food sources (e.g. Mown grass verges, nectar-producing shrubs) which attract animals to the road edge
- have high speed limits
- provide poor visibility of wildlife (e.g. due to bends, crests and poor lighting).

While it is not possible to eliminate the risk of roadkill occurring, it is possible to minimise this through consideration of the above factors in the design of roads/access routes, landscaping, fauna connectivity structures and infrastructure and the implementation of road signs and speed limits.

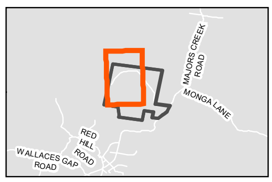
Minimisation of roadkill will be achieved through use of these strategies, particularly during construction when vehicle traffic will be at its highest. Furthermore, due to the small scale of the proposal and low traffic levels generated through the project's operation, it is unlikely that the proposal would contribute significantly to vehicle strike to native fauna, and the consequences of impacts to species are likely to be negligible.

Dargues Gold Mine, Jembaicumbene

Figure 9 - 1
Directly Impacted Areas

Legend

- Subject Lot (Option A)
- Subject Lot (Option B)
- Directly Impacted Areas (9.3ha)
- Waterbody
- Watercourse
- Project Site Boundary (ML 1675)
- Road



0 0.09 0.18
Kilometres

Coordinate system: GDA2020 MGA Zone 55

Scale ratio correct when printed at A3

1:7,500 Date: 16/06/2022

Data sources: - NSWSS, Geoscience Australia, RWC, Metromap 2019

9.2 Assessment of indirect impacts unable to be avoided

The assessment of indirect impacts has been prepared in accordance with Section 9.1.4 of the BAM. Indirect impacts have been considered in terms of the nature, extent and duration of impacts on native vegetation, threatened ecological communities and threatened species habitats likely to be affected. The assessment of indirect impacts is presented in Table 9.2 which concludes that the proposal is unlikely to have an indirect impact on any threatened entities.

Table 9.2 Assessment of indirect impacts

INDIRECT IMPACT	CONSTRUCTION / OPERATIONAL	NATURE	EXTENT	DURATION	CONSEQUENCE
Inadvertent impacts on adjacent habitat or vegetation	Construction	PCTs Threatened species	All PCTs	Short term	**Low.** Inadvertent impacts on adjacent vegetation can include a range of indirect impacts including soil disturbance, introduction of weeds, erosion, sedimentation, enriched run-off and water quality. Construction has the potential to result in sedimentation and erosion and mobilisation of contaminants within the subject land and into adjoining native vegetation and ephemeral drainage lines, through soil disturbance and construction activities. The project will be designed (where practicable) to minimise impact to these sensitive environmental receivers. The mobilisation of sediments would be contained within the disturbance area as sediment containment measures would be implemented as part of mitigation measures.
Connectivity and habitat fragmentation	Construction/ operational	Native vegetation Threatened species All fauna	All PCTs	Long term	**Low**. The removal of native vegetation and splitting of habitat patches can result in habitat fragmentation which is dividing up of once continuous habitats into separate smaller fragments. The project is considered unlikely to result in a large increase to landscape scale fragmentation and to further limit connectivity and movement corridors than what already exists in the subject land, as the proposal occurs within an already highly fragmented agricultural landscape with no remnant native trees or other woody vegetation. The impacts from the proposal would largely involve small areas of disturbance to PCT 1100 (low), exotic plantings and exotic grassland, which would not result in significant habitat fragmentation. Overall, the habitat present within the landscape has been heavily fragmented due to agricultural practices (i.e. cropping and livestock grazing). Existing connectivity is limited to vegetated gullies and creek lines. Though pipeline will be laid adjacent to one such gully; however, no impact to native vegetation is anticipated and the proposal would not result in additional fragmentation for fauna species (i.e., birds) using this habitat.

INDIRECT IMPACT	CONSTRUCTION / OPERATIONAL	NATURE	EXTENT	DURATION	CONSEQUENCE
					Loss in connectivity and/or increase in habitat fragmentation as a result of the proposal is unlikely to impact the movement of any threatened fauna species as none have been recorded in or proximate to the site. Any threatened fauna species that may occur in the subject land are mobile species and unlikely to be impacted by the proposal or limited to the habitat available on the subject land. The predicted level of fragmentation from the proposal (i.e., impact to exotic grassland and mature exotic plantings) is not expected to be enough to prevent the breeding and dispersal of plant pollinators or the dispersal of plant propagules (i.e. seed or other vegetative reproductive material) between habitat patches.
Reduced viability of adjacent habitat due to edge effects	Construction/ operational	Native vegetation	All PCTs	Long term	**Negligible.** Edge effects create vulnerable areas subject to degradation by the establishment and spread of weeds, enriched run-off from road pavement and dumping of rubbish and have the potential to reduce the viability of adjacent habitat long-term. It is listed as a Key Threatening Processes under BC Act. The subject land occurs within a rural agricultural setting with high occurrence of exotic pasture and weed species. Current edge effects from existing and previous agricultural activities (i.e. cropping and livestock) are already impacting any native vegetation particularly through weed invasion. As the proposal involves clearing PCT 1100 in low condition, exotic grassland and exotic plantings, this impact is likely to be negligible.
Reduced viability of adjacent habitat due to noise, dust or light spill	Construction/ operational	Native vegetation Threatened species All fauna	All PCTs	Short term	**Low.** Noise, dust, light and contaminant pollution are indirect impacts that are likely to result from activities associated with the proposal. These impacts are likely to have cumulative effects. Noise, dust, light and contaminant pollution are likely to occur from all proposal activities, although will be greatest where activities take place near vegetated areas and during construction.

INDIRECT IMPACT	CONSTRUCTION / OPERATIONAL	NATURE	EXTENT	DURATION	CONSEQUENCE
					During construction of the proposal, increased noise and vibration levels in the subject land and immediate surrounds are likely due to vegetation clearing, ground disturbance, machinery and vehicle movements, and human presence. The noise and vibration from activities associated with the proposal would potentially disturb fauna and may disrupt foraging, reproductive, or movement behaviours. The impacts from noise emissions are likely to be localised to the construction areas and are not considered likely to have a significant, long-term impact on wildlife populations outside the area of impact. Elevated levels of dust may be deposited onto the foliage of vegetation adjacent to the subject land activities. This has the potential to reduce photosynthesis and transpiration and cause abrasion and heating of leaves resulting in reduced growth rates and decreases in overall health of the vegetation. Dust pollution is likely to be greatest during periods of substantial earthworks, vegetation clearing, vehicle movements for construction and decommissioning activities and during adverse weather conditions. However, deposition of dust on foliage is likely to be highly localised, intermittent, and temporary and is therefore not considered likely to be a major impact of the proposal. Ecological light pollution is the descriptive term for light pollution that includes direct glare, chronic or periodic increased illumination, and temporary unexpected fluctuations in lighting, that can have potentially adverse effects on wildlife. Night works may be required during the construction phase of the proposal and will increase light pollution. The changes to light conditions associated with the construction phase of the proposal are temporary and would therefore be unlikely to have a significant impact on local fauna populations.

INDIRECT IMPACT	CONSTRUCTION / OPERATIONAL	NATURE	EXTENT	DURATION	CONSEQUENCE
					During the construction phase localised release of contaminants (i.e. hydraulic fluids, oils, fluids, etc.) into the surrounding environment (including drainage lines) could accidentally occur. The most likely result of contaminant discharge would be the localised contamination of soil and potential direct physical trauma to flora and fauna that come into contact with contaminants. Any accidental release of contaminants is likely to be localised and would be unlikely to have a significant effect on the environments of the subject land, particularly due to the implementation of mitigation measures to immediately address any spills.
Transport of weeds from the site to adjacent vegetation	Construction/ operational	Native vegetation	All PCTs	Long term	**Negligible.** The clearing of native vegetation for the proposal, including earthworks would increase the potential for weed invasion into adjacent patches of native vegetation. Management measures would be required to minimise the risk of introduction and spread of weeds.
Transport of pathogens from the site to adjacent vegetation	Construction	Native vegetation	All PCTs	Short term	**Low**. The proposal has the potential to increase the spread of pathogens that threaten native biodiversity values, such as the soil-borne pathogen *Phytophthora cinnamomi* (Phytophthora) and *Austropuccinia psidii* (Myrtle rust). Phytophthora infects root systems whereas Myrtle Rust deforms leaves and leads to heavy defoliation. Both pathogens are associated with damage and death to native plants and may be dispersed over large distances. Phytophthora can be spread through flowing water, such as storm runoff, or may be spread within a site via mycelial growth from infected roots to roots of healthy plants. Propagules of Phytophthora may also be dispersed by vehicles (e.g., cars and earth moving equipment), animals, walkers and movement of soil. Myrtle rust spores can be spread easily via contaminated clothing, hair, skin and personal items, infected plant material, equipment as well as by insect/animal movement and wind dispersal. The proposal construction activities are likely to lead to an increased risk of dispersal of Phytophthora and/or Myrtle Rust through works involving soil disturbance. This indirect impact corresponds to several Key Threatening Processes listed under BC Act:

INDIRECT IMPACT	CONSTRUCTION / OPERATIONAL	NATURE	EXTENT	DURATION	CONSEQUENCE
					— infection of native plants by *Phytophthora cinnamomic* — introduction and establishment of Exotic Rust Fungi of the order *Pucciniales* pathogenic on plants of the family *Myrtaceae.* Mitigation and management measures would be put in place for the proposal which would minimise the spread of pathogens.
Increased risk of starvation, exposure and loss of shade or shelter	Construction	All fauna species	All PCTs	Short term	**Negligible.** Displacement of resident fauna species during native vegetation clearing is considered relatively low as the proposal occurs primarily in exotic-dominated grassland and extensive and better-quality vegetation occurs adjacent to the subject land. No native trees are likely to be impacted by the proposal, and impacts are largely limited to exotic grassland, small patches of low-condition PCT 1100 and a small number of mature exotic plantings. Given the small-scale impact associated with the proposal and relative mobile nature of most potential resident fauna species, the increased risk of starvation, exposure and loss of shade or shelter due to the proposal is likely to be low.
Loss of breeding habitats	Construction	All fauna species	All PCTs	Long term	**Negligible.** The loss of breeding habitat such as mature trees, rocks and fallen timber has the potential to affect native animals such as: — canopy-nesting birds — arboreal mammals — reptiles. No hollow-bearing trees are likely to be directly impacted by the proposal and indirect impacts on adjacent habitat will be minimised through mitigation and management measures. Small patches of rocky habitat may be removed as a result of the proposal; however, these outcrops are surrounded by exotic grassland and were not found to be sheltering fauna during surveys, so are unlikely to represent important breeding habitat. A small number of mature exotic trees will be removed as a result of the proposal, but these trees did not contain any hollows or potential nests and better-quality habitat for birds and mobile fauna species occurs in the immediate locality. Fallen timber in the subject land was minimal and unlikely to provide additional habitat for small birds or

INDIRECT IMPACT	CONSTRUCTION / OPERATIONAL	NATURE	EXTENT	DURATION	CONSEQUENCE
					mammals. Consequently, no loss or significant impact to breeding habitat is anticipated because of the proposal.
Increase in predatory species populations	Construction / operation	All fauna species	All PCTs	Long term	**Low**. Predation by feral cats and the Fox are listed as key threatening processes under the BC Act and have potential to impact local fauna populations in adjacent habitat. It is unlikely that the proposal would further increase the impact from predator species populations within the locality. Mitigation measures would be put in place for the proposal to minimise the spread and invasion of pest species.

9.3 Assessment of prescribed biodiversity impacts

Assessment of prescribed impacts is prepared in accordance with Section 9.2 of the BAM. The proposal will not cause any prescribed biodiversity impacts.

9.4 Assessment of impacts on Matters of National Environmental Significance

Chapter 7outlines the MNES considered to be relevant to the proposal. Assessment for each MNES was done in accordance with the Significant Impact Guidelines 1.1 – Matters of National Environmental Significance (Appendix B) and a summary of the outcomes of these are provided in this chapter.

9.4.1 Impacts on threatened ecological communities

No candidate threatened ecological communities listed under the EPBC Act was considered to have a moderate or greater potential to occur in the subject land based on the vegetation and habitat present.

9.4.2 Impacts on threatened species

No EPBC Act listed threatened species are considered to have a moderate or higher likelihood of occurring within the subject land based on the availability of habitat (refer to Section 7.1).

9.4.3 Impacts on migratory species

The proposal is unlikely to impact migratory species.

9.4.4 Impacts on wetlands of national and international importance

The proposal is unlikely to impact wetlands of national and international importance.

9.4.5 Impacts on world and national heritage

The proposal is unlikely to impact world and national heritage.

9.5 Key Threatening Processes

This section identifies whether the proposed action of any component of the proposal would be classified as a Key Threatening Process (KTP) listed under the BC Act, EPBC Act or FM Act.

Any process that threatens, or may threaten, the survival, abundance or evolutionary development of a native species or ecological community is considered a KTP. KTPs listed in Schedule 4 of the BC Act and section 183 of the EPBC Act were individually assessed against the proposal to determine their relevance.

A total of six KTPs listed under the BC Act and three listed under the EPBC Act were considered relevant to the proposal and have been detailed in Table 9.3 below. Mitigation measures have been developed to minimise these Key Threatening Processes.

Table 9.3 Key threatening processes relevant to the proposal

KEY THREATENING PROCESS	RELEVANT LEGISLATION	RELEVANCE TO THE PROPOSAL
Clearing of native vegetation/land clearance	BC Act/ EPBC Act	Clearing of native vegetation is defined as the destruction of a sufficient proportion of one or more strata (layers) of vegetation within a stand or stands of native vegetation. The proposal will involve the clearing of very small amount of native groundcover in an exotic-dominant grassland. Impacts to native vegetation from the proposal will be negligible.
Infection of native plants by *Phytophthora cinnamomi*	BC Act/ EPBC Act	Any activity that moves soil, water or plant material can spread or introduce *Phytophthora cinnamomi*. *Phytophthora cinnamomi* is known to occur in the South Eastern Highlands bioregion. The construction and operation of the proposed substation upgrade may increase the risk of introducing or spreading *Phytophthora cinnamomi* as it will require the movement of soil, water and plant material.
Introduction and establishment of Exotic Rust Fungi of the order *Pucciniales* pathogenic on plants of the family Myrtaceae	BC Act	Exotic Rust Fungi is known to occur in the South Eastern Highlands bioregion. Spores of *Uredo rangelii* (Myrtle rust) are dispersed by wind, water, on plant material including seed, on equipment and clothing. The construction and operation of the proposal may increase the risk of introducing or spreading Exotic rust fungi through the movement of soil and water as well as the presence and movement of equipment.
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	EPBC Act	Chytridiomycosis is potentially fatal to all native species of amphibian. It is currently predicted within South Eastern Highlands bioregion. Fifty species of Australian frogs have been found infected with the chytrid fungus. In NSW, 22 species, more than one quarter of the total NSW amphibian fauna, have been diagnosed with the disease. The construction and operation of the proposed modification may increase the risk of introducing and/or spreading this pathogen as it will require the movement of soil, water and plant material.
Invasion of native plant communities by exotic perennial grasses	BC Act	The invasion and establishment of exotic perennial grasses is a potential indirect impact of the construction and operation of the proposal. It is currently predicted or known within the South Eastern Highlands bioregion. The spread and establishment exotic perennial grasses (i.e. *Paspalum dilatatum**) and may be facilitated through the movement of soils and machinery. Mitigation measures are recommended to effectively manage these key threatening processes.
Bushrock removal	BC Act	Bushrock removal is the removal of natural surface deposits of rock from rock outcrops or from areas of native vegetation. Bushrock removal is likely to occur in the subject land as a result of the proposal, as small areas of surface rock occur within the proposed storage dam impact area.

9.6 Cumulative impacts

9.6.1 Overview

Cumulative impacts can be defined as the successive, incremental, and combined effect of multiple impacts, which may in themselves be minor but could become significant when considered together.

9.6.2 Cumulative impacts during construction and operation

The most significant cumulative impact of the proposed development is the continued loss of biodiversity in the region. The proposal has the potential to contribute to the cumulative loss of habitat and will likely place further pressure on local threatened flora and fauna species and ecological communities.

The direct impacts on PCTs and threatened species habitat are the most likely contribution to cumulative impacts. This proposed modification further increases the disturbance footprint of the Dargues Gold Mine and will result in the removal of a relatively small area of 2.82 hectares of native vegetation in low condition (PCT 1100 low). Although this does contribute to the cumulative impacts in the area, the impact of the proposal is relatively minor.

10 Mitigation and management

This section has been prepared in accordance with Section 9.3 of the BAM to address the potential impacts of the proposal on biodiversity as discussed in Chapter 9. Mitigation and management measures have been developed and would be implemented as part of the proposal, as described below.

10.1 Approach to mitigation and management

The environmental management approach has been developed to be consistent with the regulatory requirements for management of biodiversity impacts, identified as likely to be encountered during the construction and operational phases of the proposal.

Environmental management during the construction and operation phases of the project will be consistent with Big Island Mining environmental management systems. Mitigation measures would be implemented during construction to manage the potential impacts of the proposal on biodiversity values.

Construction and operation environmental management will include:

- during construction, implementation of a Construction Environmental Management Plan (CEMP)
- during operation, implementation of an Environmental Management System (EMS), and Biodiversity Management Plan (BMP).

Big Island Mining Limited have an existing Biodiversity Management Plan (BMP) that sets out measures to minimise and manage impacts on biodiversity during construction and operation (Big Island Mining Limited 2016). The BMP will be updated to include changes to the existing measures required due to the implementation of MOD 5.

10.2 Summary of mitigation and management measures

This section outlines the impact mitigation measures and safeguards to be implemented to reduce the impacts for the proposal on terrestrial biodiversity values. These measures will be set out in the mine's Construction Environmental Management Plan (CEMP), Environmental Management System (EMS), and Biodiversity Management Plan (BMP).

Key risks for the proposal include the clearing of mature trees and rocky habitat, fauna injury and mortality during construction and indirect impacts offsite as a result of sediment runoff, spread of weeds and pathogens, and erosion. Control measures to be implemented would include (as a minimum):

- measures to minimise impacts to biodiversity, including measures to reduce disturbance to sensitive flora and fauna
- procedures for clearing of vegetation, including pre-clearing inspections and procedures for the relocation of flora and fauna
- procedures for the demarcation and protection of retained vegetation, including vegetation adjacent to construction areas (no go zones)
- weed and pathogen management
- rehabilitation strategies including progressive rehabilitation, and measures for the management and maintenance of rehabilitated areas (including duration)
- procedures for unexpected, threatened flora and fauna species finds during construction, including stop work procedures
- monitoring requirements and compliance management.

Proposed mitigation measures are detailed in Table 10.1.

Table 10.1 Proposed mitigation measures

MITIGATION MEASURE (ACTION)	TARGET	TIMING	RESPONSIBILITY	LIKELIHOOD OF SUCCESS	CONSEQUENCE OF RESIDUAL IMPACT
The final disturbance area will seek to avoid the clearing of native vegetation and habitats as far as practicable.	Threatened species Native vegetation All fauna	Detailed design	Big Island Mining Designers	High. Known to be effective.	Clearing of native vegetation and habitats avoided as far as practicable. Impact to native vegetation and habitats.
Where native vegetation disturbance activities are required in areas that have not been previously subject to biodiversity survey, additional survey will be carried out prior to works occurring in any such areas and to inform detailed design. These surveys will be carried out by a suitably qualified ecologist.	Threatened species Native vegetation All fauna	Detailed design	Big Island Mining	High. Known to be effective.	Clearing of native vegetation and habitats avoided as far as practicable. Impact to native vegetation and habitats updated as necessary.
Opportunities to locate project works and ancillary infrastructure in areas of limited biodiversity value (e.g. exotic dominated grassland, disturbed areas, existing tracks) will be prioritised during detailed design.	Threatened species Native vegetation	Detailed design	Big Island Mining Designers	High. Known to be effective.	Clearing of native vegetation and habitats avoided as far as practicable. Impact to native vegetation and habitats.

MITIGATION MEASURE (ACTION)	TARGET	TIMING	RESPONSIBILITY	LIKELIHOOD OF SUCCESS	CONSEQUENCE OF RESIDUAL IMPACT
Existing tracks and clearings will be used, where possible, to avoid the construction of new tracks. Where this is not possible, the design will seek to minimise impacts to native vegetation.	Threatened species Native vegetation All fauna	Detailed design	Big Island Mining Designers	High. Known to be effective.	Clearing of native vegetation and habitats avoided as far as practicable. Impact to native vegetation and habitats.
Pre-clearing surveys of potential habitat (i.e. mature tree plantings, rocky habitat) will be completed prior to construction by a suitability qualified ecologist. Clearing protocols, including pre-clearing surveys, daily surveys and staged clearing will be implemented, using a trained ecologist or licensed wildlife handler during clearing events.	Threatened species All fauna	Pre-construction	Big Island Mining Construction contractor	High. Known to be effective.	Clearing of native vegetation and habitats avoided as far as practicable. Impact to native vegetation and habitats.
Adoption of clearing protocols that identify vegetation to be retained, prevent inadvertent damage and reduce soil disturbance.	Threatened species Native vegetation All fauna	Pre-construction	Big Island Mining Construction contractor	High. Known to be effective.	Clearing of native vegetation and habitats avoided as far as practicable. Impact to native vegetation and habitats.

MITIGATION MEASURE (ACTION)	TARGET	TIMING	RESPONSIBILITY	LIKELIHOOD OF SUCCESS	CONSEQUENCE OF RESIDUAL IMPACT
Biodiversity exclusion zones (temporary fencing) for retained vegetation will be clearly identified by a suitably qualified ecologist prior to the commencement of construction.	Threatened species Native vegetation All fauna	Pre-construction	Big Island Mining Construction contractor	High. Known to be effective.	Clearing of native vegetation and habitats avoided as far as practicable. Impact to native vegetation and habitats.
Construction workforce will be supplied with sensitive area maps (showing clearing boundaries and exclusion zones) including updates as required. Training of staff and conducting site briefings to communicate measures to be implemented.	Threatened species Native vegetation All fauna	Pre-construction	Big Island Mining Construction contractor	High. Known to be effective.	Clearing of native vegetation and habitats avoided as far as practicable. Impact to native vegetation and habitats.
A threatened species unexpected finds protocol will be implemented if threatened flora and fauna species, not assessed in the biodiversity assessment, are identified in the disturbance area.	Threatened species	Construction	Big Island Mining Construction contractor	High. Known to be effective.	Residual impact would be determined if there were any unexpected finds.
Relocating habitat features (e.g. surface rock, fallen timber) from the development footprint to adjacent retained vegetation will be undertaken where practicable.	Threatened species All fauna	Construction	Big Island Mining Construction contractor	High. Known to be effective.	Relocating habitat features may reduce the impact of removing habitat features.

MITIGATION MEASURE (ACTION)	TARGET	TIMING	RESPONSIBILITY	LIKELIHOOD OF SUCCESS	CONSEQUENCE OF RESIDUAL IMPACT
Hygiene protocols will be implemented to prevent the introduction and/or spread of weeds or pathogens.	Threatened species Native vegetation All fauna	Construction	Big Island Mining Construction contractor	High. Known to be effective.	No residual impact expected if hygiene protocols are implemented.
Providing for the ecological restoration, rehabilitation and/or ongoing maintenance of retained native vegetation and habitat on, or adjacent to, the development to industry best practice and standards.	Threatened species Native vegetation All fauna	Operation	Big Island Mining Maintenance contractor	High. Known to be effective.	No residual impact expected. Outcome should be restoration, rehabilitation and/or ongoing maintenance of retained native vegetation and habitat on, or adjacent to, the development.

11 Impact summary–Thresholds for assessment and offsetting impacts

This chapter sets out the impact thresholds for residual impacts to biodiversity values after avoiding, minimise and mitigate measures have been applied. Thresholds for assessment and offsetting impacts are outlined in Chapter 9 of the BAM and include:

- impacts on biodiversity values at risk of a serious and irreversible impact
- impacts that require offsetting
- impacts which do not require offsetting
- impacts that do not require further assessment.

11.1 Serious and irreversible impacts

This section identifies every potential serious and irreversible impact (SAII) entity that are listed to assist a decision-maker to determine a serious and irreversible impact that would be impacted on the subject land.

Impact assessment of potential entities of SAII impacts on biodiversity values are outlined under Chapter 9 of the BAM and addressed below.

11.1.1 Threatened ecological communities

To assist the determining authority to evaluate the nature of an impact on a potential entity at risk of a serious and irreversible impact, the BDAR must contain details of the assessment of SAII, in accordance with the assessment criteria set out in the Biodiversity Assessment Method.

No threatened ecological communities (TECs) listed under the BC Act are considered likely to occur within the subject land affected, as such no TEC SAII entities will be affected by the proposal.

11.1.2 Threatened flora candidate SAII entities

No threatened flora listed under the BC Act are considered likely to occur within the subject land affected, as such no threatened flora SAII entity will be affected by the proposal.

11.1.3 Threatened fauna candidate SAII entities

No threatened fauna listed under the BC Act are considered likely to occur within the subject land affected, as such no threatened fauna SAII entity will be affected by the proposal.

11.2 Determining an offset requirement for impacts

Biodiversity offsetting for residual impacts on biodiversity values listed under the BC Act is mandatory for SSD developments being assessed under Part 7 of the BC Act and subject to a BDAR.

11.2.1 Impacts on native vegetation and TECs (ecosystem credits)

In accordance with section 9.2.1 of the BAM, an offset is required for all impacts of proposals on PCTs that are associated with a vegetation zone that has a vegetation integrity score of:

- ≥15, where the PCT is representative of an EEC or a CEEC
- ≥17, where the PCT is associated with threatened species habitat (as represented by ecosystem credits) or represents a vulnerable ecological community

– ≥20, where the PCT does not represent a TEC and is not associated with threatened species habitat.

Based on this, there are no areas of the subject land are subject to a biodiversity offset, as outlined in Sections 9.1.1 and 9.1.2, and illustrated in Figure 11.1. The required ecosystem and species credit obligations are outlined below.

11.2.2 Impacts requiring biodiversity offsets (ecosystem credits)

Impacts requiring biodiversity offset ecosystem credits are detailed in Table 11.1.

Table 11.1 Impacts requiring biodiversity offset ecosystem credits

BAM-C #	VEGETATION TYPE	VEGETATION ZONE	TEC	SAII	SPECIES SENSITIVITY TO GAIN CLASS	VEGETATION INTEGRITY SCORE	OFFSET REQUIRED
1	PCT 1100	Low	No	No	High Sensitivity to Potential Gain	0.4	No

11.2.3 Impacts on threatened species and their habitat (species credits)

In accordance with section 9.2.2 of the BAM, an offset is required for all impacts on threatened species and their habitat where offsets are determined for the impacts of the proposal on threatened species that require species credits, identified in accordance with Chapter 5 of the BAM.

No threatened species or their habitat listed under the BC Act are considered likely to occur within the subject land affected, as such no threatened species will be affected by the proposal.

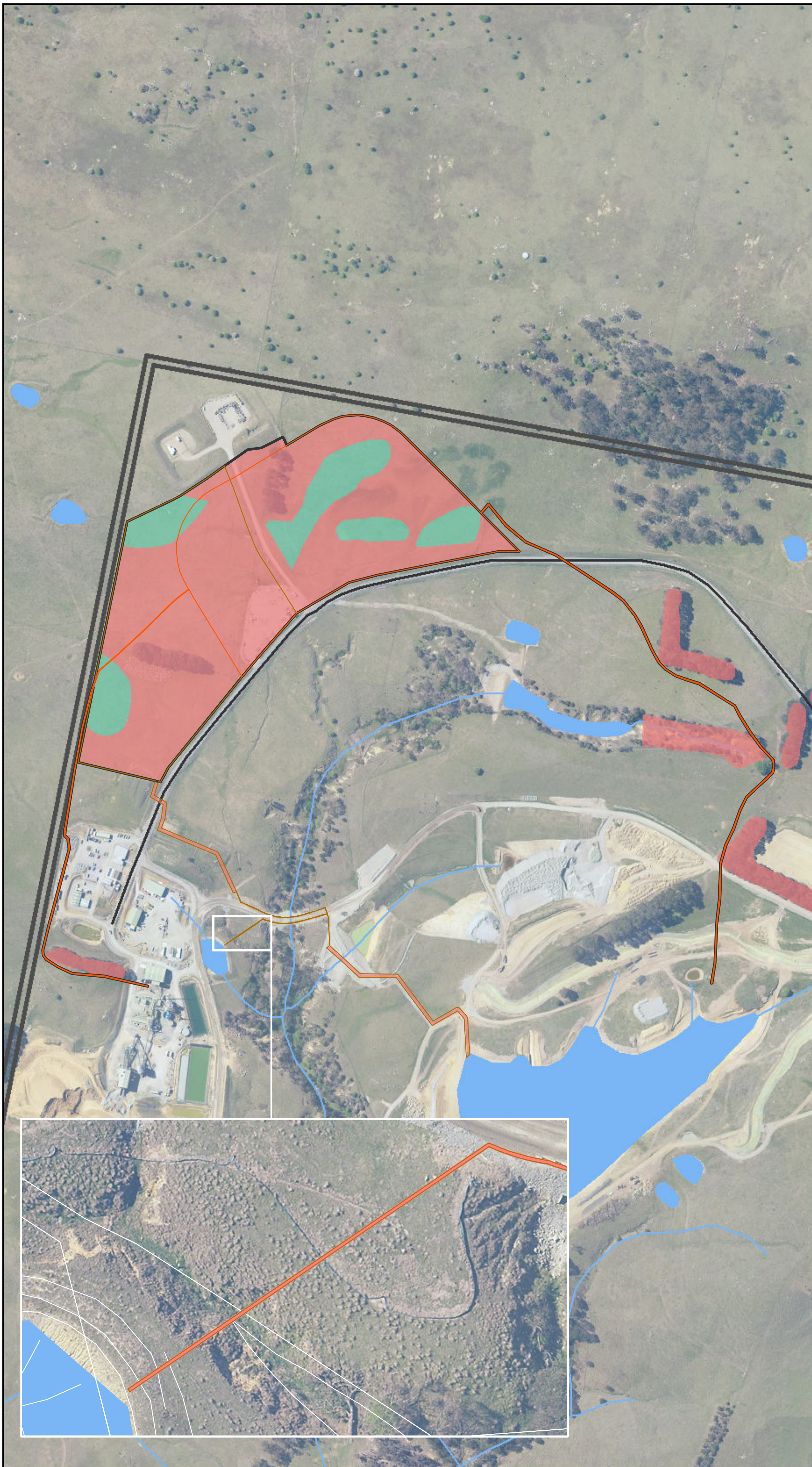
11.2.4 Impacts requiring biodiversity offsets (species credits)

No threatened species or their habitat listed under the BC Act are considered likely to occur within the subject land affected, as such no threatened species will be affected by the proposal.

11.2.5 Impacts that do not need further assessment

In accordance with Section 9.3 of the BAM the following impacts to non-native vegetation types do not need further assessment and do not require a biodiversity offset:

- the impact of 10.73 hectares of miscellaneous ecosystem – exotic grassland, which is highly disturbed with no or limited native vegetation.
- the impact of 0.54 hectares of exotic tree plantings, with no or limited native vegetation and no threatened species habitat.

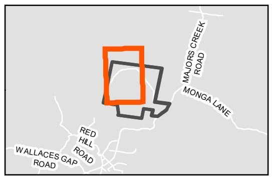


Dargues Gold Mine, Jembaicumbene

Figure 11 - 1
Impact Summary

Legend

- Subject Lot (Option A)
- Subject Lot (Option B)
- Offsets not required (VI<20)
- No further assessment required
- Waterbody
- Watercourse
- Project Site Boundary (ML 1675)
- Road



0 0.09 0.18
Kilometres

Coordinate system: GDA2020 MGA Zone 55

Scale ratio correct when printed at A3

1:7,500 Date: 20/06/2022

Data sources: - NSWSS, Geoscience Australia, RWC, Metromap 2019

12 Impact summary–No net loss standard

No net loss in biodiversity value is the standard that underpins the BAM. The standard is attained through ensuring that the amount of biodiversity offset credit required from an impact is proportional to the amount of credit generated through improvements in the condition of native vegetation or threatened species habitat at a biodiversity stewardship site. The application of no net loss standard is set out in Chapter 10 of the BAM.

12.1 Applying the no net loss standard

No net loss in biodiversity is achieved where:

- the impacts on biodiversity values from a proposal are avoided, minimised or mitigated through reasonable measures (refer Chapters 8 and 10)
- all residual direct impacts on biodiversity values from clearing native vegetation and habitat loss are offset by:
  - retiring the required number of biodiversity credits determined in Section 10.1 of the BAM, with a class of credit identified in Section 10.2 of the BAM that meets the 'like-for-like' or 'variation' rules required in clauses 6.3 and 6.4 of the BC Regulation 2017 respectively.

All residual impacts on biodiversity resulting from the proposal, after applying the avoid, minimise and mitigate hierarchy, have been outlined in Section 11.2. The ecosystem credit offset requirements calculated for these residual impacts are presented below. There are no species credit offset requirements.

12.2 Ecosystem credit offset requirement

The required ecosystem credit offset requirement, as determined using the BAM-C (version 1.3.0.00), for impacts on native vegetation are provided in Table 12.1. The ecosystem credit species predicted to utilise the PCT that is listed in the BAM credit report in Appendix C. Due to the low vegetation integrity score of PCT 1100 (low) in the subject land, no biodiversity offset ecosystem credit requirements will be generated by the proposal.

Table 12.1 Impacts requiring biodiversity offset ecosystem credits

BAM-C veg zone	VEGETATION TYPE (ZONE)	TEC	SAII	BIODIVERSITY RISK WEIGHTING	VEGETATION INTEGRITY LOSS	FUTURE VEGETATION INTEGRITY SCORE	AREA (ha)	CREDITS REQUIRED
1	PCT 1100 Ribbon Gum - Snow Gum grassy forest on damp flats, eastern South Eastern Highlands Bioregion (low)	no	no	2	-0.4	0	2.82	nil
Total ecosystem credit obligation								**nil**

12.3 Species credit offset requirement

No species credit species are being impacted by the proposal; therefore, no biodiversity offset species credit obligations are being generated.

12.4 Biodiversity offset approach

The proposal will not generate any biodiversity offset requirements; therefore, no offset approach is needed.

13 Conclusion

The proposal will have a residual impact on 2.82 hectares of native vegetation comprised of one vegetation types (PCT 1100 in low condition). No threatened ecological communities (TEC) or threatened species listed under the BC Act or EPBC Act occur within the subject land; therefore, no threatened entities will be impacted by this proposal.

There are no prescribed impacts from this proposal and indirect impacts are low or negligible.

The proposal has been designed with the principles of avoid and minimise impact on native vegetation and habitat where possible in accordance with BAM.

This assessment has assumed that the either subject land option A or B (disturbance area) will be cleared totally of all native vegetation that generates nil credit requirements, leading to a change in vegetation integrity score from 0.4 to zero for that area.

Assessments of impact significance were conducted for all MNES threatened species, populations and ecological communities considered likely to be affected by the proposal. Through these assessments, it was concluded that the proposal is unlikely to have a significant impact on any threatened species, populations and ecological communities or their habitat or any other MNES relating to ecological matters.

14 Limitations

This report is provided by WSP Australia Pty Limited (*WSP*) for Big Island Mining Limited (*Client*) in response to specific instructions from the Client and in accordance with WSP's proposal and agreement with the Client (*Agreement*).

14.1 Permitted purpose

This report is provided by WSP for the purpose described in the Agreement and no responsibility is accepted by WSP for the use of this report in whole or in part, for any other purpose (*Permitted Purpose*).

14.2 Qualifications and assumptions

The services undertaken by WSP in preparing this report were limited to those specifically detailed in this report and are subject to the scope, qualifications, assumptions and limitations set out in this report or otherwise communicated to the Client.

Except as otherwise stated in this report and to the extent that statements, opinions, facts, conclusion and / or recommendations in this report (*Conclusions*) are based in whole or in part on information provided by the Client and other parties identified in the report (*Information)*, those Conclusions are based on assumptions by WSP of the reliability, adequacy, accuracy and completeness of the Information and have not been verified. WSP accepts no responsibility for the Information.

WSP has prepared this report without regard to any special interest of any person other than the Client when undertaking the services described in the Agreement or in preparing this report.

14.3 Use and reliance

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14.5 Field survey limitations

No sampling technique can eliminate the possibility that a species is present within the subject land. For example, some species of plant may be present in the soil seed bank and some fauna species use habitats on a sporadic or seasonal basis and may not be present within the subject land during surveys.

The conclusions in this report are based upon data acquired for the proposal and the environmental field surveys carried out by WSP for this proposal. Consequently, the conclusions in this report are only indicative of the environmental condition of the subject land at the time of preparing the report, including the presence or otherwise of species. Subject land conditions, including the presence of threatened species, can change with time.

Targeted surveys have been conducted to detect one threatened flora species that is considered likely to occur within the subject land based on habitat characteristics and previous records. As the actual distribution and the range of habitat utilised by some species is not fully understood, there is always a possibility that other species could occur on the site despite being considered to have a low likelihood of occurrence based on their known range and known habitats.

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Appendix A

BAM vegetation integrity plot data & opportunistic fauna records

Quadrat 1			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			16	3	0	0	2	1	0	0	13	0
Species	Cover	Abundance	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			83.8	0.5	0	0	0.3	0.2	0	0	83.3	0
Lolium perenne	1	80	EX								1	
Trifolium repens	0.5	50	EX								0.5	
Holcus mollis	40	500	EX								40	
Acetosella vulgaris	0.1	5	EX								0.1	
Dactylis glomerata	35	300	EX								35	
Plantago lanceolata	0.3	35	EX								0.3	
Hypochaeris radicata	0.5	50	EX								0.5	
Trifolium subterraneum	0.2	20	EX								0.2	
Bromus catharticus	0.1	20	EX								0.1	
Asperula conferta	0.2	25	FG					0.2				
Festuca arundinacea	5	50	EX								5	
Schoenus apogon	0.1	20	GG				0.1					
Poa annua	0.2	20	EX								0.2	
Vulpia myuros	0.2	20	EX								0.2	
Poa labillardierei var. *labillardierei*	0.2	10	GG				0.2					
Bromus molliformis	0.2	20	EX								0.2	

Easting	748631
Northing	6063985
Orientation	248
Plot size	20 x20
BAM Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	0
20-29	0
10-19	0
5-9	0
<5	0
Hollows	0
Length logs (m)	0
BAM Attributes 1x1 plot (%)	
Litter (%)	2.5

Quadrat 2

Species	Cover	Abundance	Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			18	5	0	0	2	3	0	0	13	0
			Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			90.9	2.3	0	0	1.1	1.2	0	0	88.6	0
Lolium perenne	0.2	30	EX								0.2	
Trifolium repens	0.1	20	EX								0.1	
Holcus mollis	40	3000	EX								40	
Acetosella vulgaris	1	50	EX								1	
Dactylis glomerata	30	250	EX								30	
Plantago lanceolata	0.1	10	EX								0.1	
Hypochaeris radicata	0.2	30	EX								0.2	
Bromus catharticus	0.2	20	EX								0.2	
Asperula conferta	0.1	10	FG					0.1				
Poa annua	0.1	10	EX								0.1	
Vulpia myuros	1.5	50	EX								1.5	
Poa labillardierei var. *labillardierei*	1	25	GG				1					
Bromus molliformis	15	200	EX								15	
Geranium solanderi var. *solanderi*	1	80	FG					1				
Cirsium vulgare	0.1	2	EX								0.1	
Phalaris minor	0.1	10	EX								0.1	
Juncus australis	0.1	5	GG				0.1					
Oxalis sp.	0.1	5	FG					0.1				

Easting	748718
Northing	6064048
Orientation	327
Plot size	20 x20
BAM Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	0
20-29	0
10-19	0
5-9	0
<5	
Hollows	0
Length logs (m)	0
BAM Attributes 1x1 plot (%)	
Litter (%)	1

Quadrat 3			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
			# spp	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
			21	**8**	0	0	5	2	0	1	**13**	0
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			131.7	**7.7**	0	0	2.5	5.1	0	0.1	**124**	0
Lolium perenne	0.2	40	EX								0.2	
Trifolium repens	0.2	40	EX								0.2	
Holcus mollis	40	300	EX								40	
Acetosella vulgaris	10	80	EX								10	
Dactylis glomerata	30	250	EX								30	
Plantago lanceolata	0.2	30	EX								0.2	
Hypochaeris radicata	0.2	25	EX								0.2	
Bromus catharticus	2	50	EX								2	
Poa annua	1	20	EX								1	
Vulpia myuros	0.1	10	EX								0.1	
Poa labillardierei var. *labillardierei*	2	20	GG				2					
Bromus molliformis	20	150	EX								20	
Geranium solanderi var. *solanderi*	5	80	FG					5				
Cirsium vulgare	0.1	5	EX								0.1	
Juncus australis	0.1	10	GG				0.1					
Oxalis sp.	0.1	5	FG					0.1				
Festuca arundinacea	20	100	EX								20	
Microlaena stipoides var. *stipoides*	0.2	25	GG				0.2					
Schoenus apogon	0.1	20	GG				0.1					
Glycine clandestina	0.1	10	OG							0.1		
Lachnagrostis filiformis	0.1	10	GG				0.1					

Easting	748669
Northing	6064128
Orientation	71
Plot size	20x 20
BAM Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	0
20-29	0
10-19	0
5-9	0
<5	
Hollows	0
Length logs (m)	0
BAM Attributes 1x1 plot (%)	
Litter (%)	1

Quadrat 4

			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
			# spp	**Count**	Count	Count	Count	Count	Count	Count	**Count**	Count
			15	**3**	0	0	2	1	0	0	**12**	1
Species	**Cover**	**Abundance**	**Sum cover**	**Sum**	Sum	Sum	Sum	Sum	Sum	Sum	**Sum**	Sum
			68.9	**25.6**	0	0	25.1	0.5	0	0	**43.3**	0.1
Lolium perenne	10	100	EX								10	
Trifolium repens	0.5	80	EX								0.5	
Holcus mollis	25	200	EX								25	
Acetosella vulgaris	5	100	EX								5	
Plantago lanceolata	0.2	20	EX								0.2	
Hypochaeris radicata	0.1	10	EX								0.1	
Bromus catharticus	1	50	EX								1	
Poa annua	0.1	5	EX								0.1	
Vulpia myuros	0.2	20	EX								0.2	
Poa labillardierei var. *labillardierei*	25	180	GG				25					
Geranium solanderi var. *solanderi*	0.5	50	FG					0.5				
Cirsium vulgare	0.1	5	EX								0.1	
Juncus australis	0.1	10	GG				0.1					
Festuca arundinacea	1	30	EX								1	
Rubus fruticosus agg.	0.1	2	HT									0.1

Easting	748608
Northing	6063884
Orientation	159
Plot size	20x 20
BAM Attributes 20x50m plot	
Stem classes	
80+	0
50-79	0
30-49	0
20-29	0
10-19	0
5-9	0
<5	
Hollows	0
Length logs (m)	0
BAM Attributes 1x1 plot (%)	
Litter (%)	0

Quadrat 5

Species	Cover	Abundance	Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			34	22	2	3	6	9	1	1	12	3
			Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			123.7	67.3	7	25.3	31.4	3.4	0.1	0.1	56.4	3.5
Trifolium repens	0.1	10	EX								0.1	
Holcus mollis	50	250	EX								50	
Acetosella vulgaris	0.5	40	EX								0.5	
Plantago lanceolata	0.5	30	EX								0.5	
Bromus catharticus	0.1	30	EX								0.1	
Poa labillardierei var. *labillardierei*	0.5	30	GG				0.5					
Geranium solanderi var. *solanderi*	0.5	30	FG					0.5				
Cirsium vulgare	0.5	10	EX								0.5	
Oxalis sp.	0.1	20	FG					0.1				
Microlaena stipoides var. *stipoides*	30	500	GG				30					
Glycine clandestina	0.1	5	OG							0.1		
Acacia melanoxylon	5	2	TG		5							
Acacia mearnsii	25	6	SG			25						
Sonchus oleraceus	0.1	5	EX								0.1	
Rytidosperma spp.	0.5	50	GG				0.5					
Rubus fruticosus agg.	0.5	10	HT									0.5
Crataegus monogyna	2	3	HT									2
Conyza bonariensis	0.1	10	EX								0.1	
Euchiton involucratus	0.3	50	FG					0.3				
Solanum nigrum	1	10	EX								1	
Cytisus scoparius	1	10	HT									1
Eucalyptus pauciflora	2	5	TG		2							
Asperula conferta	0.1	10	FG					0.1				
Hydrocotyle laxiflora	1	50	FG					1				
Senecio quadridentatus	1	30	FG					1				
Vittadinia cuneata	0.2	50	FG					0.2				
Themeda triandra	0.1	10	GG				0.1					
Echinopogon ovatus	0.2	30	GG				0.2					
Cassinia trinerva	0.2	5	SG			0.2						
Rubus parvifolius	0.1	5	SG			0.1						
Chrysocephalum apiculatum	0.1	5	FG					0.1				
Austrostipa sp.	0.1	15	GG				0.1					
Gonocarpus tetragynus	0.1	10	FG					0.1				
Cheilanthes sieberi	0.1	5	EG						0.1			

Easting	748841
Northing	6063472
Orientation	337
Plot size	20 x20
BAM Attributes 20x50m plot	
Stem classes	
80+	
50-79	2
30-49	
20-29	
10-19	
5-9	
<5	
Hollows	1
Regen	No
Fallen Timber	13
BAM Attributes 1x1 plot (%)	
Litter (%)	4

Quadrat 6			Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
			# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
			18	7	0	0	4	3	0	0	11	1
Species	**Cover**	**Abundance**	Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
			84.2	2.7	0	0	2.4	0.3	0	0	81.5	2
Lolium perenne	0.2	20	EX								0.2	
Trifolium repens	1	45	EX								1	
Holcus mollis	10	100	EX								10	
Acetosella vulgaris	1	30	EX								1	
Dactylis glomerata	25	200	EX								25	
Plantago lanceolata	0.2	10	EX								0.2	
Hypochaeris radicata	1	50	EX								1	
Poa labillardierei var. *labillardierei*	2	20	GG				2					
Geranium solanderi var. *solanderi*	0.1	10	FG					0.1				
Cirsium vulgare	0.1	5	EX								0.1	
Juncus australis	0.1	10	GG				0.1					
Oxalis sp.	0.1	5	FG					0.1				
Festuca arundinacea	1	10	EX								1	
Microlaena stipoides var. *stipoides*	0.1	10	GG				0.1					
Carex inversa	0.2	40	GG				0.2					
Asperula conferta	0.1	10	FG					0.1				
Paspalum dilatatum	2	30	HT									2
Eragrostis pilosa	40	500	EX								40	

Easting	748832
Northing	6064099
Orientation	150
Plot size	20x 20
BAM Attributes 20x50m plot	
Stem classes	
80+	
50-79	0
30-49	0
20-29	0
10-19	0
5-9	0
<5	0
Hollows	0
Length logs (m)	0
BAM Attributes 1x1 plot (%)	
Litter (%)	1

4/20/2022

Sheet version: 20170224.1531

Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
# spp	Count	Count	Count	Count	Count	Count	Count	Count	Count
19	4	0	0	3	1	0	0	16	1
Sum cover	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum	Sum
78.4	16.1	0	0	15.6	0.5	0	0	64.3	15

Easting	748963
Northing	6064190
Orientation	68
Plot size	20x 20

	Species	Cover	Abundance	Covers	Native	Trees	Shrubs	Grass	Forb	Fern	Other	Exotic	HighThreat
A	Lolium perenne	0.5	50	EX								0.5	
P	Trifolium repens	0.5	40	EX								0.5	
P	Holcus mollis	30	200	EX								30	
P	Acetosella vulgaris	2	80	EX								2	
p	Plantago lanceolata	0.2	20	EX								0.2	
p	Hypochaeris radicata	0.1	10	EX								0.1	
a	Bromus catharticus	0.5	60	EX								0.5	
p	Poa annua	0.1	2	EX								0.1	
a	Vulpia myuros	0.2	20	EX								0.2	
p	Poa labillardierei var. labillardierei	15	45	GG				15					
p	Geranium solanderi var. solanderi	0.5	30	FG					0.5				
p	Cirsium vulgare	0.1	6	EX								0.1	
p	Juncus australis	0.1	10	GG				0.1					
P	Festuca arundinacea	1	30	EX								1	
p	Paspalum dilatatum	15	200	HT									15
p	Rumex crispus	0.1	2	EX								0.1	
p	Dactylis glomerata	10	150	EX								10	
p	Eragrostis pilosa	2	50	EX								2	
p	Microlaena stipoides	0.5	50	GG				0.5					

80+	0
50-79	0
30-49	0
20-29	0
10-19	0
5-9	0
	0
Litter (%)	0

Table A.2 Opportunistic fauna records on subject land

COMMON NAME	SCIENTIFIC NAME
Birds	
Sulfur-crested Cockatoo	*Cacatua galerita*
Australian Raven	*Corvus coronoides*
Magpie Lark	*Grallina cyanoleuca*
Australian Magpie	*Gymnorhina tibicen*
Common Starling*	*Sturnus vulgaris*
Mammals	
Common Wombat	*Vombatus ursinus*
Swamp Wallaby	*Wallabia bicolor*
Reptiles	
Three-toed Skink	*Saiphos equalis*
Amphibians	
Common Eastern Froglet	*Crinia signifera*
Striped Marsh Frog	*Limnodynastes peroni*

Appendix B

Matters of National Environmental Significance – Likelihood of Occurrence

B1.1 EPBC Act threatened flora -likelihood of occurrence

Table B.1 Listed EPBC Act threatened flora considered for assessment and likelihood of occurrence on the subject land

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	EPBC ACT[1]	SAII	ASSOCIATED HABITAT & DISTRIBUTION	LIKELIHOOD OF OCCURRENCE	
						LIKELIHOOD	JUSTIFICATION
Baloskion longipes	Dense Cord-rush	V	V	No	Populations are small, including the Clyde Mountain area and Ballalaba (south of Braidwood). Commonly found in swamps or depressions in sandy alluvium, sometimes growing with sphagnum moss. Also occurs in swails within tall forest, and in Black Gum (*Eucalyptus aggregata*) Woodland.	Low	No swamps or woodland/forest habitat occurs on site. Not previously recorded in locality. Not recorded despite targeted survey.
Caladenia tessellata	Thick-lipped Spider-orchid	E	V	Yes	Grows in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil.	Low	No suitable woodland habitat occurs on site. Not previously recorded in locality.
Calotis glandulosa	*Mauve Burr-daisy*	V	V	Yes	Found in subalpine grassland (dominated by *Poa* spp.), and montane or natural temperate grassland dominated by Kangaroo Grass (*Themeda australis*) and Snow Gum (*Eucalyptus pauciflora*) Woodlands on the Monaro and Shoalhaven area. Appears to be a coloniser of bare patches, often occurring on roadsides. Common on roadsides in parts of the Monaro, though it does not persist for long in such sites. Does not persist in heavily-grazed pastures of the Monaro or the Shoalhaven area.	Low	No habitat available on site - grassland is highly degraded (grazed by stock) and no natural temperate grassland or woodland present.
Commersonia prostrata	Dwarf Kerrawang	E	E	No	Dwarf Kerrawang occurs on the Southern Highlands and Southern Tablelands. Occurs on sandy, sometimes peaty soils in a wide variety of woodland and forest habitats.	Low	No suitable woodland/forest habitat occurs on site. Not previously recorded in locality.

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	EPBC ACT[1]	SAII	ASSOCIATED HABITAT & DISTRIBUTION	LIKELIHOOD OF OCCURRENCE	
						LIKELIHOOD	JUSTIFICATION
Cryptostylis hunteriana	Leafless Tongue-orchid	V	V	No	Known from a range of communities, including swamp-heath and woodland.	Low	No suitable woodland/heath habitat occurs on site. Not previously recorded in locality.
Diuris ochroma	Pale Golden Moths	V	V	Yes	Recorded on the sub-alpine plains of Kosciuszko National Park and the Kybean area. Also recorded in eastern Victoria.Open grassy woodland of *Eucalyptus viminalis / E. pauciflora* or *E. pauciflora / E. parvula* (or secondary grassland). Also found in sub-alpine grassland.	Low	No suitable habitat present on site - secondary grassland is highly degraded and high cover of exotic ground species. No previous records in locality.
Dodonaea procumbens	Trailing Hop-bush	V	V	No	Occurs in the dry areas of the Monaro, mostly in Natural Temperate Grassland or *Eucalyptus pauciflora* Woodland. One population at Lake Bathurst (northern-most occurrence of the species) occurs adjacent to the lake bed in grassland dominated by Corkscrew Grass (*Austrostipa scabra*) and Curly Sedge (*Carex bichenoviana*).	Low	No suitable habitat present on site (no natural temperate grassland or woodland). No previous records in locality.
Eriocaulon australasicum	Austral Pipewort, Southern Pipewort	E	E	Yes	Occurs in NSW including a very early "Murray River" collection and recent collections near Braidwood and in the Pilliga. Occurs in wet places along the Murray towards junction of Murrumbidgee. In populations near Braidwood and in the Pilliga, it grows in mud in ephemeral water bodies.	Low	No suitable habitat (ephemeral waterbodies) present on site.
Eucalyptus kartzoffiana	Araluen Gum	V	V	Yes	Found in the Araluen, Bendethera and Majors Creek area, south of Braidwood. Grows near rivers, in grassy or shrubby woodland or in wet sclerophyll forest on moderately fertile sandy soil on granite.	Low	No suitable habitat occurs on site - woodland/forest or riparian habitat absent. Species is conspicuous and not recorded on site.

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	EPBC ACT[1]	SAII	ASSOCIATED HABITAT & DISTRIBUTION	LIKELIHOOD OF OCCURRENCE	
						LIKELIHOOD	JUSTIFICATION
Lepidium hyssopifolium	Basalt Pepper-cress, Peppercress	E	E	No	Occurs in NSW including a small population near Bathurst, one population at Bungendore, and one near Crookwell. Known to occur in both woodland with a grassy understorey and in grassland. May be a disturbance opportunist.	Low	No suitable habitat present on site as grassland is highly disturbed. Not previously recorded in locality.
Leptospermum thompsonii	Monga Tea-tree	V	V	No	Mostly found in Monga National Park near Braidwood. Two populations have also been recorded in Morton National Park to the north (near The Vines). Grows in swamps and drainage lines. It also invades road verges.	Low	No suitable habitat present on site (no swamps or drainage lines). No records from locality. Species is conspicuous and was not recorded during field flora surveys.
Leucochrysum albicans subsp. *tricolor*	Hoary Sunray	-	E	No	In NSW it currently occurs on the Southern Tablelands adjacent areas in an area roughly bounded by Albury, Bega and Goulburn, with a few scattered localities know from beyond this region In NSW and ACT, Hoary Sunray occurs in grasslands, grassy areas in woodlands and dry open forests, and modified habitats, on a variety of soil types including clays, clay loams, stony and gravely soil.	Low	Potential habitat on site is highly degraded and consists primarily of exotic grassland. Species was not recorded despite targeted flora surveys.
Persicaria elatior	Tall Knotweed	V	V	No	Normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.	Low	No suitable habitat (streams/lakes, swamp forest) present on site. Not previously recorded in locality.

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	EPBC ACT[1]	SAII	ASSOCIATED HABITAT & DISTRIBUTION	LIKELIHOOD OF OCCURRENCE	
						LIKELIHOOD	JUSTIFICATION
Pomaderris cotoneaster	Cotoneaster Pomaderris	E	E	No	Has a very disjunct distribution, from the Nungatta area, northern Kosciuszko National Park (near Tumut), the Tantawangalo area in South-East Forests National Park and adjoining freehold land, Badgery's Lookout near Tallong, Bungonia State Conservation Area, the Yerranderie area, Kanangra-Boyd National Park, the Canyonleigh area and Ettrema Gorge in Morton National Park. The species has also been recorded along the Genoa River in Victoria	Low	No records from locality. Species is conspicuous and was not recorded despite field flora surveys.
Pomaderris pallida	Pale Pomaderris	V	V	Yes	This species usually grows in shrub communities surrounded by Brittle Gum (*Eucalyptus mannifera*) and Red Stringybark (*E. macrorhyncha*) or *Callitris* spp. woodland.	Low	No records from locality. No suitable woodland habitat available on site. Not recorded despite field flora surveys.
Pomaderris parrisiae	Parris' Pomaderris	V	V	No	Found on skeletal soils in rocky shrubland or tall open forest chiefly on escarpment ranges.	Low	No records from locality. No suitable woodland habitat available on site. Not recorded despite flora surveys.
Prasophyllum petilum	Tarengo Leek Orchid	E	E	No	Occurs on relatively fertile soils in grassy woodland or natural grassland. Highly susceptible to grazing.	Low	Habitat degraded and no suitable habitat (natural grassland/woodland) available on site.

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	EPBC ACT[1]	SAII	ASSOCIATED HABITAT & DISTRIBUTION	LIKELIHOOD OF OCCURRENCE	
						LIKELIHOOD	JUSTIFICATION
Rhizanthella slateri	Eastern Underground Orchid	V	E	Yes	In NSW, currently known from fewer than 10 locations, including near Bulahdelah, the Watagan Mountains, the Blue Mountains, Wiseman's Ferry area, Agnes Banks and near Nowra. No particular vegetation type has been associated with the species, although it is known to occur in sclerophyll forest. Grows almost completely below surface, usually located only when the soil is disturbed.	Low	Species is rare and not previously recorded in locality. Known only to occur in sclerophyll forest which is not present on site. Grassland is highly degraded and primarily exotic.
Senecio macrocarpus	Large-fruit Fireweed, Large-fruit Groundsel	-	V	No	In NSW it occurs as one population near Gundaroo. Occurs in partly cleared dry forests and box-gum woodlands which transition to Brittle Gum Forest with a relatively undisturbed understorey of native grasses, forbs and subshrubs.	Low	Known only from one population in NSW and not recorded in the locality of the site. No suitable woodland/forest habitat occurs on site.
Thesium australe	Austral Toadflax	V	V	No	Occurs in grassland or grassy woodland. Grows on kangaroo grass tussocks but has also been recorded within the exotic coolatai grass. Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass (*Themeda australis*). A root parasite that takes water and some nutrient from other plants, especially Kangaroo Grass.	Low	Habitat degraded and no suitable habitat (native grassland/*Themeda* sp.) occurs on site.
Xerochrysum palustre	Swamp Everlasting	-	V	No	In New South Wales it occurs as far north as the Southern Tablelands and ranges up to about 1300 m altitude. Grows in wetlands including sedge-swamps and shallow freshwater marshes, often on heavy black clay soils.	Low	Habitat degraded and no suitable habitat (wetlands/swamps/marsh) occurs on site.

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	EPBC ACT[1]	SAII	ASSOCIATED HABITAT & DISTRIBUTION	LIKELIHOOD OF OCCURRENCE	
						LIKELIHOOD	JUSTIFICATION
Zieria adenophora	Araluen Zieria	CE	E	Yes	Currently known only from a single population of only 18 mature plants in 2020 near Araluen, south of Braidwood. Occurs in shrubland amongst large granite boulders and granite tors on a steep west facing hillside.	Low	No suitable habitat occurs on site. Site is primarily exotic-dominant grassland and exotic plantings. Does not occur on hillside.

(1) Threat status: V = Vulnerable, E = Endangered, CE = Critically endangered, M = Migratory.

B1.2 EPBC Act threatened fauna - likelihood of occurrence

Table B.2 Listed EPBC Act threatened fauna considered for assessment and likelihood of occurrence

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	EPBC ACT[1]	SAII	ASSOCIATED HABITAT & DISTRIBUTION	LIKELIHOOD OF OCCURRENCE	
						LIKELIHOOD	JUSTIFICATION
Amphibians							
Heleioporus australiacus	Giant Burrowing Frog	V	V	No	In south eastern NSW and Victoria, as two distinct populations: a northern population largely confined to the sandstone geology of the Sydney Basin and extending as far south as Ulladulla, and a southern population occurring from north of Narooma through to Walhalla, Victoria. Found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based.	Low	No suitable habitat presents on site. Site consists only of degraded grassland and exotic plantings. Not previously recorded in locality.
Litoria booroolongensis	Booroolong Frog	E	E	No	Found along permanent western flowing streams of the Great Dividing Range through most of NSW and down into northern Victoria. Occurs along streams in both forested areas and open pasture but has been affected by the presence of the introduced willow tree.	Low	No suitable habitat present on site. Site consists only of degraded grassland and exotic plantings. Not previously recorded in locality.
Litoria castanea	Yellow-spotted tree frog	CE	CE	Yes	Currently known only from one site - in the Southern Tablelands near Yass. It requires large permanent ponds or slow flowing 'chain-of-ponds' streams with abundant emergent vegetation such as bulrushes and aquatic vegetation.	Low	No suitable habitat present on site. Site consists only of degraded grassland and exotic plantings. Not previously recorded in locality.

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	EPBC ACT[1]	SAII	ASSOCIATED HABITAT & DISTRIBUTION	LIKELIHOOD OF OCCURRENCE	
						LIKELIHOOD	JUSTIFICATION
Mixophyes balbus	Stuttering Frog, Southern Barred Frog (in Victoria)	E	V	Yes	Occur along the east coast of Australia from southern Queensland to north-eastern Victoria. Recently has only been recorded at three locations south of Sydney. The Dorrigo region, in north-east NSW, appears to be a stronghold for this species. Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range.	Low	No suitable habitat present on site. Site consists only of degraded grassland and exotic plantings. Not previously recorded in locality.
Birds							
Actitis hypoleucos	Common Sandpiper	-	M	-	Found along all coastlines of Australia and in many areas inland. Is widespread in small numbers.Generally forages in shallow water and on bare soft mud at the edges of wetlands; often where obstacles project from substrate, e.g. rocks or mangrove roots. Birds sometimes venture into grassy areas adjoining wetlands.	Low	No suitable habitat present on site. Site consists only of degraded grassland and exotic plantings. Not previously recorded in locality.

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	EPBC ACT[1]	SAII	ASSOCIATED HABITAT & DISTRIBUTION	LIKELIHOOD OF OCCURRENCE	
						LIKELIHOOD	JUSTIFICATION
Apus pacificus	Fork-tailed Swift	-	M	-	Breeds in the northern hemisphere, wintering in Australia. It is almost exclusively aerial, flying from less than 1m to at least 300 m above ground. It mostly occurs over inland plains but sometimes above foothills or in coastal areas over cliffs, beaches, islands and well out to sea. It also occurs over towns and cities. It mostly occurs over dry and/or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh, grassland, spinifex sandplains, farmland and sand-dunes. It sometimes occurs above forests. It probably roosts aerially but has occasionally been observed to land.	Low	Almost exclusively aerial. Potential occurrences in air space above site cannot be discounted, however, not previously recorded in this area. If present, individuals would not be restricted or reliant on habitat within the site.
Calidris acuminata	Sharp-tailed Sandpiper	-	M	-	Migrates to Australia in the non-breeding season, in both inland and coastal locations and in both freshwater and saline habitats. Prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. Also occur in saltworks and sewage farms. Use flooded paddocks, sedge lands and other ephemeral wetlands, but leave when they dry. Use intertidal mudflats in sheltered bays, inlets, estuaries or seashores, and also swamps and creeks lined with mangroves. Tends to occupy coastal mudflats mainly after ephemeral terrestrial wetlands have dried out, moving back during the wet season.	Low	No suitable habitat present on site. Site consists only of degraded grassland and exotic plantings. Not previously recorded in locality.

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	EPBC ACT[1]	SAII	ASSOCIATED HABITAT & DISTRIBUTION	LIKELIHOOD OF OCCURRENCE	
						LIKELIHOOD	JUSTIFICATION
Calidris ferruginea	Curlew Sandpiper	E	CE	yes	Distributed around most of the coastline of Australia, along the entire coast of NSW, particularly in the Hunter Estuary, and sometimes in freshwater wetlands in the Murray-Darling Basin. It generally occupies littoral and estuarine habitats, and in NSW is mainly found in intertidal mudflats of sheltered coasts. It also occurs in non-tidal swamps, lakes, and lagoons on the coast and sometimes inland.	Low	No suitable habitat present on site. Site consists only of degraded grassland and exotic plantings. Not previously recorded in locality.
Calidris melanotos	Pectoral Sandpiper	-	M	-	In Australasia, prefers shallow fresh to saline wetlands. Frequents coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. It is in coastal or near coastal habitat but occasionally further inland. It prefers wetlands that have open fringing mudflats and low, emergent or fringing vegetation, such as grass or samphire. It has also been recorded in swamp overgrown with lignum. They forage in shallow water or soft mud at the edge of wetlands.	Low	No suitable habitat present on site. Site consists only of degraded grassland and exotic plantings. Not previously recorded in locality.

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	EPBC ACT[1]	SAII	ASSOCIATED HABITAT & DISTRIBUTION	LIKELIHOOD OF OCCURRENCE	
						LIKELIHOOD	JUSTIFICATION
Callocephalon fimbriatum	Gang-gang Cockatoo	V	E	No	Species is distributed from southern Victoria through south- and central-eastern New South Wales. In New South Wales, the Gang-gang Cockatoo is distributed from the south-east coast to the Hunter region, and inland to the Central Tablelands and south-west slopes. It occurs regularly in the Australian Capital Territory.. In spring and summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In autumn and winter, the species often moves to lower altitudes in drier more open eucalypt forests and woodlands, particularly box-gum and box-ironbark assemblages, or in dry forest in coastal areas and often found in urban areas.	Low	Species was recorded flying over site but is not considered to occur within or adjacent to the subject site as no suitable habitat is present. The site consists only of degraded grassland and exotic plantings.
Falco hypoleucos	Grey Falcon	E	-	No	Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast. Also occurs near wetlands where surface water attracts prey.	Low	No suitable habitat present on site. Site consists only of degraded grassland and exotic plantings. Not previously recorded in locality.
Gallinago hardwickii	Latham's Snipe, Japanese Snipe	-	M	-	Occurs in freshwater or brackish wetlands generally near protective vegetation cover. This species feeds on small invertebrates, seeds and vegetation. It migrates to the northern hemisphere to breed.	Low	No suitable habitat present on site. Site consists only of degraded grassland and exotic plantings. Not previously recorded in locality.

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	EPBC ACT[1]	SAII	ASSOCIATED HABITAT & DISTRIBUTION	LIKELIHOOD OF OCCURRENCE	
						LIKELIHOOD	JUSTIFICATION
Grantiella picta	Painted Honeyeater	V	V	No	Inhabits Boree/ Weeping Myall (*Acacia pendula*), Brigalow (*A. harpophylla*) and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus Amyema.	Low	No suitable habitat present on site. Site consists only of degraded grassland and exotic plantings - no mistletoe present on site. Species has not been previously recorded in locality.
Hirundapus caudacutus	White-throated Needletail	-	V, M	No	Migratory usually seen in eastern Australia from October to April. More common in coastal areas, less so inland. An aerial species found in feeding concentrations over cities, hilltops, and timbered ranges.	Low	Almost exclusively aerial. Potential occurrences in air space above site cannot be discounted, however, not previously recorded in this area. If present, individuals would not be restricted or reliant on habitat within the site.
Lathamus discolor	Swift Parrot (foraging)	E	CE	No	Occurs in woodlands and forests of NSW from May to August, where it feeds on eucalypt nectar, pollen, and associated insects. Dependent on flowering resources across a wide range of habitats in its wintering grounds in NSW. This species is migratory, breeding in Tasmania and nomadic, moving about in response to changing food availability.	Low	No suitable foraging or breeding habitat present on site. Site consists only of degraded grassland and exotic plantings. Not previously recorded in locality and site is not within an important mapped area.

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	EPBC ACT[1]	SAII	ASSOCIATED HABITAT & DISTRIBUTION	LIKELIHOOD OF OCCURRENCE	
						LIKELIHOOD	JUSTIFICATION
Monarcha melanopsis	Black-faced Monarch	-	M	-	Occurs in rainforests, eucalypt woodlands, coastal scrubs, damp gullies in rainforest, eucalypt forest and in more open woodland when migrating.	Low	No suitable habitat for migrating birds is present on site. Site consists only of degraded grassland and exotic plantings. Not previously recorded in locality.
Motacilla flava	Yellow Wagtail	-	M	-	Occurs in a range of habitats including estuarine habitats such as sand dunes, mangrove forests and coastal saltmarshes. Also occurs in open grassy areas including disturbed sites such as sports grounds and has been recorded on the edges of wetlands, swamps, lakes and farm dams. Migrates from Asia to Australia in spring-summer. It has been recorded in the estuarine areas of the Hunter River in Newcastle NSW and in QLD and the north of NT and WA.	Low	Uncommon non-breeding migrant to Australia. Occasional potential occurrences of migrating birds cannot be discounted, however, not previously recorded in this locality. If present, individuals would not be restricted or reliant on habitat within the site, as higher quality potential habitat occurs in the locality and broader region.
Myiagra cyanoleuca	Satin Flycatcher	-	M	-	Widespread in eastern Australia. Inhabits heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests. Mainly recorded in eucalypt forests, especially wet sclerophyll forest, often dominated by eucalypts.	Low	No suitable habitat present on site. Site consists only of degraded grassland and exotic plantings - no Eucalypts present on site. Species has not been previously recorded in locality.

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	EPBC ACT[1]	SAII	ASSOCIATED HABITAT & DISTRIBUTION	LIKELIHOOD OF OCCURRENCE	
						LIKELIHOOD	JUSTIFICATION
Numenius madagascariensis	Eastern Curlew	-	CE, M	Yes	A primarily coastal distribution. Found in all states, particularly the north, east, and south-east regions including Tasmania. Rarely recorded inland. Mainly forages on soft sheltered intertidal sand flats or mudflats, open and without vegetation or cover. Breeds in the northern hemisphere.	Low	No suitable foraging or breeding habitat present on site. Site consists only of degraded grassland and exotic plantings. Not previously recorded in locality.
Polytelis swainsonii	Superb Parrot	V	V	No	Found throughout eastern inland NSW. On the South-western Slopes their core breeding area is roughly bounded by Cowra and Yass in the east, and Grenfell, Cootamundra and Coolac in the west. Breeding in this region is usually absent during winter, when they migrate north to the region of the upper Namoi and Gwydir Rivers. Inhabits box-gum, box-cypress-pine and boree woodlands and river red gum forest. Breeding habitat can be identified by the presence of habitat features and observed nest OR two or more birds seen on site.	Low	No suitable habitat (Eucalypt forest/woodland) present on site. Site consists only of degraded grassland and exotic plantings. Species has not been previously recorded in locality.
Rhipidura rufifrons	Rufous Fantail	-	M	-	Found in northern and eastern coastal Australia, more common in the north. Found in rainforest, dense wet forests, swamp woodlands and mangroves, preferring deep shade, and is often seen close to the ground. During migration, it may be found in more open habitats or urban areas.	Low	No suitable habitat (Eucalypt forest/woodland, mangroves) present on site. Site consists only of degraded grassland and exotic plantings. Species has not been previously recorded in locality.

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	EPBC ACT[1]	SAII	ASSOCIATED HABITAT & DISTRIBUTION	LIKELIHOOD OF OCCURRENCE	
						LIKELIHOOD	JUSTIFICATION
Rostratula australis	Australian Painted Snipe	E	E, M	No	In NSW, has been recorded at the Paroo wetlands, Lake Cowell, Macquarie Marshes and Hexham Swamp. Most common in the Murray-Darling Basin. Prefers fringes of swamps, dams, and nearby marshy areas where there is a cover of grasses, lignum, low scrub, or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks, or reeds.	Low	Not previously recorded in locality or known to occur in area. Preferred aquatic habitat not present on site.
Fish							
Macquaria australasica	Macquarie Perch		E		Found in both river and lake habitats; especially the upper reaches of rivers and their tributaries	Low	No suitable habitat (waterways) present on site.
Prototroctes maraena	Australian Grayling	E	V		Occurs in streams and rivers on the eastern and southern flanks of the Great Dividing Range, from Sydney, southwards to the Otway Ranges of Victoria and in Tasmania. The species is found in fresh and brackish waters of coastal lagoons, from Shoalhaven River in NSW to Ewan Ponds in South Australia	Low	No suitable habitat (waterways) present on site.

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	EPBC ACT[1]	SAII	ASSOCIATED HABITAT & DISTRIBUTION	LIKELIHOOD OF OCCURRENCE	
						LIKELIHOOD	JUSTIFICATION
Invertebrates							
Synemon plana	Golden Sun Moth	E	CE	Yes	NSW populations are found in the area between Queanbeyan, Gunning, Young and Tumut. Occurs in Natural Temperate Grasslands and grassy Box-Gum Woodlands in which groundlayer is dominated by wallaby grasses (Austrodanthonia spp), that are typically low and open. The bare ground between the tussocks is an important microhabitat feature as it is typically these areas on which the females are observed displaying to attract males. Habitat may contain several wallaby grass species, which are typically associated with other grasses particularly spear-grasses Austrostipa spp. or Kangaroo Grass Themeda australis.	Low	No suitable feed species (wallaby grass or Chilean needle grass) present on site. Site consists of dense grassland, primarily exotic and no bare patches. Habitat is not suitable for this species, and no individuals recoded during survey.
Mammals							
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Yes	Found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes. Potential breeding habitat is PCTs associated with the species within 100m of rocky areas containing caves, or overhangs or crevices, cliffs or escarpments, or old mines, tunnels, culverts, derelict concrete buildings.	Low	No suitable roosting, breeding or foraging habitat for this species occurs on site. Species occurs primarily in open forest/woodland well-timbered gullies near roost sites (caves, cliffs, old mines, fairy martin nests).

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	EPBC ACT[1]	SAII	ASSOCIATED HABITAT & DISTRIBUTION	LIKELIHOOD OF OCCURRENCE	
						LIKELIHOOD	JUSTIFICATION
Dasyurus maculatus maculatus	Spotted-tailed Quoll	V	E	No	Found on the east coast of NSW across a range of habitat types, including rainforest, open forest, woodland, coastal heath, and inland riparian forest, from the sub-alpine zone to the coastline.	Low	No suitable habitat for this species occurs on site. May pass through area in transit to higher quality habitat on occasion. Is unlikely to be reliant on habitat within the site for connectivity as more suitable habitat is available broadly in the locality.
Isoodon obesulus obesulus	Southern Brown Bandicoot (eastern), Southern Brown Bandicoot (south-eastern)	E	E	No	Found in south-eastern NSW, east of the Great Dividing Range south from the Hawkesbury River, southern coastal Victoria and the Grampian Ranges, south-eastern South Australia, south-west Western Australia and the northern tip of Queensland. Generally only found in heath or open forest with a heathy understorey on sandy or friable soils.	Low	No suitable habitat for this species occurs on site (no heath or open forest with a heathy understorey). No records in locality.
Petauroides volans	Greater Glider	-	V	No	Occurs in eucalypt forests and woodlands. Nests in hollows typically found in older forests.	Low	No suitable habitat for this species occurs on site (no eucalypt forest or woodland, no HBT). No records in locality.
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	Yes	Found in rocky areas in a wide variety of habitats including rainforest gullies, wet and dry sclerophyll forest, open woodland, and rocky outcrops in semi-arid country. Commonly sites have a northerly aspect with numerous ledges, caves, and crevices.	Low	No suitable habitat for this species occurs on site. Rocky areas on site are small and surrounded by degraded pasture. No woodland or forest present on site.

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	EPBC ACT[1]	SAII	ASSOCIATED HABITAT & DISTRIBUTION	LIKELIHOOD OF OCCURRENCE	
						LIKELIHOOD	JUSTIFICATION
Phascolarctos cinereus	Koala (breeding)	V	E	No	Inhabits eucalypt forests and woodlands. The suitability of these forests for habitation depends on the size and species of trees present, soil nutrients, climate and rainfall. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species.	Low	No suitable habitat for this species occurs on site. May have rare occurrences in transit to higher quality habitat. Not likely to be reliant on habitat within the site for connectivity as more suitable habitat is available broadly in the locality and wider region. No Eucalypts present on site.
Potorous tridactylus tridactylus	Long-nosed Potoroo (SE Mainland)	V	V	No	Found on the south-eastern coast of Australia, from Queensland to eastern Victoria and Tasmania. In NSW it is generally restricted to coastal heaths and forests east of the Great Dividing Range, with an annual rainfall exceeding 760 mm. Inhabits coastal heaths and dry and wet sclerophyll forests.	Low	No suitable habitat (forest/heath) present on site. No records in locality.
Pteropus poliocephalus	Grey-headed Flying-fox (breeding)	V	V	No	A canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, melaleuca swamps and banksia woodlands. Bats commute daily to foraging areas, usually within 15 km of the day roost although some individuals may travel up to 70 km.	Low	No suitable foraging (forest/woodland swamps) or breeding habitat (i.e. camps) present on site. No records in locality.

SCIENTIFIC NAME	COMMON NAME	BC ACT[1]	EPBC ACT[1]	SAII	ASSOCIATED HABITAT & DISTRIBUTION	LIKELIHOOD OF OCCURRENCE	
						LIKELIHOOD	JUSTIFICATION
Reptiles							
Aprasia parapulchella	Pink-tailed Legless Lizard	V	V	No	Inhabits sloping, open woodland areas with predominantly native grassy ground layers, particularly those dominated by Kangaroo grass. Sites are typically well-drained, with rocky outcrops or scattered, partially buried rocks.	Low	Very limited rocky habitat available on site. Habitat is degraded, surrounded by exotic grassland. Survey of rocks failed to detect any individuals.
Delma impar	Striped Legless Lizard	V	V	No	Found mainly in natural temperate grassland but has also been captured in grasslands that have a high exotic component. Also found in secondary grassland near natural temperate grassland and occasionally in open box-gum woodland. Sometimes found in grasslands with significant amounts of surface rocks, which are used for shelter.	Low	Habitat on site is largely degraded (exotic pasture with limited rocky habitat). No records from locality.

(1) Threat status: V = Vulnerable, E = Endangered, CE = Critically Endangered, M = Migratory.

Appendix C

Biodiversity credit report

"U:\ProjectsAU\PS127xxx\PS127850_Proposed_Modifica\4_WIP\Docs\Report\Appendices\PS127850 Appendix C CreditSummaryReport.pdf"

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00030094/BAAS17071/21/00030112	Dargues Gold Mine MOD 5	24/11/2021
Assessor Name	**Report Created**	**BAM Data version ***
Liza Hill	21/02/2022	50
Assessor Number	**BAM Case Status**	**Date Finalised**
BAAS17071	Open	To be finalised
Assessment Revision	**Assessment Type**	**BOS entry trigger**
0	Part 4 Developments (General)	BOS Threshold: Area clearing threshold

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	Sensitivity to loss (Justification)	Species sensitivity to gain class	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAII	Ecosystem credits

Ribbon Gum - Snow Gum grassy forest on damp flats, eastern South Eastern Highlands Bioregion												
1	1100_Low	Not a TEC	0.5	0.5	1.4	PCT Cleared - 83%	High Sensitivity to Potential Gain			2.00		0
											Subtotal	**0**
											Total	**0**

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	Sensitivity to loss (Justification)	Sensitivity to gain (Justification)	BC Act Listing status	EPBC Act listing status	Potential SAII	Species credits

ABOUT US

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Appendix 6

Aboriginal and Historic Heritage Assessment Report

prepared by

Lantern Heritage Pty Ltd

(Total No. of pages = 151)

Dargues Gold Mine – MOD 5

Aboriginal and Historic Heritage Assessment Report

Report to R. W. Corkery & Co. Pty Ltd

Version 2.0 – July 2022

Lantern Heritage

shining a light on people and place

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PO BOX 239
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Project Name
Dargues Gold Mine – MOD 5
Aboriginal and Historic Heritage Assessment

Project Reference Number
#139

Local Government Area
Queanbeyan - Palerang

Report Author
Christine Gant-Thompson

Version	Date	Reviewer(s)	Notes
1.0	8/5/22	Anna Biggs	Internal review
1.1	11/5/22	Client review	Comments on draft report
1,2	6/6/22	Lantern Heritage	Incorporation of client review
2.0	21/7/22	Lantern Heritage	Incorporation of RAP review comments

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EXECUTIVE SUMMARY

Project background

The Dargues Gold Mine (the Mine) is owned by Big Island Mining Pty Ltd and is located about 13km south of Braidwood and immediately to the north of the village of Majors Creek (Figure 1). The Mine is classified as a State Significant Development and operates under Modified Project Approval (MP) 10_1154. This approval has been modified four times since it was originally granted on 7 February 2012. A further modification, MOD 5, is currently proposed.

R.W. Corkery & Co. Pty Ltd (RWC) has been commissioned by Big Island Mining Pty Ltd to prepare the MOD 5 modification report. The proposed MOD 5 activities include a number of adjustments to maximise the efficiency of mining activities and tailings residue management. These activities include increasing the processing rate, construction of a Water Storage Dam, minor changes to the mine layout, and emergency trucking of water to the mine (Corkery 2021).

Of these modifications, only the proposed Water Storage Dam and associated pipelines (raw water and excess water from the Tailings Storage Facility) have the potential to impact Aboriginal and/or Historic cultural heritage. The proposed dam will have a disturbance area of about 10ha and capacity of approximately 180ML.

The proposed construction of the Water Storage Dam has potential to impact Aboriginal and Historic objects and/or items. As such, RWC has engaged Lantern Heritage Pty Ltd (Lantern) to conduct an Aboriginal and Historic assessment of the study areas.

Field results

Field survey of the proposed Dargues Gold Mine MOD 5 study area was conducted over two days in March 2022. The first day of survey covered the initial MOD 5 design on 9 March with Christine Gant-Thompson and Glenn van der Kolk of Lantern Heritage and Marcelle Nye from Mogo LALC. The second day of survey covered the final MOD 5 design on 31 March with Christine Gant-Thompson of Lantern Heritage and Marcelle Nye from Mogo LALC.

While no Aboriginal sites/objects or Historic items were recorded in the field an area of Potential Archaeological Deposit (PAD) was identified. This area is located within the boundary of the proposed Water Storage Dam and is recorded as Dargues Gold Mine PAD 22-1 (AHIMS #57-6-0477)

Summary and recommendations

The works proposed as part of Dargues Gold Mine MOD 5 activities would result in direct harm to site Dargues Gold Mine PAD 22-1(AHIMS #57-6-0477)

The assessment of scientific values associated with this site has been conducted on the basis of field survey. The scientific significance is unknown as excavation is required to determine the type, extent and nature of archaeological subsurface deposit.

On the basis of the current investigations undertaken for the Dargues Gold Mine MOD 5 activities, the following recommendations are made:

a) Test excavation within Dargues Gold Mine PAD 22-1 (AHIMS #57-6-0477) is required, prior to impacts, to determine the type, extent and nature of archaeological deposit.

b) A copy of this report should be forwarded to all Registered Aboriginal Parties for their review and comment.

c) In the event that human skeletal remains, or suspected human skeletal remains, are encountered during any of the proposed works or salvage actions, all work must stop, and the procedures outlined in Appendix 3 must be implemented.

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1 PROJECT OVERVIEW

1.1 Introduction

The Dargues Gold Mine (the Mine) is owned by Big Island Mining Pty Ltd and is located about 13km south of Braidwood and immediately to the north of the village of Majors Creek (Figure 1). The Mine is classified as a State Significant Development and operates under Modified Project Approval (MP) 10_1154. This approval has been modified four times since it was originally granted on 7 February 2012. A further modification, MOD 5, is currently proposed.

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Of these modifications, only the proposed Water Storage Dam and associated pipelines (raw water and excess water from the Tailings Storage Facility) have the potential to impact Aboriginal and/or Historic cultural heritage. The proposed dam and ancillary infrastructure, located in the north-western corner of the project area (Figure 2), will have a disturbance area of about 10ha and capacity of approximately 180ML.

The proposed construction of the Water Storage Dam has potential to impact Aboriginal and Historic objects and/or items. As such, RWC has engaged Lantern Heritage Pty Ltd (Lantern) to conduct an Aboriginal and Historic assessment of the study area.

This report documents the archaeological assessment undertaken within the proposed MOD 5 activity area at Dargues Gold Mine. It has been prepared in accordance with the NSW Office of Environment and Heritage's *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW 2010b). It has also been has been compiled in accordance with the *Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance* (Australia ICOMOS, 2013a).

1.2 Location of study area

Dargues Gold Mine comprises 18 land titles and operates under NSW Mining Lease (ML) 1675 on land that is owned or controlled by Big Island Mining Pty Ltd. The study area is located within Queanbeyan-Palerang LGA in the parish of Araluen.

The study area is located on gentle to moderate mid and basal slopes forming a bowl around the upper reaches of Spring Creek (Figure 2). This semi-permanent creekline runs east-west before heading south to south-west towards the village of Majors Creek. The study area includes the existing infrastructure associated with Dargues Gold Mine such as roads, buildings, spoil heaps and carparks.

1.3 Personnel

Personnel involved in the survey work at Dargues Gold Mine included Lantern Heritage staff and Mogo Local Aboriginal Land Council (MLALC) staff. Lantern Heritage staff included Christine Gant-Thompson (Senior Archaeologist) and Glenn van der Kolk (Archaeologist). Mogo Local Aboriginal Land Council was represented by Marcelle Nye.

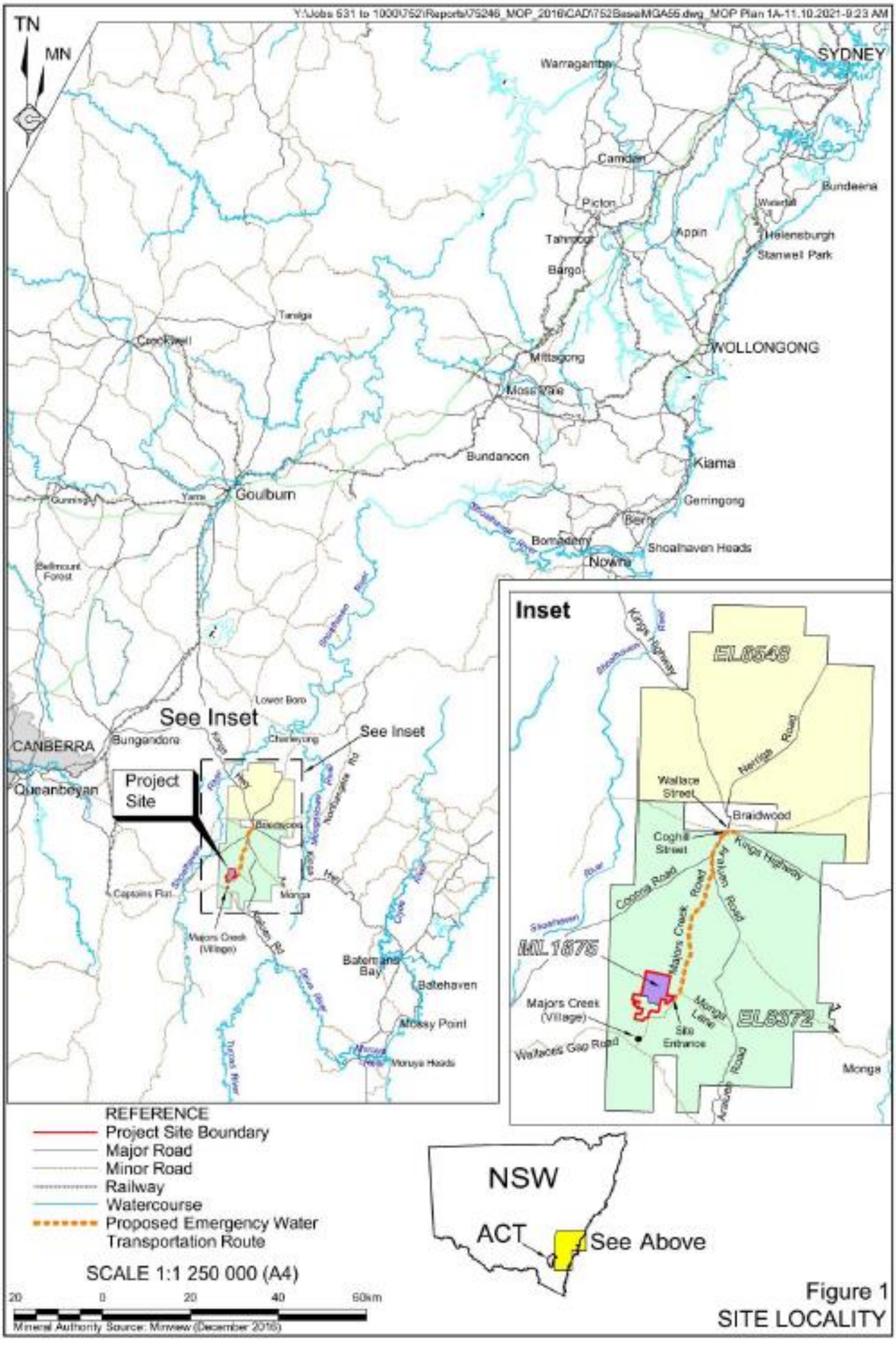

Figure 1: General location of Dargues Gold Mine (after Corkery 2021: 2).

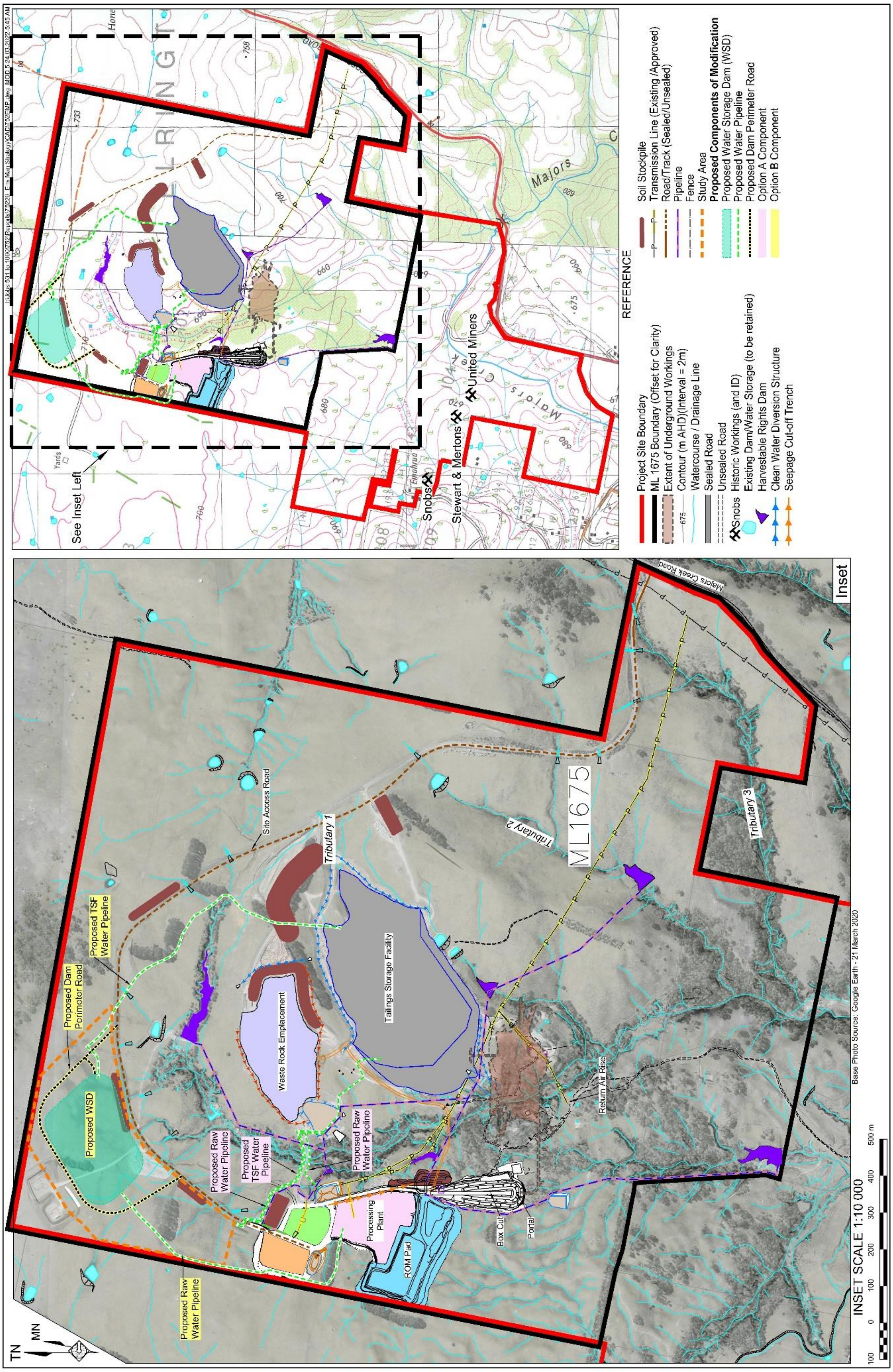

Figure 2: Location of proposed MOD 5 activities – Dargues Gold Mine (after Corkery 2021).

1.4 Legislative framework and required approvals

Dargues Gold Mine was transitioned from a Part 3A Project, to a State Significant Development (SSD) on 23 November 2018. In accordance with Clause 3BA(6) of Schedule 2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) *Savings, Transitional and Other Provisions) Regulation 2017*, the relevant reference point for comparison is the last modification granted under Section 75W of Part 3A of the EP&A Act. In this case, MOD 3 (granted on 10 August 2016) is the development to which the test for 'substantially the same' will be applied.

Aboriginal and Historic heritage is regulated by the NSW Heritage Division within Department of Planning and Environment (DPE), under the overriding ethos of the International Council on Monuments and Sites (ICOMOS) *Burra Charter.* As Dargues Gold Mine has received approval as an SSD under Part 3A of the EP&A Act, the project is exempt from obtaining permits under the *National Parks and Wildlife Act 1974* (NP&W Act). However, in the interests of best practice the Aboriginal Heritage Management Plan (AHMP) recommends that the requirements of the following guidelines be followed where feasible:

- Code of Practice for Archaeological Investigation of Aboriginal Objects 2010 (DECCW 2010a); and
- Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010 (DECCW 2010b) (Artefact Heritage Services 2019)

The application to modify MP10_0054 will be made under Section 4.55 (2) of the EP&A Act, and will be assessed by the DPE.

1.4.1 Approvals background

Modified project approval (MP) 10_0054 was granted by the Land and Environment Court on 7 February 2012, with subsequent modifications granted:

- 12 July 2012: Modification 1 for the use of paste fill at the Project Site;
- 24 October 2013: Modification 2 to regularise changes to the layout of the project;
- 10 August 2016: Modification 3 for an extension of the mine life and increase in the resource extracted; and
- 23 May 2019: Modification 4 for the relocation of the approved heavy vehicle crossing of Spring Creek and the reinstatement of the previously approved access track from the site access road to the tailings storage facility.

1.4.2 Aboriginal Heritage Management Plan

The original project approval required that an Aboriginal Heritage Management Plan (AHMP) be prepared. This plan was prepared in 2012 by Artefact Heritage Services, and sets out measures to manage Aboriginal cultural heritage values throughout the life of the project. The AHMP has been revised several times with the latest 2019 version providing:

- A summary of the Aboriginal heritage values present within the project site;
- Protocols for the management and protection of Aboriginal objects/sites located within the project site;
- A description of measures that would be implemented if any Aboriginal objects are encountered during the life of the project;
- A description of measures that would be implemented if any Aboriginal skeletal remains are encountered during the life of the project; and

- A protocol for the ongoing consultation and involvement of the Aboriginal community in the conservation and management of the Aboriginal heritage of the project site.

Any activities associated with the construction and operation of Dargues Gold Mine must comply with the AHMP.

1.4.3 Aims and Objectives

This Aboriginal and Historic Heritage Assessment Report (AHHAR) has been prepared to support the MOD 5 application for Dargues Gold Mine. The assessment detailed in this report documents potential harm from the proposed activities to Aboriginal and Historic objects and/or items. This report sets out which impacts are avoidable, and which are not, and where they are applicable, recommendations to reduce the extent and severity of harm to Aboriginal and Historic objects and/or items. It includes actions to be taken before, during and after an activity to manage and protect Aboriginal and Historic objects and/or items where harm cannot be avoided.

1.4.4 Report restrictions and copyright

None of the information contained in this report has been identified as confidential or restricted.

2 DESCRIPTION OF DEVELOPMENT PROPOSAL

2.1 Proposed Development

Big Island Mining Pty Ltd is proposing a range of adjustments to Dargues Gold Mine as part of the currently proposed MOD 5 works. The proposed MOD 5 works include a number of activities to maximise the efficiency of mining activities and tailings residue management. These modifications include increasing the processing rate, construction of a Water Storage Dam, minor changes to the mine layout, and emergency trucking of water to the mine (Corkery 2021).

Of these modifications, only the proposed Water Storage Dam and associated pipelines (raw water and excess water from the tailings storage facility) have the potential to impact Aboriginal and/or Historic cultural heritage (Figure 2). The proposed dam will have a disturbance area of about 10ha and would be constructed using cut and fill methods.

Activities associated with the proposed dam are summarised below:

- Construction of a turkey-nest style water management dam—Proposed dam to have no natural catchment, and a capacity of about 180ML for receipt and storage of excess water from the tailings storage facility, water pumped from underground workings and raw water from other on-site sources. The proposed dam would also be used to store water during periods of reduced rainfall or drought. Cut and fill construction methods will be used for the dam with the embankment built from materials sourced from within the dam footprint;
- Ancillary infrastructure including an access road, pump stand/laydown area and surface water diversion bunds would also be constructed adjacent to the proposed water management dam; and
- A raw water pipeline and a tailings storage facility (TSF) water pipeline are proposed to link the dam to the existing water pipeline network, mine processing plant and TSF. The majority of these pipelines will be laid directly on the surface resulting in no ground disturbance. At one point, the pipeline will cross beneath the main access road to the Mine through underboring.

2.2 Potential Harm to Aboriginal Objects and/or Historic items

The proposed MOD 5 works include construction of a Water Storage Dam, water pipeline placement and underboring for water pipeline. The potential impacts associated with these works are described in detail below.

2.2.1 Construction of Water Storage Dam

Removal of vegetation, trees and topsoil across the proposed dam area followed by major excavation of soil deposits to create a 180ML water storage area. Excavation of soil will have an impact on any surface, Aboriginal objects and/or Historic items and subsurface archaeological deposits. Movement of machinery during these activities will have an impact on Aboriginal objects and/or Historic items located on the surface of the proposed impact area. Any stockpiling of materials may have a crushing impact on Aboriginal objects and/or Historic items. Following dam construction, this area will be landscaped and erosion controls installed. This range of works will result in major ground disturbance, and as such have the potential to directly harm any Aboriginal objects and/or Historic items present in this area.

2.2.2 Placement of water pipelines

Placement of water pipelines across the MOD 5 study area has the potential to damage or displace Aboriginal objects and/or Historic items that may be present on the surface where the pipes are laid. However, impacts are considered to be minor and limited in area.

2.2.3 Underboring for water pipeline

The MOD 5 works propose using directional drilling to bore underneath the main access road to the Mine for the water pipelines. This drilling process may result in direct harm to Aboriginal objects and/or Historic items that may be present in this area, however, the impact area will be relatively small.

3 LANDSCAPE CONTEXT

Dargues Gold Mine site is located in the South Eastern Highlands bioregion, a temperate area of plateaus and north-south oriented dissected ranges that extends from the Great Escarpment in the east to the western fall of the Great Dividing Range (NPWS NSW, 2003). The complex geology of the Lachlan Fold Belt, where this area is located (Johnson, 2009), provides the resources sought by modern miners, but also a range of raw materials that were exploited by Aboriginal communities in the past. This geological substrate has also resulted in complex topography and varied environments that are reflected in the region's diverse ecology.

3.1 Hydrology

Spring Creek is a first order stream that forms a hook shaped feature within the landscape of Dargues Gold Mine. This semi-permanent creekline runs east-west before heading south to south-westerly towards the village of Majors Creek. Several small water courses feed into Spring Creek within the current MOD 5 study area. About 1.8km from the MOD 5 study area, Spring Creek joins Majors Creek which in turn is a tributary of the Deua River. During the current field survey. following a summer of above average rainfall, Spring Creek and its minor tributaries contained significant amounts of water. However, it is most likely that in pre-contact periods, the granite bedrock within the study area would have formed natural waterholes along the creeklines.

3.2 Geology and soils

The geological environment of the South Eastern Highlands Bioregion consists of Palaeozoic granites with metamorphosed sedimentary rocks and Tertiary basalts (Johnson, 2009). The Lachlan Orogeny has resulted in complex series of metamorphosed Ordovician to Devonian sandstones, shales and volcanic rocks, which are intruded by numerous granite bodies and deformed by successive episodes of folding, faulting and uplift (Figure 3). The topography strongly reflects the general north-south structural trend that results from these orogenic processes, and the dominant features of the bioregion are plateau remnants, granite basins with prominent ridges formed on contact metamorphic rocks, and the western ramp grading to the South Western Slopes (NPWS NSW, 2003). Streams cutting through the bioregion are deeply entrenched with few terrace features, narrow valleys and little Quaternary sediment, except in the numerous lake basins of the Monaro province to the south of the study area. The study area is located at the boundary between the Shoalhaven and Deua catchments, on a relatively level plateau area directly to the northwest of a steeply incised river valley where a tributary of the Deua river flows (R W Corkery 2010).

Soils vary across the bioregion in relation to altitude, temperature and rainfall. Mottled red and yellow texture-contrast soils are formed on the Palaeozoic slates, sandstones and volcanics. On the granites, shallow red earths occur on ridges, while yellow texture contrast soils are found on all slopes (NPWS NSW, 2003).

The area directly surrounding the study area (Figure 4) was classified as the Braidwood Granites Mitchell landscape (Mitchell 2002). This landscape type is characterized by rounded and undulating to moderately steep hills formed on Silurian-Devonian granite and granodiorite. General elevation across the area ranges from 800m to 1100m with local relief 50m to 200m. Gritty yellow texture-contrast soils with hard setting A horizons form on hills and slopes (NPWS NSW, 2003), while harsh clays are common along drainage lines. Wide waterways, which would have originally contained 'chain of ponds' type streams are now gullied, exposing dark gritty clays.

3.3 Ecology

For detailed assessments of the floral and faunal communities that are present at the Dargue's gold mine site, readers are referred to R W Corkery's 2010 environmental assessment. Reflecting the pedological and geological environment, vegetative communities vary across the bioregion in relation to altitude, temperature and rainfall. Granite-derived soils support apple box (*Eucalyptus bridgesiana*), yellow box (*E. melliodora*), some white box (*E. albens*) and red stringybark (*E.*

obliqua) associations, with ribbon gums (*E. viminalis*) on the lower slopes and brown barrel (*E. fastigata*) occurring in the eastern parts of the bioregion. Rocky outcrops support patches of black cypress pine (*Callitris endlicheri*), whereas cold plateaus support open woodlands of snow gum (*E. pauciflora*) and black sallee (*E. stellulata*). River oak (*Casuarina cunninghamiana*) is widespread along streams (NPWS NSW, 2003).

Fauna

Eighty-eight fauna species from the South Eastern Highlands Bioregion are listed in the schedules of the *Threatened Species Conservation Act 1995* (TSC Act) (NSW NPWS 2001). Observed changes in faunal composition are consistent with landscape fragmentation and gradual decay in diversity in remnant patches (NPWS NSW, 2003). The extent of prior impacts makes it difficult to assess what faunal resources were available to Aboriginal communities in the past.

3.4 Aboriginal use of the land

As discussed in Section 4, the Dargues Gold Mine falls within the tribal boundary of the Walbinga people. Aboriginal people thrived on the seasonal food resources available across the South Eastern Highlands. Yam daisy tubers were in season during spring, summer and autumn, with wattleseeds plentiful in July and August. In late winter and early spring, orchid tubers were available. Possums and large grazing marsupials such as wallabies and kangaroos were hunted throughout the year. Within the study area, there are a number of high points with first order gullies that would have provided intermittent water sources to Aboriginal people that supplemented the more reliable water from Majors Creek and tributaries of the Shoalhaven and Deua Rivers. Within the Shoalhaven River a variety of aquatic resources including nardoo, waterfowl, fish, turtles and crayfish were harvested (NPWS 2003).

The forested plains and hills of the South Eastern Highlands would have provided a variety of resources for tools, habitation and food. Walbinga people also participated in the annual summer pilgrimage to the Snowy Mountains to participate in Bogong Moth feasts (NPWS 2003).

3.5 Land-use History

The study area is located within Portion 102 in the Parish of Araluen. Post-colonial activities in the form of rural land selections date back to the mid-1820s. As detailed in Section 5, this land selection resulted in vegetation clearance to support cattle and sheep grazing with construction of dams to provide water for stock.

Alluvial gold was first discovered along Majors Creek in 1851, resulting in an influx of individuals and their families trying their luck with gold panning. After the easily won alluvial gold was exhausted, mining techniques developed to involve greater impacts to the creeks and surrounding landscape. Examples of these impacts include construction of water races to direct water where it was needed, placement of mullock heaps throughout the landscape, construction of dams, and excavation of puddling depressions. A railway was built to connect Dargues Reef with the battery located at Majors Creek to crush the ore (ca 1889). The subsurface deposit known as Dargues Reef was mined during two periods: from 1870 to 1891 and from 1914 to 1916 (AS&R 2010a).

The most recent phase of gold mining commenced in 2009 with exploratory drilling of the Dargues reef. As detailed in section 1.1 planning approval for the project was granted in 2012. These recent mining activities have resulted in the construction of mining infrastructure, vehicle parking areas, construction of drilling-pads, road upgrades, laydown areas and levelling of areas for buildings with various functions. In addition, significant revegetation works have been completed to reduce erosion along Spring Creek.

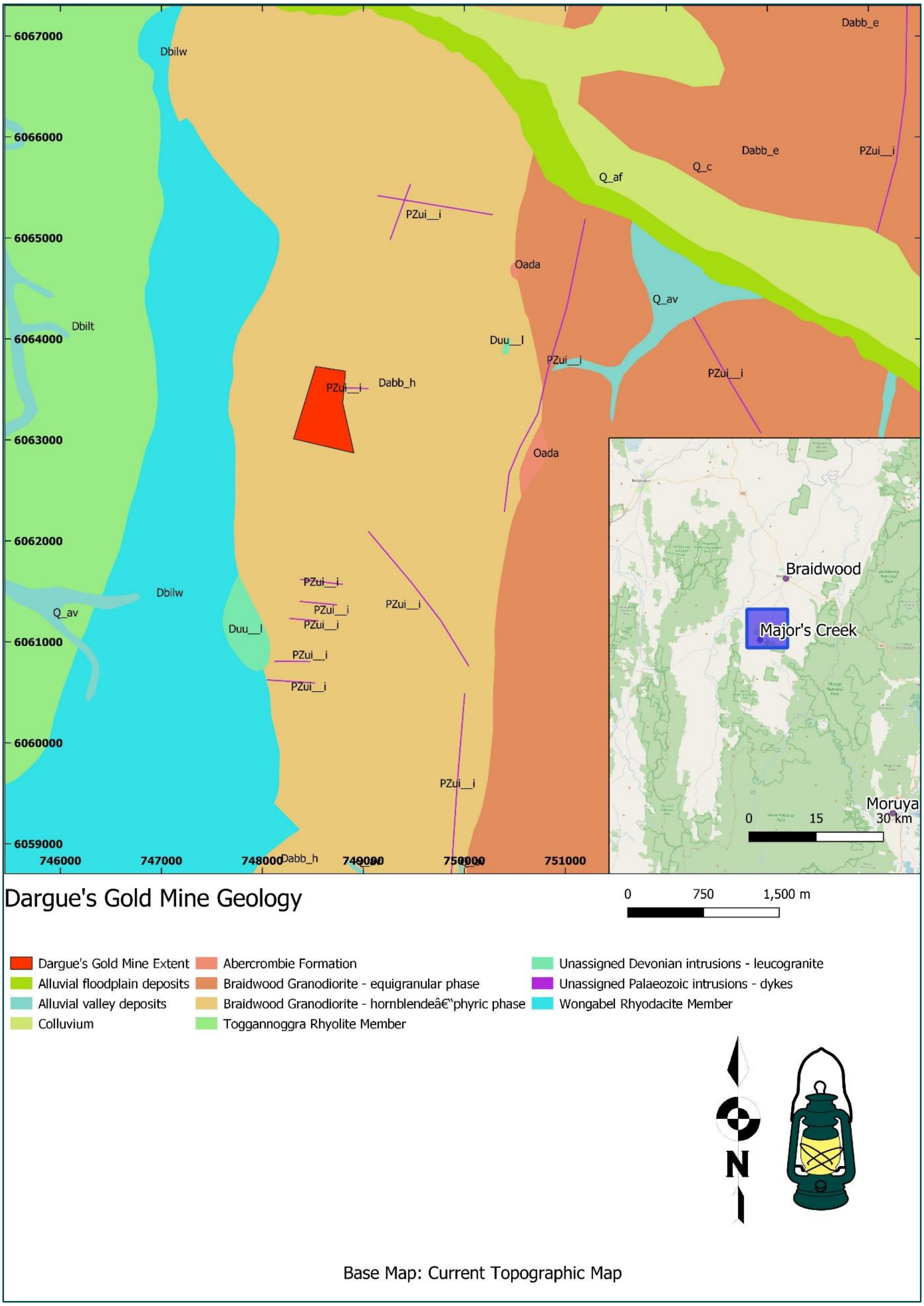

Figure 3: Geological setting of Dargue's Gold Mine (indicated by red polygon).

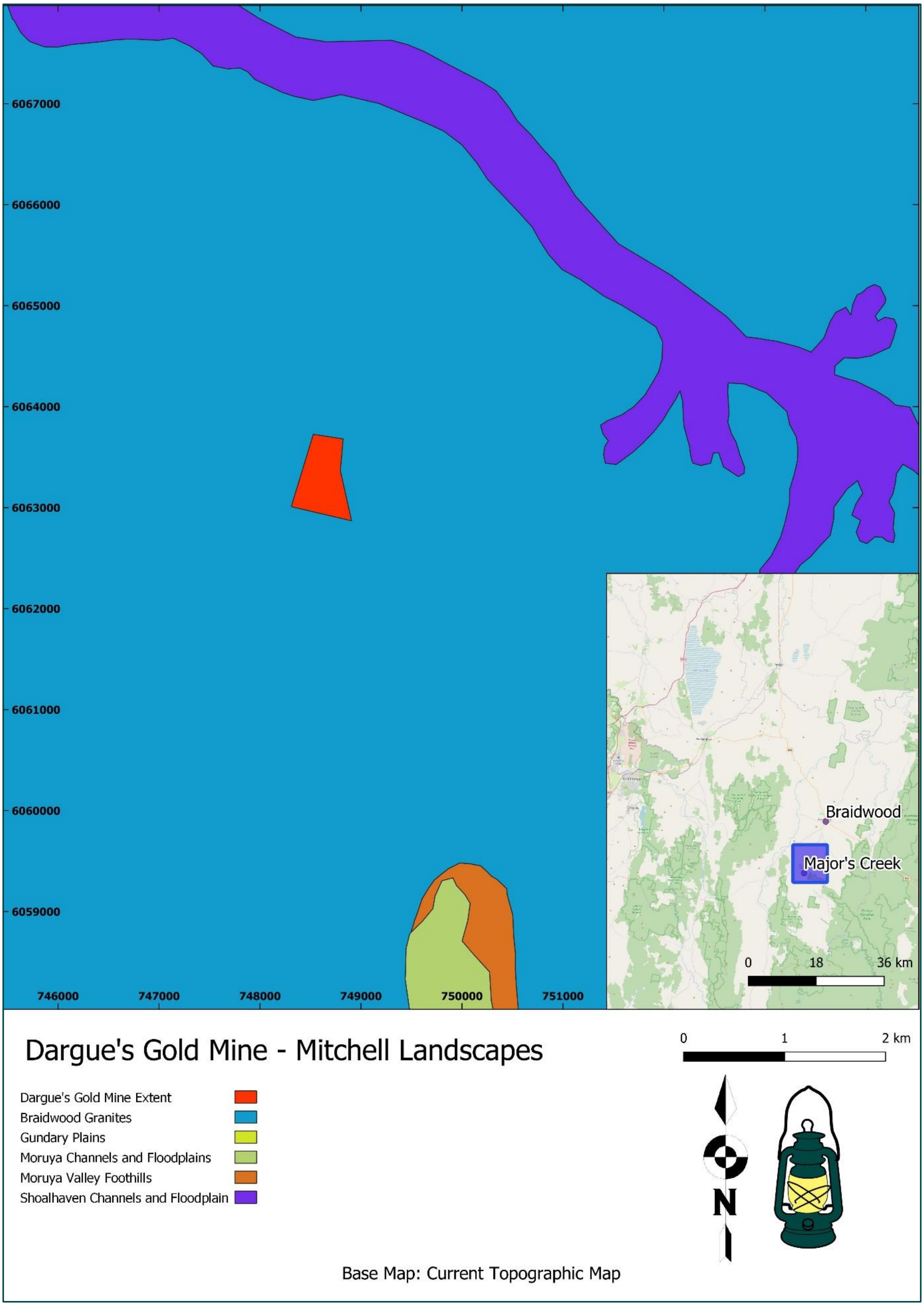

Figure 4: Mitchell landscapes surrounding Dargue's Gold Mine (indicated by red polygon).

4 ETHNOHISTORY

Our understanding of the lifestyle of past Aboriginal people from the Majors Creek area is largely limited to the existence of first-hand European sources. These sources are relatively scarce and often biased in many ways.

Today the study area is known as Majors Creek. Historically, the area was inhabited by the Walbinja (Walbanga) and Wandanndian people, whose country encompassed the areas around Bungendore and Braidwood (Clarke 2020). Many of their descendants continue to live in the local area. (It is important to note that names of places that identify with Aboriginal language may differ in spelling due to the interpretation of western pronunciation).

Walbinja and Wandandian people identify their country as the valleys north of the Tuross and Moruya Rivers, near the junction of the Shoalhaven and Mongarlowe Rivers (HO & DUAP 1996). Three language groups are known to identify with this area: Dhurga, Djiringanj, and Dyirringan (Clarke 2020). However, these three Clan groups intermarried and formed part of a larger kin group that extended from the southeast coast and over the mountains. Food was particularly plentiful in coastal zones, however it was ceremonial events (e.g. Bora-Bora) that brought many coastal families inland, where marriages and other unions (e.g. trade networks) then strengthened the ties between mountains and coast. (Donaldson & Feary 2021). This also meant that crossovers of dialects from two or more clan groups occurred.

One noted individual found in historical records is Umbarra (Black Duck) or King Merriman, who was a Traditional Owner of the Yuin Nation. Umbarra is recorded as one of the first Yuin kings, being awarded this designation in 1892. At the time of his birth and during his life, King Merriman would have witnessed and experienced firsthand the impacts of the gold mining era at Majors Creek on south coast tribes (Donaldson 2006).

Records show that Yuin (South Coast) tribes would engage in marriages to different clan groups so that lore and culture were sustained. In accordance with the rule of Urabunna, men would marry woman from different tribes and localities. This rule contributed to the strength of a tribe and the continuation of oral history and traditions (Howitt 1904).

The seasons played a major role in food acquisition practices before the interruption of traditional lifestyles by European colonisation. Seasonal migration of the bogong moth is celebrated in oral histories of the region and local area, which detail the accompanying ceremonies, celebration and feasting. Some of these culturally important gatherings took place in and around Majors Creek and Braidwood. Another activity that was interrupted by European settlement was the production and harvesting of the daisy yam (Donaldson & Feary 2021).

Geological and archaeological investigations in the greater Braidwood region have revealed that the primary stone sources used to manufacture tools were silcrete and quartz. These sources are recorded primarily located along the banks of Spring Creek, located about 2.5km northwest of Majors Creek. (Appleton 2010).

Prior to the impacts from gold mining, there would have been many areas of resource gathering and cultural significance along the creek banks of Majors Creek and nearby Araluen Creek. The suggested Aboriginal meaning of Arauluen or Arr-a l-yin is "place of the water lilies" (Anon 2022b), indicating that these watercourses would have provided a range of food resources for Aboriginal people.

Aboriginal people managed their country through cultural burning to sustain their food resources. This cleared low shrubs from the understory and made the land more attractive to the colonial settlers as the land was already cleared for cattle and sheep farming.

In the early 1800s colonial settlers began moving further south from Sydney to establish pastoral holdings, and started encroaching on the homelands of Aboriginal people within the South Eastern

Highlands Region. This resulted in violence and altercations disrupting Aboriginal people and their cultural practices (HO & DUAP1996).

The South Eastern Highlands Region was impacted as the population of European settlers expanded. An example of this was the change to Aboriginal lifestyle caused by the diminishing quality of water, fish and native animals. These are all important aspects of Aboriginal diet. Some Aboriginal people adapted to this change by working for the new settlers as farm hands, washing sheep, cutting bark and picking potatoes, while others remained on country. The traditional lifestyles and complex Aboriginal communities of this region were destroyed within 50 years of European settlement (HO and DUAP 1996).

It must be noted that although Tindale's 1974 mapping of Aboriginal land boundaries references the unique Aboriginal Nations, these boundaries have been questioned by some clan groups based on landscape (natural) markers that once existed and served as clan group boundaries. Many such landmarks and features have been removed by modern modification of roads and or housing estates.

5 HISTORIC BACKGROUND

5.1 First Historical Settlement

Between 1827 and 1845, an extensive area of land, including what is now Dargues Gold Mine, was owned by Major William Sandy Elrington. Elrington was a British military veteran of the Napoleonic Wars, who was granted the land for free, receiving some 2650 acres. During this time, the property, known as 'Mt Elrington', was used for various farming activities. In 1831, Elrington purchased additional land and extended the farm. This purchase encompassed the existing town, and land further south over the falls into the Araluen valley.

Major Elrington was an influential figure, who was the first Justice of Peace appointed in the district, and one of only two magistrates who served and enforced law and order (Anon 2022a). Like most farms in the area, Mt Elrington was staffed primarily by convicts. Until 1836, any reoffenders were taken to Mt Elrington to face justice by Major Elrington, himself.

Records indicate that from 1840, Mt Elrington was first used for dairy, sheep and horse farming, and the cultivation of wheat and vegetables. Later, after the goldrush, it produced oats, potatoes, corn and turnips.

Elrington's interests extended beyond farming. In 1840, he founded another settlement, a village, also eponymously named, 'Elrington'. However, this village did not prosper. Later, during the gold strikes of 1851 a town was founded in this location, which was named 'Majors Creek' in his honour (Figure 5). By this time, Elrington had sold his land holdings, having retired to England in 1845. He died there in 1860.

5.2 Gold Fever

Alluvial gold first was discovered in 1851, east of the present town of Majors Creek by Catherine Baxter accompanied by Jack Higgins (McQueen 2014). They recovered four ounces of gold on their first day of prospecting. Within two days of the discovery, 50 prospectors had descended upon Majors Creek. By December, there were between two and three thousand. Further prospecting successes by Baxter and Higgins enabled them to purchase a farm, which provided vegetables and chickens to the miners until Baxter passed away in 1858 (McQueen 2014).

Few records remain of gold exploration and extraction in the area prior to the existence establishment of Majors Creek Mine. Many of the records that did exist have presumably been lost due to the closure of tenements (AS&R 2010a). During this early period, gold exploration and extraction was undertaken by individual prospectors seeking their fortunes. Their luck depended predominantly on the weather, the availability of water, and developments in extraction and processing techniques.

With alluvial gold discoveries continuing, by late 1852 the gold rush extended to Spring Creek (McQueen 2014). The sheer number of miners occupying the Majors Creek area created a lively environment, by all accounts, with numerous, "so called hotels on the creek" (Brennan 1907). However, by the early 1860s, the source of easily recovered gold had been exhausted. As a result, many Europeans left town, and the population dwindled.

Chinese Prospectors

By 1859 Chinese gold miners were well established in the Majors Creek area panning for alluvial gold. Up to 1500 Chinese prospectors a year were said to occupy the Majors Creek area, making up a significant proportion of the miners. The Chinese men rarely married, and when they did, they typically chose either European or Aboriginal wives (McGowan n.d.). Chinese gardens were established in most major gold mining areas, particularly Majors Creek, to assist with the European demand for produce. Due to subsequent gold dredging and farming, no sign of the Chinese settlements remains. However, artefacts recovered from this period are displayed in the Braidwood Museum. After the mass exodus of the European miners from town, many Chinese miners stayed to "work over the old claims". The lack of registration of gold discovery at the time has resulted in a dearth of records of the Chinese miners. Although, it is known that there were many hundreds or even thousands of Chinese miners in the area, there are no records of who they were or where they worked. They worked quietly and anonymously, collecting unknown quantities of gold (AS&R 2010a).

Tom Cook and the Gold Reef

Some time around 1865 Tom Cook discovered a gold "reef" by following a quartz vein. By 1868, there was talk that Majors Creek could become a "reefing district" (McQueen 2014). Reefing is a more difficult process of gold removal requiring different machinery and more cooperative effort. In the later gold mining period, only larger mining companies had the capacity to extract gold using the reef technique. Most of the reefing operations carried out utilised a work force of paid employees.

Joseph Dargue

By 1868 Joseph Dargue was at Majors Creek mining gold. When the availability of alluvial gold, declined a number of European and Chinese miners remained using ground sluicing and 'surfacing'. Dargue hit the jackpot, when he sampled an ant bed and recovered 20 pounds of gold. By 1869, he and his associates had established an open-cut mine on both sides of Spring Creek (McQueen 2014). This was the origin of the Dargues Gold Mine.

Farming and Mining

The goldrush, and its resultant influx of people helped to facilitate the expansion of sheep and cattle farming in the surrounding regions. And, in return, the farms provided food resources for the growing workforce. Majors Creek, and neighbouring Braidwood were communities built on both the farming and mining industries (HO and DUAP 1996).

Relationships with Aboriginal People

The effects of European colonisation on the local Aboriginal population cannot be overstated. Although, many of the early settlers developed overwhelmingly positive relationships with Aboriginal people, there were also some negative interactions. The impossibility for many Aboriginal people to continue their cultural traditions in the face of European settlement must also be acknowledged (HO & DUAP 1996). Amidst this upheaval, alcohol was introduced by the European miners and opium by the Chinese miners. This resulted aggressive encounters, disease and even death (Wesson, 2002).

Remains of Historic Mining

Over eighty years of mining activities at Majors Creek and Dargues Reef goldfields have left visible, albeit non-specific, evidence of their high impact on the land (AS&R 2010a). In 2010, the only European heritage items of interest that remained at the site were three dredge shelves or buckets, and an abandoned shaft of Dargues Reef Mine. Other material evidence of past mining activities consisted of: traces of railway from Dargues Reef to a crushing plant located at Majors Creek; several dams; footings of the chlorination plant; water-races and puddling depressions, (AS&R 2010a). Various smaller items were uncovered comprising fragments of ceramic, stoneware, and glass. These finds do not provide enough evidence to support the association of occupation at the site (AS&R 2010a).

5.3 Study Area

The 2nd edition (1901) parish map of Elrington, County St Vincent, shows that the study area corresponds to Portion 102 (Figures 5 and 6). Crown Plan v23.787 (Figure 7), indicates that this land was purchased in 1836—under regulation of 1831 Land Grant—by William Roberts, (trove.nia.gov.au/search/category/newspapers?keyword=William%20roberts%20 jembaicumbene).

Roberts was the brother-in-law of Andrew Badgery, another active landholder in the local area. Roberts was born 1805 in Sydney, He married Andrew Badgery's sister, Anne, in 1823, and together they had five children (Ancestry.com.au). Roberts died in 1841 in Sydney. Andrew Badgery was born 1806 in Windsor, New South Wales, and died in Braidwood in 1857. He was the principle

European settler to take up land holdings outside of Sydney. In 1827, he received a grant for land in Araluen in County Camden. In the 1830s, he extended his land holdings with his brother-in-law, Roberts.

Neither Badgery nor Roberts showed much interest in gold mining, themselves. However, they developed enterprises to profit from the gold rush. William Roberts and Andrew Badgery, together, purchased several lots for grazing. This established the family's fortune, as the land holdings were released in the 1850s for mining licenses, (AS&R 2010a , Anon 2022a). The total land area of seven separate lots, amounting to 5,823 acres, encompasses the study area of Majors Creek. In the 1850s, as the intensity of gold mining increased, Badgery opened a store on the gold fields, while Roberts opened the first inn at the site of the current Doncaster Inn at Braidwood. (AS&R 2010a , Anon 2022a). The relationship between the two men seems to be not only that of in-laws, but also long-term business partners. Badgery, no stranger to business, appears to have been the conduit for Roberts to establish himself as a land title holder in Majors Creek,

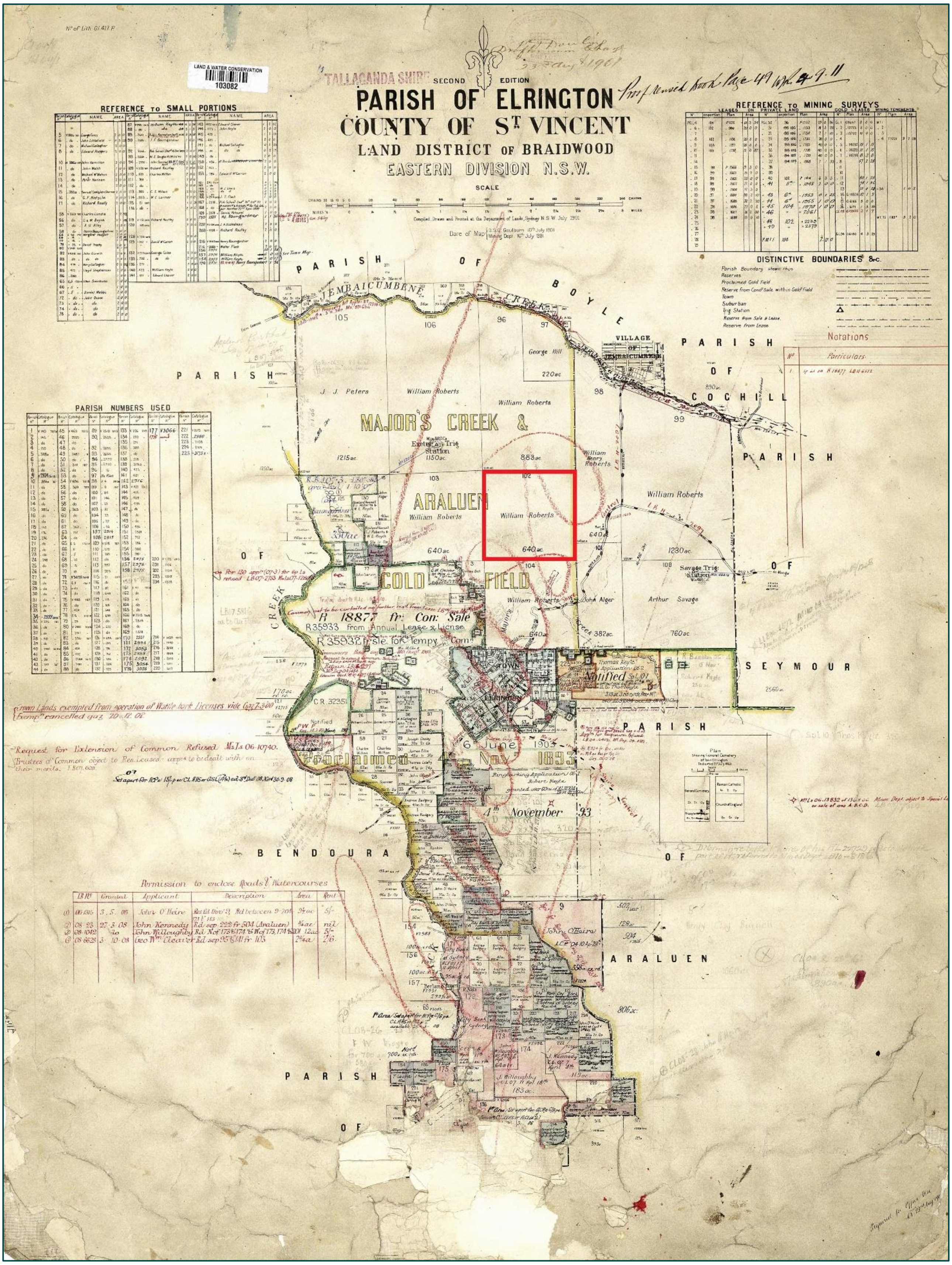

Figure 5: Location of Portion 102 (red outline) on 1901 (2nd edition) Parish map of Elrington (NSW Land Registry Services)

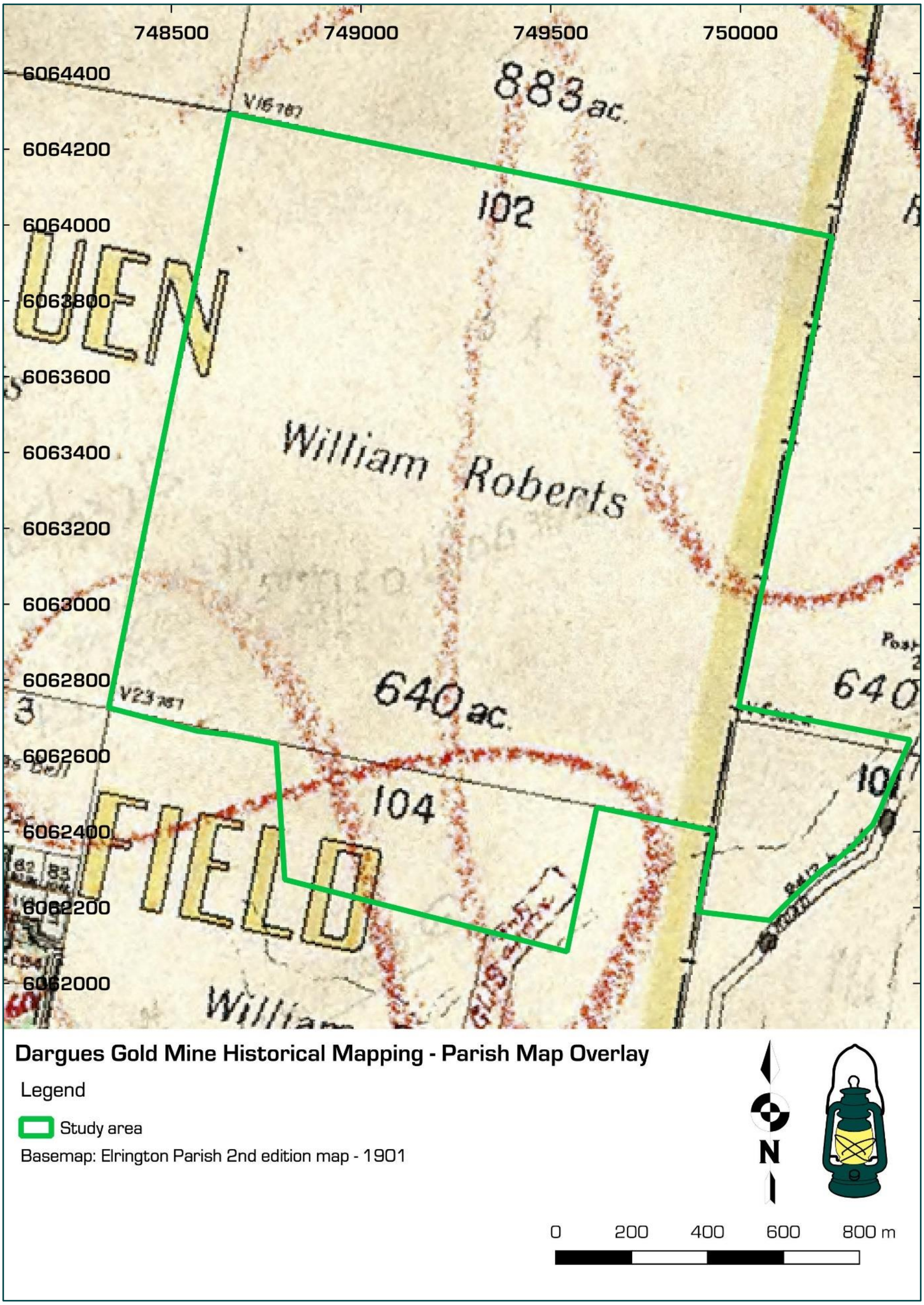

Figure 6: Location of Dargues Gold Mine study area (green outline) on 1901 (2nd edition) Parish map of Elrington (NSW Land Registry Services)

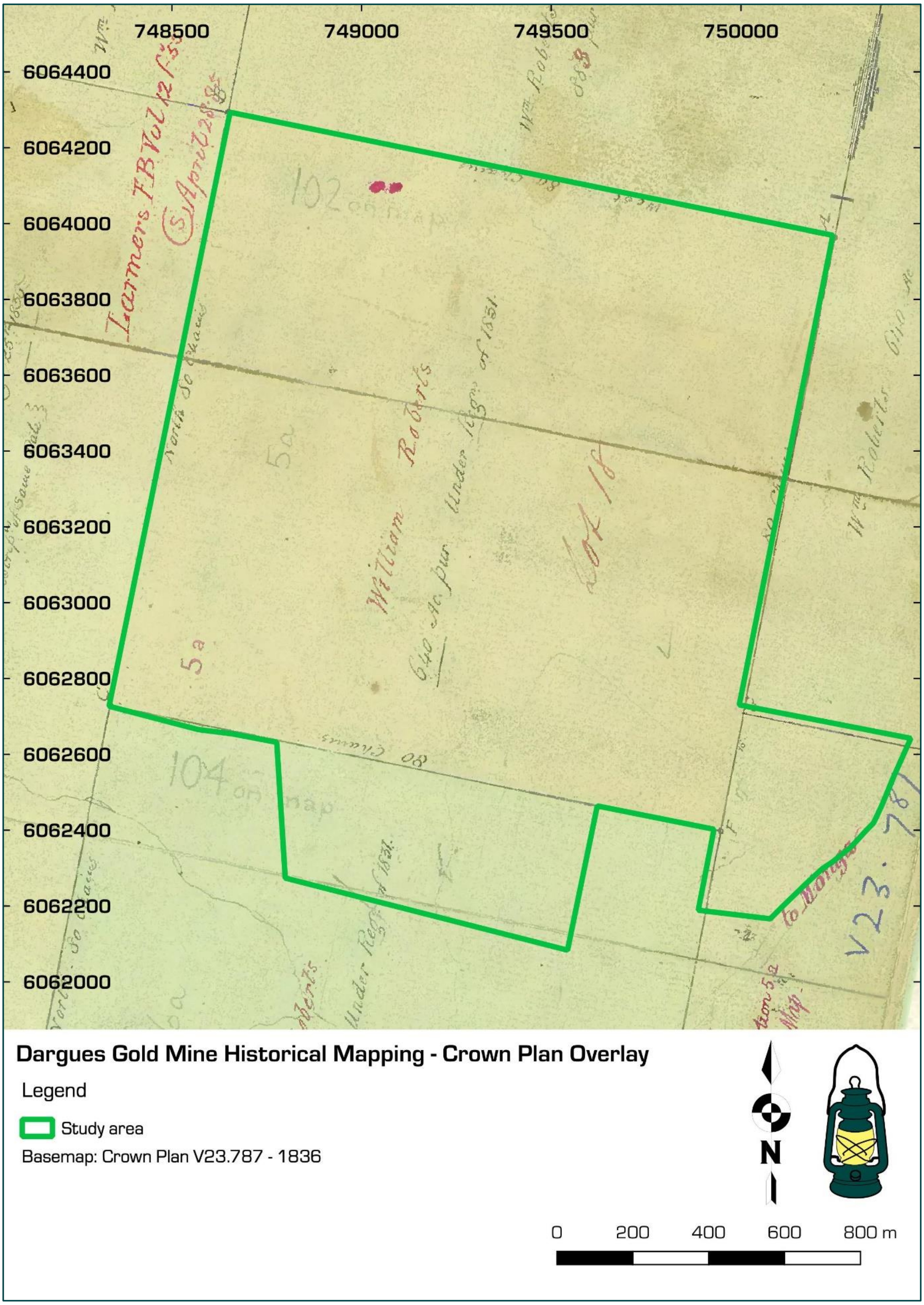

Figure 7: Location of Dargues Gold Mine study area (green outline) on Crown Plan v23.787 (National Library of Australia)

5.4 Historical Themes

Understanding the historical themes that frame the history of a heritage item or site is a critical component of assessing heritage significance. Historical themes assist with contextualising places and regions into the broader framework of the history of NSW and Australia as a whole. This can be especially important in terms of assessing the level of significance of a place (e.g. local, State or National), or for assessing the rarity of an item, event or pattern of development.

Historical themes are also an integral component of establishing the associations and/or relationships between items, places, individuals, communities, social groups, and technological developments and innovations. This contextual information in turn plays an important role in identifying potential research questions that are relevant to assessing the scientific/archaeological value of a heritage item.

Table 1 provides an overview of the identified themes relating to Australian, New South Wales and local history in accordance with those described by the Australian Heritage Commission (2001) and Heritage Council of New South Wales (2001). The themes identified in Table 1 relate to the proposed activities within Dargues Gold Mine study area as well as historic land use, and the people and events that relate to the history of the study area.

Table 1: Themes relating Dargues Gold Mine.

Australian themes	News South Wales themes	Local themes
2. Peopling Australia	Aboriginal cultures and interactions with other cultures - Activities associated with maintaining, developing, experiencing and remembering Aboriginal cultural identities and practises, past and present; demonstrating distinctive ways of life; and with interactions demonstrating race relations.	Aboriginal land across the South Eastern Highlands in the form of archaeological sites, stone arrangements and ongoing associations.
2. Peopling Australia	Ethnic influences - Activities associated with common cultural traditions and peoples of shared descent, and with exchanges between such traditions and peoples.	Influence of Chinese migrant miners on regional gold fields in form of structural remains, mine raceways, and stacked tailing mounds.
3. Developing local, regional and national economies	Mining – Activities associated with identification, extraction, processing and distribution of alluvial and deep lead gold deposits.	Exploitation of gold deposits within Spring Creek in form of mine raceways, ground sluicing and crushing plant remains.
3. Developing local, regional and national economies	Pastoralism - Activities associated with the breeding, raising, processing and distribution of livestock for human use.	Developing the pastoral and agricultural economies in form of homestead remains, fencing and vegetation clearing.
4. Building settlements, towns and cities	Land tenure - Activities and processes for identifying forms of ownership and occupancy of land and water, both Aboriginal and non-Aboriginal.	Aboriginal habitation sites. Land claims with associated fencing and structures.

Australian themes	News South Wales themes	Local themes
4. Building settlements, towns and cities	Towns, suburbs and villages - Activities associated with creating, planning and managing urban functions, landscapes and lifestyles in towns, suburbs and villages	Development of Majors Creek and surrounding villages in form of town plans, infrastructure.

6 ABORIGINAL ARCHAEOLOGICAL CONTEXT

6.1 AHIMS and other heritage register searches

An extensive site search was conducted via AHIMS on the 2nd December 2021 (AHIMS Search ID. #644182). The search was conducted within the area of lat. -35.58 to -35.52 and long. 149.69 to 149.82 with a buffer of 0 metres (Appendix 1).

6.1.1 AHIMS search results

Nine (9) Aboriginal sites or objects were listed as being present within or near the study area at the Dargues Gold Mine. A summary of these sites is provided in Table 2 below. Figure 8 shows the locations of these sites based on the grid references provided by AHIMS.

While sites have been recorded throughout the search area, there is a tendency for them to be more common close to freshwater sources.

Seven previously recorded sites are located within Dargues Gold Mine, however, none of the previously recorded sites are located within the MOD 5 study area.

Table 2: Previously recorded Aboriginal sites in proximity to the Dargues Gold Mine study area

Site ID	Site Name	Site Type
57-6-0475	GT OS 1 Reburial	Reburial site[1]
57-6-0470	GT IS03	Isolated artefact
57-6-0467	GT OS 2	Artefact scatter
57-3-0232	Manar 3	Artefact scatter
57-6-0471	GT-IS06	Isolated artefact and potential archaeological deposit (PAD)
58-4-0469	Foot Track - JC6	Artefact scatter
57-6-0466	GT IS05	Isolated artefact
57-6-0468	GT OS4	Artefact scatter
57-6-0469	GT OS1	Artefact scatter

Table 3 provides an overview of the previously recorded sites within or adjacent to the study area according to site types and features. The majority of sites are artefact scatters (5). Other site types include two isolated artefacts, and one isolated artefact site with PAD. A site of repatriation/reburial also exists. This site contains repatriated artefacts which were salvaged from the surface of GT OS1 (AHIMS #57-6-0469).

Table 3: Overview of previously recorded site types within the Dargues Gold Mine AHIMS search area

Site types	Total
Artefact scatter	5
Isolated artefact	2
Reburial site	1
Isolated artefact and potential archaeological deposit (PAD)	1

[1] Repatriation of artefacts from surface collection of AHIMS #57-6-0469

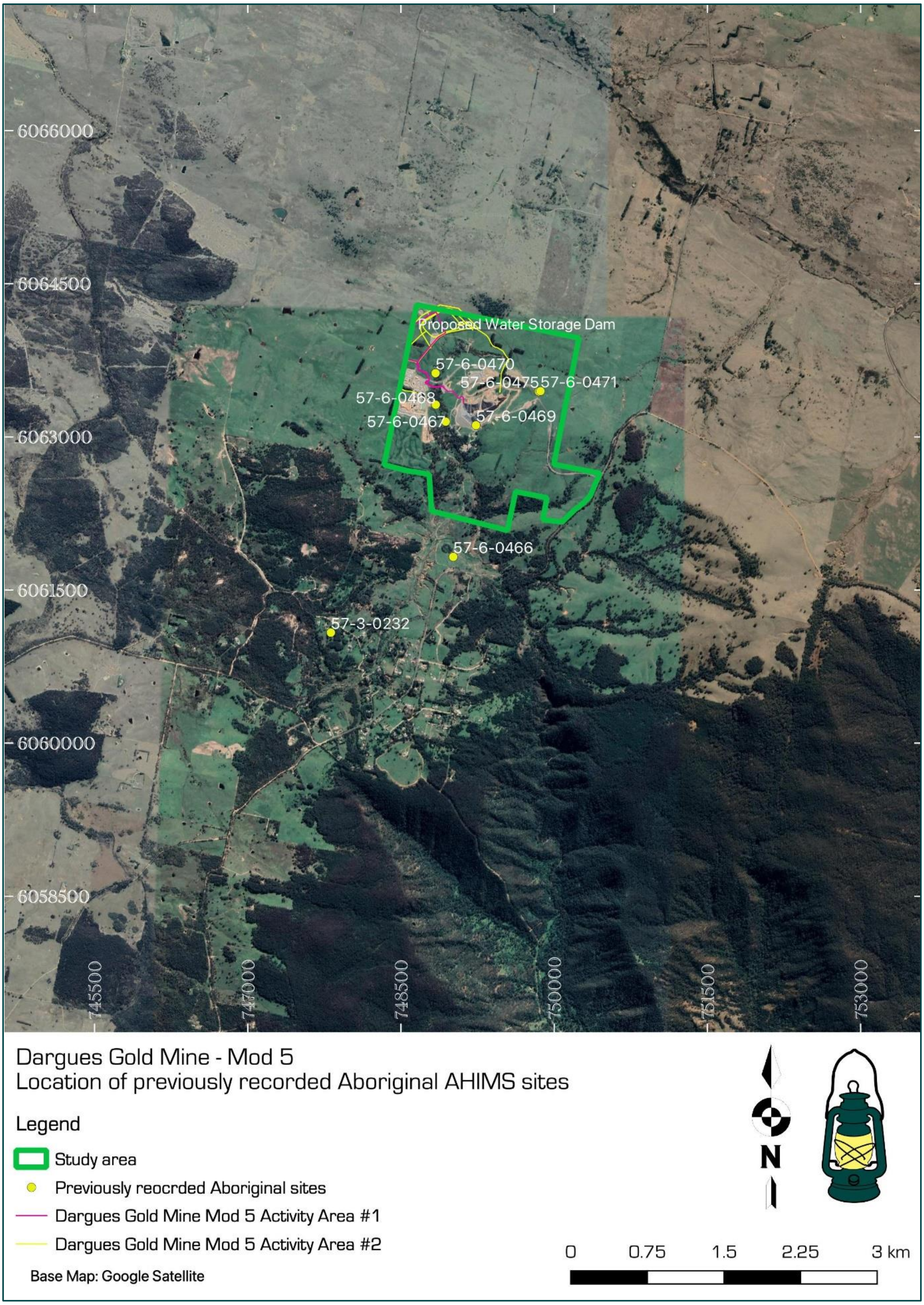

Figure 8: Location of previously recorded AHIMS sites relative to Dargues Gold Mine study area.

6.1.2 Heritage register searches

The Australian Heritage Database (AHD) contains information about natural, historic and Aboriginal places of World and National heritage significance. The NSW State Heritage Inventory (SHI) is a database that contains sites listed on the NSW State Heritage Register, on Schedule 5 of Local Environmental Plans (LEP) and registered Aboriginal Places. Searches of the SHI and AHD were completed on 2nd December 2021. No Aboriginal places are listed on any of the above heritage registers within or adjacent to the study area.

6.2 Material Evidence of Aboriginal Land Use

Aboriginal occupation of Australian extends back well into the Pleistocene. Current theories place the arrival of humans to Sahul between 47,000 years before present (BP) and 65,000 BP (O'Connell and Allen 2004, 2015; Allen and O'Connell 2014; Clarkson *et al.*, 2017, O'Connell *et al.*, 2018). While debate continues regarding the earliest arrival in Australia, there is general agreement that all environmental zones across the continent were colonised by around 35,000 BP (Mulvaney and Kamminga 1999). Since that time, there has been substantial climatic variation, which has influenced choices people made regarding the locations they lived.

6.2.1 Regional archaeological investigations

A number of archaeological investigations have been completed within the larger Braidwood region over the past 40 years. The following summary is discussed in order of investigations closest to the Dargues Gold Mine study area.

Bonhomme (1984) surveyed land around the Ballalaba Bridge over the Shoalhaven River ahead of proposed upgrades to the bridge. The bridge is located about 23km southwest of Braidwood and about 19km west of Majors Creek. Two small (10–13 artefacts) artefact scatters were identified during the survey. Raw materials comprised silcrete, quartzite, quartz and rhyolite. One possible scarred tree was also identified during the survey.

Feary (1987) inspected the route of a proposed road through the 'Manar' property located 25km southeast of Bungendore and about 22km east of Majors Creek. Ten artefact scatters were recorded along the proposed road, with artefacts made from a variety of materials including quartz, black chert, silcrete and chalcedony. Artefact types identified included flakes, flaked pieces, cores and retouched pieces. All sites were recorded on flat or gently sloping landforms within a few hundred metres of the permanent Woolshed Creek. While artefacts were recorded in areas of bare ground (ie vehicle tracks and eroded areas), it was predicted that they would also occur on vegetated ground beyond these exposures. These sites are interpreted to be representative of open camp sites found within the Southern Tablelands region.

Attenbrow (1984) and Hughes undertook a three-stage archaeological investigation for the proposed Welcome Reef Dam, located about 33km northeast of Braidwood and about 45km northeast of Majors Creek. The survey included landforms both within and outside the proposed inundation area. During Stage 1 of the survey, 119 sites were identified comprising 116 stone artefact scatters, two rock shelters and one mussel shell midden. A further 77 sites, including 27 isolated finds, were recorded during Stage 2 surveys. One of those sites comprised a complex of a stone arrangement and two possible scarred trees. The remaining sites were all open artefact scatters. The artefact scatters were mainly dominated by silcrete artefacts, and one of the sites included a possible silcrete quarry.

Grinberg Knight & Associates (GK&A 1995a) undertook a survey within Tallaganda State Forest as part of an EIS for a broader forest management plan. Tallaganda State Forest is located about 34km northwest of the study area. The surveys identified 220 artefact scatters and isolated finds. There was a tendency for sites with higher artefacts densities to be found on lower gradient landforms associated with stream banks and swamp edges. Within the more elevated portions of the study area that formed part of the Great Dividing Range, artefacts tended to be found on lower gradient spurs and ridgelines. Quartz was by far the most common raw material encountered during the surveys.

Grinberg Knight & Associates (GK&A 1995b) undertook a survey of seven portions of land, 8km south of Bungendore as part of an EIS for Nubrik Pty Ltd. The study area is located about 40km north northwest of Majors Creek. The survey area was situated at the base of the western foot slopes of the Turallo Range, within the drainage basin of Halfway Creek, a tributary of Lake George. Two artefact scatters and four isolated finds were identified during the survey. However, it was also noted that prior disturbance and variable visibility were factors in the survey results. The artefact scatters (NB1 and NB2) were both identified within erosion scours on the eastern margins of Halfway Creek. The artefact assemblage was dominated by quartz flakes and flaked pieces. However, silcrete, quartzite, volcanic and chert artefacts were also present.

Bulbeck and Boot (1990) surveyed portions of Kowen Forest, within the Australian Capital Territory (ACT) as part of an investigation of the archaeological landscape of the forestry land. The study area is located about 44km northwest of Majors Creek. The survey identified 34 Aboriginal artefact scatters, most of which were situated on relatively low gradient landforms within 100m of permanent water

Kuskie (1989) undertook a survey of some 90 hectares of land at Jumping Creek, south of Queanbeyan. The study area is located about 48km west northwest of Majors Creek. It comprised valley floor landforms within the Queanbeyan River catchment. That survey identified 20 artefact scatters and one isolated find. Kuskie (1989: 29, 37) noted that most sites were within 200m of permanent water and higher artefact densities tended to be associated with lower elevation landforms..

Byrne (1981) undertook a survey of the Wandella-Dampier forests as part of an EIS for the NSW Forestry Commission. The northern portion of the study area is located about 70km southeast of Majors Creek within the South Eastern Slopes region. The survey was conducted across a ten percent sample of 1km square units sampling creeks, sandstone outcrops and "other" landforms. A total of 27 artefact scatters were identified, most of which were less than half a hectare in area. The artefact assemblages were variously comprised of quartz, acid volcanic rock and silcrete. The vast majority (26) of sites were located on ridges, whilst one site was recorded on a river flat. Byrne (1981) noted that while distance to water was highly variable, all of the sites were in close proximity with a reliable water source.

6.2.2 Archaeological work in and around Dargues Gold Mine

Since 2010, several archaeological assessments have been completed for the Dargues Gold Mine. These include an assessment for the original proposal and assessments for subsequent modifications.

In 2010 an Aboriginal Heritage Assessment was conducted in response to the original proposal of an underground gold mine and associated works at Dargues Reef (AS&R 2010b). A desktop assessment identified one previously recorded AHIMS site, an artefact scatter site located outside of the proposed development area. The report identified, however, that the locality had high potential to contain artefact scatters or isolated artefacts. The report also identified a moderate potential for cultural modifications (scars or carvings) on trees aged over 150 years.

A pedestrian survey was conducted, targeting areas of high exposure. This survey identified five sites comprised of three low density artefacts scatters (GT OS1, GT OS2 and GT OS4) and two isolated artefacts (GT OS3 and GT OS5). With one exception, all of the artefacts were recorded within 50m of Spring Creek within bare soil exposures. The exception was located on the toe of a south facing spur within 100m of Spring Creek (GT OS1). Artefacts were recorded as made from silcrete (4), metasedimentary (3), quartz (2) and black chert (1) materials (AS&R 2010b).

Site GT OS1 was located in close proximity to the downstream toe of the Tailings Storage Facility embankment. In order to avoid impacts to this site, the proponent redesigned the facility to ensure a minimum 20m buffer between the recorded location of the site and the toe of the embankment. The remaining four sites were located outside the proposed development area, and as a result the report did not recommend any further investigation or assessment of the sites prior to development (AS&R 2010b).

In June 2011 Artefact Heritage Services were engaged to assess an unexpected find at the Mine. The isolated artefact (GT IS06) was located in a sandy topsoil during soil testing at a depth of between 20cm and 30cm (AHS 2015).

An Aboriginal Heritage Management Plan (AHMP) was developed in 2012 by Artefact Heritage Services. This plan satisfies the requirements of Project approval 10-0054 and is intended to be used as a referral document throughout the life of the project. The AHMP provides:

- A summary of Aboriginal heritage values present within the project area;
- Protocols for the management and protection of Aboriginal objects/sites located within the project area;
- Description of the measures that would be implemented should any Aboriginal objects be encountered during the project;
- Description of measures that would be implemented should any Aboriginal skeletal remains be encountered during the project; and
- Protocol for ongoing consultation and involvement of the Aboriginal community in the conservation and management of the Aboriginal heritage of the project site (AHS 2012: 3).

In 2013, modifications to the proposed footprint resulted in the Office of Environment and Heritage (OEH) (now Heritage NSW) recommending a survey be conducted of areas that were not assessed during the original 2010 survey (R W Corkery & Co Pty Ltd, 2013). In particular, OEH recommended that the boundaries of two sites, 'OS2' and 'OS4' be fully assessed, including their proximity to the updated footprint location. The Corkery report identified the boundaries of these sites as not being within the proposed impact area, and recommended that during development these sites be fenced off with a 20m buffer for protection. The report also recommended that the workforce for the site be trained in recognition of Aboriginal objects, for the optimum protection of unexpected finds that may occur within the development area. The report did not recommend any further survey or excavation in the survey area (R W Corkery & Co Pty Ltd, 2013).

In 2015, an updated Aboriginal Heritage Assessment report (AHS 2015) was completed as part of the proposed MOD 3 alterations to the Mine. The proposed MOD 3 was found to have little impact on the Aboriginal cultural heritage in the area. However, two sites (GT OS1 and GT OS2) would be impacted by the proposed works, and the report recommended that the artefacts from these sites be collected and moved to an area away from future harm.

In 2019, an updated Aboriginal heritage management plan was completed (AHS 2019). This report outlined the changes which had occurred in regard to Aboriginal heritage in the locality associated with the Dargues Gold Mine project. All sites identified within the survey area over the course of various assessments were understood to have low archaeological sensitivity. The report also recommended exclusion zones be established around all sites that were not to be impacted. It was recommended that these exclusion zones include 20m buffers, and fencing. In addition, the report described the collection of artefacts from GT OS1 and GT OS2 in April and June 2017. Due to thick grass cover no artefacts were identified at site GT OS2. The recovered artefacts from GT OS1 were reburied and recorded as AHIMS site #57-6-0475. Figure 9 illustrates the results of these salvage activities.

6.3 Predictive Model

Known archaeological sites immediately surrounding the study area are confined to a limited range of site types, dominated by artefact scatters and isolated artefacts (Table 2). But in the wider region a range of site types have been discovered (Section 6.2.1), including stone arrangements and culturally modified trees. This means that while we may expect to come across only stone artefacts or stone artefact scatters, the potential to discover a wider range of cultural heritage sites persists.

By understanding the geomorphological and ecological heritage of the study area, we can appreciate the factors that may have influenced the occupation of this area by Aboriginal inhabitants in the past. In highland landscapes like the study area, slope gradient is a key factor influencing the location of campsites (inferred from open artefact scatters) (Bulbeck and Boot, 1990). Where low-gradient plateau areas overlook permanent water sources, we can assume a relatively high likelihood of encountering isolated artefact or artefact scatters indicative of past occupation (Section 6.2.2). However, environmental factors profoundly affect the detection of archaeological sites. For example, the amount of ground surface exposure, together with erosional features that expose subsoils, will often dictate the likelihood of identifying the presence of stone artefacts during survey (Goldberg and Macphail, 2006). This means that the distribution of archaeological sites that are detected may reflect these processes of site degradation, rather than patterns of occupation in the past. A key example of this is the extent of prior historic impacts affecting the distribution of old-growth vegetation. We know that where trees of 150 years old or more persist, there is a likelihood of finding cultural modifications (i.e. scarring), but the impacts of historic settlement may have removed such trees from across much of the study area.

A more detailed discussion of archaeological potential in the study area, by site type, is presented below in Table 4.

Table 4: Summary of predictive model for landforms that may occur in the study area

Landscape type	Landform	Potential Sites	Archaeological potential
Highlands	Rock outcrops	Quarries, resource gathering sites	High
	Exposed crests	Rock art, ceremonial sites	High
	Steep slopes	Isolated artefacts, artefact scatters	Low
	Moderate slopes	Isolated artefacts, artefact scatters, PAD	Low-moderate
	Gentle slopes overlooking water courses	Isolated artefacts, artefact scatters, PAD	High
	Valley floors	Isolated artefacts, artefact scatters	Low

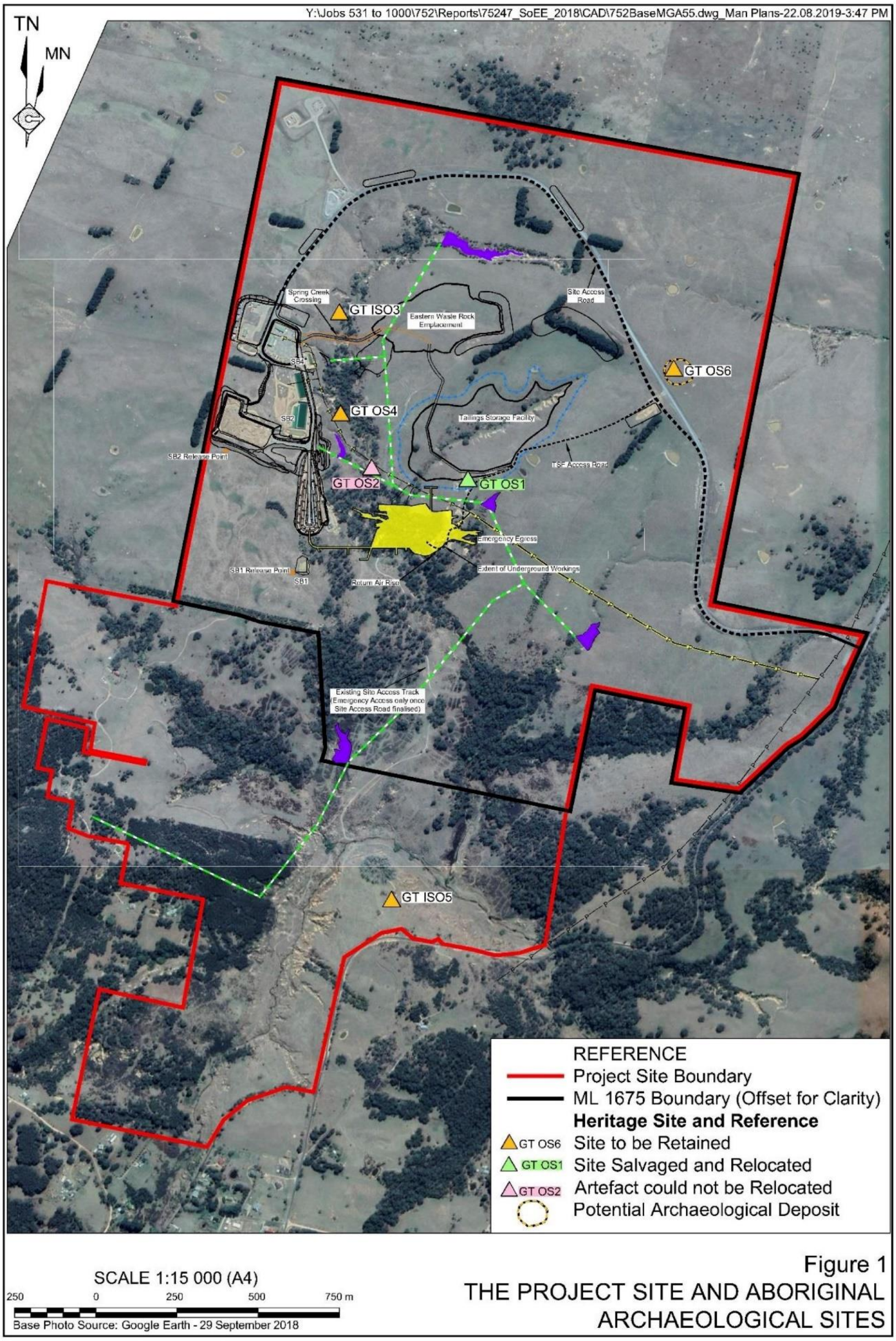

Figure 9: Results of archaeological salvage actions (after Artefact Heritage 2019)

Summary predictive statement

Granite uplands, like the study area, generally preserve a limited range of Aboriginal sites. These site types are generally restricted to isolated artefacts and artefact scatters that are likely to have been affected by colluvial movement and erosive processes. Culturally modified trees may also remain in areas where old-growth vegetation persists. These landscapes are dissected by steeply channeled, intermittently active watercourses with alluvial deposits that are of limited archaeological potential, due to the flashy, dynamic nature of the streams. Important symbolic activities, such as conducting ceremonies and creating rock art, are known to be associated with granite upland landscapes. In addition, there is also potential for rock outcrops of material suitable for stone tool manufacture.

6.4 Predictive statement for Dargue's Gold Mine study area

Predications regarding location of different site types within the study area are:

Isolated artefacts – are found across the entire landscape. These finds can occur in any location as Aboriginal people traversed the country for thousands of years. Isolated finds may end up in a recorded location as a result of humans, erosion or depositional forces. These sites are likely to occur in the study area, and three isolated artefacts have previously been identified within the study area.

Stone artefact scatters – representing a camping location, these sites are identified by a concentration of stone flakes. They are a common site type as they are more likely to survive in the archaeological record. Artefact scatters will occur across the landscape, usually in association with a resource such as permanent water. Low-gradient landforms close to major water sources were a preferred location for camping. As the study area is in close proximity to five permanent water sources, artefact scatters are likely to occur on areas of low gradient.

Potential Archaeological Deposit (PAD) – buried archaeological materials, or soils and sediment thought to contain buried archaeological materials, can occur in locations where past activity created sediment deposition, or where soil and sediment aggradation has been an active geomorphological process. Paradoxically, PADs are most likely to be observed where erosive processes are active, e.g. where sediment exposures reveal the stratigraphy of the subsurface environment.

Scarred / Culturally modified trees – display evidence of human modification and manipulation. They require the presence of mature trees and are likely to be found in any area that supports old-growth vegetation.

Hearths/ovens – indicate locations where a fire was lit for one-off (hearth) or multiple uses (oven) and are identified by presence of charcoal or burnt clay (used as heat retainers). Hearths are recorded either in isolation or in association with other Aboriginal cultural features such as camp sites. Ovens are generally larger than hearths and often include other materials such as bone. No hearths or ovens have been recorded near the study area.

Ceremonial places – are found in isolated locations throughout the landscape. The preferred location of these places will vary from region to region. No such sites have been found in the immediate vicinity of the study area, however a stone arrangement is recorded north of Braidwood.

Grinding grooves – are likely to be located wherever suitable outcrops of rock are found.

Quarries – are likely to be located where outcrops of rocks exist that are useful for stone tool manufacture.

Burials – are generally found in elevated, soft sandy, alluvial deposits or in proximity to rivers and major creeks. Acid soils, such as those that form on granites in the study area, are not conducive to the preservation of bone. We may not, therefore, expect to find them in the study area. However, is important to note that burials are typically only detected through disturbance and they may occur anywhere.

Shell middens – show evidence of shell discard after people have collected, eaten and discarded shellfish. Middens may also contain other cultural material including stone artefacts, other faunal remains or charcoal from cooking. They are unlikely to be found in upland areas, especially those with acid soils, such as the study area, however a mussel shell midden has been recorded north of Braidwood.

6.5 Predictive mapping from Aboriginal Site Decision Support Tool

This section provides an overview of the predictive modelling available through the Aboriginal Site Decision Support Tool (ASDST). The ASDST is a modelling tool that was developed in order to provide a set of spatial GIS layers combined with analytical techniques that provide visual and quantitative information regarding the distribution of Aboriginal site features across the landscape and associated accumulated impacts (Ridges 2006; SGNSW & DPIE 2021). The modelling provides GIS layers for likely areas where artefacts, rock art, burials, earth mounds, grinding grooves, hearths, shell middens, stone quarries and culturally modified trees are located. In addition, the ASDST provides GIS layers relating to accumulated impacts, model reliability and survey priority.

For the purposes of this assessment the ASDST modelling has been used to review the accuracy of the predictive model described above. Maps showing results of the ASDST modelling follow with basic interpretation of the modelling below:

- Figure 10 shows the general level of archaeological sensitivity in the area, and suggests that the study area is in a moderate to high sensitivity zone;
- Figure 11 shows the calculated likelihood of encountering Aboriginal artefacts, indicating that the study area is highly sensitive and likely to contain Aboriginal artefacts;
- Figure 12 shows that there is low to moderate chance of encountering culturally modified trees within the area;
- Figure 13 suggests that the chances of encountering grinding grooves may also be moderate;
- Figure 14 indicates there is little chance of encountering hearths in the area, and
- Figure 15 indicates the study area is part of an area of moderate to high survey priority. This means that the study area would benefit from on-ground assessment.

Overall, these results are consistent with the predictive model presented above and suggest that isolated artefacts and artefact scatters are most likely to be encountered, followed by scarred trees. While site types such as ceremonial places and burials are less likely to be encountered, their presence cannot be ruled out. It is important to note that the ASDST modelling is based on imperfect data and incomplete datasets

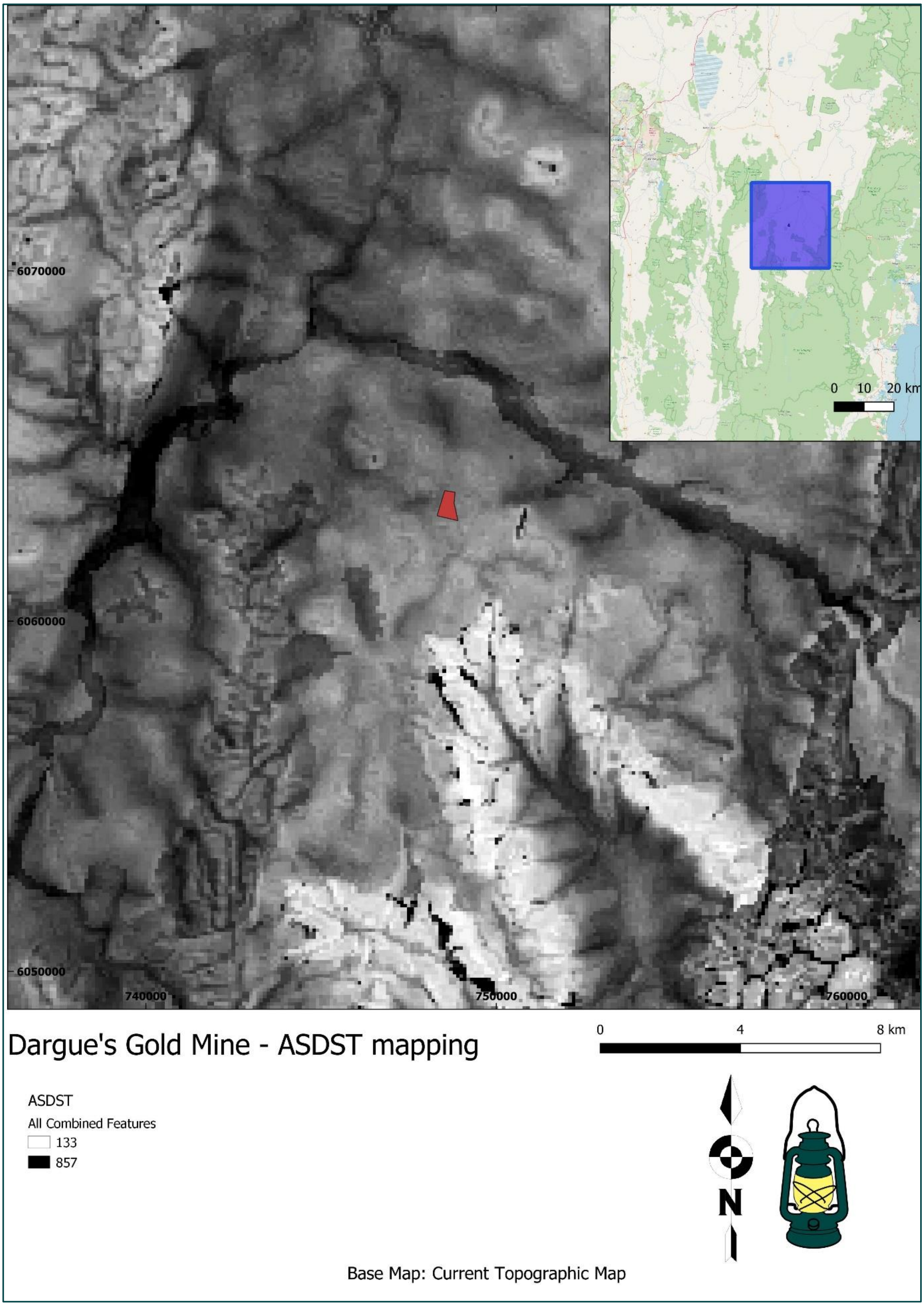

Figure 10: ASDST mapping showing moderate-high archaeological sensitivity of study area based on all types of archaeological features (black represents high sensitivity and white represents low sensitivity).

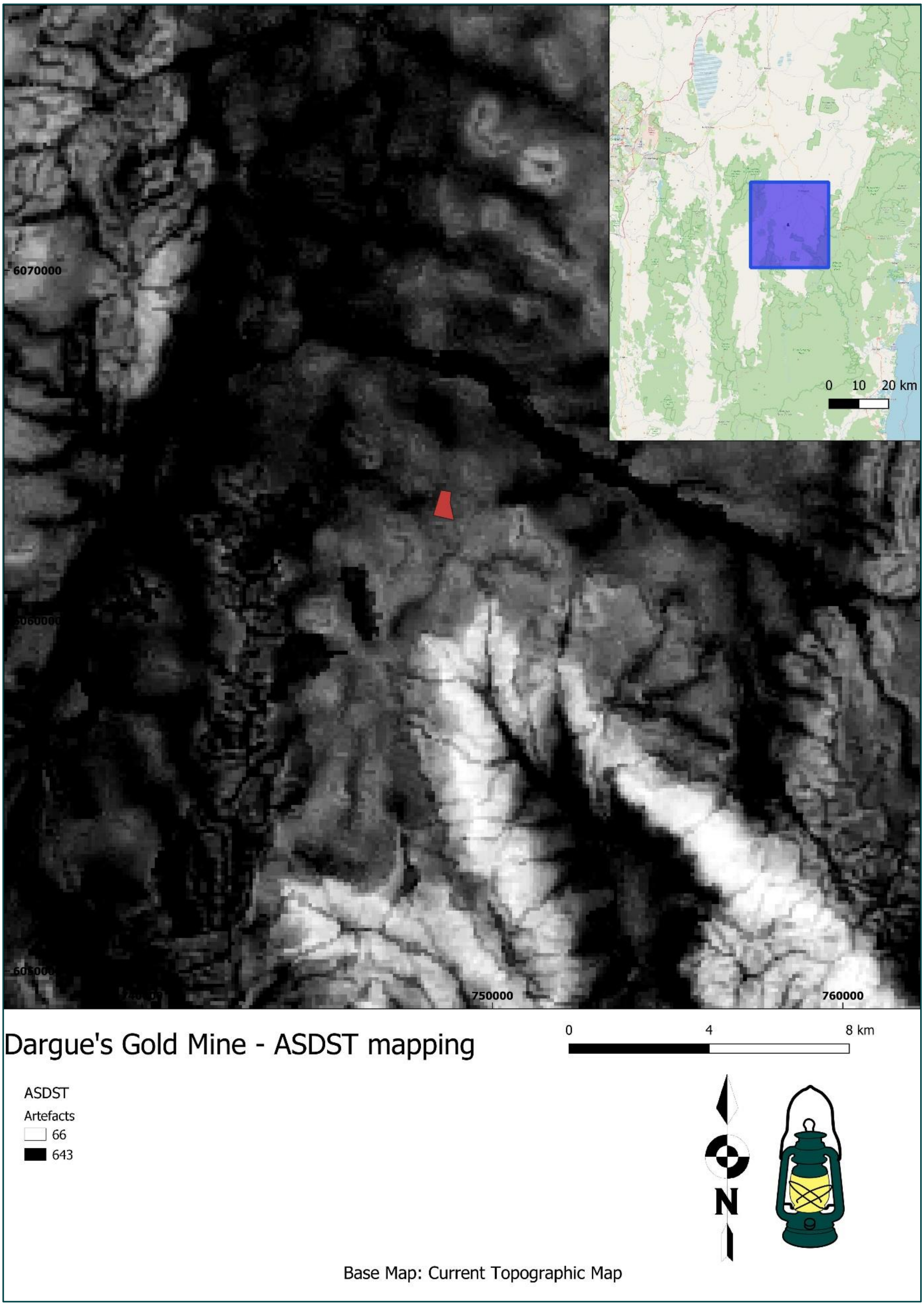

Figure 11: ASDST mapping showing archaeological sensitivity of study area based on likely presence of artefact scatters (black represents high sensitivity and white represents low sensitivity).

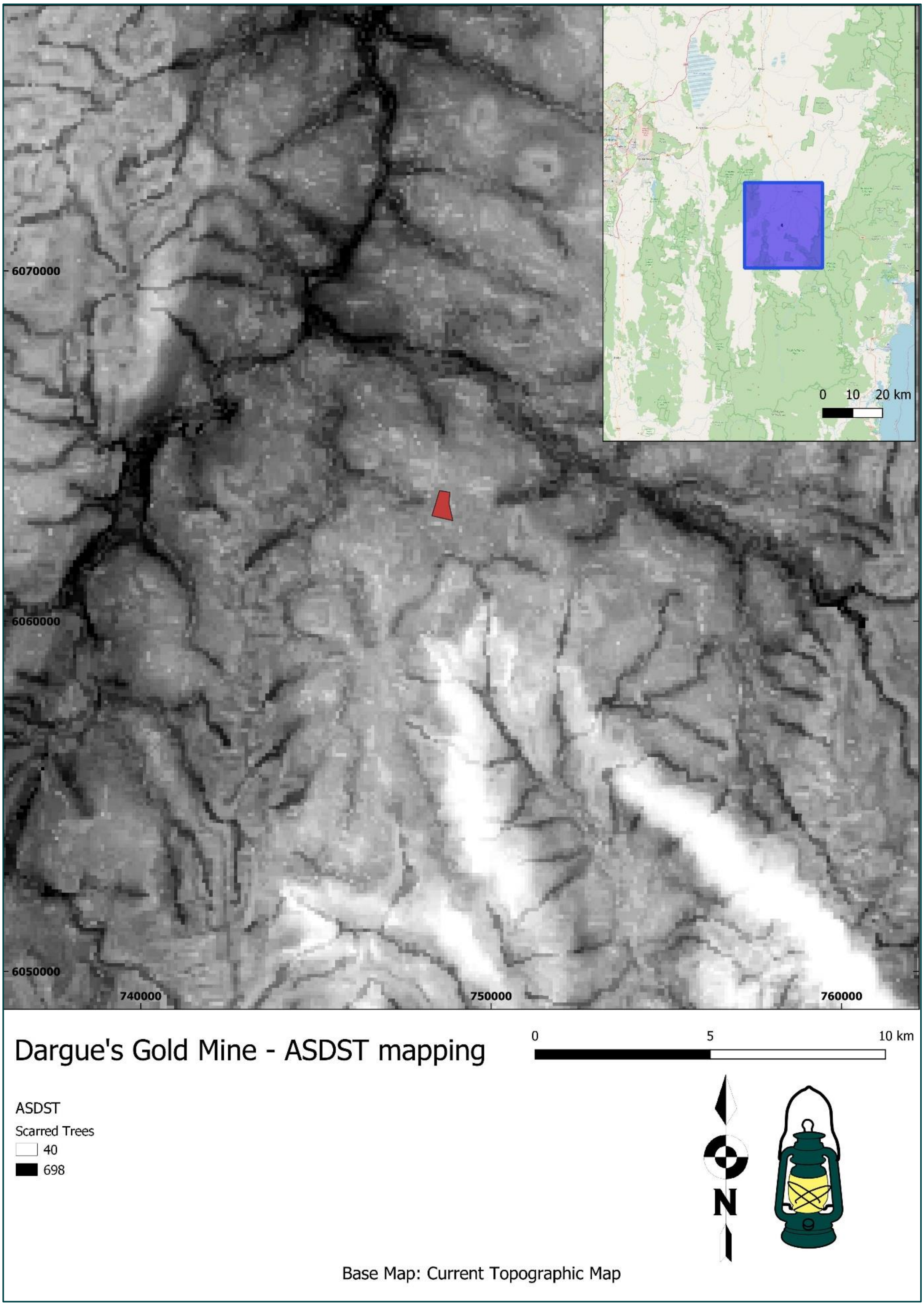

Figure 12: ASDST mapping showing archaeological sensitivity of study area based on likely presence of culturally modified trees (black represents high sensitivity and white represents low sensitivity).

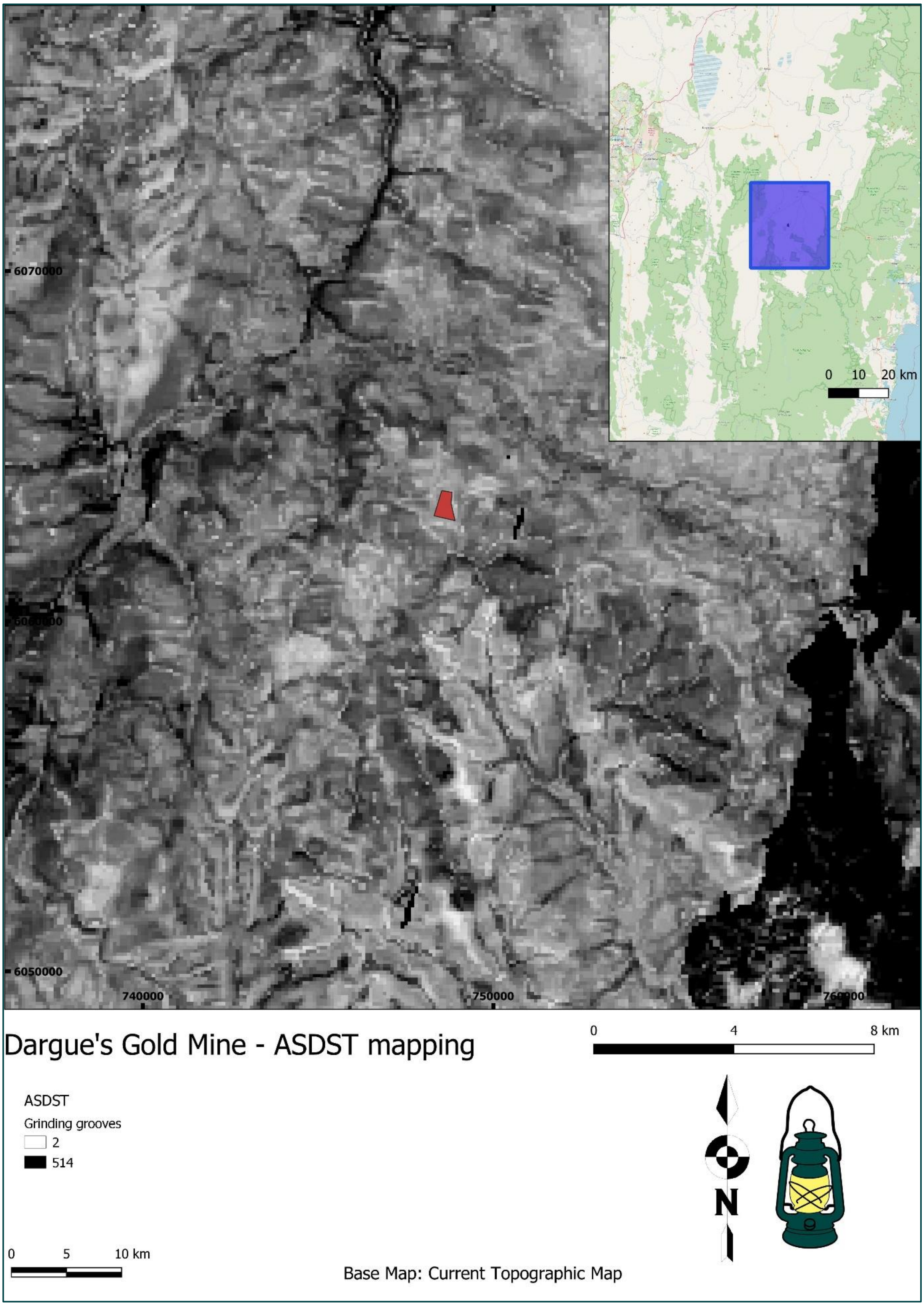

Figure 13: ASDST mapping showing archaeological sensitivity of study area based on likely presence of grinding grooves (black represents high sensitivity and white represents low sensitivity).

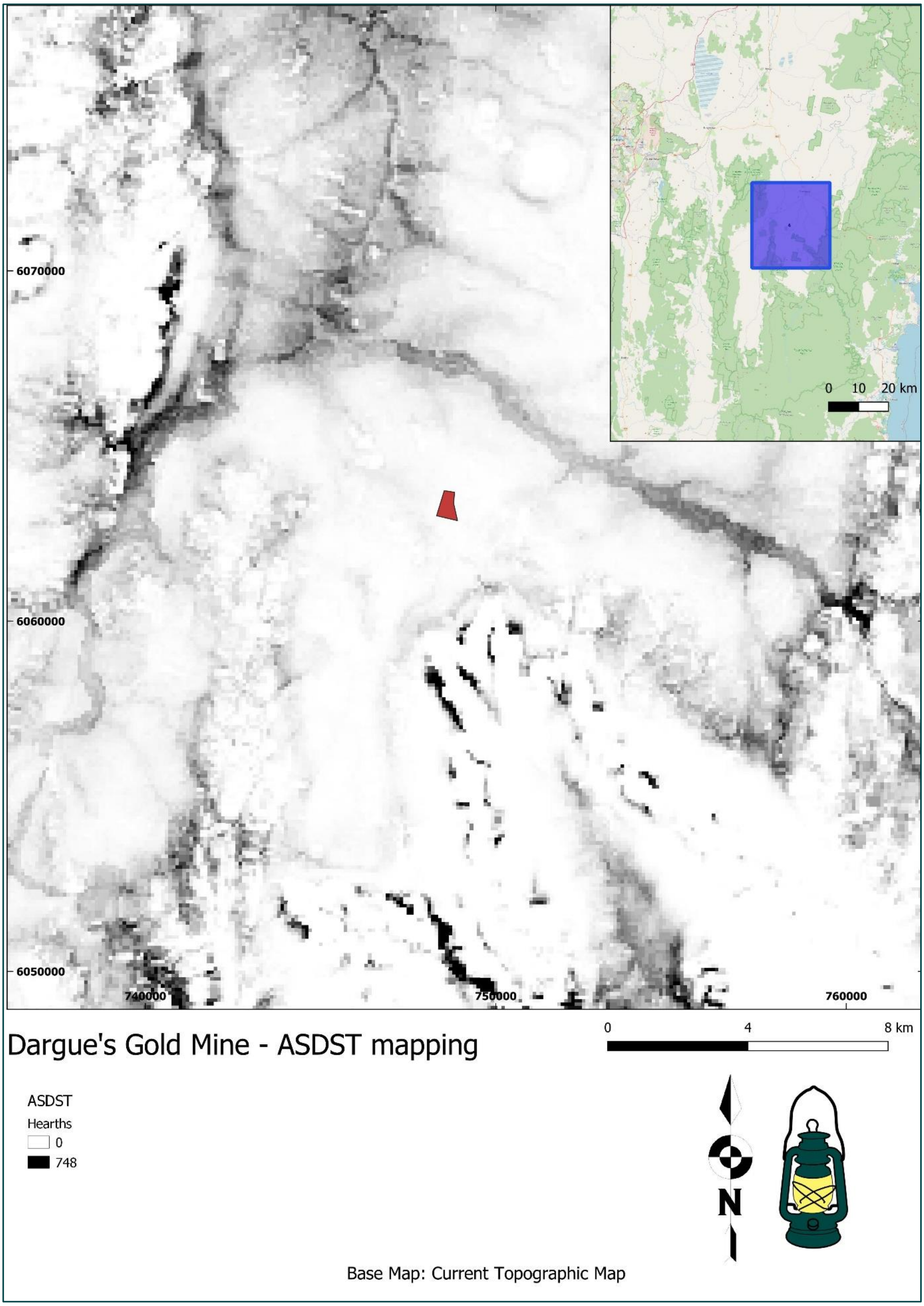

Figure 14: ASDST mapping showing archaeological sensitivity of study area based on likley presence of hearths (black represents high sensitivity and white represents low sensitivity).

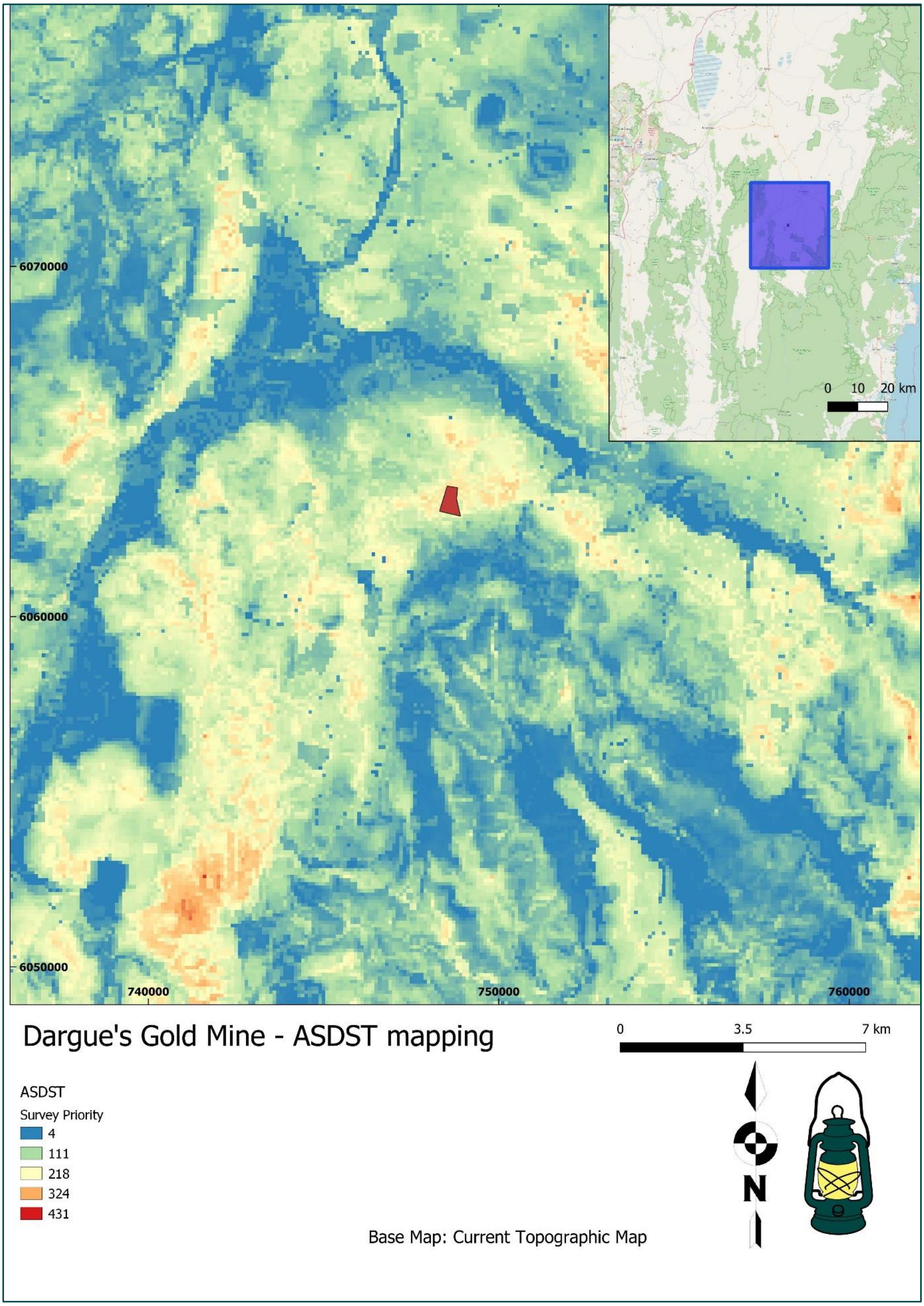

Figure 15: Map showing survey priority of landscapes surrounding study area, according to ASDST tool (blue represents low priority for survey, while red represents high priority areas for survey).

6.6 Limitations

The following limitations should be noted regarding the investigations at Dargues Gold Mine:

- Vegetation cover across the entire subject area limited the ability to observe Aboriginal objects;
- The southern extent of each proposed pipeline could not be visually inspected due to access restrictions caused by the existing dam; and
- The waterlogged soil also hindered visibility and access to certain areas.

7 HISTORIC ARCHAEOLOGICAL CONTEXT

7.1 Heritage register searches

The Australian Heritage Database (AHD) contains information about natural, historic and Aboriginal places of World and National heritage significance. The NSW State Heritage Inventory (SHI) is a database that contains sites listed on the NSW State Heritage Register, on Schedule 5 of Local Environmental Plans (LEP). Searches of the SHI and AHD were completed on 2nd December 2021. No Historic items are listed on any of the above heritage registers within or adjacent to the study area.

7.2 Material evidence of Historic items

7.2.1 Previous archaeological investigations at Dargues Gold Mine

The Dargues Gold Mine study area was assessed for historical heritage in 2010 (ARS 2010b). The investigation was undertaken by ARS for R.W. Corkery & Co. Pty Limited (RWC) on behalf of Big Island Mining Pty Ltd (the Proponent) as part of an environmental impact assessment.

The project at that time comprised a proposed underground gold mine, processing plant, haul road, temporary waste rock emplacement and a Tailings Storage Facility, as well as ancillary activities and associated infrastructure.

The report states that three dredge shelves or buckets and an abandoned mine shaft are items of heritage interest (ARS 2010b). The only evidence remaining of the mine shaft is the shaft itself which is currently capped but no longer contains any other remains. However, the cage used to lower the miners into the shaft remains.

The crumbling stone footings of the chlorination plant remain along with earthworks or modifications from the railway tracks. Otherwise, the only evidence remaining is fragments of metal, ceramic and glass.

ARS (2010b) identified various historical features across the study area including water races across various tributaries of Spring Creek, other associated evidence of ground sluicing activities, and the remains of a former chlorination plant, railway and crushing plant. However, they concluded that none of these items met the threshold of relics or other items of historical heritage significance.

8 SURVEY METHODS

Field survey of the proposed Dargues Gold Mine MOD 5 study area was conducted over two days guided by Requirement 5 and Requirement 16 of the *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW*. The first day of survey covered the initial MOD 5 design (Figure 16) on 9 March with Christine Gant-Thompson and Glenn van der Kolk of Lantern Heritage and Marcelle Nye from Mogo LALC. The second day of survey covered the final MOD 5 design (Figure 16) on 31 March with Christine Gant-Thompson of Lantern Heritage and Marcelle Nye from Mogo LALC.

8.1 Sampling strategy

A comprehensive pedestrian survey of all landforms that would potentially be impacted was completed. Particular focus was given to areas of exposure, however survey was impeded by thick vegetation cover in the majority of areas (refer to Section 6.6). As a result the surveyed area was limited to areas of erosion and other forms of exposure such as those trampled by stock. Consequently, only 10% to 20% of the potential impact area was able to be visually inspected (see Plate 1 for example of exposure).

It should also be noted that survey was more heavily focused on landforms predicted to be archaeologically sensitive, and in areas where sites had previously been recorded. So, while survey encompassed all landforms and all areas, and aspects of potential impacts, there was an overall increased ratio of time and effort spent inspecting and recording areas of predicted archaeological sensitivity.

8.2 Survey Method

The archaeological survey was undertaken on foot, and included all landforms and areas of potential impacts. The purpose of the survey was to identify and record Historic items/objects, Aboriginal objects, and/or areas of potential archaeological deposits that relate to Aboriginal occupation. The participants in the survey were all involved in inspecting ground exposures for the presence of Aboriginal objects. This process involved walking along/across proposed impact areas with individual participants inspecting all ground exposures that they encountered.

Survey pins (flags) were supplied to mark the locations of identified objects. All survey participants were also involved in discussions regarding the nature of soil deposits, prior impacts and predicted archaeological potential at each landform.

8.2.1 Survey Units

The study area was divided into survey units that corresponded to different landform elements (e.g. crest, slope, clifftop margin, beach). The boundaries of the survey units were identified through a combination of referring to 1:25,000 topographic maps, and in-field observations of landform soils, gradients and aspects. Where one or more of these landform components changed, a new survey unit was identified. Microtopographic features and/or areas of disturbance within a survey unit were also recorded but were not treated as individual survey units.

Within each survey unit, observations were made regarding the soils, geology, vegetation, prior disturbance, ground surface exposures and visibility. All identified Aboriginal objects were also recorded.

The subsurface archaeological potential within a given survey unit was assessed with reference to landform type, gradient, context and aspect, archaeological visibility and presence of Aboriginal objects at surface, as well as observations regarding the nature and depth of soils, and the nature and extent of prior impacts. The survey unit, or components thereof (e.g. where variable levels of disturbance were encountered), were then assessed as having very low/negligible, low, moderate, high or very high archaeological potential.

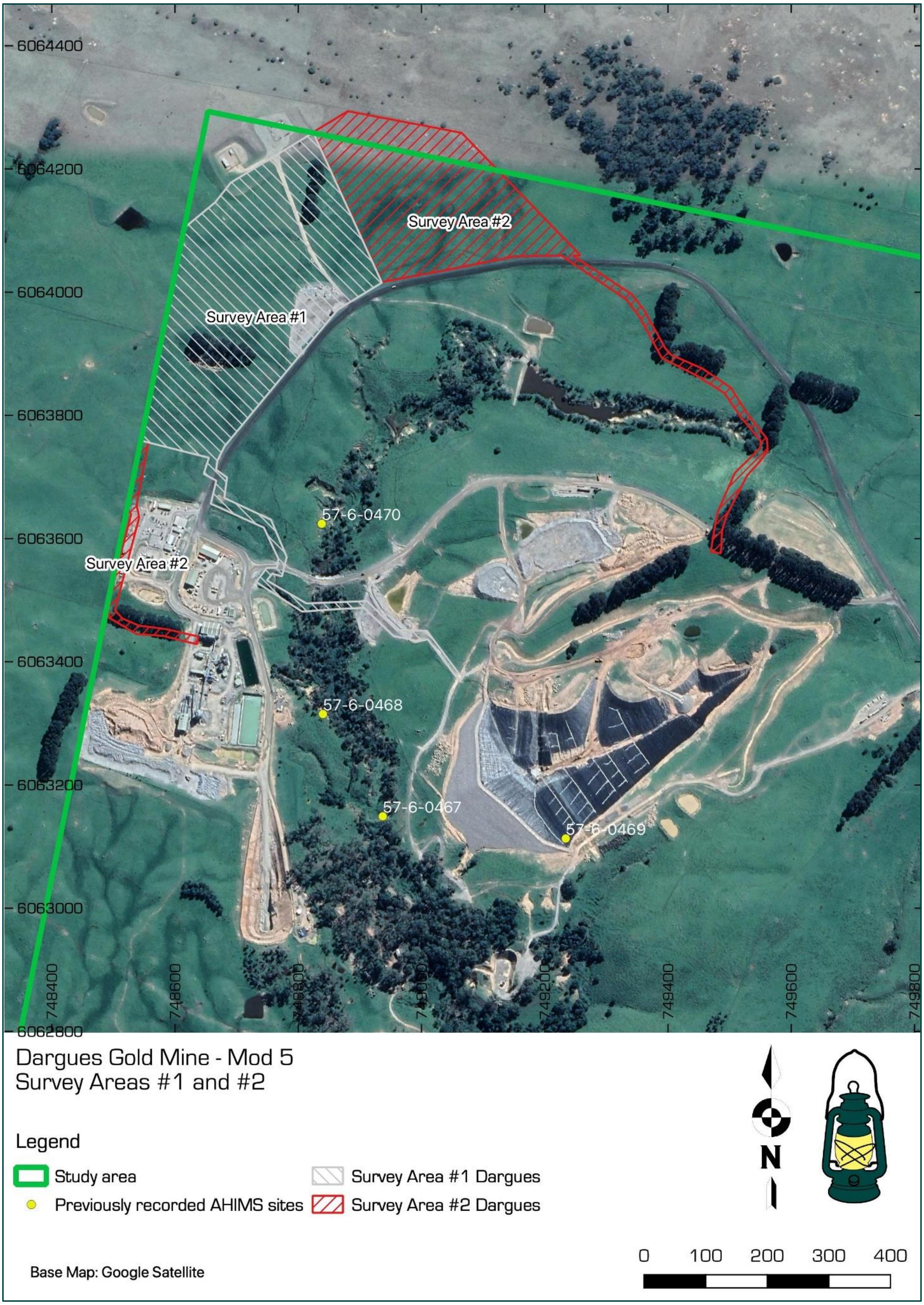

Figure 16: Survey coverage relative to Dargues Gold Mine study area – survey #1 and survey #2

The definitions and criteria for these different levels of potential are summarised as follows:

Very low/Negligible where soil deposits are very shallow (i.e. < 5cm) and/or where prior subsurface disturbance is extensive (i.e. extends to the full depth of soil deposits), the landform type/gradient/context is predicted to have low potential for Aboriginal objects to be present, and field survey has confirmed that prediction.

Low - where field survey has confirmed that prior disturbance is likely to have removed or substantially disturbed deposits, and/or the landform type/gradient/context is predicted to have low potential for Aboriginal objects to be present.

Moderate - where soil deposits are at least 5-10cm deep, and the landform type/gradient/context is predicted to have moderate or greater potential for Aboriginal objects to be present, but the actual presence of Aboriginal objects is uncertain (e.g. no identifiable archaeological evidence in any surface exposures), or the nature and extent of prior disturbance is such that the presence of relatively undisturbed deposits is unclear.

High - where soil deposits are at least 10-20cm deep, the landform type/gradient/context is predicted to have high or very high potential for Aboriginal objects to be present, and field survey has confirmed the presence or high likelihood of Aboriginal objects, but there may be uncertainties surrounding the nature and extent of subsurface deposits (e.g. uncertainties surrounding the extent of prior disturbance, or uncertainties regarding the nature and content of archaeological deposits).

Very high - where soil deposits are at least 10-20cm deep, relatively undisturbed (i.e. prior disturbance is minimal in horizontal or vertical extent), the landform type/gradient/context is predicted to have high to very high potential for Aboriginal objects to be present, and/or field survey has confirmed the presence of Aboriginal objects in situ at surface and/or within exposed soil profiles, and stratified deposits are known or suspected to be present.

8.3 Field Recording

Field recording was primarily undertaken digitally, on an iPad, with supplementary handwritten notes on hard copy maps of the study area. Copies of site cards (digital and/or hardcopies) for previously recorded sites were carried and referred to during the field survey. All field records were entered and managed by Christine Gant-Thompson and Glenn van der Kolk. In-field measurements of all identified stone artefacts were recorded using digital callipers, and/or a hand tape measure. Stone artefact recording included artefact type, material type and colour, measurements in millimetres for length, breadth, thickness and maximum dimension, and additional notes as appropriate regarding retouch/usewear, damage, patination, cortex, platforms, terminations etc.

Additional details regarding individual aspects of the survey recording methods (e.g. photography, soils, survey coverage etc.) are provided in the relevant subsections below.

8.3.1 Photography

All photographs were captured on a mobile device with georeferencing of locations enabled. Photographic records of each survey unit include images to illustrate characteristics such as vegetation and visibility, landform context/aspect, soil and bedrock exposures, and locations/details of identified Aboriginal objects. Depending upon the nature of the photographs, either a ranging pole or mini-rod photographic scale was used, except in the instance of more generic landscape photographs that did not illustrate archaeological features.

8.3.2 Soils and geology

Observations were made and recorded within each survey unit and at each occurrence of Aboriginal objects regarding the nature and depth of soils. This included notes on soil colour, texture and inclusions, opportunities to observe soil depth, and where possible, the nature of subsoils, and observations regarding evidence of soil disturbance.

Where surface bedrock was visible, or natural gravels, cobbles or pebbles present at the surface, observations were made regarding rock types. This included notes regarding material, type of occurrence, size and form (e.g. rounded, angular etc.). Particular attention was given to whether or not the background geology included material suitable for artefact manufacture. This was recorded with reference to whether there were sources of procurable stone suitable for artefact manufacture, and with regard to whether examples of flaked stone may be present that were not the result of Aboriginal activity (e.g. natural conchoidal fractures, or material broken by vehicles/modern equipment).

8.3.3 Vegetation and visibility

The presence, nature and composition of vegetation was recorded for each survey unit, including observations regarding vegetation density, height, estimated age and species. Notes were also compiled regarding the frequency and extent of surface ground exposures (areas devoid of vegetation), and constraints on identifying Aboriginal objects within those exposures (e.g. leaf litter, gravels, introduced materials). The average percentage of ground exposure, and visibility within exposures, was recorded to the nearest 10% for each survey unit and/or occurrence of Aboriginal objects.

8.3.4 Survey coverage and effectiveness

Survey coverage and effectiveness was calculated in accordance with the methods outlined in the Code of Practice (DECCW 2010b). The size of individual survey units was calculated with reference to the field records of survey unit extent, and to the corresponding extent of that landform within the study area. This was then multiplied by the average incidence of ground surface exposure, and average visibility within those exposures to determine the effective survey coverage area within a given survey unit. The effective survey coverage area was then converted into an overall percentage of the survey unit area.

These calculations of effective survey coverage were then reviewed in terms of landform type, predicted archaeological sensitivity, recorded occurrences of Aboriginal objects, and the overall effectiveness of the survey. i.e. to what extent the survey results could be relied on as an accurate reflection of the presence of Aboriginal objects within a given survey unit, and across the study area as a whole.

8.3.5 Mapping

The boundaries of the study area, and locations of any previously recorded sites were uploaded to a mobile device prior to survey. The Avenza Maps app was used in the field to assist with navigation, track survey coverage, and to record geo-spatial information regarding photographs, occurrences of Aboriginal objects, extent of survey units, and observations relating to these recordings. All data collected during the field was then uploaded as GIS files for the purposes of results analysis and mapping within this report.

9 SURVEY RESULTS

9.1 Survey Units

The survey of the proposed Dargues Gold Mine MOD 5 area was completed over two days due to a change in the project scope. The original survey included Survey Unit 1 (SU1) which was the location of the proposed Water Storage Dam, while SU2, SU3 and SU4 covered the proposed water transfer pipelines.

The project area was adjusted due to changes to the proposed impact area for the Water Storage Dam, and revised locations of water pipelines. As a result, SU1 was expanded and was relabelled SU1 #1 (west portion) and SU1 #2 (east portion). Two new pipeline alignments were also added to the far western and eastern extends of the proposed Water Storage Dam. The eastern pipeline is covered by SU7 to SU10 and the western pipeline is covered by SU5 and SU6.

A low level of visibility, due to thick vegetation growth, was encountered across the entire study area resulting in limited opportunity to effectively assess the subsurface potential. As such, the assessments of subsurface potential relied heavily on observations regarding prior disturbance, soil deposit types and geomorphic processes.

The survey of the proposed Dargues Gold Mine MOD 5 study area did not identify any Aboriginal or Historic objects and/or items except for an area of Potential Archaeological Deposit (PAD). This area is located within the boundary of the proposed Water Storage Dam and is recorded as Dargues Gold Mine PAD 22-1. While there was limited visibility throughout the study area, it is unlikely that the landforms within SU1 #2 and SU2 to SU10 contain high potential for artefacts. However, whilst there was also very little visibility in SU1 #1 it is located on a gentler gradient than SU1 #2 indicating that there is moderate potential for subsurface archaeological material.

As shown in Table 5, the level of effective coverage was very low as a result of the low levels of visibility and exposure. However, these results are not uncommon in archaeological surveys within south-eastern New South Wales. Figure 17 illustrates the location of each survey unit recorded during field inspection of the MOD 5 study area.

Table 5: Survey coverage within MOD 5 study area

Survey Unit	Landform	Survey Unit Area (m2)	Visibility %	Exposure %	Effective Coverage Area (m2)	Effective Coverage %
SU1 #1 & #2	Lower section of simple slope	178,248	5.00%	70.00%	6239	3.5%
SU2	Simple slope	414	1.00%	5.00%	0	0.05%
SU3	Drainage line	2456	1.00%	5.00%	1	0.05%
SU4	Simple slope	2152	5.00%	5.00%	5	0.25%
SU5	Simple slope	3448	10.00%	80.00%	276	8.0%
SU6	Open depression	1880	1.00%	5.00%	1	0.05%
SU7	Simple slope	4884	5.00%	80.00%	195	4.0%
SU8	Open depression	974	1.00%	80.00%	8	0.8%
SU9	Simple slope	2205	20.00%	60.00%	265	12.0%
SU10	Crest	538	10.00%	70.00%	38	7.0%

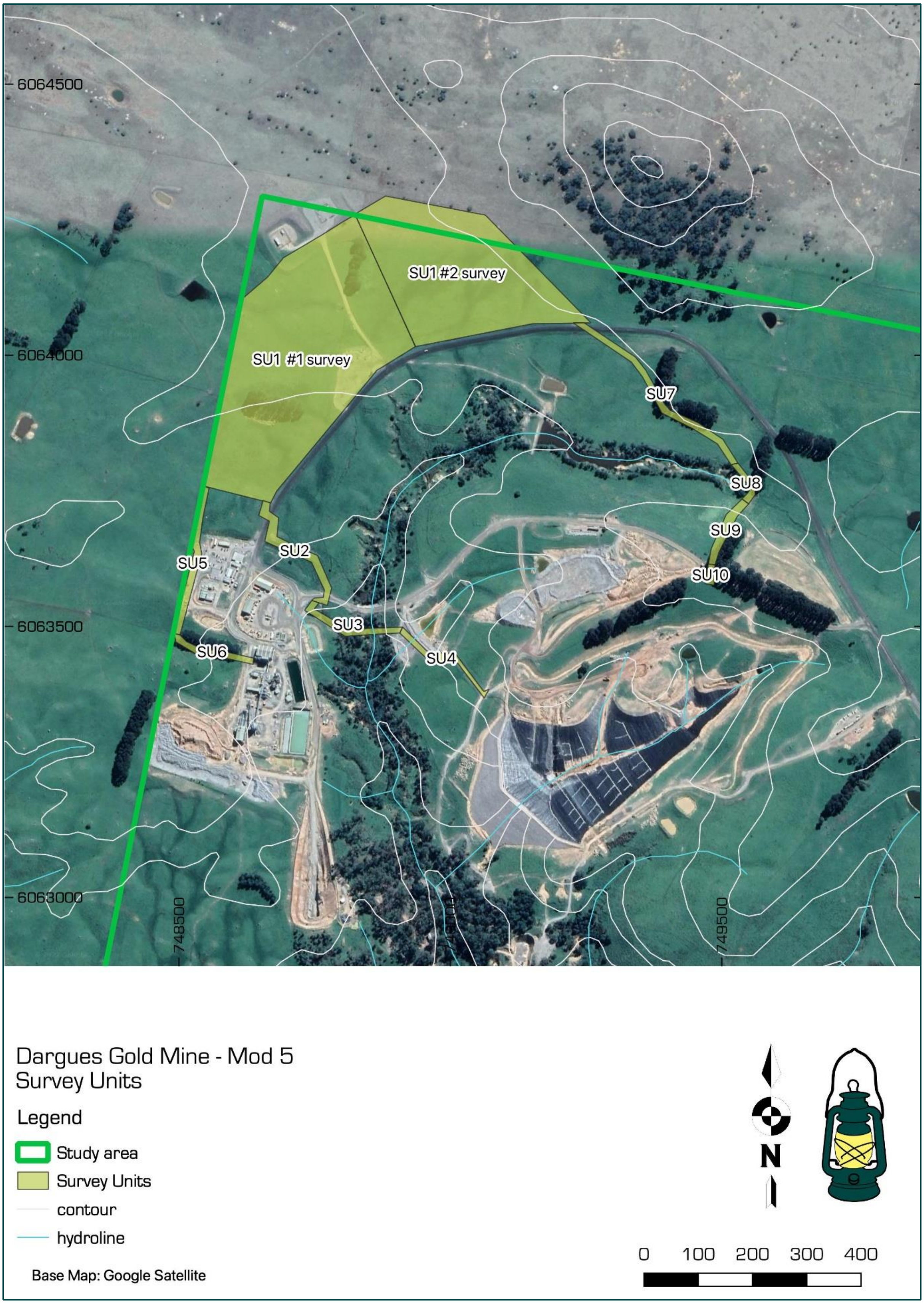

Figure 17: Survey units recorded within the Dargues Gold Mine MOD 5 study area

9.1.1 Survey Unit 1

Survey Unit 1 (SU1) comprises the large section of a lower slope with gentle gradient (Plates 1 to 4). This survey unit was divided into SU #1 (western portion) and SU #2 (eastern portion) following revisions to the location of the proposed Water Storage Dam. Although it is a lower slope landform, SU1 forms a broad saddle, marking the watershed between the Shoalhaven River catchment to the north and the Deua River to the south. Within this broader landform there are low rises adjacent to minor drainage lines. No previously recorded AHIMS sites or Historic items are located within this survey unit. Impacts proposed within this area include construction of a Water Storage Dam, and placement of water pipes.

The slope faces south and southwest with exposed profiles indicating that soils comprise a light brown humic layer about 25cm deep with orange brown decomposed granite below. The nearest permanent water source is Spring Creek located about 220m to the south. Previous land use impacts include vegetation clearance, planting of introduced pine trees as windbreaks, vehicle track construction, grader scrapes, levelling and filling to create laydown area, placement of mine tailing mounds and construction of small dams (Plates 5 to 7). The vehicle track and laydown area are constructed of imported sand and crushed granite material (Plate 9).

Both portions of SU1 were characterised by thick grass cover in water logged conditions. These two factors resulted in poor ground visibility (Plate 10). On average, exposure was less than 5%, with visibility averaging 70% within these exposures. Exposures were varied across both portions of SU1, including grader scrapes, stock trampled areas, occasional vehicle tracks and one wombat burrow (Plates 8 to 10). Despite this variety of exposures, no Aboriginal or Historic objects and/or items were identified in SU1 #1 or SU1 #2.

Due to the poor ground surface visibility, the presence or absence of surface Aboriginal objects could not be determined. However, based on the predictive archaeological model, the following factors indicate that this area may contain subsurface Aboriginal objects: the elevated saddle position of SU1, proximity to Spring Creek and the low gradient of this landform. Previously recorded Aboriginal sites along Spring Creek show that there are artefacts in the vicinity of SU1 even if they are not located in their original location due to previous land use impacts.

Based on results of field survey and the regional predictive model, an area of potential archaeological deposit (PAD) was identified within SU1 #1. This PAD discussed further in section 9.2.1. No Historic objects and/or items were identified in SU1 #1 or SU1 #2.

The proposed Water Storage Dam will result in removal of vegetation, topsoil and subsurface deposits across a 10 ha area. Due to this large impact area, and lack of surface visibility, archaeological test excavation is recommended to determine the nature and extent of subsurface archaeological deposits.

Plate 1: Overlooking gentle gradient of slope from south-eastern corner of SU1 #1, facing west. Example of survey conditions and of poor ground exposure within SU1 #1.

Plate 2: View from north-eastern corner of SU1 #1 to southeast.

Plate 3: View from north-western corner of SU1 #1, facing south.

Plate 4: View from south-western corner of SU1 #1, facing northeast.

Plate 5: Example of impacts from grader scrapes in western portion of SU1 #1, facing south towards small rise.

Plate 6: View of impacts associated with laydown area located along southern border of SU1 #1, facing southwest.

Plate 7: Example of dam construction located within northern portion of SU1 #1, facing north.

Plate 8: Example of ground exposure created by cattle trampling in north-eastern portion of SU1 #2, facing northeast.

Plate 9: Example of ground exposure and visibility within laydown area located on southern boundary of SU1 #1.

Plate 10: Example of ground exposure and visibility within eastern portion of SU1 #2, facing east northeast.

9.1.2 Survey Unit 2

Survey Unit 2 (SU2) comprises a simple slope on the western side of Spring Creek. This area was inspected as the initial MOD 5 plans proposed two water pipelines there. SU2 comprised a 10m wide linear survey corridor. Impacts within this area relate to placement of water pipelines.

This landform has a south-easterly aspect with a gentle slope (Plate 11). There are no previously recorded AHIMS sites or Historic items located within this survey unit. Disturbance related to previous land use activities includes vegetation clearance, pastoral activities, construction of vehicle tracks, and placement of mine tailing mounds (Plate 12). As this survey unit borders Spring Creek, there would have been significant ground disturbance resulting from current and 19th century gold mining activities in this area.

Within SU2 there was limited exposure due to thick grass cover (Plates 13 and 14). Exposures averaged less than 1% and were primarily related to vehicle tracks, with visibility within these exposures averaging less than 5%. Sediments appeared to be light brown humic topsoil of unknown depth due to lack of visibility. No Aboriginal or Historic objects and/or items were identified in SU2.

Though one AHIMS sites is recorded about 105m to the north, and the survey unit is beside a permanent water source, the extent of disturbance and lack of archaeological remains observed during field assessment suggest this area is of low archaeological potential.

The narrow corridor of proposed pipeline represents a minor portion of the entire landform. No further investigation is recommended.

Plate 11: Start of SU2 facing southeast. Mine tailing mound located on right side of picture.

Plate 12: View of previous disturbance in SU2: overlooking mine tailing mounds on left and right of picture, facing northwest.

Plate 13: Example of survey conditions in SU2, looking south southeast.

Plate 14: Example of ground visibility and water-logged conditions within SU2.

9.1.3 Survey Unit 3

Survey Unit 3 (SU3) comprises the steeply incised drainage channel formed by the first order creekline of Spring Creek. This area was inspected as the initial MOD 5 plans proposed placement of two water pipelines here. SU3 comprises a 10m wide linear survey corridor. Impacts within this area relate to placement of water pipelines. There are no previously recorded AHIMS sites or Historic items located within Survey Unit 3 (SU3), This survey unit is a heavily eroded drainage gully with steep sides that are about 7m high (Plates 15 and 16). Based on the exposures within the gully, sediments are orange brown decomposed granite up to 7m deep.

This landform is heavily disturbed, most likely by recent as well as 19^{th} century gold mining activities. Additional impacts have resulted from vegetation clearance and pastoral activities as well as from construction of a road across Spring Creek to provide mine vehicles with access to tailing mounds (Plate 18).

Within SU3 there was limited exposure due to thick vegetation cover as seen in Plates 15 and 17. Exposures averaged less than 1%, primarily related to minor erosion scalds, with visibility within these exposures averaging less than 5%.

No Aboriginal or Historic objects and/or items were identified in SU3. While there are several AHIMS sites recorded along Spring Creek to the north and south of SU3, the massive amount of disturbance within this survey unit indicates that it now has low archaeological potential.

The narrow corridor of proposed pipeline represents a minor portion of the entire landform. No further investigation is recommended.

Plate 15: Overlooking SU3, showing steep gully walls and thick vegetation cover, facing east towards Spring Creek.

Plate 16: Looking along gully towards existing mine infrastructure, facing west.

Plate 17: Example of survey conditions in SU3. Looking south over gully formed by Spring Creek.

Plate 18: View of existing crossing over Spring Creek showing built up roadway, facing northeast.

9.1.4 Survey Unit 4

Survey Unit 4 (SU4) comprises a simple slope on the eastern side of Spring Creek. This area was inspected as the initial MOD 5 plans proposed placement of two water pipelines here. SU4 comprises a 10m wide linear survey corridor. Impacts within this area relate to placement of water pipelines. This landform has a south-westerly aspect with a gentle slope (Plate 19). There are no previously recorded AHIMS sites or Historic items located within this survey unit.

Disturbance related to previous land use activities in this survey unit includes vegetation clearance, pastoral activities, construction of vehicle tracks and small dams, as well as placement of mine tailing mounds (Plates 20 and 21). As this survey unit borders Spring Creek, there would have been significant ground disturbance resulting from current and 19th century gold mining activities in this area.

Exposure was limited within SU4 due to grass cover and placement of mine tailings across the landform (Plate 19). Exposures averaged less than 5% with visibility within these exposures averaging less than 5%. Sediments are predicted to comprise orange brown decomposed granite of unknown depth due to lack of visibility. No Aboriginal or Historic objects and/or items were identified within SU4. Based on extent of previous disturbance dating from 19th century to current gold mining activities, the archaeological potential of this section of the study area is assessed as low.

The narrow corridor of proposed pipeline represents a minor portion of the entire landform. No further investigation is recommended.

Plate 19: View of SU4 facing south showing low visibility from grass cover and mine tailings. Spring Creek is on left side of picture.

Plate 20: View of small dam constructed within SU4, facing north.

Plate 21: Example of impacts from vehicle access tracks within southern end of SU4, facing east. Existing water storage dam is in background.

9.1.5 Survey Unit 5

This survey unit comprises a gently inclined simple slope with an easterly aspect. This area was inspected as the final MOD 5 plans proposed placement of two water pipelines here. Survey Unit 5 (SU5) comprised a 10m wide linear survey corridor. Impacts within this area relate to placement of water pipelines. There are no previously recorded AHIMS sites or Historic items located within this survey unit. The northern 110m of the survey unit has been impacted by previous land use activities including vegetation clearance and pastoral activities (Plate 22). By comparison, the remaining southern section of SU5 has been extensively impacted through levelling and filling of the landform to accommodate staff and visitor carparking, excavation of drainage channels, as well as construction of site offices and various other facilities (Plate 23).

There was limited exposure within SU5 due to imported gravel within carpark area (Plate 24), and thick grass cover in the remaining sections of the survey unit. Exposures averaged less than 10% and were primarily related to small patches of bare earth, and the drainage channel (Plate 25).

Visibility within these exposures averaged 80%. Exposed profiles indicate that sediments comprise a light brown humic layer on top of orange brown decomposed granite. No Aboriginal or Historic objects and/or items were identified in SU5.

In comparison with landforms along Spring Creek, SU5 would most likely have been used for travelling through country rather than longer term activities. Based on the regional archaeological model and previous levels of disturbance, the archaeological potential of SU5 is assessed as low.

The narrow corridor of proposed pipeline represents a minor portion of the entire landform. No further investigation is recommended.

Plate 22: View of northern portion of SU5 from existing carpark, facing north.

Plate 23: Example of survey conditions in SU5, facing southwest.

Plate 24: Example of visibility encoutered in carpark within SU5.

Plate 25: View of exposure and visibility within drainage channel in SU5, facing southwest

9.1.6 Survey Unit 6

Survey Unit 6 (SU6) comprises an open depression, thickly vegetated with grass and two rows of introduced pine trees (Plate 26). This area was inspected as the final MOD 5 plans proposed placement of two water pipelines. SU6 comprises a 10m wide linear survey corridor. Impacts within this area relate to placement of water pipelines.

The rows of pine trees are located on the southern side of the depression and are oriented in a north to south-easterly direction. Running perpendicular to the boundary, a drainage channel about 2m deep has been excavated at the eastern end of this survey unit (Plate 27). Disturbance related to previous land use activities in this survey unit includes vegetation clearance, pastoral activities, construction of a drainage line and planting of the pine tree wind break.

Exposure was limited within SU6 due to thick grass cover (Plate 28). Exposures averaged less than 1% with visibility within these exposures averaging less than 5%. Due to the lack of visibility, Sediments are predicted to comprise of orange brown decomposed granite similar to other survey units. No Aboriginal or Historic objects and/or items were identified in SU6.

Based on the regional archaeological model and previous levels of disturbance, the archaeological potential of this section of the study area is assessed as low.

The narrow corridor of proposed pipeline represents a minor portion of the entire landform. No further investigation is recommended.

Plate 26: Overview of SU6 with open depression on left side of picture (facing north southeast).

Plate 27: View of drainage channel at eastern end of SU6, facing north.

Plate 28: Example of low exposure and visibility in SU6.

9.1.7 Survey Unit 7

Survey Unit 7 (SU7) comprises a simple slope on the northern side of Spring Creek. This area was inspected as the final MOD 5 plans proposed placement of two water pipelines here. SU7 comprises a 10m wide linear survey corridor. Impacts proposed in this area relate to underboring the access road and placement of water pipelines. This landform has a southerly aspect with gentle gradients leading to the creekline (Plate 29). There are no previously recorded AHIMS sites located within this survey unit. Based on descriptions within the 2010 European Heritage report (AH&S 2010b) there may have been a water raceway in this survey unit, however no evidence of this was identified during survey.

Previous land use impacts include road construction, vegetation clearance, pastoral activities, planting of introduced pine trees as windbreaks and construction of dams. SU7 was characterised by thick grass cover resulting in poor ground visibility (Plate 31). There was also minimal visibility in the location of the proposed underboring activity as shown in Plate 30. On average, exposure was less than 5%, with visibility averaging 80% within these exposures. Exposures were limited to stock trampled areas and occasional vehicle tracks (Plate 32). Due to the lack of visibility, sediments are predicted to comprise light brown humic soil on top of orange brown decomposed granite similar to other survey units.

No Aboriginal or Historic objects and/or items were identified within SU7. In comparison with other landforms within the study area SU7 would most likely have been used for travelling through country rather than longer term activities. Based on the regional archaeological model and previous disturbance, the archaeological potential of SU7 is assessed as low.

The narrow corridor of proposed pipeline and section of underboring represents a minor portion of the entire landform. No further investigation is recommended.

Plate 29: Overlooking gentle slope of SU7, facing southeast.

Plate 30: Overview of proposed underboring location on southern side of main access road, facing east.

Plate 31: Example of survey conditions and thick grass cover in SU7, facing southeast.

Plate 32: Example of ground exposure from cattle trampling within SU7.

9.1.8 Survey Unit 8

Survey Unit 8 (SU8) comprises an open depression located at the source of Spring Creek. This area was inspected as the final MOD 5 plans proposed placement of two water pipelines here. SU8 comprises a 10m wide linear survey corridor. Impacts within this area relate to placement of water pipelines.

This landform has a north-westerly aspect and is located above the gully forming Spring Creek (Plate 33). There are no previously recorded AHIMS sites or Historic items located within this survey unit.

Previous land use impacts include vegetation clearance, pastoral activities and planting of native trees to stabilise the creek bank. SU8 was characterised by thick grass cover and pools of water resulting in poor ground visibility (Plate 33). On average, exposure was less than 1%, with visibility averaging 80% within these exposures. Exposures were limited to stock trampled areas. Sediments comprise light brown humic soil of unknown depth due to lack of visibility.

No Aboriginal or Historic objects and/or items were identified within SU8. Though SU8 comprises a landform adjacent to a permanent watercourse, the proposed pipeline traverses the area above the source of Spring Creek. Based on the regional archaeological model and previous disturbance, the archaeological potential of SU8 is assessed as low to moderate.

The narrow corridor of proposed pipeline represents a minor portion of the entire landform. No further investigation is recommended.

Plate 33: Overview of SU8, showing thick grass cover and pools of water (facing northeast).

9.1.9 Survey Unit 9

Survey Unit 9 (SU9) comprises a gentle to moderately inclined simple slope on the southern side of Spring Creek. This area was inspected as the final MOD 5 plans proposed placement of two water pipelines here. SU9 comprises a 10m wide linear survey corridor. Impacts within this area relate to placement of water pipelines.

Previous land use impacts include vegetation clearance, pastoral activities, and planting of introduced pine trees (Plate 34). SU9 was characterised by thick grass cover resulting in poor ground visibility (Plate 34). On average, exposure was less than 20%, with visibility averaging 60% within these exposures (Plate 35). Exposures were limited to stock trampled areas underneath pine trees. Sediments comprise light brown humic soil of unknown depth due to lack of visibility. No Aboriginal and Historic objects and/or items were identified in SU9.

Though SU9 comprises a landform adjacent to a permanent water source, this survey unit would most likely have been used for travelling through country rather than longer term activities. Based on the regional archaeological model, previous disturbance and landform, the archaeological potential of SU9 is assessed as low.

The narrow corridor of proposed pipeline represents a minor portion of the entire landform. No further investigation is recommended.

Plate 34: Overview of SU9 facing northeast towards tree line marking source of Spring Creek.

Plate 35: Example of exposure and visibility within SU9

9.1.10 Survey Unit 10

Survey Unit 10 (SU10) comprises a crest about 200m south of Spring Creek (Plate 36). This area was inspected as the final MOD 5 plans proposed placement of two water pipelines here. SU10 comprises a 10m wide linear survey corridor. Impacts within this area relate to placement of water pipelines. There are no previously recorded AHIMS sites or Historic items located within this survey unit.

The crest is located between the headwaters of Spring Creek and the existing water storage dam about 180m to the south (Plate 37). Previous land use impacts include road construction, vegetation clearance, pastoral activities and planting of introduced pine trees. There was limited exposure within SU10 due to imported gravel along the vehicle track (Plate 38) and thick grass cover in the remaining sections of the survey unit. Exposures averaged less than 10% and were primarily related to small patches of bare earth alongside the road. Visibility within these exposures averaged 70%.

No Aboriginal or Historic objects and/or items were identified in SU10. While there are two AHIMS sites recorded about 400m to the southeast of SU10, these sites are locations of salvaged artefacts from Dargues Gold Mine and not an indicator of archaeological potential. In comparison with landforms along Spring Creek, SU10 would most likely have been used for travelling through country rather than longer term activities. Based on the regional archaeological model and previous levels of disturbance, the archaeological potential of SU10 is assessed as low.

The narrow corridor of proposed pipeline represents a minor portion of the entire landform. No further investigation is recommended.

Plate 36: View along SU10 towards northwest.

Plate 37: Overview of SU10 located on left side of picture between water storage dam and pine trees, facing southwest.

Plate 38: Example of existing impacts and visibility within SU10, facing south.

9.2 Aboriginal Sites

9.2.1 Dargues Gold Mine 22-1 PAD (DGM PAD 22-1) (AHIMS #57-6-0477)

Grid References: GDA Zone 55 748733E and 6064050N (centre point)

This site is an area of potential archaeological deposit (PAD) on a gentle midslope within SU1 #1. The topography of the site gently slopes towards the southwest with small rises across the landform adjacent to minor drainage lines (Plates 39 to 41). The site is approximately 200m north of the main course of the permanent Spring Creek. The area of PAD is illustrated in Figure 18 and measures approximately 265m (north-south) by 180m (east-west). The PAD is bounded by an access road to the north, the laydown area in the east, project area boundary fence in the west and southwest, with the southern boundary formed by a pine tree wind break.

No Aboriginal objects were observed at the site due to very low average visibility across the site. Exposures across the site were approximately 5% with 70% visibility within them. Where visible, the soil deposit is comprised of 20-25cm of light brown humic sandy silt overlying yellowish orange clayey gravels including decomposing granitic material (Plate 42).

While not meeting the traditional definition of a narrow saddle landform, this site does exhibit many features that match the regional site location model. Site DGM PAD 22-1 is located on a gently inclined landform in close proximity to a permanent water source. The areas with highest archaeological potential within the PAD comprises micro-topographic elevated rises located adjacent to minor drainage lines. These elevated landforms, are considered to be areas of higher potential within the regional predictive mode. The location of this elevated landform between two major river catchments is another feature supporting the high archaeological potential of this site.

In addition to the landform characteristics of this PAD, a number of AHIMS sites are recorded nearby. These previously recorded artefacts are located on the banks of Spring Creek, and most likely eroded out of surrounding soil deposits due to earlier land use impacts. Given the range of impacts from 19th century gold mining along Spring Creek, it is possible that these artefacts moved downslope from their original location through a combination of human and natural forces.

Based on these observations this site has moderate potential for subsurface archaeological material.

The proposed Water Storage Dam in this location will result in removal of vegetation, topsoil and subsurface deposits across a 10 ha area. Due to this large impact area, poor surface visibility, and lack of subsurface archaeological investigations in the immediate area, test excavation is recommended to determine the nature and extent of archaeological deposits within Dargues Gold Mine PAD 22-1 (AHIMS #57-6-0477) prior to any ground disturbing activity.

Plate 39: Overview of northern portion DGM PAD 22-1, facing south southwest.

Plate 40: Overview of southern portion of DGM PAD 22-1, facing south.

Plate 41: Looking south towards locally elevated rise within DGM PAD 22-1.

Plate 42: Example of soil deposit located within DGM PAD 22-1 (facing east).

9.3 Historic Sites

No structures, relics or potential sites of historical significance were identified within the activity area.

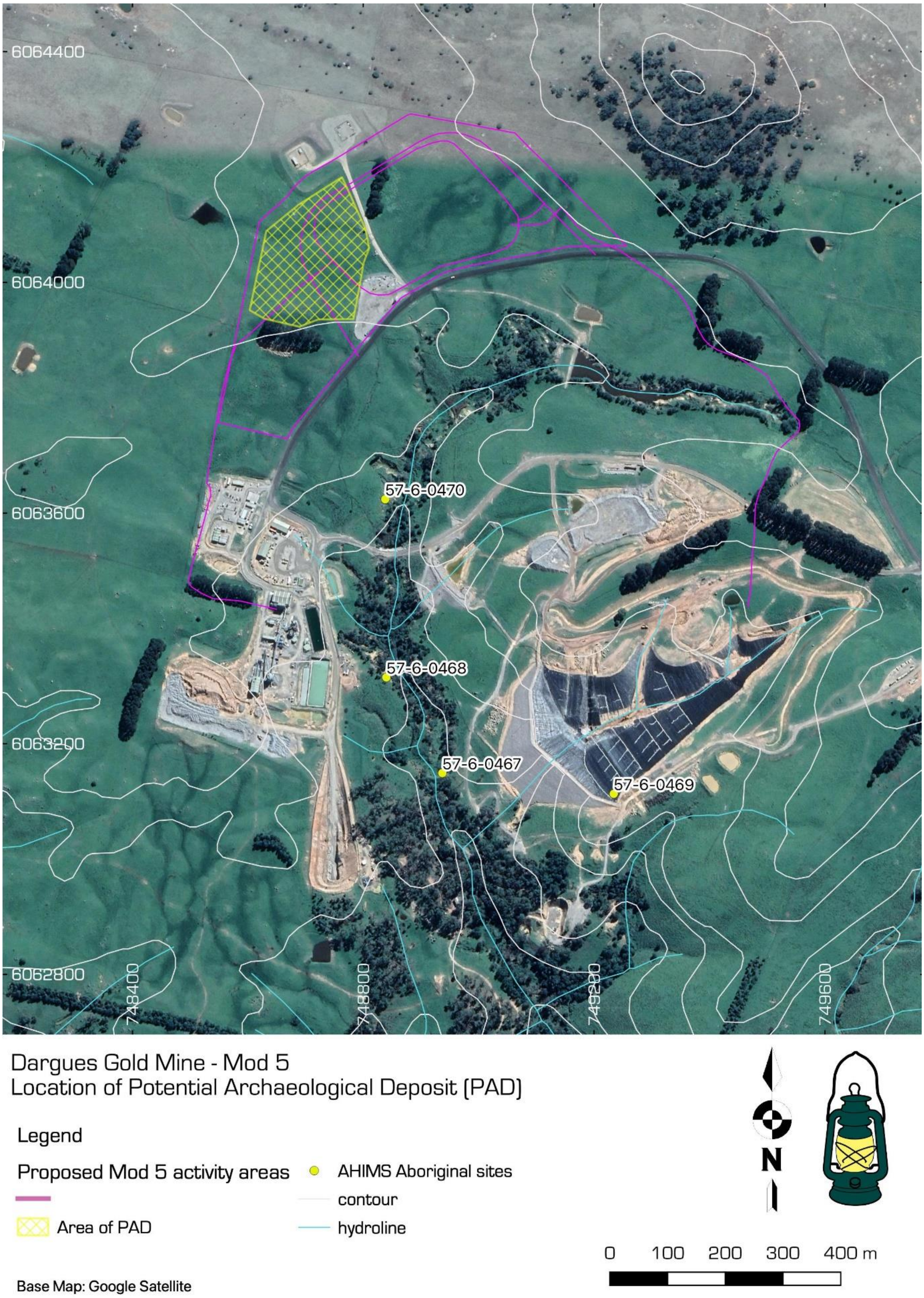

Figure 18: Location of Dargues Gold Mine PAD 22-1 shown by hatched polygon.

10 ABORIGINAL CONSULTATION PROCESS

10.1 Background to Aboriginal consultation process

Aboriginal stakeholders were identified and notified in January 2010 in accordance with the *Guidelines for Aboriginal Cultural Heritage Impact and Community Consultation* (DECCW 2005). This notification was initiated prior to the original Aboriginal Heritage Assessment undertaken by Archaeological Surveys and Reports (2010). Registered Aboriginal stakeholders identified during this process are:

- Ngunnawal Elders Corporation.
- Ngunnawal Heritage Aboriginal Corporation (now Mundawari Heritage Consultants Pty Ltd).
- Buru Ngunawal Aboriginal Corporation Traditional Carer Group.
- Konanggo Aboriginal Cultural Heritage Services.
- Yurwang Gundana Consultancy Cultural Heritage Services.
- King Browns Tribal Group Pty Ltd.
- Yukembruk Merung Ngarigo Consultancy Pty. Ltd. (formerly Bega Traditional Elders Council).
- Walbunja Aboriginal Corporation.
- Batemans Bay LALC.
- Little Gudgenby River Tribal Council. (now called Mirrabee).

The 2019 AHMP recommends that consultation follows the Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010 (DECCW 2010b) (Artefact Heritage Services 2019).

Further details of each phase of consultation undertaken for the various Dargues Gold Mine modifications can be found in each of the associated modification assessments.

10.2 Aboriginal consultation for MOD 5

As shown in Appendix 2, letters were sent out to the RAPs identified above informing them of the proposed MOD 5 changes and asking them if they want to continue to be consulted about the project. Requests for continued involvement were received from: Yurwang Gundana Consultancy; Buru Ngunawal Aboriginal Corporation and Ngunnawal Heritage Aboriginal Corporation.

For the MOD 5 field survey both Mogo LALC and Batemans Bay LALC were invited to participate. Mogo LALC sent a site officer for the surveys in March 2022, however Batemans Bay LALC were unable to send a site officer. For the subsequent field survey, which was arranged at short notice, only Mogo LALC were contactable.

All Registered Aboriginal Parties were given until 6 July 2022 to provide feedback and comment on the Aboriginal and Historic Cultural Heritage Assessment Report All responses are included in Appendix 2, with a summary provided below:

- Mundawari Heritage Consultants (formerly Ngunnawal Heritage Aboriginal Corporation) support the recommendations in the report, in particular the requirement for test excavation.
- Mogo LALC were contacted by phone on 20 July 2022 to check if they had any comments on the report. At the date of report submission, no comments were received. However, the proposed impacts were discussed in depth with the Mogo LALC site officer as the survey area was walked over. The site officer supported Lantern's identification of the area of archaeological potential and proposed test excavation prior to impacts.
- No other comments were received from RAPs.

11 CULTURAL HERITAGE VALUES AND STATEMENT OF SIGNIFICANCE

This section details the assessment of all cultural heritage values at the proposed Dargues Gold Mine locality. It has been compiled in accordance with the processes outlined in the *Burra Charter* (Australia ICOMOS 2013a). Each of the sub-sections below provides an overview of how different cultural heritage values are defined in the *Burra Charter*, followed by discussion of how these values apply to the study area and the site assessed during field survey. This is followed by statements of significance for areas of anticipated impact.

11.1 Social or Cultural Values

Within the Burra Charter Practice Note on *Understanding and Assessing Cultural Significance* (Australia ICOMOS 2013b: 4) Social Value is defined as follows:

> ***Social value*** *refers to the associations that a place has for a particular community or cultural group and the social or cultural meanings that it holds for them.*

Within the context of assessing Aboriginal cultural heritage, spiritual values are often closely tied to social values. Within the Burra Charter Practice Note on *Understanding and Assessing Cultural Significance* (AICOMOS 2013b: 4) Spiritual Value is defined as follows:

> ***Spiritual value*** *refers to the intangible values and meanings embodied in or evoked by a place which give it importance in the spiritual identity, or the traditional knowledge, art and practices of a cultural group. Spiritual value may also be reflected in the intensity of aesthetic and emotional responses or community associations, and be expressed through cultural practices and related places.*
>
> *The qualities of the place may inspire a strong and/or spontaneous emotional or metaphysical response in people, expanding their understanding of their place, purpose and obligations in the world, particularly in relation to the spiritual realm.*
>
> *The term spiritual value was recognised as a separate value in the Burra Charter, 1999. It is still included in the definition of social value in the Commonwealth and most state jurisdictions. Spiritual values may be interdependent on the social values and physical properties of a place.*

Little is known of Aboriginal cultural connection to places within the Dargues Gold Mine study area due to the displacement of Aboriginal people in the area following European colonisation. RAPs present during the survey were unable to provide any insights into cultural practices in the area in the past. However, due to the proximity of Spring Creek and other natural water sources it is likely that this area was used extensively in the past for habitation.

11.2 Historic Values

Within the Burra Charter Practice Note on *Understanding and Assessing Cultural Significance* (AICOMOS 2013b: 3) Historic Value is defined as follows:

> ***Historic value*** *is intended to encompass all aspects of history—for example, the history of aesthetics, art and architecture, science, spirituality and society. It therefore often underlies other values. A place may have historic value because it has influenced, or has been influenced by, an historic event, phase, movement or activity, person or group of people. It may be the site of an*

> *important event. For any place the significance will be greater where the evidence of the association or event survives at the place, or where the setting is substantially intact, than where it has been changed or evidence does not survive. However, some events or associations may be so important that the place retains significance regardless of such change or absence of evidence.*

The Dargues Gold Mine activity area contains the mid-19th century Spring Creek gold rush area and various phases of deep lead mining activity. While no evidence of these activities was visible within the proposed MOD 5 activity area, the Spring Creek gold rush forms a small but important component of the history of gold extraction in the area, and the establishment of the town of Braidwood.

11.3 Scientific/Archaeological Values

Within the Burra Charter Practice Note on *Understanding and Assessing Cultural Significance* (AICOMOS 2013b: 3-4) Scientific Value is defined as follows:

> ***Scientific value** refers to the information content of a place and its ability to reveal more about an aspect of the past through examination or investigation of the place, including the use of archaeological techniques. The relative scientific value of a place is likely to depend on the importance of the information or data involved, on its rarity, quality or representativeness, and its potential to contribute further important information about the place itself or a type or class of place or to address important research questions. To establish potential, it may be necessary to carry out some form of testing or sampling. For example, in the case of an archaeological site, this could be established by a test excavation.*

It is currently unknown what scientific/archaeological value the MOD 5 activity area contains due to the poor visibility. Additionally, due to the lack of previous subsurface archaeological investigation in the area, the value of the archaeological material that may be located subsurface is unknown. The presence of a relatively undisturbed portion of earth in a somewhat elevated position with artefacts that have eroded out of the deposit downslope suggests that DGM PAD 22-1 has at least moderate scientific/archaeological value.

11.4 Aesthetic Values

Within the Burra Charter Practice Note on *Understanding and Assessing Cultural Significance* (AICOMOS 2013b: 3) Aesthetic Value is defined as follows:

> ***Aesthetic value** refers to the sensory and perceptual experience of a place—that is, how we respond to visual and non-visual aspects such as sounds, smells and other factors having a strong impact on human thoughts, feelings and attitudes. Aesthetic qualities may include the concept of beauty and formal aesthetic ideals. Expressions of aesthetics are culturally influenced.*

The site itself does not exhibit any aesthetic value, however, the elevation and position of the site has a view of the surrounding landscape. The visual vantage is such that an individual can see as far as Bateman's Bay to the east and the mountains to the southwest. This would have been useful for Aboriginal people prior to European settlement in terms of signals and other human activity in the region.

11.5 Statement of Significance

The following statement of significance has been compiled on the basis of the Aboriginal consultation undertaken for this report, together with the research and accompanying archaeological analysis documented in the archaeological report in Appendix 2.

Table 6: Statement of significance

Site	Statement of Significance
DGM PAD 22-1 AHIMS #57-6-0477	This site is part of a broader complex of sites and associated cultural landscape that is assessed to be of moderate Aboriginal cultural value. It has low significance in terms of social/cultural values. It has moderate significance in terms of Aesthetic values relating to its position within the broader landscape. It also has moderate scientific value as a site that can contribute to an understanding of Aboriginal occupation of the Southern Highlands of which little is yet known.

12 IMPACT ASSESSMENT

As outlined above, in Section 2.2, various aspects of the proposed MOD 5 works at Dargues Gold Mine have the potential to result in direct and/or indirect harm to Aboriginal objects and/or Historic items. Direct impacts are anticipated within the area of the proposed Water Storage Dam resulting in total loss of value. The remaining activities may result in indirect harm, however the loss will be partial only.

The proposed impacts and degree of harm within the MOD 5 activity area is summarised in Table 7.

Table 7: proposed impacts within the MOD 5 activity area

Survey Unit	Type/degree of harm	Consequences
SU1 #1	Direct / total	Total loss of value
DGM PAD 22-1	Direct/ total	Total loss of value
SU1 #2	Indirect /Partial	Partial loss of value
SU2	Indirect /Partial	Partial loss of value
SU3	Indirect /Partial	Partial loss of value
SU4	Indirect /Partial	Partial loss of value
SU5	Indirect /Partial	Partial loss of value
SU6	Indirect /Partial	Partial loss of value
SU7	Indirect /Partial	Partial loss of value
SU8	Indirect /Partial	Partial loss of value
SU9	Indirect /Partial	Partial loss of value
SU10	Indirect /Partial	Partial loss of value

The type of impacts proposed from the immediate actions involved with the proposed MOD 5 works at Dargues Gold Mine are described below in Table 8. This table provides notes on the direct and indirect impacts that may be anticipated from the proposed works. It should also be noted that sites outside the current MOD 5 activity area will not be directly impacted by the proposed works.

12.1.1 Impacts on Aboriginal and Historic cultural heritage values

Overall, the proposed works will result in a range of impacts across a large area. The placement of the proposed water pipelines on the surface of the activity area will have minimal impacts. By contrast, the proposed Water Storage Dam construction will have a direct impact on any surface or subsurface archaeological material. While there will be an increase in direct harm to the archaeological deposits within the area of the proposed dam, it is unclear to what extent archaeological deposits exist. These impacts will result in the loss of any archaeological scientific/research potential.

Impacts to historic and aesthetic values will be very limited. The construction of a proposed Water Storage Dam in an already developed landscape will not change the overall historic and aesthetic values of the site. No historical sites or relics were identified during the survey.

The social and cultural values of this site have already been impacted by the dispossession of local Aboriginal people from their country. This project is located in an area that has already been cleared and developed. Despite this, local Aboriginal people retain their cultural links to country and the proposed development will not result in any net increase to loss of cultural heritage significance.

Table 8: Overview of the proposed MOD 5 works and the ways in which impacts may result.

Action/Works	Impact Type	Notes
Site preparation earthworks	Direct	Earthworks will occur to surface and subsurface deposits within the area of the proposed Water Storage Dam
	Indirect	Transport and stockpiling of materials may result in indirect impacts.
Placement of water pipeline	Direct	Placement of water pipeline across the ground surface may result in direct impacts.
	Indirect	Transport and placement of pipeline may result in indirect impacts.
Underground pipeline trench	Direct	Excavation of underbore for water pipeline will result in ground disturbance.
	Indirect	The installation of underground services will result in changes to subsurface drainage which may result in indirect impacts to subsurface deposits.

13 AVOIDING AND/OR MITIGATING HARM

In Australia, the principal document that provides guidance for the conservation and management of places of cultural significance is the *Burra Charter* (Australia ICOMOS 2013a). The *Burra Charter* is based on the knowledge and experience of Australia ICOMOS members; it "advocates a cautious approach to change: do as much as necessary to care for the place and to make it useable, but otherwise change it as little as possible so that its cultural significance is retained" (Australia ICOMOS 2013a: 1).

It is not necessarily practicable to conserve all places of cultural heritage significance. Consequently, decisions must be made regarding the heritage values of a given place, or item, the impacts that are proposed, and the overall effect on the cultural heritage within the study area, as it applies locally, at state level or nationally.

In the case at hand, the proposed works as part of the Dargues Gold Mine expansion will have no impact on the heritage significance of the Historic sites located within the study area. The impacts on the significance of Historic sites within the study area against criteria a, b, c, d, f and g will be negligible. The potential impacts on any research potential will similarly be minor, particularly given that previously recorded Historic sites are outside the area of proposed direct impacts.

In terms of the Aboriginal sites at Dargues Gold Mine, the proposed works will result in the full loss of values to DGM PAD 22-1 (AHIMS #57-6-0477). The proposed activities with potential to directly harm Aboriginal Objects will only occur across SU1 #1. A program of test excavation is recommended for this DGM PAD 22-1 before impacts can occur.

The only management measures applicable to the proposed development are as follows:

- A program of test excavation is required before ground surface disturbance can occur within site DGM PAD 22-1 (AHIMS #57-6-0477).

13.1 Justification for any likely harm

It is not clear what the extent of subsurface archaeology is at DGM PAD 22-1 (AHIMS #57-6-0477). This cannot be ascertained without test excavation. Without these results, it is not possible to determine the extent of harm that will occur at this site.

The impacts that are proposed across the majority of the activity area from the water pipeline placement are not likely to harm Aboriginal or historical objects. The exception to this is SU1 #1 which contains potential archaeological deposit. As stated elsewhere, test excavation of DGM PAD 22-1 is required to determine the presence or extent of archaeological deposits.

13.2 Ecologically Sustainable Development

The project has ecological impacts from the excavation required to construct the Water Storage Dam. However, Big Island Mining are making an effort to divert waste water away from the natural water sources such as Spring Creek. The use of polypipe above ground will also reduce impacts to the surrounding landscape such as erosion.

Cumulative impacts need to be understood in terms of both the impacts at a particular site, or site complex, and the impacts to cultural heritage objects and places in the broader region. The proposed impacts must be considered in the context of the degree to which they will increase harm to cultural heritage. This applies to the context within a given site, and across the broader region.

13.3 Aboriginal Inputs

Inputs have been sought from all of the RAPs regarding the proposed impacts, and options for mitigating and/or avoiding harm. During the course of the survey on-site feedback was sought from Marcelle Nye (Mogo Local Aboriginal Land Council). Marcelle agreed that the location of Dargues

Gold Mine PAD 22-1 (AHIMS #57-6-0477) was an area that had potential to contain subsurface deposits. Across the remainder of the study area, the proposed development would have limited impacts and would not result in a loss of cultural heritage significance.

No issues were raised following distribution to RAPs of the draft report in regard to the extent of impacts or proposed mitigation. Support for test excavation prior to impacts from the water storage dam was expressed by the RAPs who responded as well as the Mogo LALC site officer who participated in survey.

14 SUMMARY AND RECOMMENDATIONS

The works proposed as part of Dargues Gold Mine MOD 5 activities would result in direct harm to the following site:

- Dargues Gold Mine PAD 22-1(AHIMS #57-6-0477)

The assessment of scientific values associated with this site has been conducted on the basis of field survey. The scientific significance is unknown as excavation is required to determine the type, extent and nature of archaeological subsurface deposit.

On the basis of the current investigations undertaken for the Dargues Gold Mine MOD 5 activities, the following recommendations are made:

d) Test excavation within Dargues Gold Mine PAD 22-1 (AHIMS #57-6-0477) is required, prior to impacts, to determine the type, extent and nature of archaeological deposit.

e) A copy of this report should be forwarded to all Registered Aboriginal Parties for their review and comment.

f) In the event that human skeletal remains, or suspected human skeletal remains, are encountered during any of the proposed works or salvage actions, all work must stop, and the procedures outlined in Appendix 3 must be implemented.

15 GLOSSARY

Aboriginal site A place where Aboriginal activity has occurred and/or a place associated with Aboriginal tradition. Aboriginal sites include locations where archaeological evidence is present and/or places of intangible heritage value, where Aboriginal tradition or oral history indicate the place has meaning or significance to the Aboriginal community.

Archaeological sensitivity A location or landform where archaeological sites or deposits are likely to occur. Such locations may include areas of identified PAD or may correspond to areas for which insufficient information is available regarding the nature and integrity of deposits to identify clear areas of archaeological potential.

Archaeological site A place where physical evidence of human activity is present on the surface (e.g. artefacts, modified trees, middens, earthworks or other structural features) and/or within subsurface deposits.

Archaeological deposit A subsurface deposit containing artefacts or other evidence/features (e.g. fire places, middens or post holes) of human activity.

Archaeological visibility Usually expressed as a percentage, this refers to the extent to which the archaeological deposits, or PAD, are visible during survey.

Artefact An object made, modified or transported (manuport) by humans.

Geomorphology The study of the nature and origin of landforms – i.e. the ways in which the landscape was formed through processes of weathering and erosion.

Historical site A place where human activity has occurred and is associated with non-Aboriginal occupation. Such places may be archaeological sites with physical evidence of activity and/or locations associated with historical events. Historical sites that contain evidence of contemporaneous Aboriginal and non-Aboriginal activity are commonly referred to as post contact sites.

Manuport A natural object that has been removed from its original location by humans (e.g. a rock that has been transported to an area where it does not occur naturally).

Midden An area of refuse. Middens contain items created (e.g. stone artefacts, bottles or ceramics), or used (e.g. shell and bone from meals) by humans. Middens can occur on both Aboriginal and historical sites.

Post contact site A place containing evidence of contact between Aboriginal people and non-Aboriginal people (e.g. an Aboriginal site with artefacts of European manufacture, or European artefacts modified by Aboriginal people) and/or a place associated with interactions between Aboriginal and non-Aboriginal people (e.g. a massacre site).

Potential archaeological deposit PAD: An area or landform predicted to contain archaeological deposits.

Scarred tree A scarred tree, also referred to as a culturally modified tree, is a tree that shows evidence of human activity. This is usually evidenced in the form of a scar where bark has been removed (either an absence of bark of an area of regrowth bark). It may also include modifications to the heartwood (e.g. carving or axe marks).

Bark removal and tree carving was practiced by both Aboriginal and non-Aboriginal people. Usually the nature of the scar, the extent of regrowth and the broader context of the tree will provide clues to the origin of the scar (e.g. a surveyor's blaze versus bark removal for a shield or coolamon).

Stone artefact A stone/rock, or piece thereof, that has been modified by humans. It generally refers to portable chipped/flaked, ground or pecked items (Clarkson and O'Connor 2013: 153).

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APPENDIX 1 – AHIMS SEARCH

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : Dargues Gold Mine

Client Service ID : 644182

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status **	SiteFeatures	SiteTypes	Reports
57-6-0475	GT OS 1 Reburial	GDA	55	749851	6063444	Open site	Valid	Artefact : -		
	Contact	**Recorders**	Artefact - Cultural Heritage Management - Pyrmont,Ms.veronica norman					**Permits**		
57-6-0470	GT IS03	GDA	55	748838	6063624	Open site	Valid	Artefact : 1		102281,102866
	Contact	**Recorders**	Mr.John Appleton					**Permits**		
57-6-0467	GT OS 2	GDA	55	748937	6063149	Open site	Destroyed	Artefact : 2		102281,102866
	Contact	**Recorders**	Mr.John Appleton,Artefact - Cultural Heritage Management - Pyrmont,Ms.veronica					**Permits**		
57-3-0232	Manar 3;	AGD	55	747700	6060898	Open site	Valid	Artefact : -	Open Camp Site	1344
	Contact	**Recorders**	Australian National University					**Permits**		
57-6-0471	GT-IS06	GDA	55	749865	6063448	Open site	Valid	Artefact : 1, Potential Archaeological Deposit (PAD) : -		102866
	Contact	**Recorders**	Doctor.Sandra Wallace,Artefact - Cultural Heritage Management - Pyrmont					**Permits**		
58-4-0469	Foot Track - JC6;	AGD	56	210560	6063050	Open site	Valid	Artefact : -	Open Camp Site	
	Contact	**Recorders**	J Clapin					**Permits**		
57-6-0466	GT IS05	GDA	55	749011	6061824	Open site	Valid	Artefact : 1		102281,102866
	Contact	**Recorders**	Mr.John Appleton					**Permits**		
57-6-0468	GT OS4	GDA	55	748840	6063315	Open site	Valid	Artefact : 3		102281,102866
	Contact	**Recorders**	Mr.John Appleton					**Permits**		
57-6-0469	GT OS1	GDA	55	749234	6063113	Open site	Destroyed	Artefact : 3		102281,102866
	Contact	**Recorders**	Mr.John Appleton,Artefact - Cultural Heritage Management - Pyrmont,Ms.veronica					**Permits**		

**** Site Status**

Valid - The site has been recorded and accepted onto the system as valid

Destroyed - The site has been completely impacted or harmed usually as consequence of permit activity but sometimes also after natural events. There is nothing left of the site on the ground but proponents should proceed with caution.

Partially Destroyed - The site has been only partially impacted or harmed usually as consequence of permit activity but sometimes also after natural events. There might be parts or sections of the original site still present on the ground

Not a site - The site has been originally entered and accepted onto AHIMS as a valid site but after further investigations it was decided it is NOT an aboriginal site. Impact of this type of site does not require permit but Heritage NSW should be notified

Report generated by AHIMS Web Service on 02/12/2021 for Majella Hammersley for the following area at Lat, Long From : -35.58, 149.69 - Lat, Long To : -35.52, 149.82. Number of Aboriginal sites and Aboriginal objects found is 9

APPENDIX 2 – ABORIGINAL CONSULTATION

MOD 5 letters sent to RAPs – 25 January 2022

Lantern Heritage Pty Ltd

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NSW 2550

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ABN: 30 620 582 658

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Web: www.lanterheritage.com.au

25 January 2022

Mr Arnold Williams
Ngunnawal Elders Corporation.
13 Fitzgibbon Place,
Queanbeyan, NSW, 2620

Mob: 0431 600 967

E: blakneycreek@gmail.com

Dear Arnold,

Dargues Gold Mine major project: proposed modification (MOD 5)

As a previously registered Aboriginal party for the Dargues Gold Mine major project, we are writing to inform you of a proposed modification to this project.

The Mine is located about 13km south of Braidwood and immediately to the north of the village of Majors Creek (see Figure 1). All mining related activities are located within Mining Lease (ML) 1675 on land that is owned or controlled by Big Island Mining Pty Ltd (the Applicant). Mining activities at the mine are approved under MP_0054 until 30 June 2025. There have been four previously approved modifications to this project.

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One previously recorded site (GT IS03) is located within 100m of the proposed dam and associated infrastructure (Figure 2).

Role of Lantern Heritage

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If you have any questions, or require any additional information, please do not hesitate to contact me.

Yours Sincerely,

Bec Parkes BA Hons, PhD
Director/Principal Archaeologist
Lantern Heritage Pty Ltd

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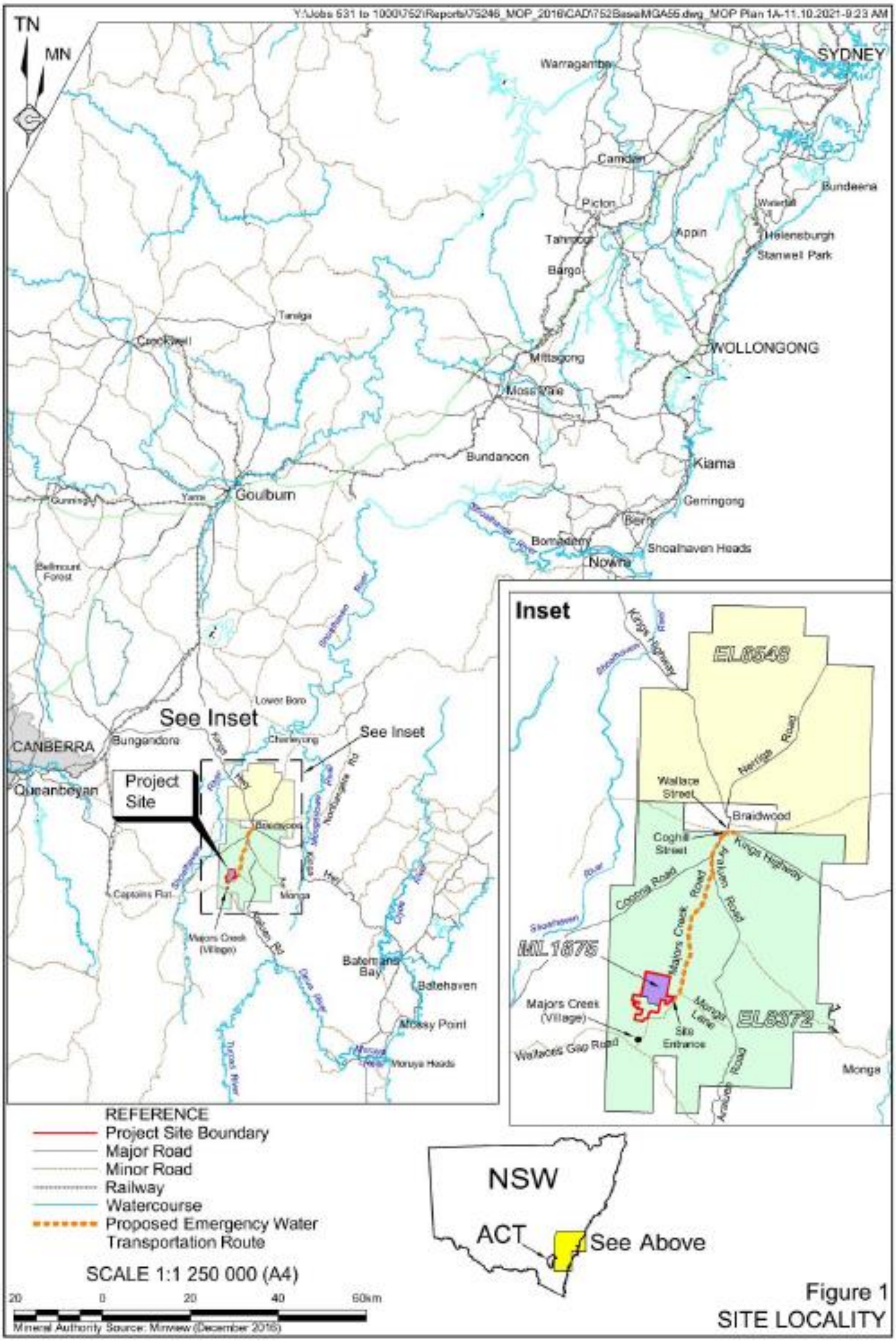
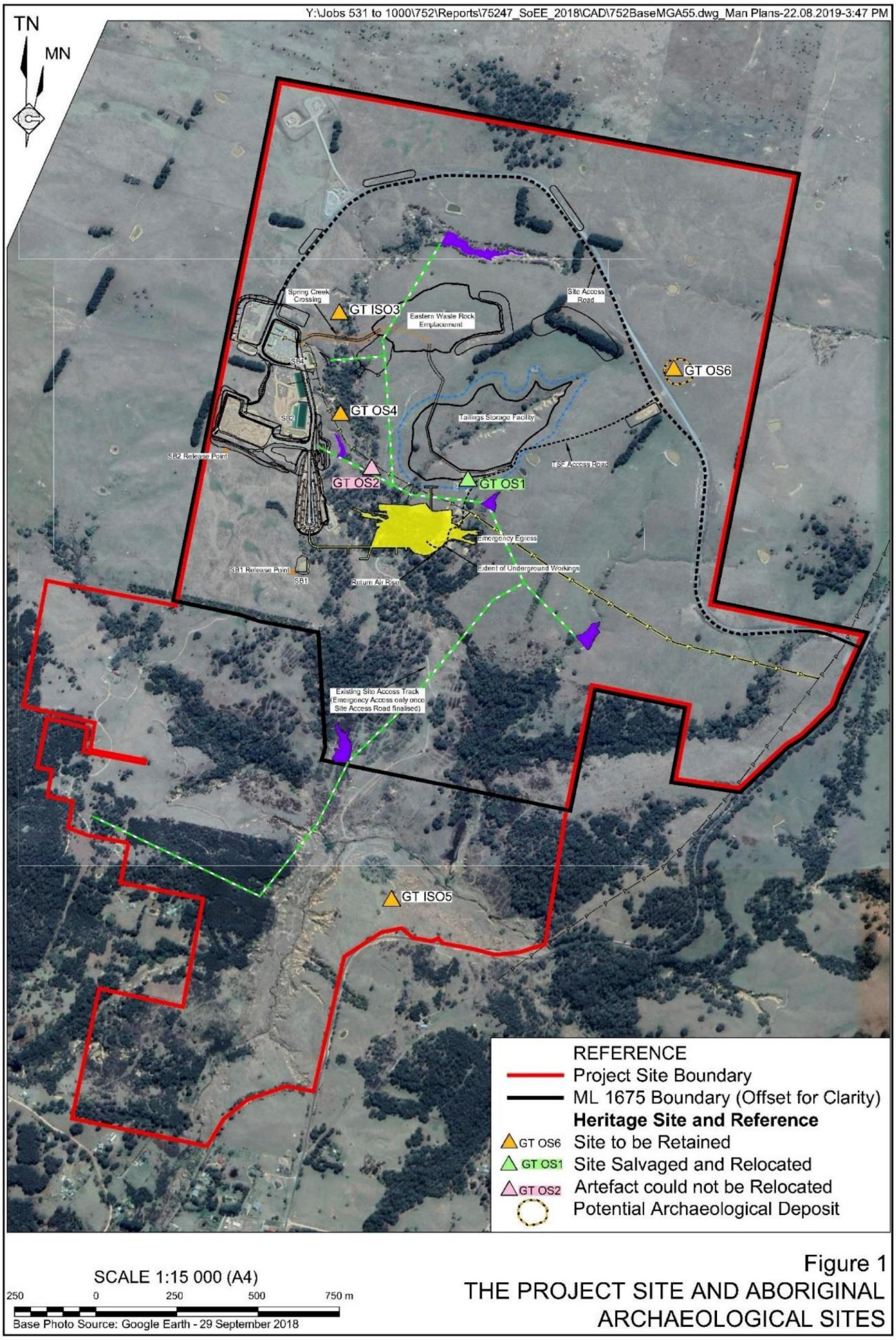
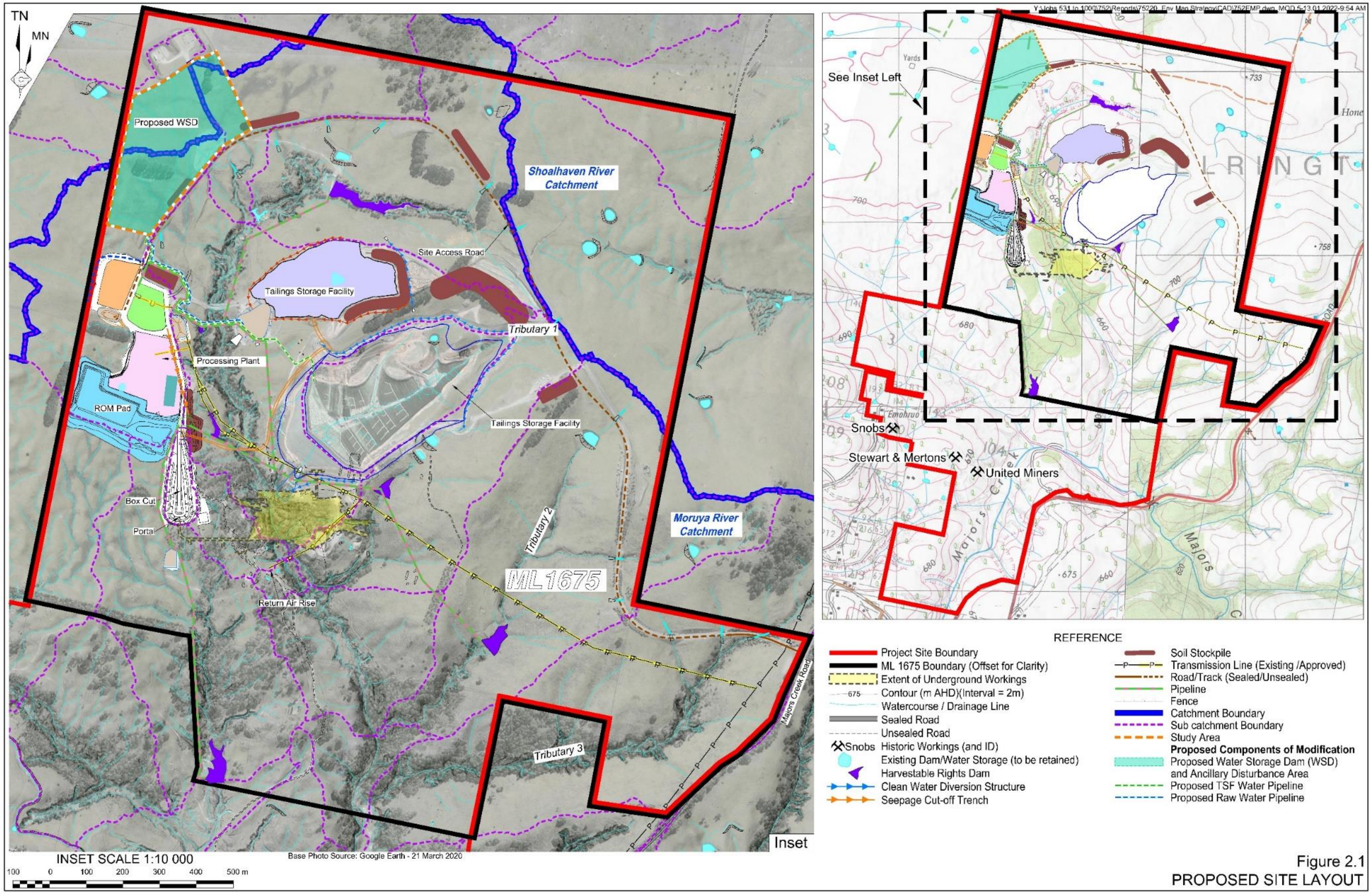


Figure 2: Location of previously recorded Aboriginal cultural heritage sites



Lantern Heritage
shining a light on people and place

Figure 3: Location of MOD5 study area



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25 January 2022

Mrs Dorothy Carroll
Ngunnawal Heritage Aboriginal Corporation.
Lot 114, Ash Road,
Prestons, NSW, 2170

0412 176 081

E: ngunawahlhac@gmail.com

Dear Dorothy,

Dargues Gold Mine major project: proposed modification (MOD 5)

As a previously registered Aboriginal party for the Dargues Gold Mine major project, we are writing to inform you of a proposed modification to this project.

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Bec Parkes BA Hons, PhD
Director/Principal Archaeologist
Lantern Heritage Pty Ltd

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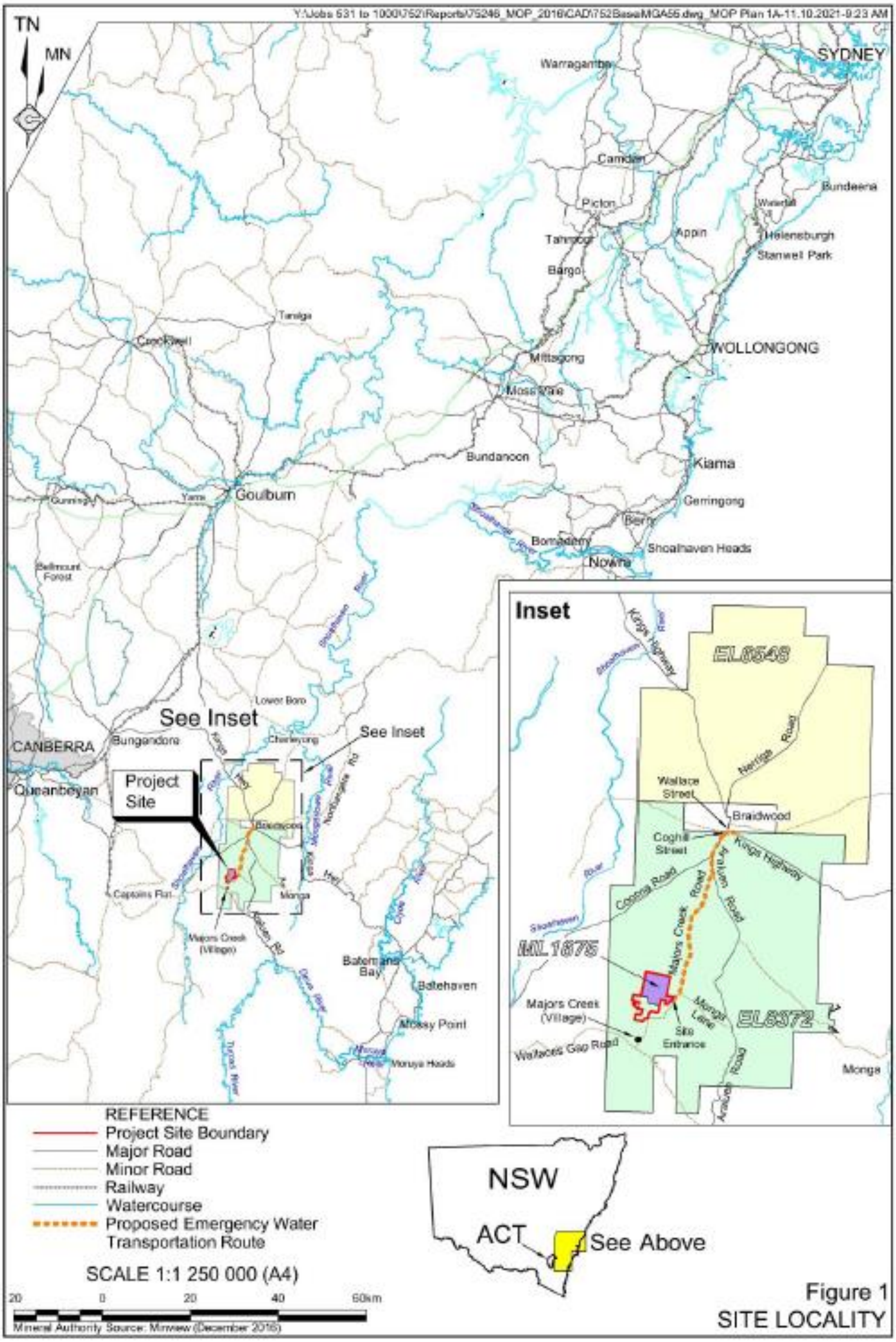

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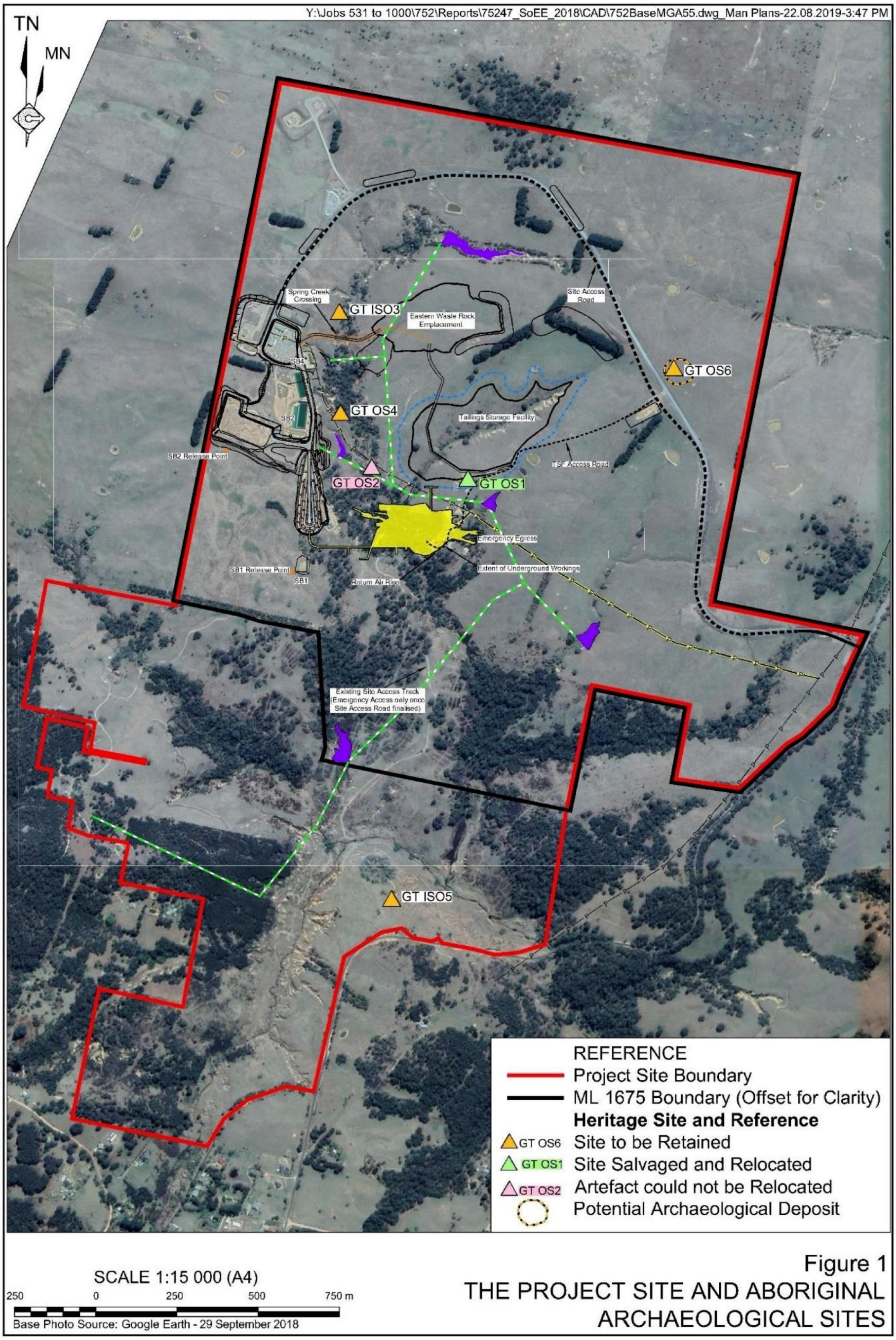
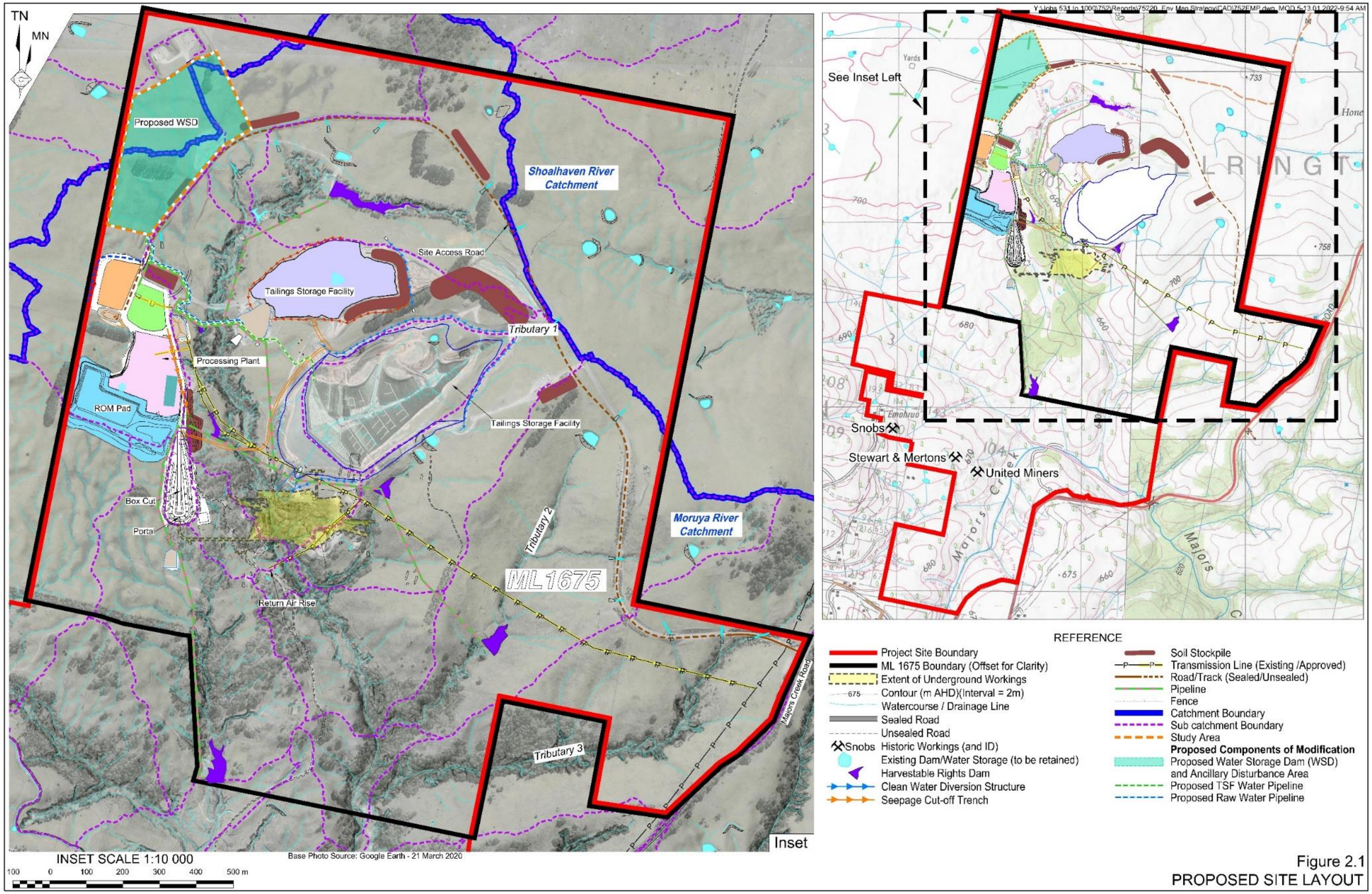


Figure 3: Location of MOD5 study area



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25 January 2022

Mr Wally Bell
Buru Ngunawal Aboriginal Corporation Traditional Carer Group.
PO Box 6900, Charnwood ACT 2615

02 6259 1672

0419 425 347

E: walbell@bigpond.net.au

Dear Wally,

Dargues Gold Mine major project: proposed modification (MOD 5)

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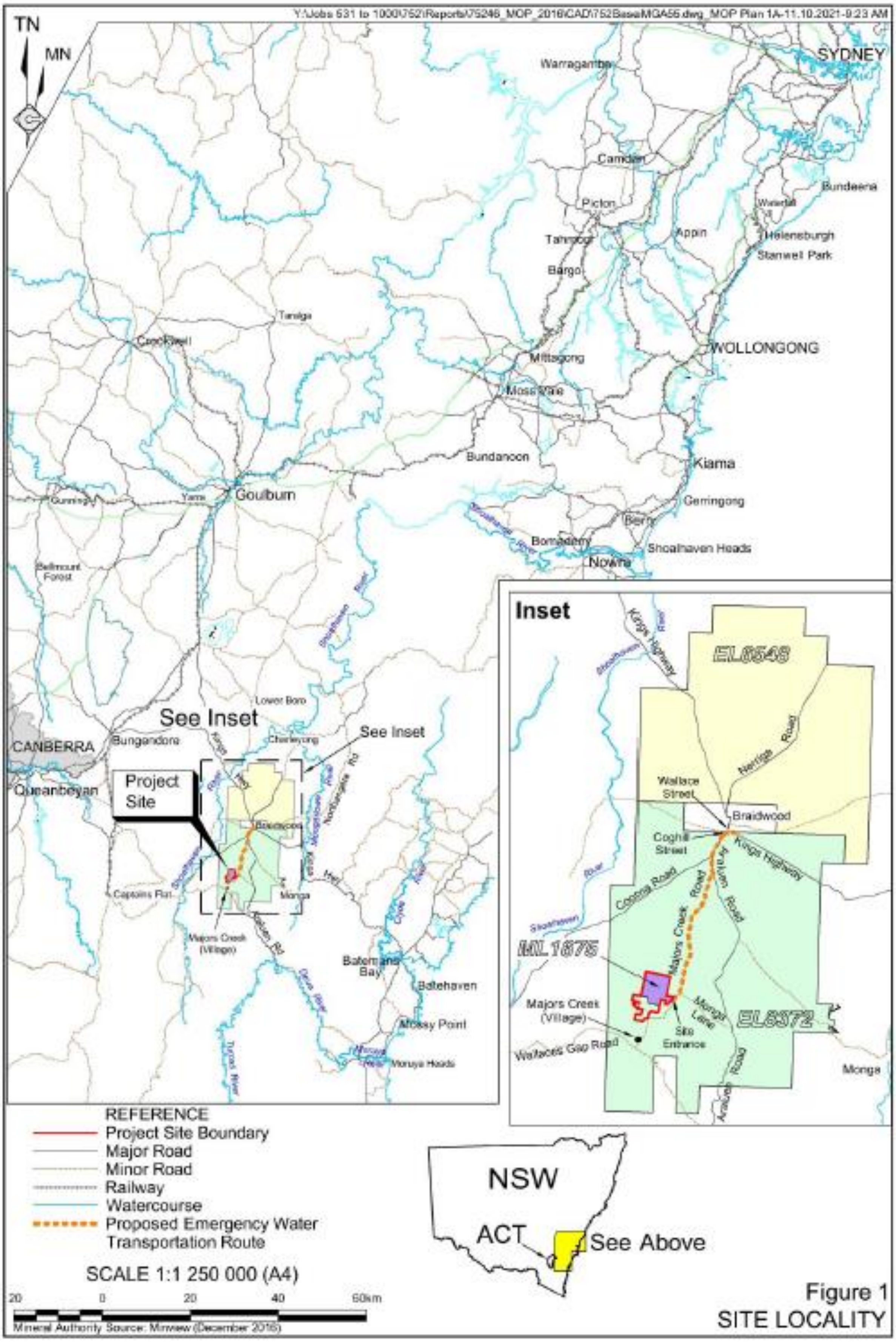

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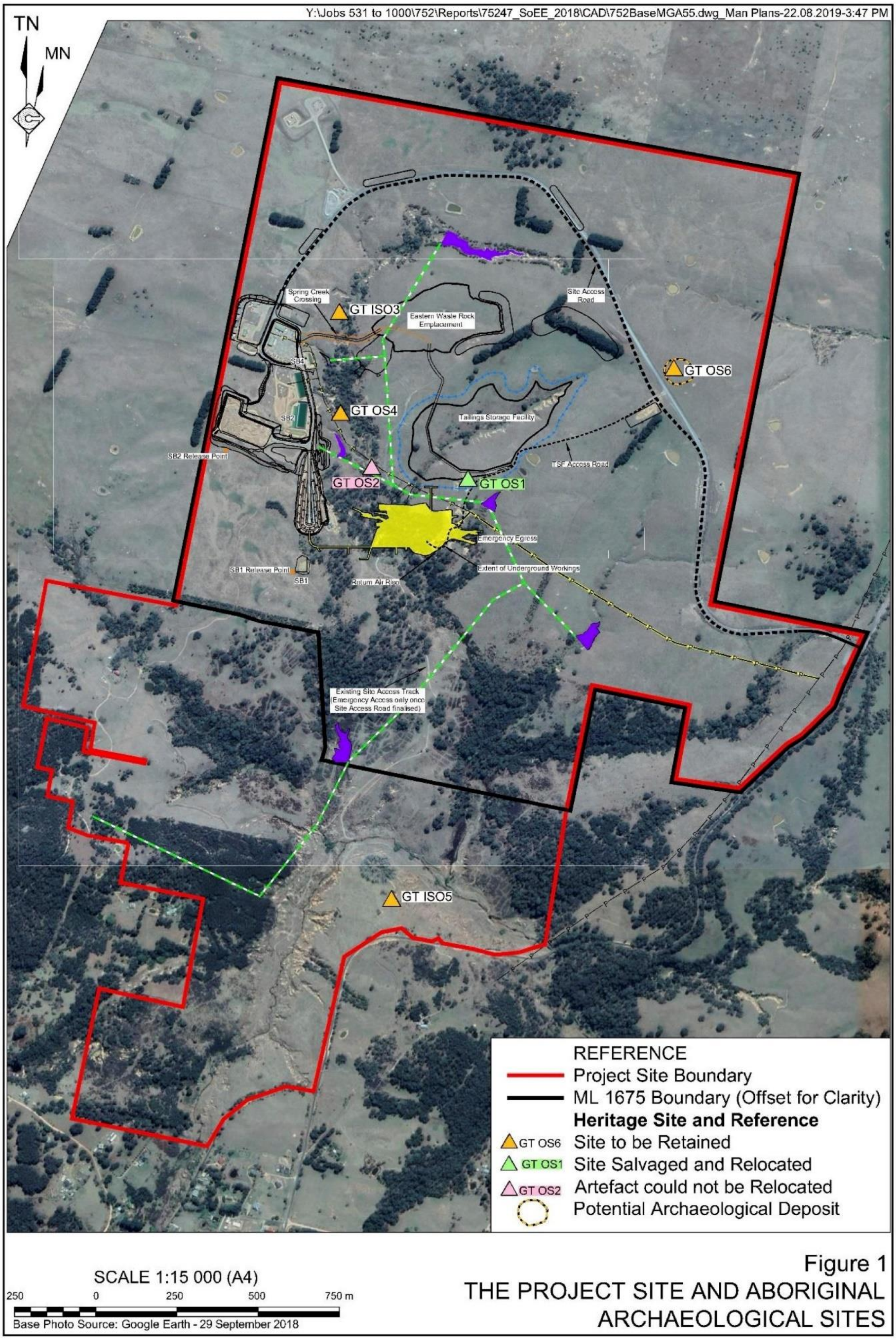

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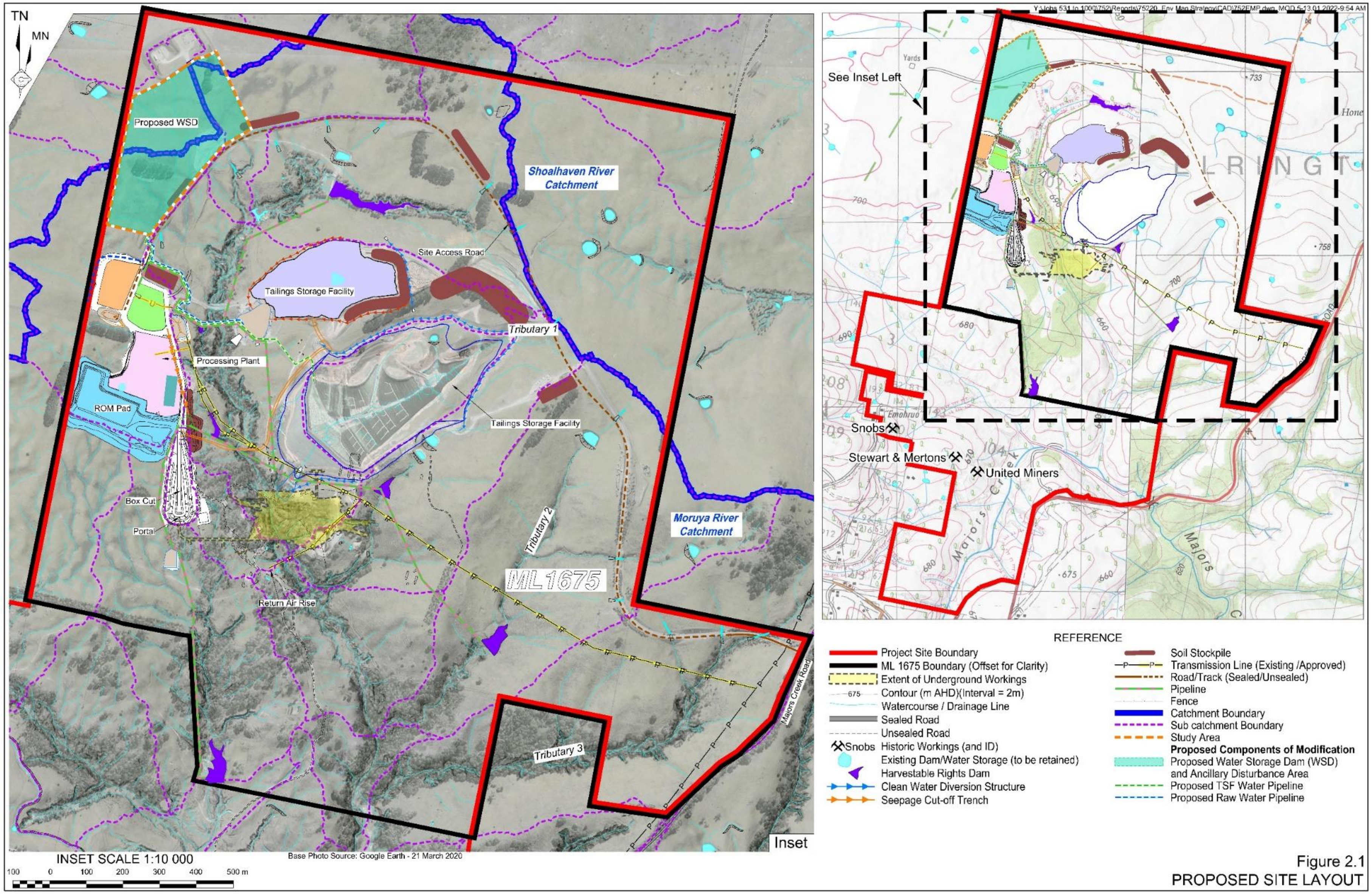

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25 January 2022

Mr. Robert Young
Konanggo Aboriginal Cultural Heritage Services.
4 Cunningham Place, South Windsor, NSW, 2756

02 4577 8401

0450 497 270

E: konanggo_consultancy@hotmail.com

Dear Robert,

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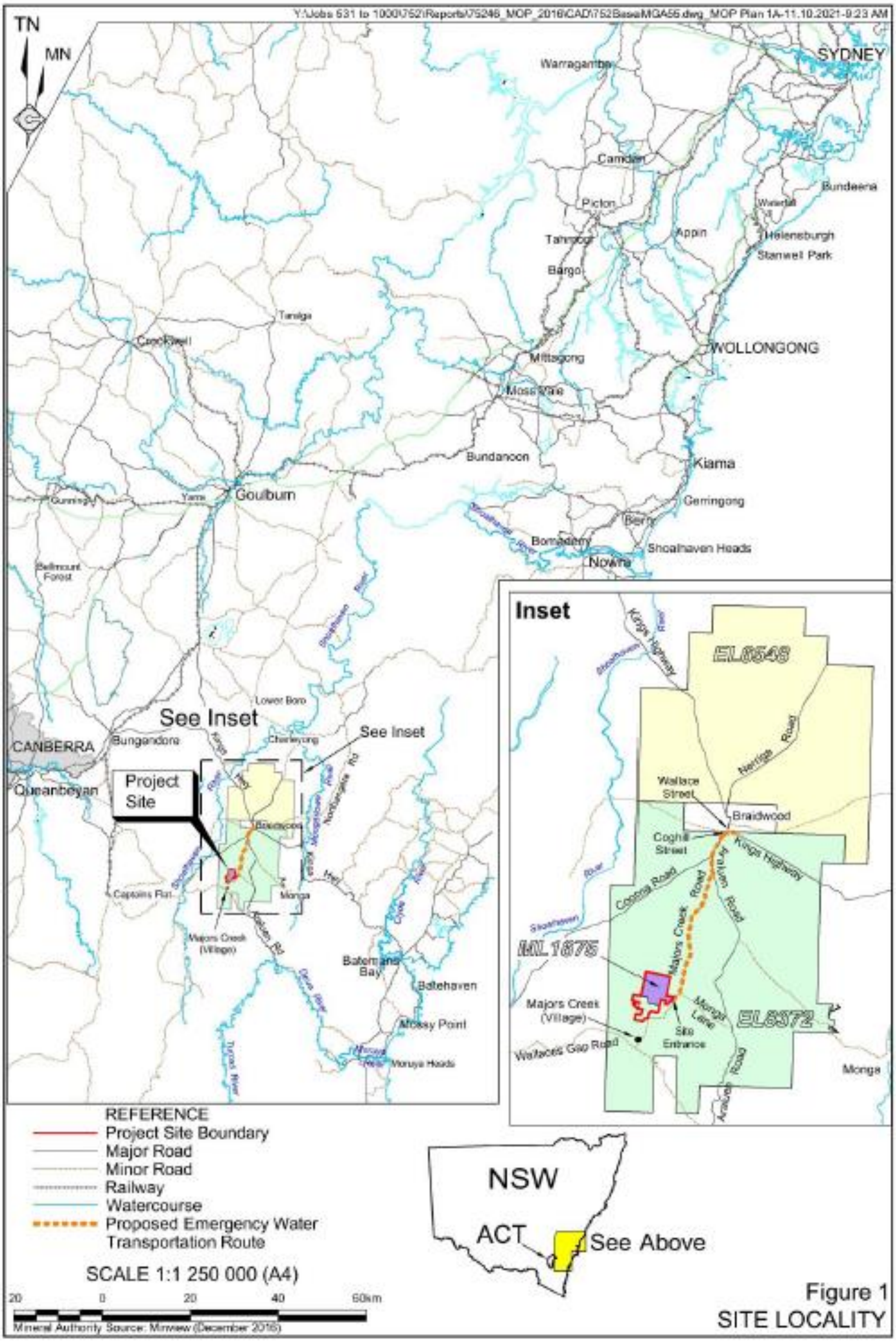

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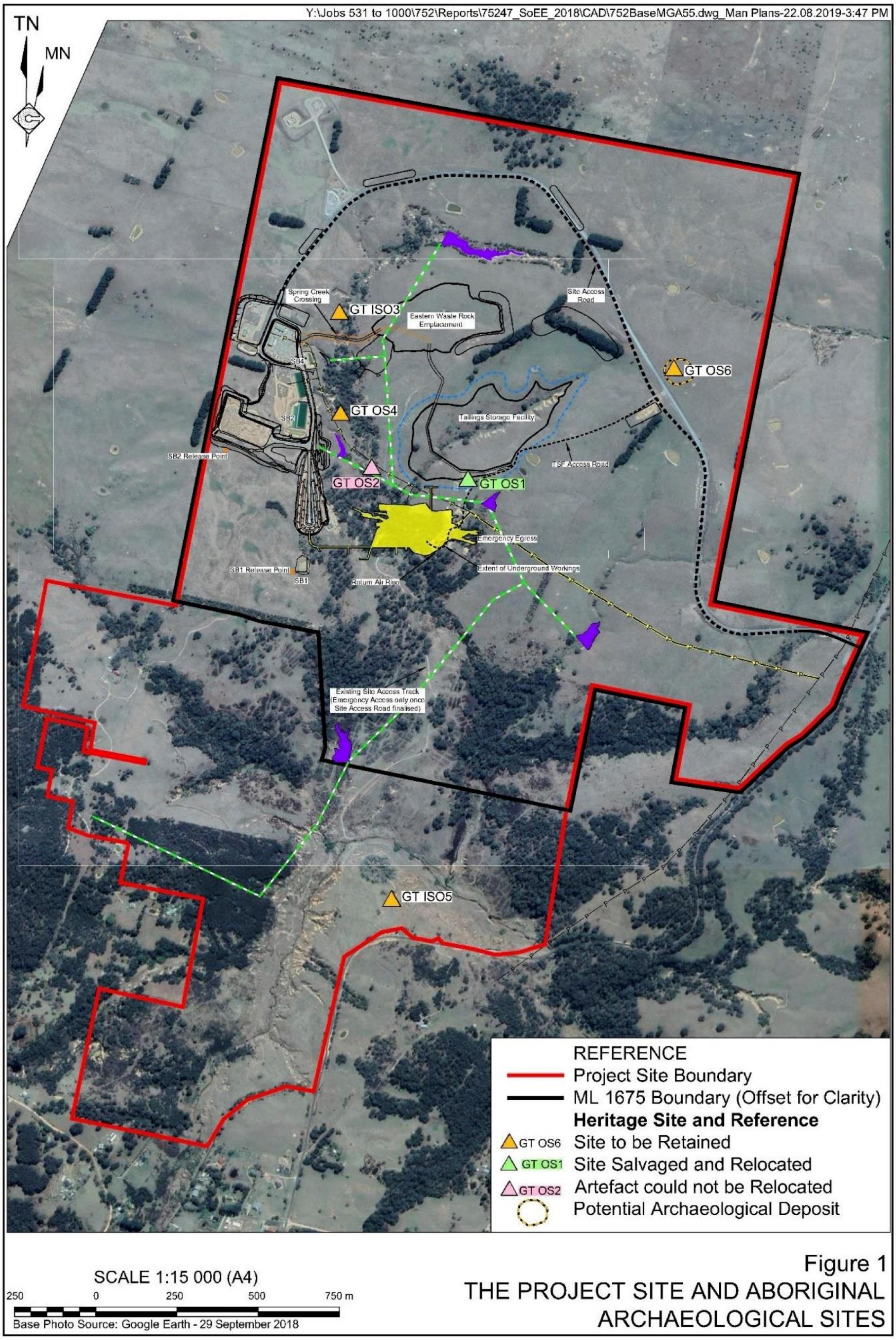

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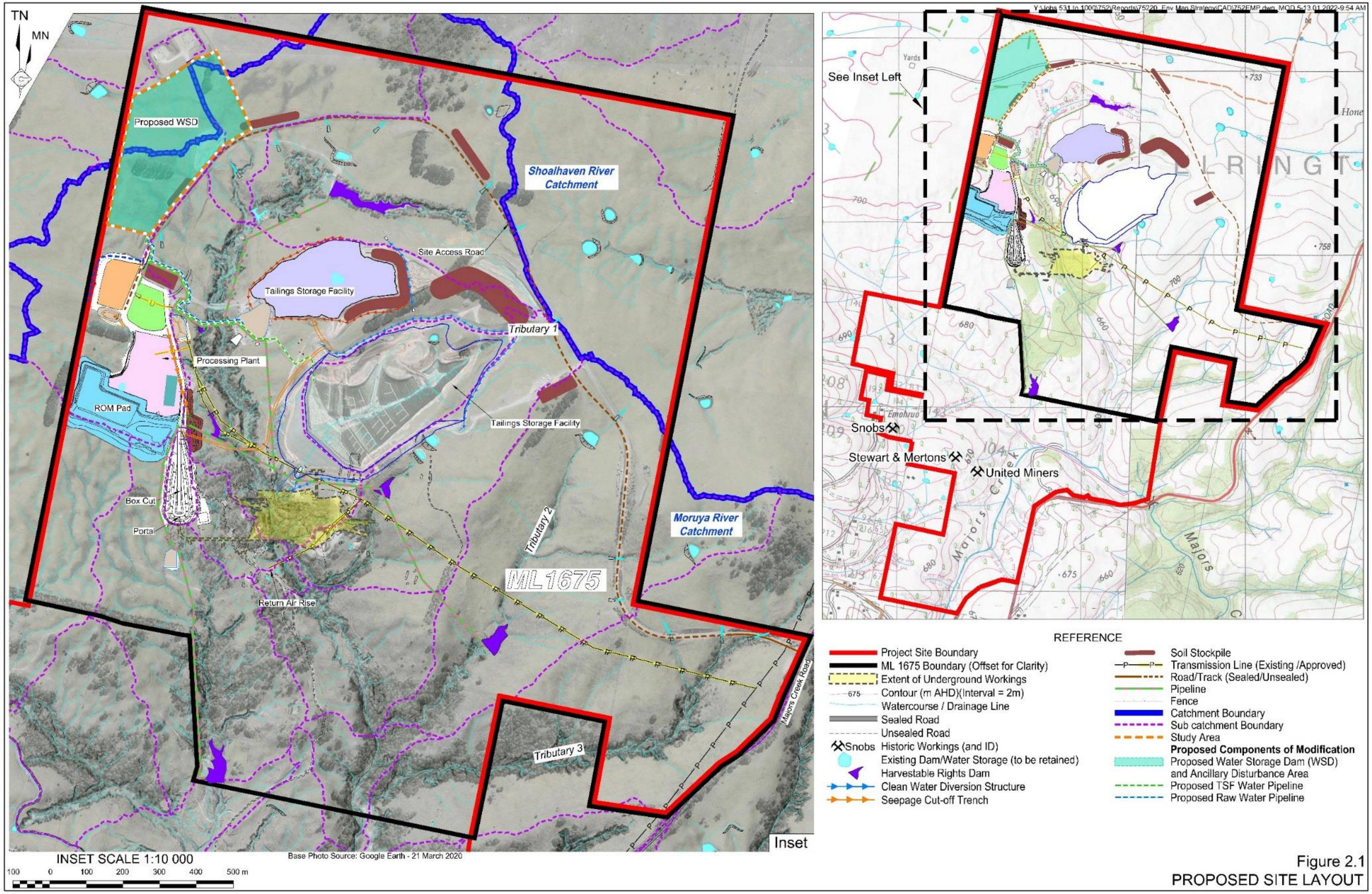

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25 January 2022

Mr. Dean Bell
Yurwang Gundana Consultancy Cultural Heritage Services.
Box 5628 South Windsor,NSW, 2756

02 4577 8401

0403 744 008

E: yurwang_gundana@bigpond.com

Dear Dean,

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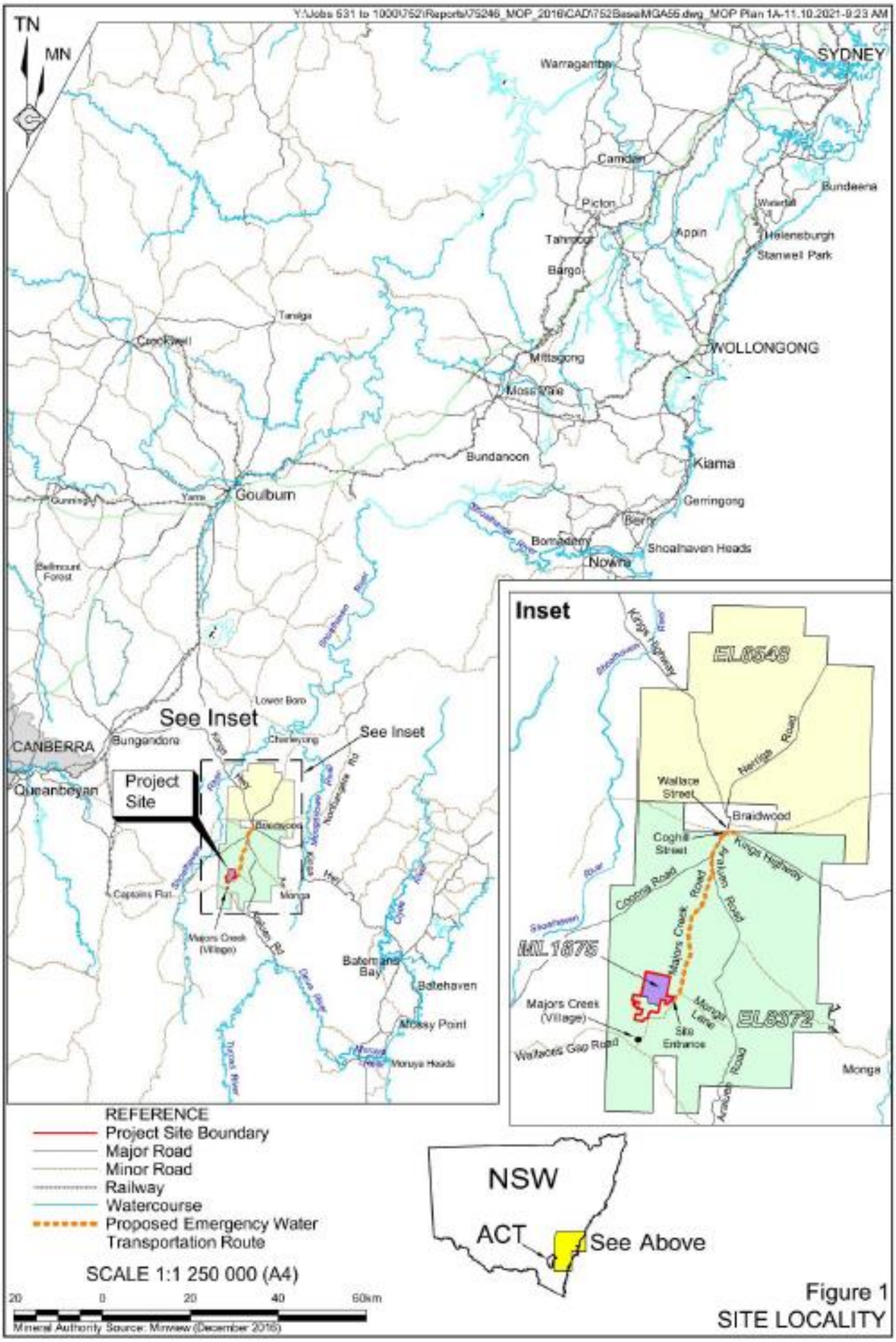

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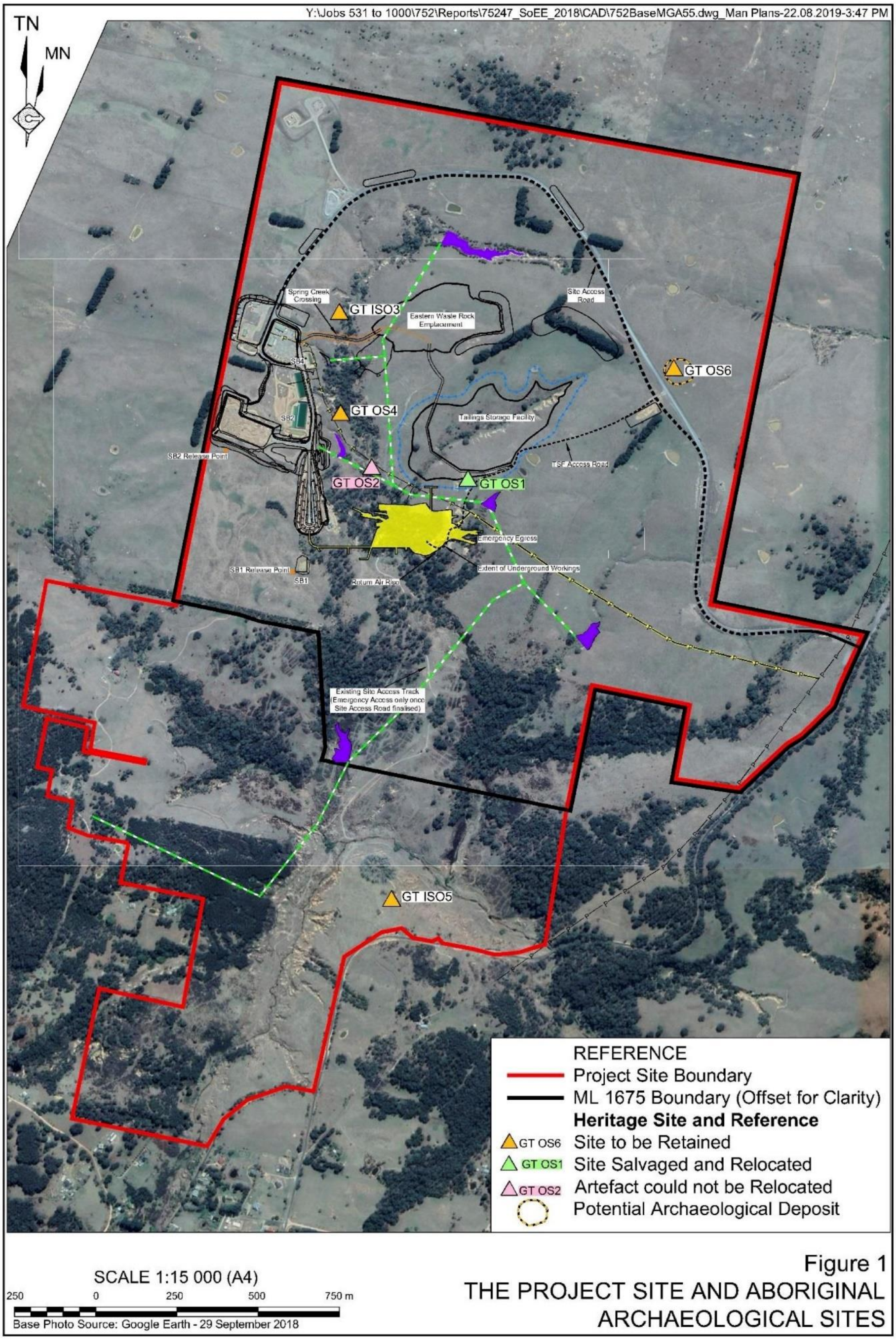

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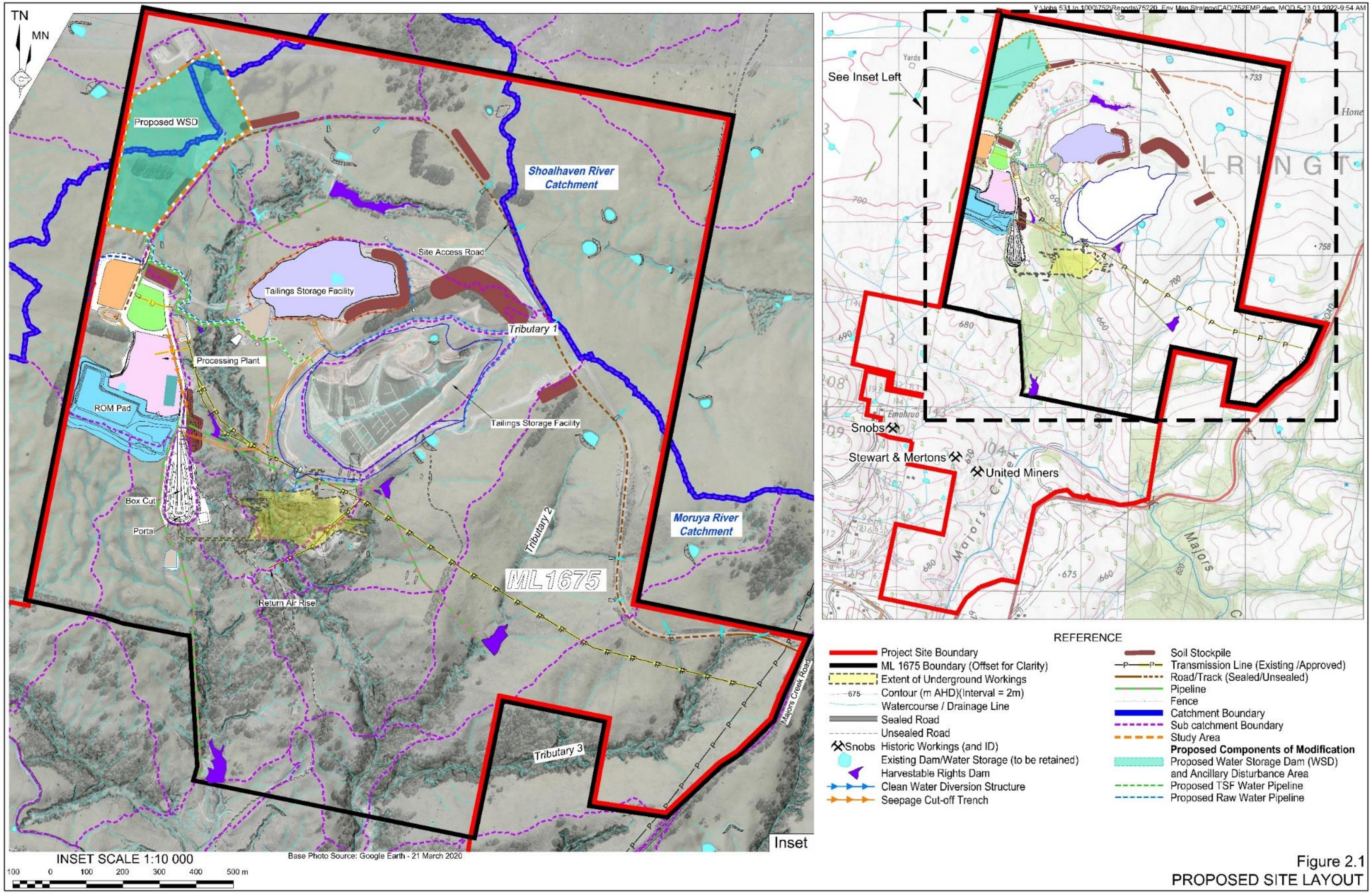

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25 January 2022

Ms Tina Brown
King Browns Tribal Group Pty Ltd.

0466 412 769

E: tina.kingbrown@gmail.com

Dear Tina,

Dargues Gold Mine major project: proposed modification (MOD 5)

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The Mine is located about 13km south of Braidwood and immediately to the north of the village of Majors Creek (see Figure 1). All mining related activities are located within Mining Lease (ML) 1675 on land that is owned or controlled by Big Island Mining Pty Ltd (the Applicant). Mining activities at the mine are approved under MP_0054 until 30 June 2025. There have been four previously approved modifications to this project.

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What we'd like to know from you

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If you have any questions, or require any additional information, please do not hesitate to contact me.

Yours Sincerely,

Bec Parkes BA Hons, PhD
Director/Principal Archaeologist
Lantern Heritage Pty Ltd

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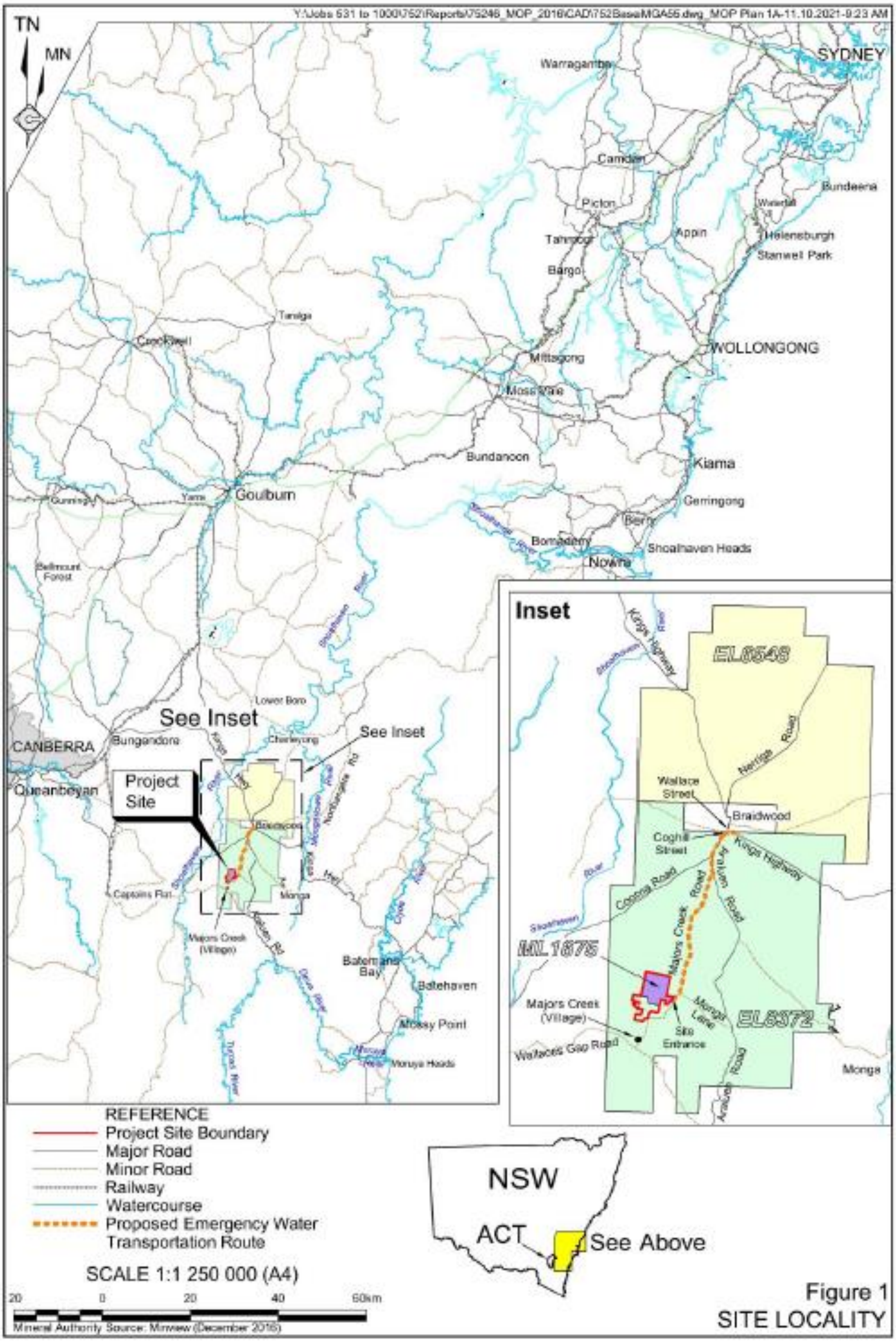

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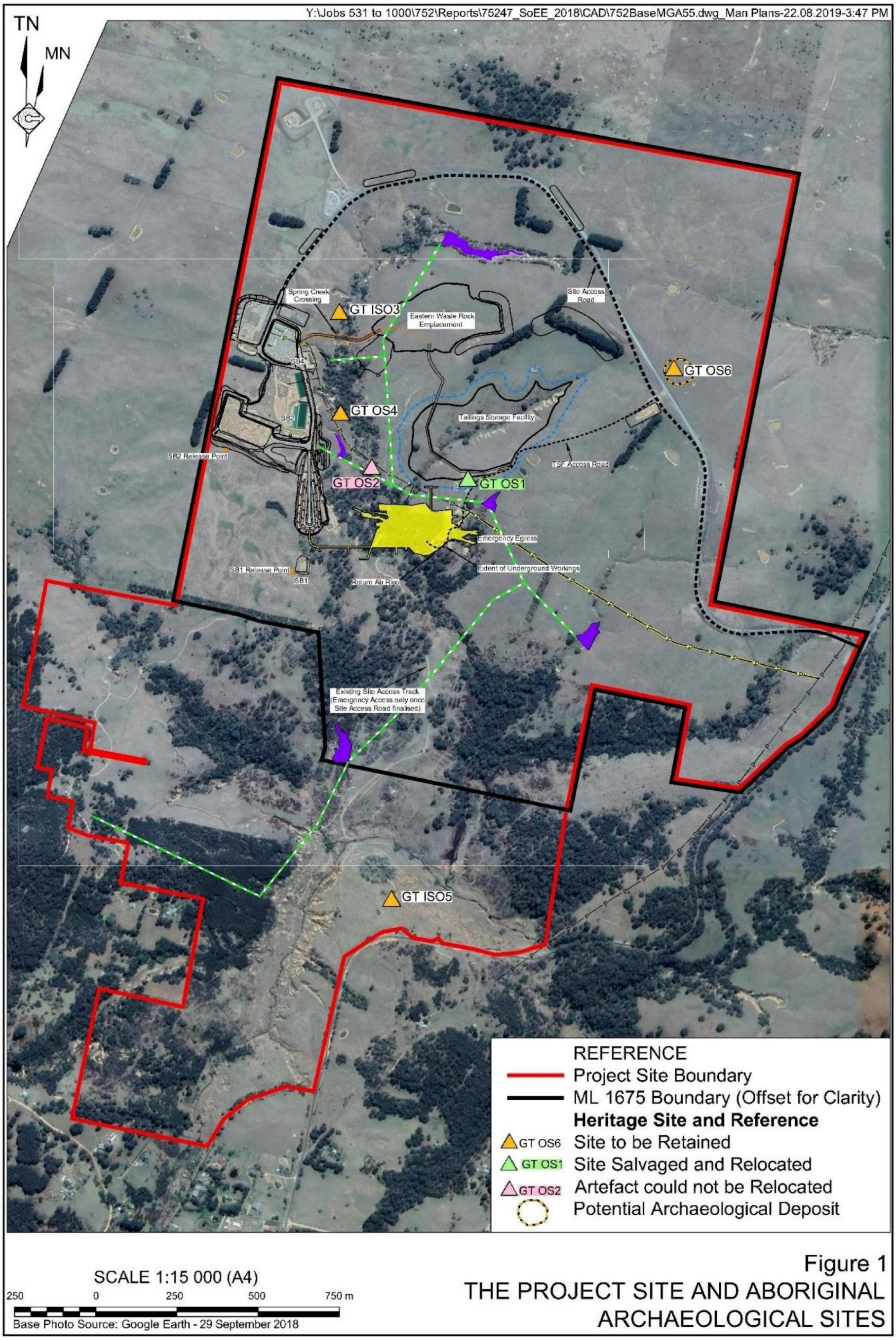

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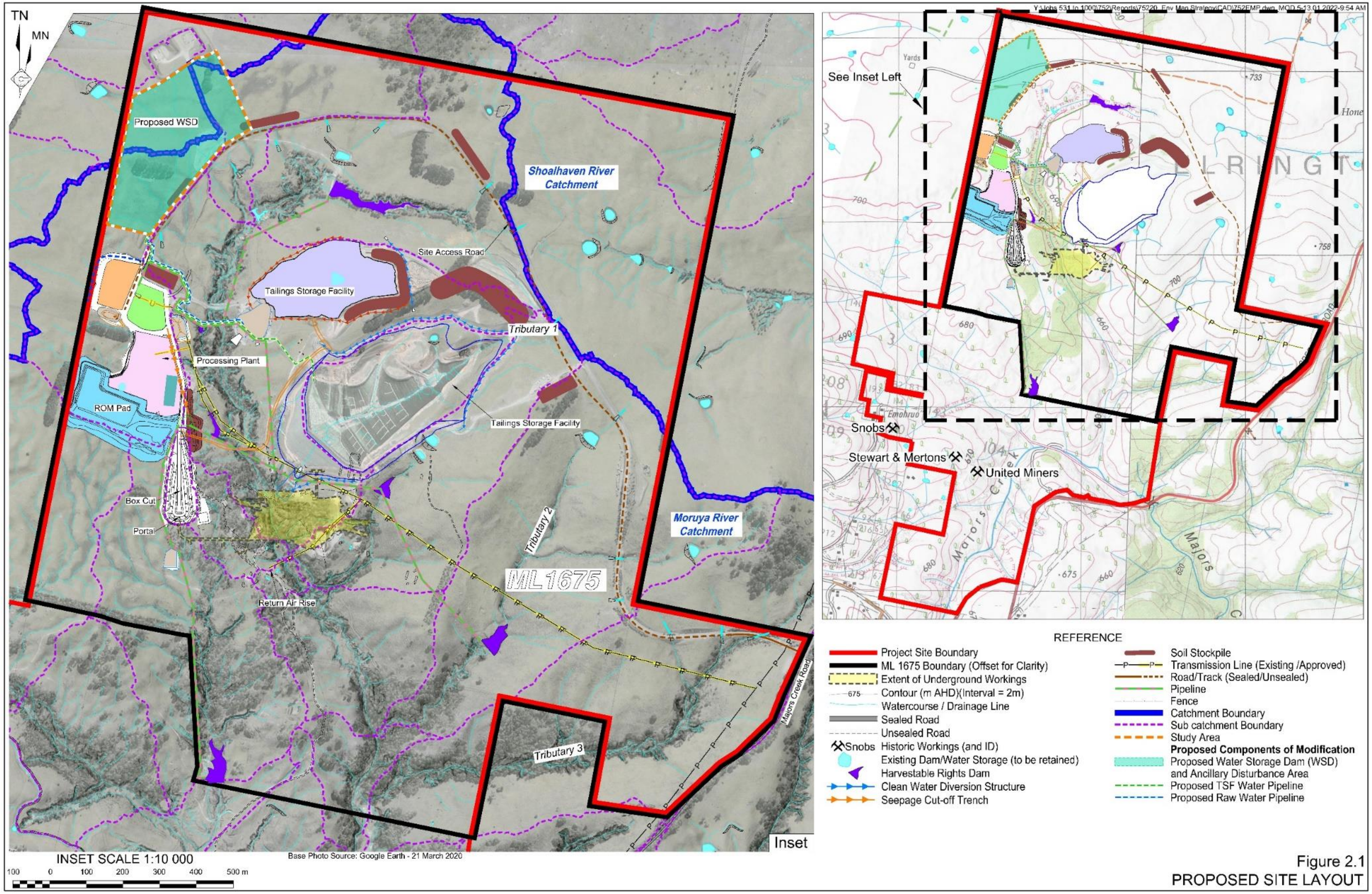

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25 January 2022

Nevada Brown
King Browns Tribal Group Pty Ltd.

0432 476 743

E: nevadabrown@yahoo.com.au

Dear Nevada,

Dargues Gold Mine major project: proposed modification (MOD 5)

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Bec Parkes BA Hons, PhD
Director/Principal Archaeologist
Lantern Heritage Pty Ltd

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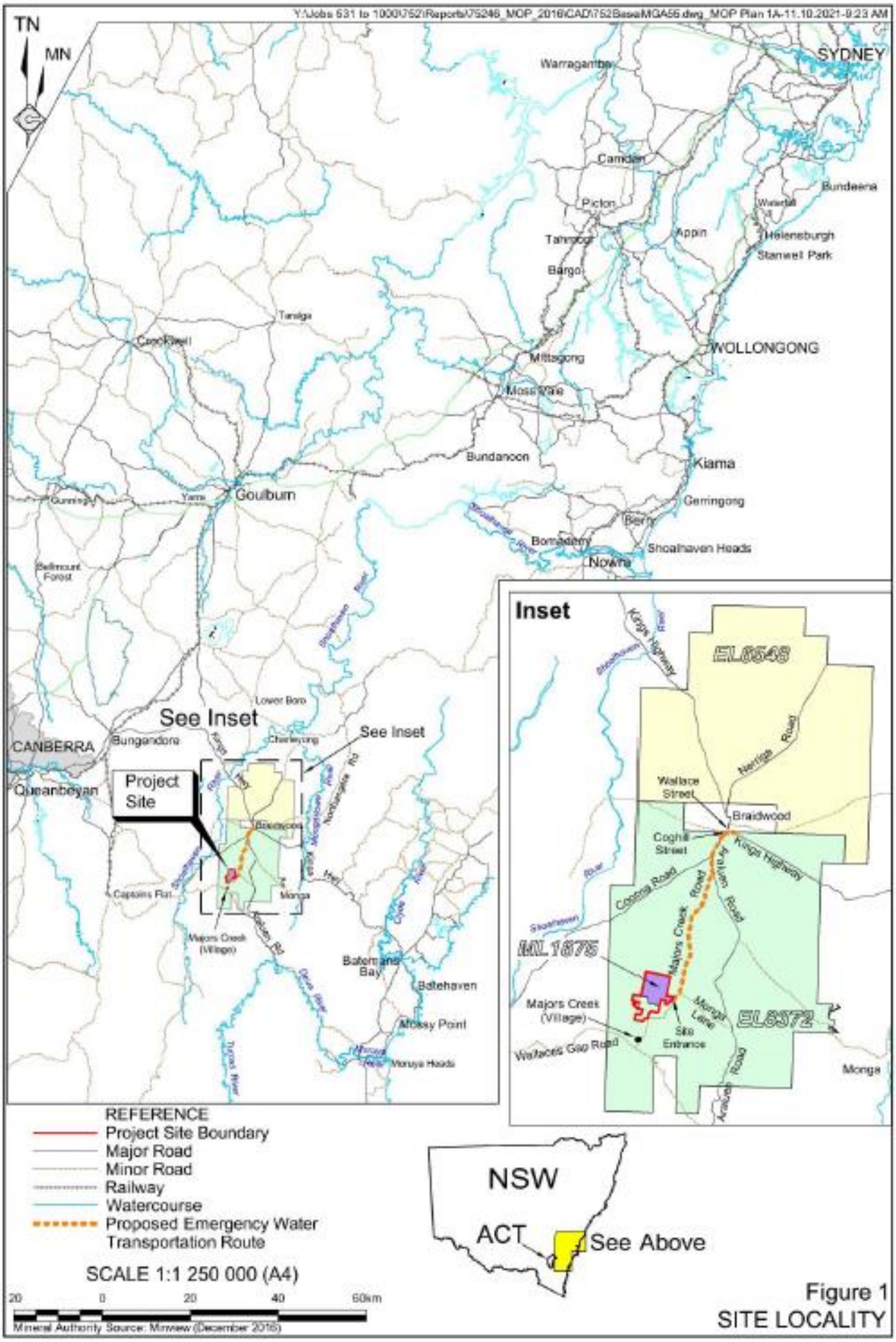

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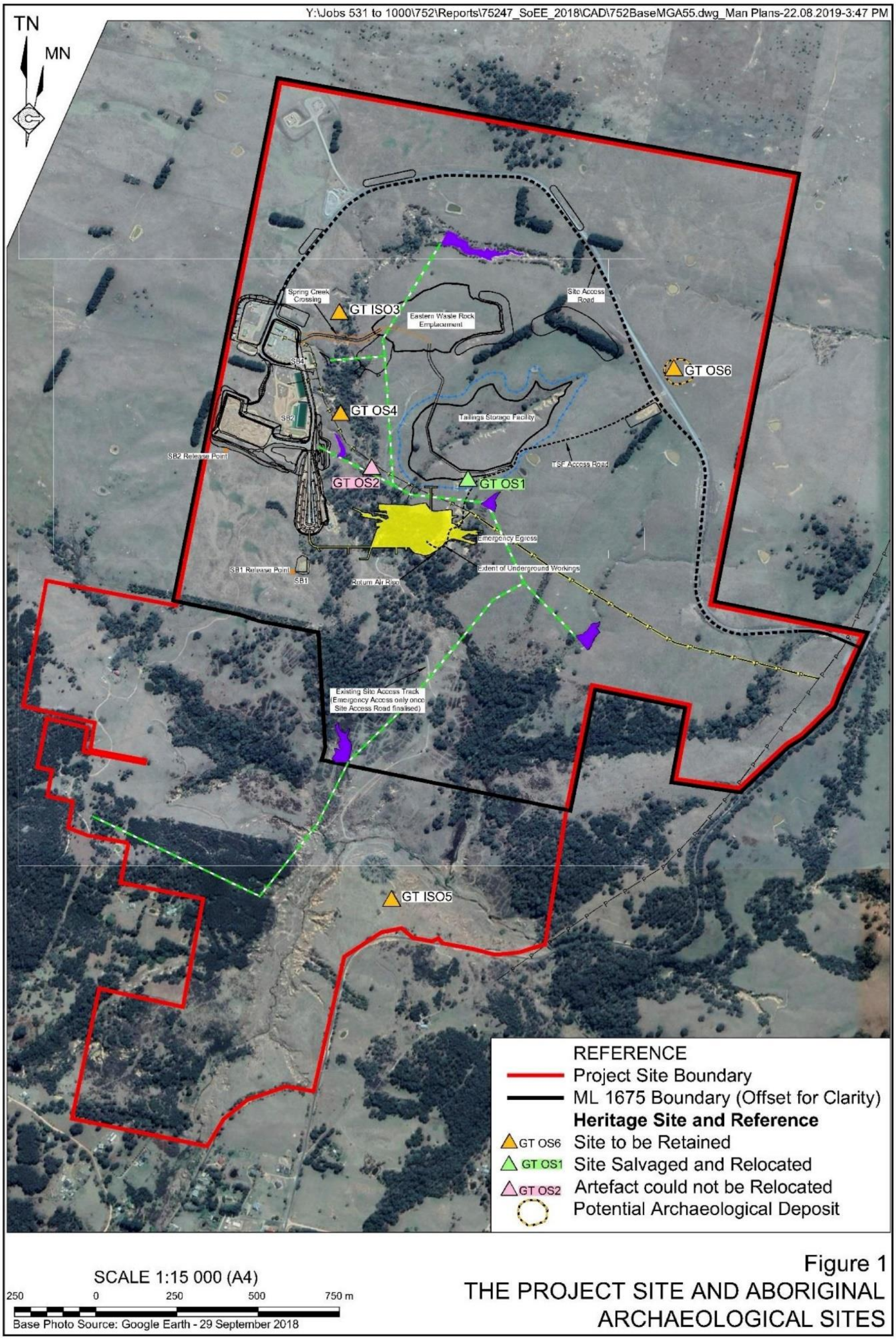

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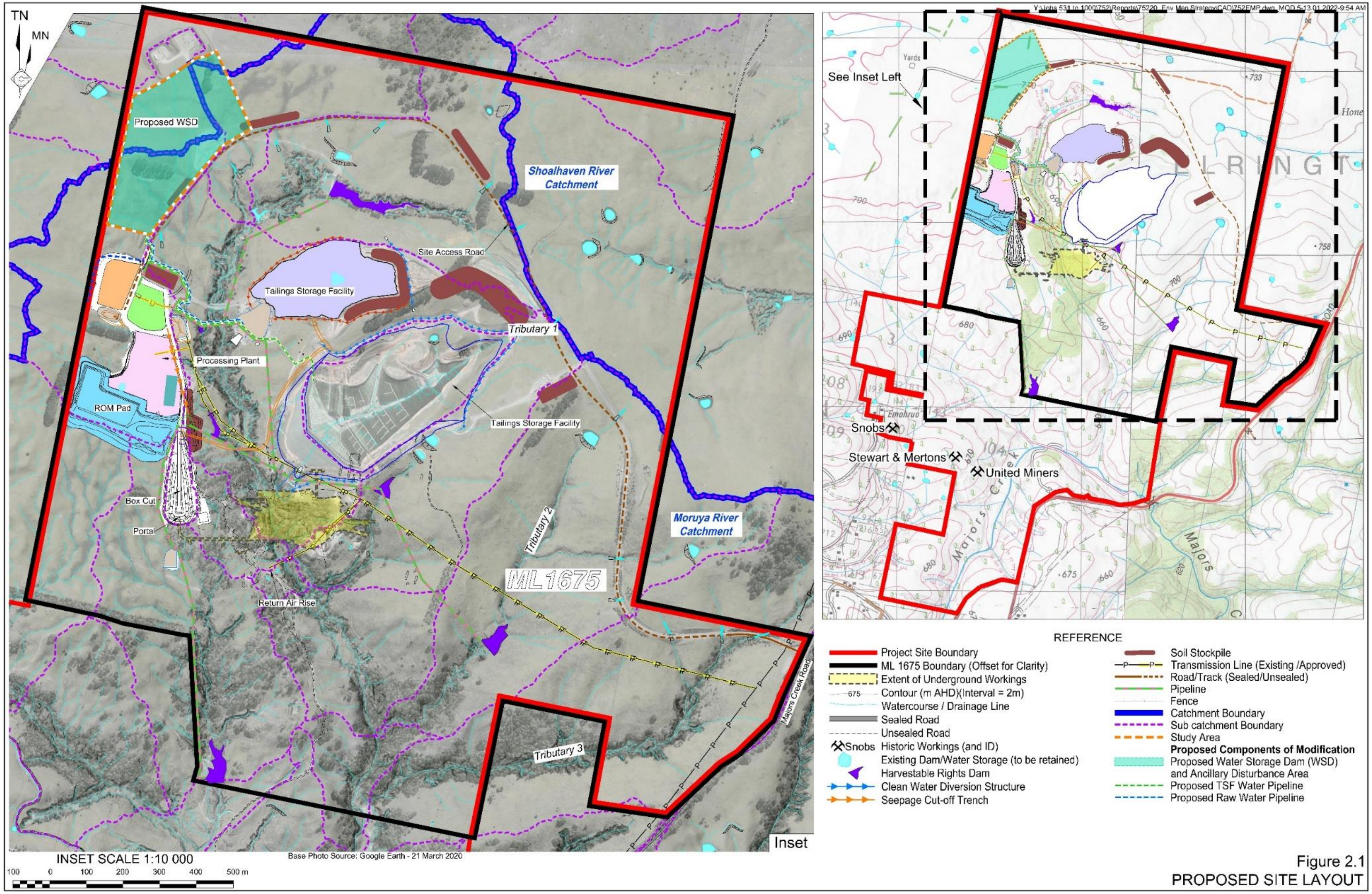

Lantern Heritage
shining a light on people and place

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25 January 2022

Adrian Brown
King Browns Tribal Group Pty Ltd.

0431 318 180

E: adrianbrown.ngunnawal@hotmail.com

Dear Adrian,

Dargues Gold Mine major project: proposed modification (MOD 5)

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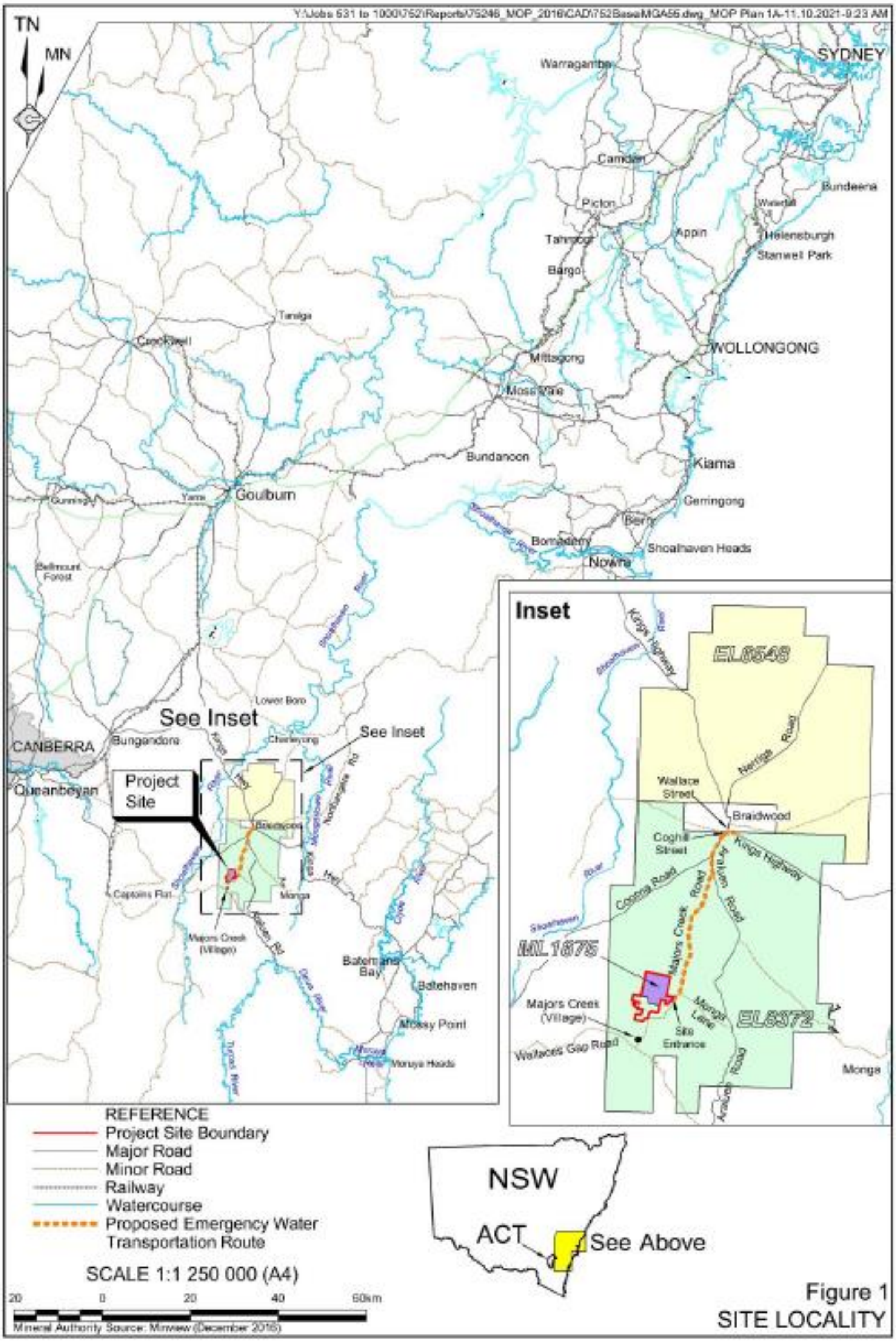

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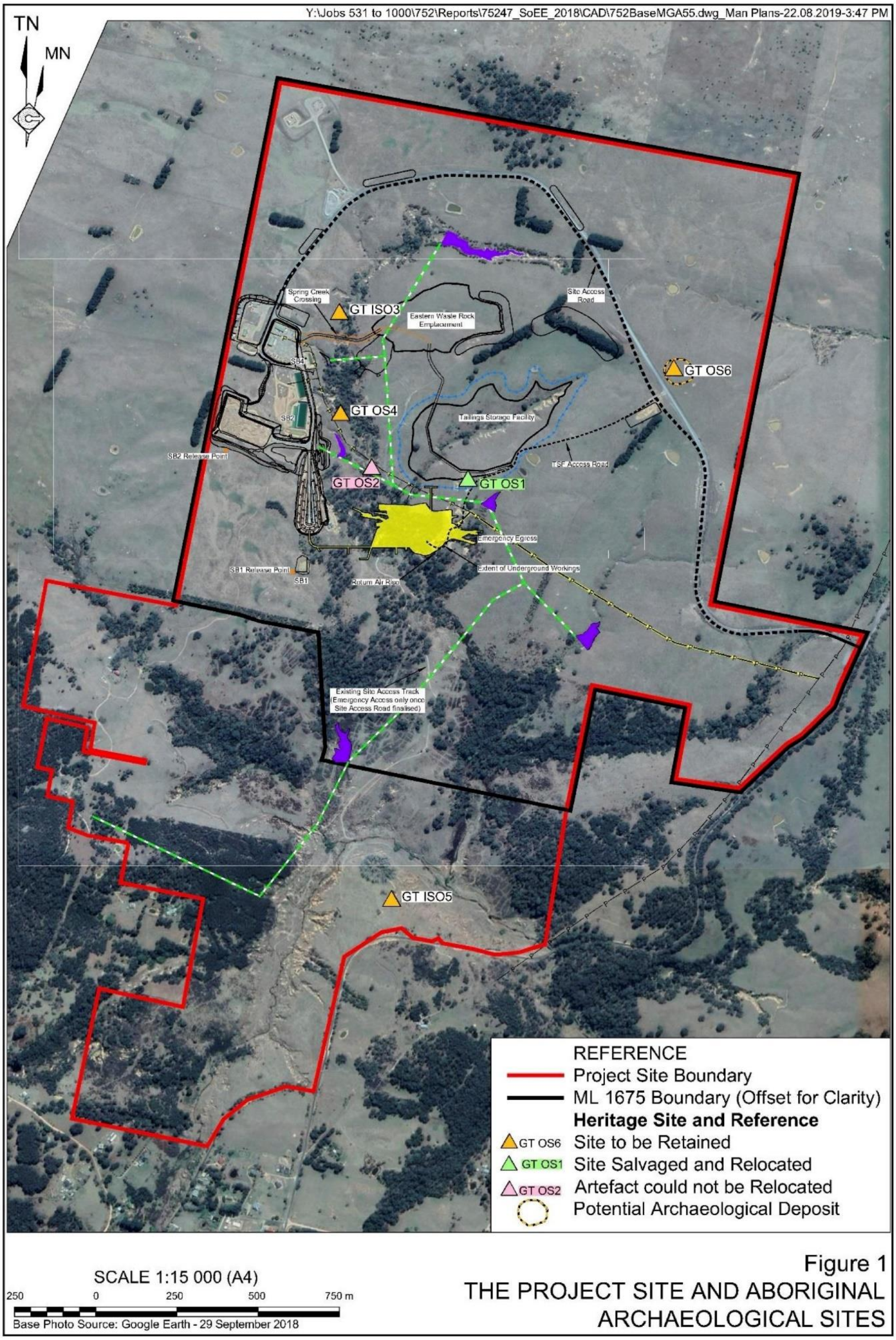

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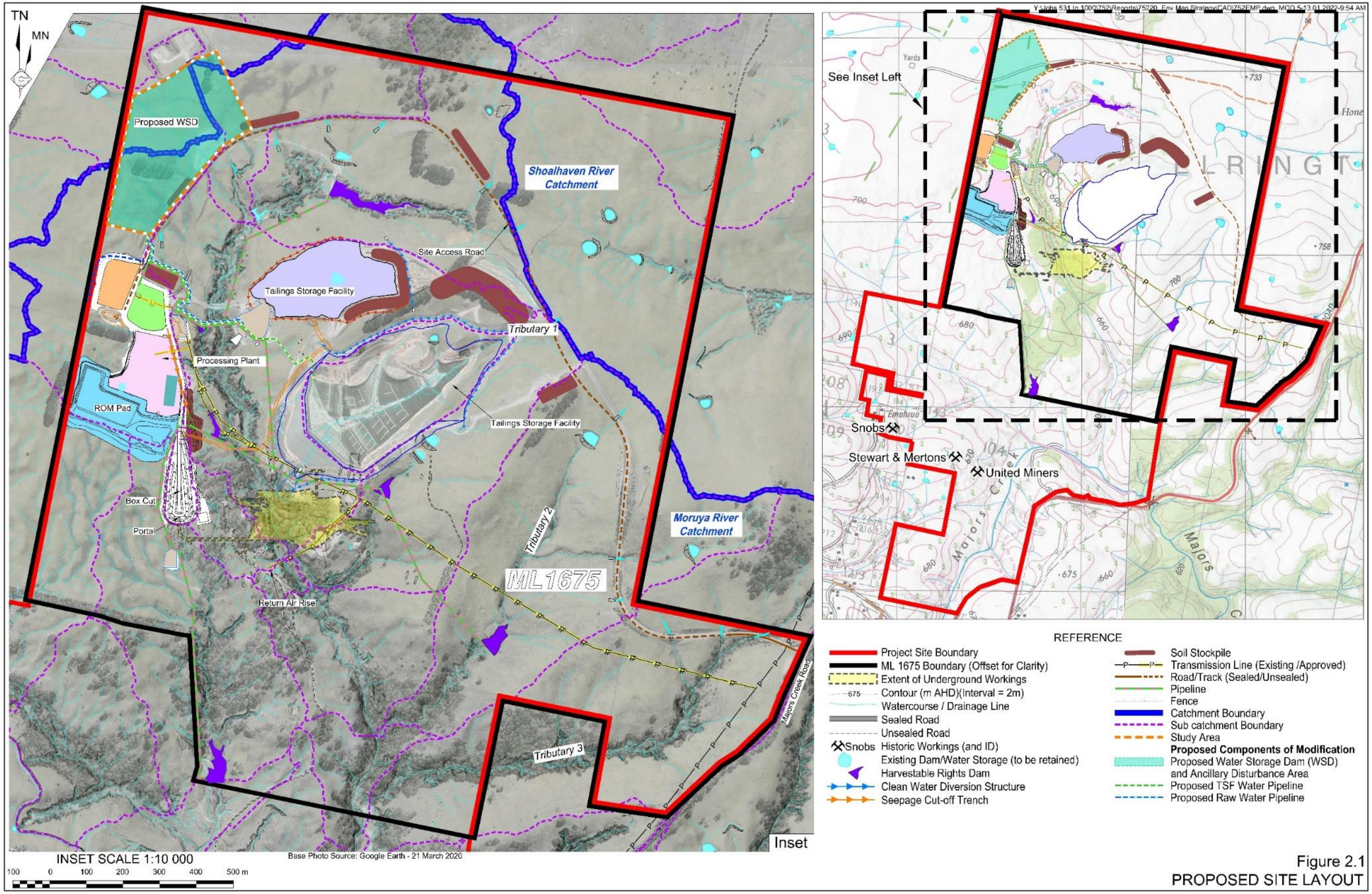

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27 January 2022

John Dixon
Ngarigo & Dijiringanj people
1 Kielpa Place
Bega NSW 2550

E: begadel@yahoo.com

Dear John

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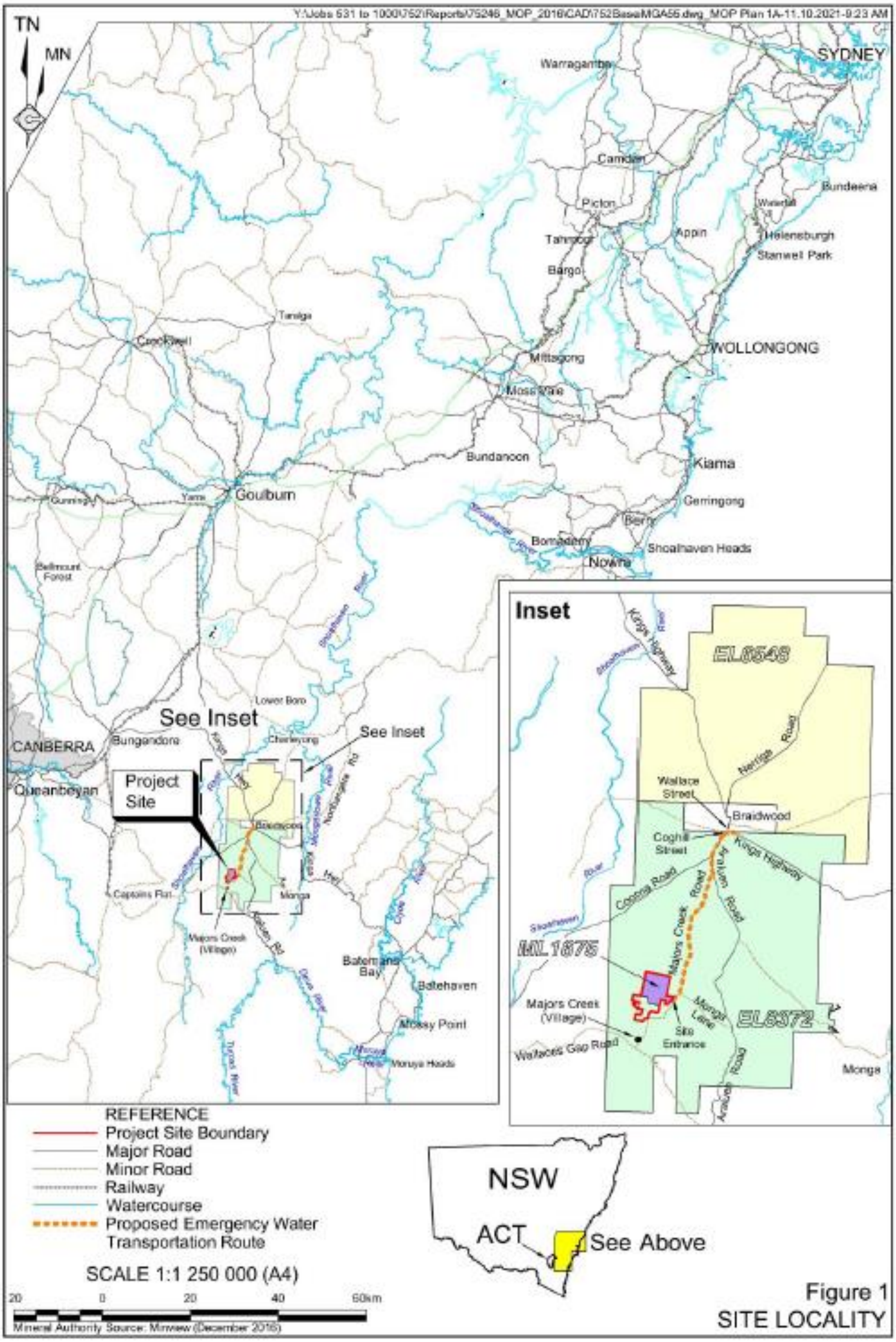

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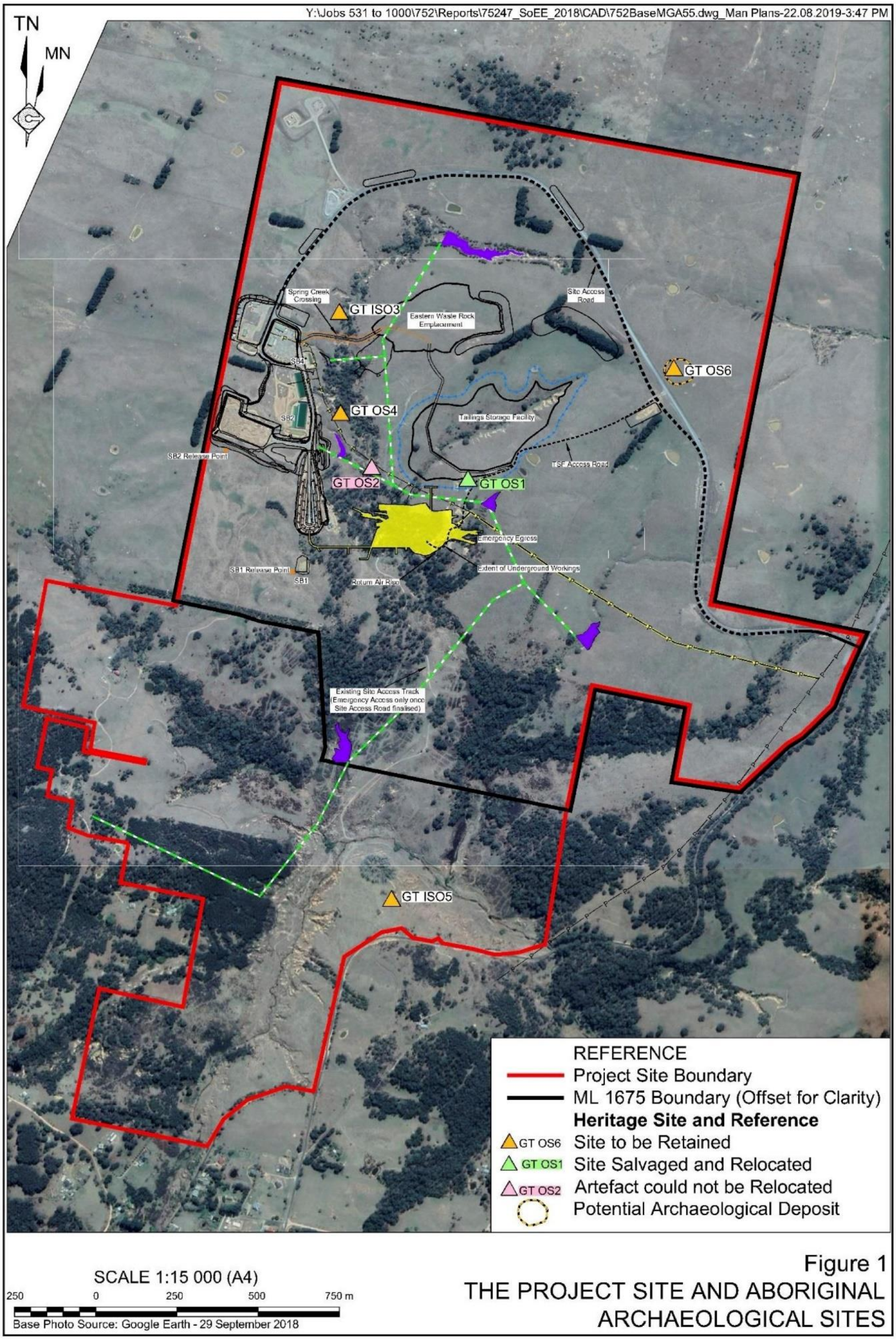

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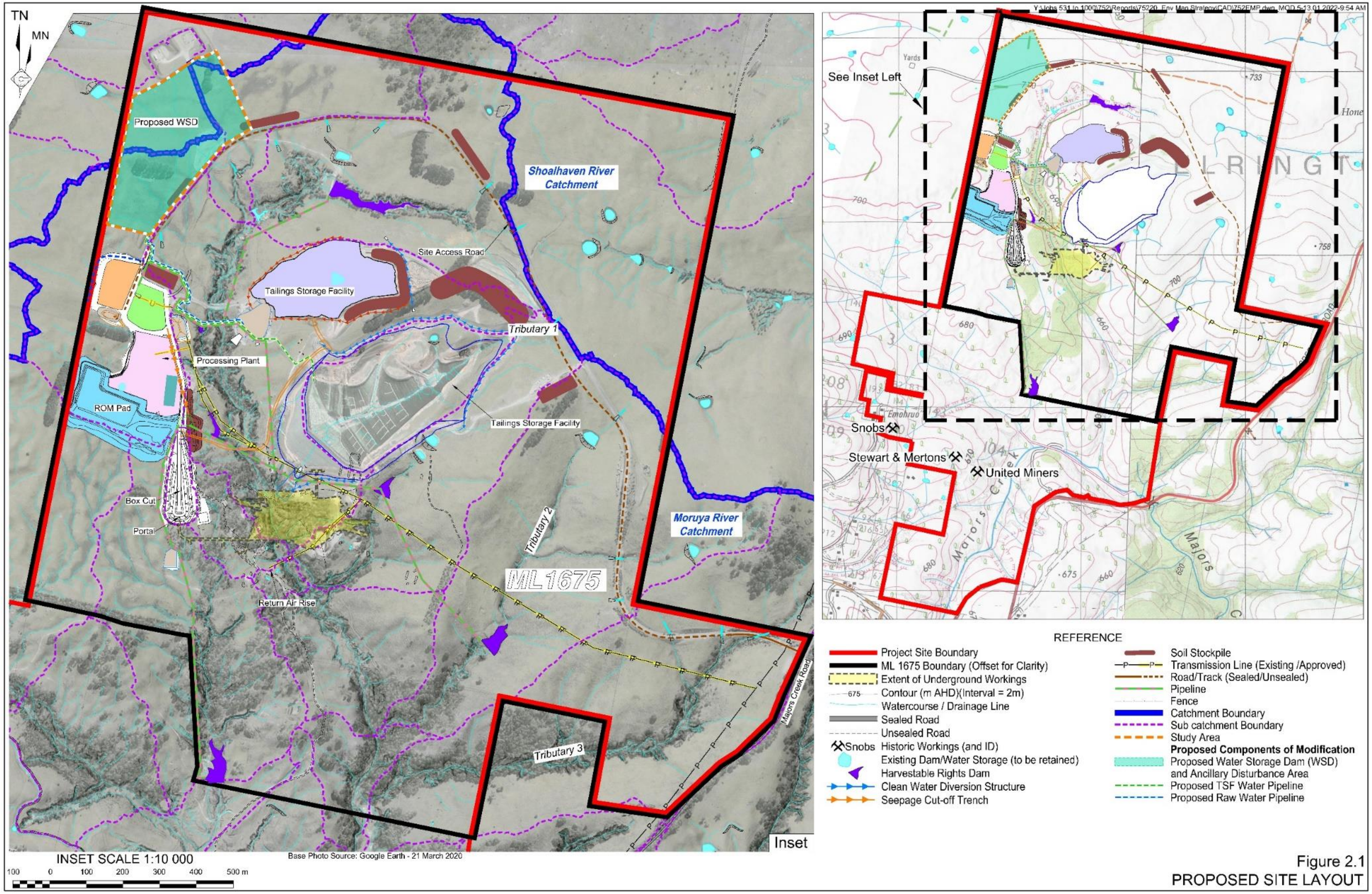

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25 January 2022

Mr. Shane Carriage
Walbunja Aboriginal Corporation.
5 Herarde St, Batemans Bat, NSW, 2536

02 4472 7916

0410 744 564

E: walbunja@gmail.com

Dear Shane,

Dargues Gold Mine major project: proposed modification (MOD 5)

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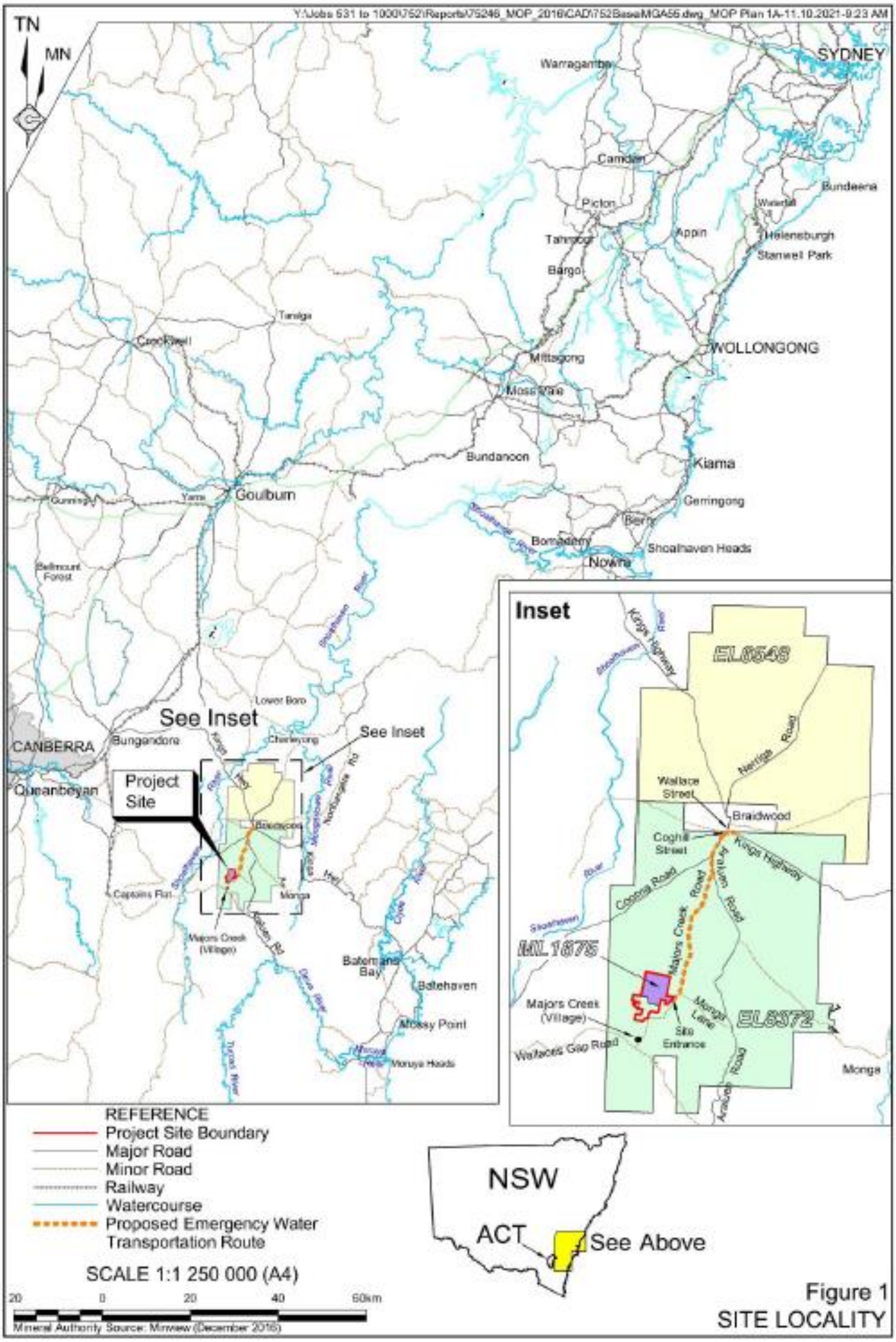

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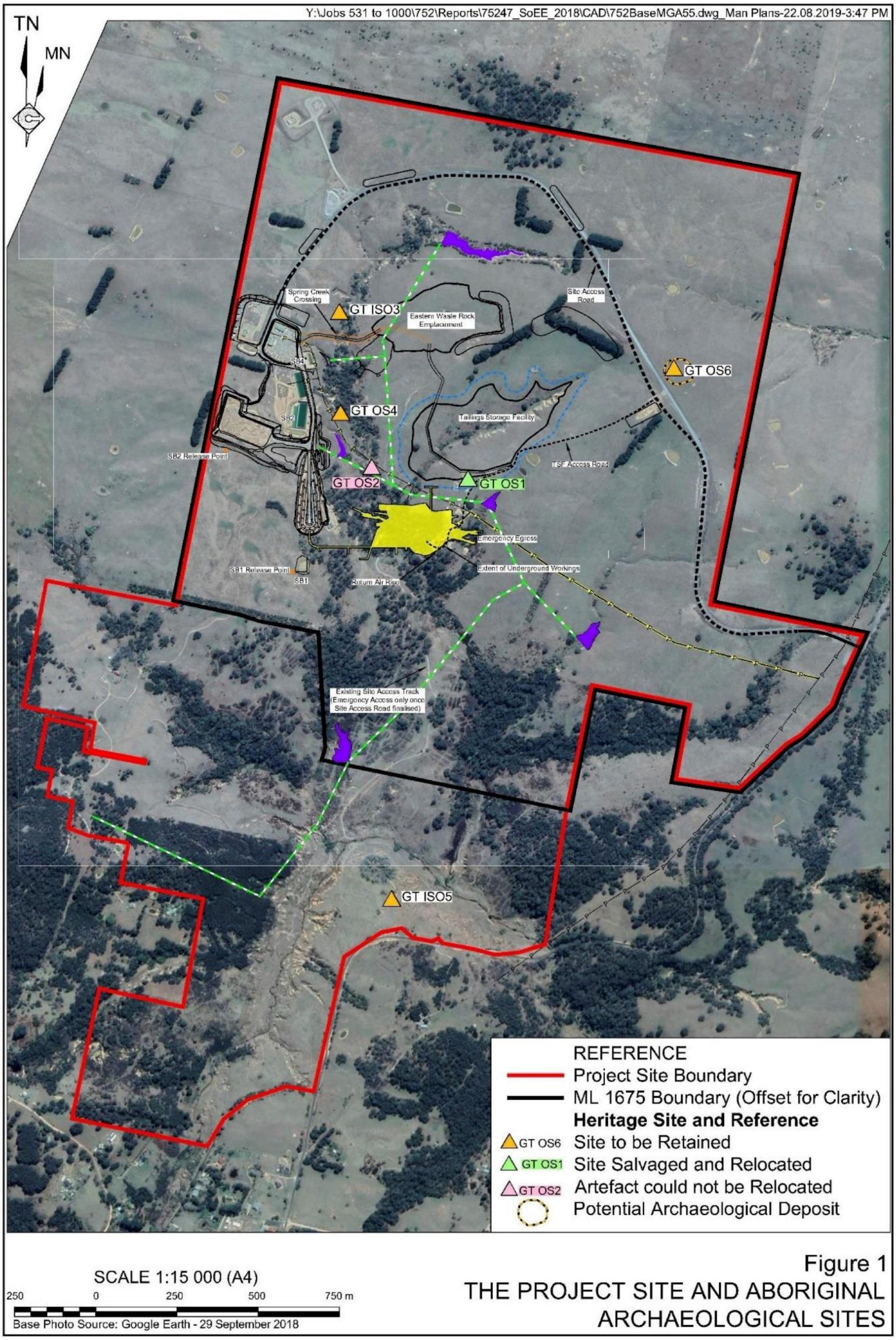

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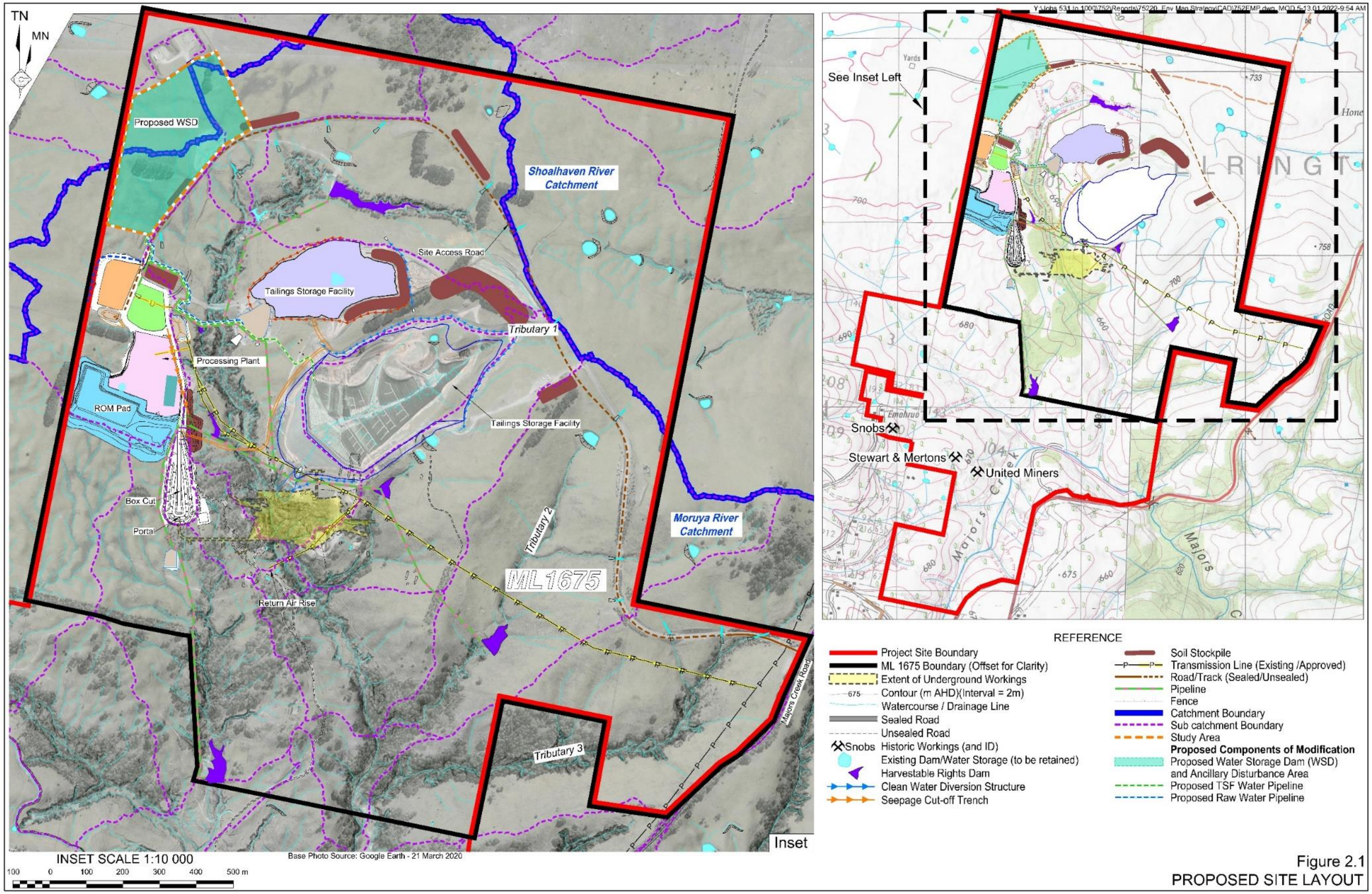

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25 January 2022

Bill Davis
Batemans Bay LALC.
PO Box 542 BATEMANS BAY NSW 2536

02 4472 7390

E: bblalc@bigpond.com

Dear Bill,

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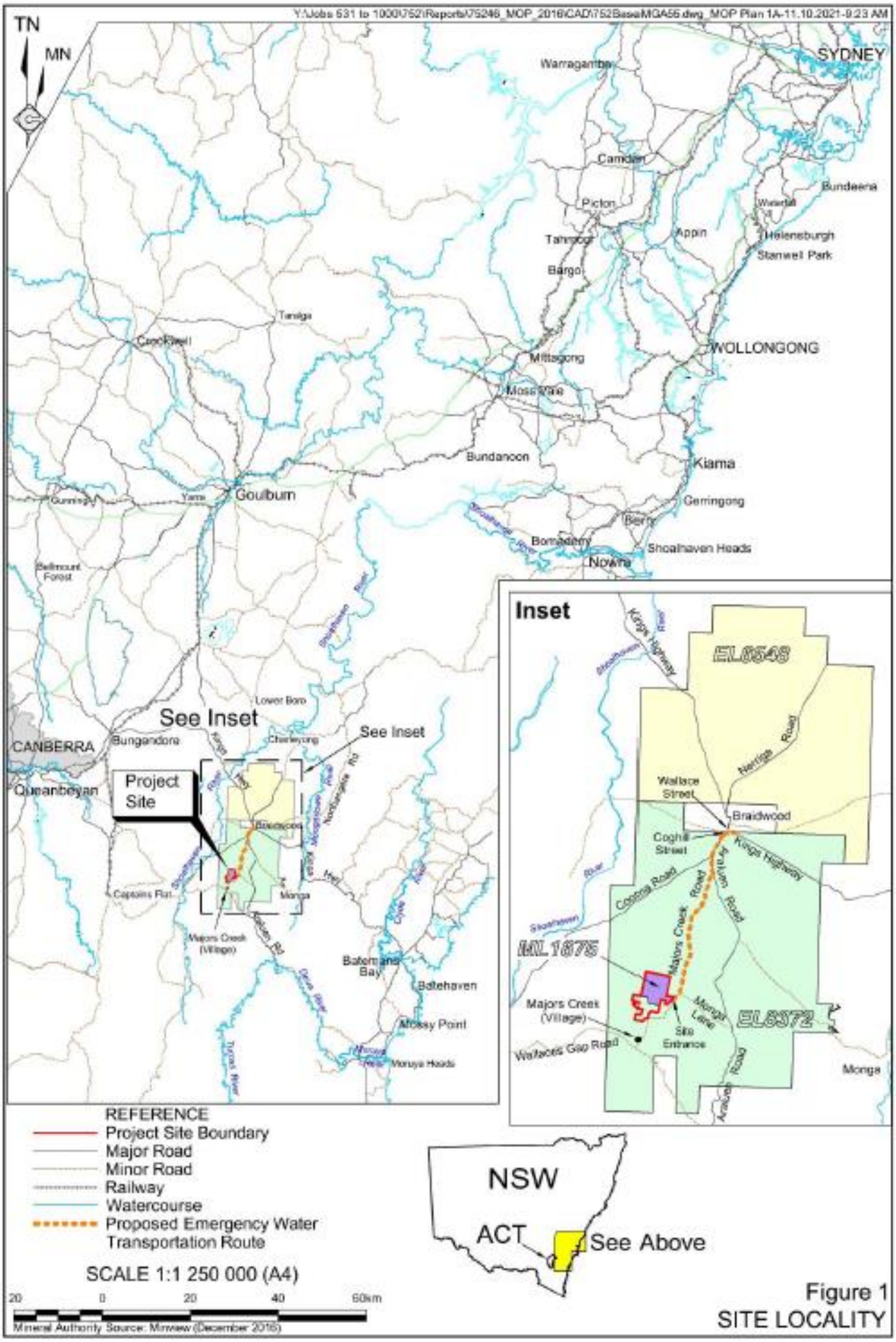

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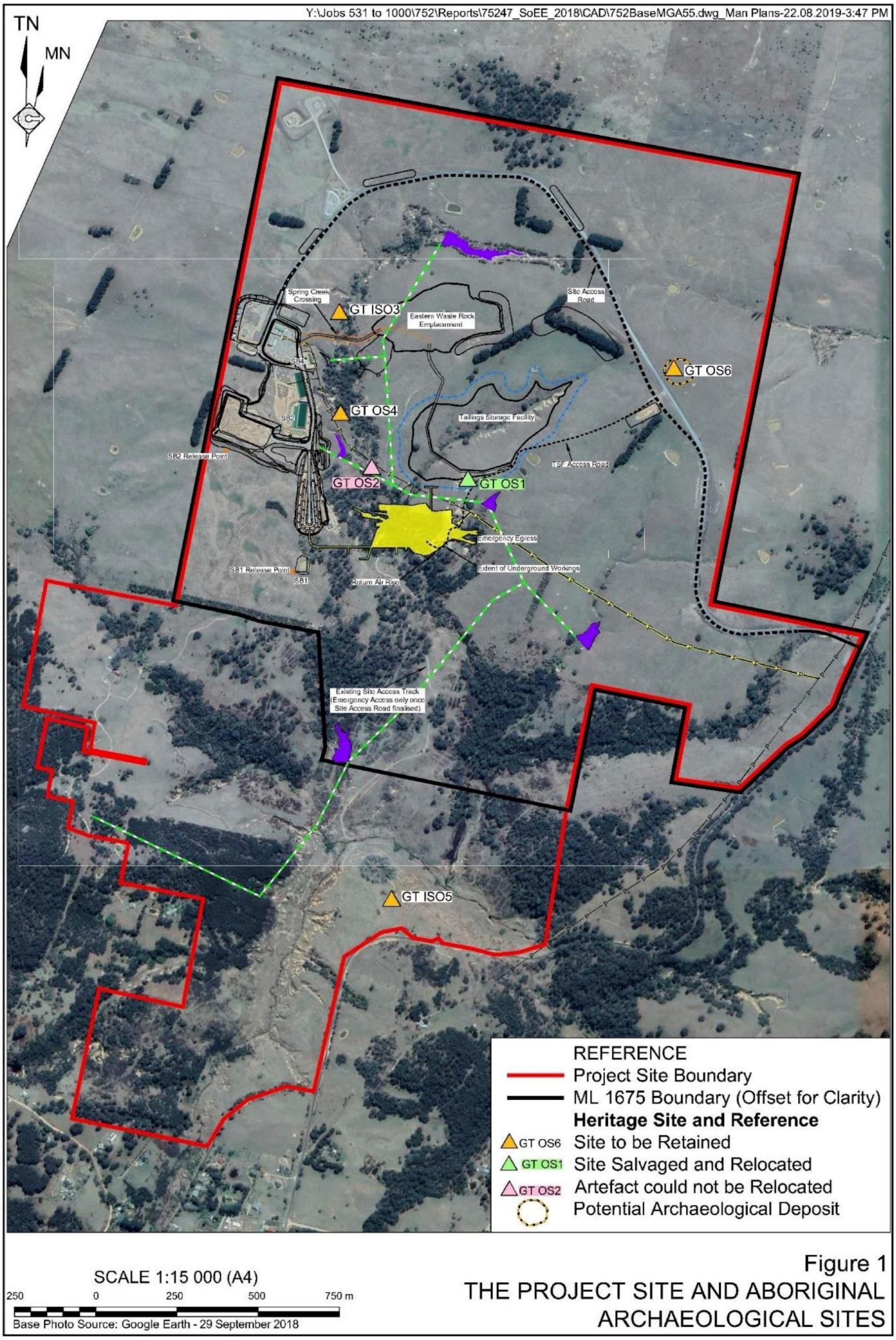
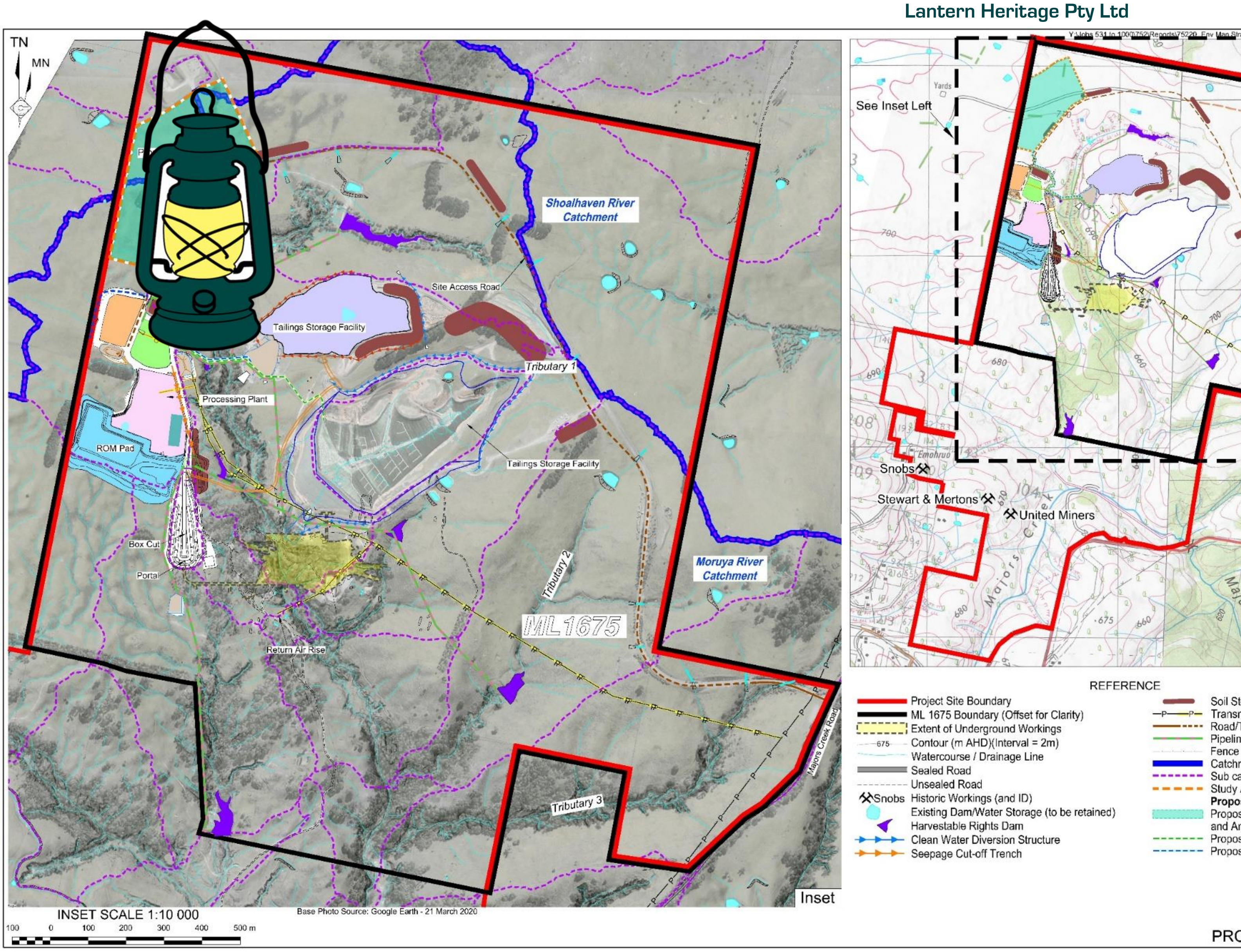


Figure 3: Location of MOD5 study area

Lantern Heritage Pty Ltd



PO Box 7039
Tathra
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ACN: 620 582 658
ABN: 30 620 582 658

Phone: (02) 6494 5759
Mobile: 0402831291

Email: info@lanternheritage.com.au
Web: www.lanterheritage.com.au

25 January 2022

Matilda House
Mirrabee
E: mirrabee1@gmail.com

Dear Matilda,

Dargues Gold Mine major project: proposed modification (MOD 5)

As a previously registered Aboriginal party for the Dargues Gold Mine major project, we are writing to inform you of a proposed modification to this project.

The Mine is located about 13km south of Braidwood and immediately to the north of the village of Majors Creek (see Figure 1). All mining related activities are located within Mining Lease (ML) 1675 on land that is owned or controlled by Big Island Mining Pty Ltd (the Applicant). Mining activities at the mine are approved under MP_0054 until 30 June 2025. There have been four previously approved modifications to this project.

Potential impacts to Aboriginal cultural heritage

As shown in Figure 2, previous assessment of the study area recorded five Aboriginal heritage sites (Archaeological Survey & Reports 2010). Two artefact scatters (GT OS1 and GT OS2) were collected and reburied in 2017 prior to start of works linked to this assessment.

The current modification (MOD 5) proposal can be viewed online at: *https://www.planningportal.nsw.gov.au/major-projects/project/43511.* Of these modifications, only the proposed Water Storage Dam and associated pipelines (raw water and excess water from the Tailings Storage Facility) have the potential to impact Aboriginal cultural heritage. The proposed dam and ancillary infrastructure are located in the north-west corner of the project area (see Figure 3), will have a disturbance area of about 10ha and capacity of about 180ML. Activities associated with the proposed dam are summarised below:

- Construction of a water management dam
  Proposed dam to have no natural catchment, and a capacity of about 180ML for receipt and storage of excess water from the Tailings Storage Facility, water pumped from underground workings and raw water from other on-site sources. The proposed dam would also be used to store water during periods of reduced rainfall or drought. Cut and fill construction methods will be used for the dam with the embankment built from materials sourced from within the dam footprint.

- A raw water pipeline and a Tailings Storage Facility water pipeline are proposed to link the dam to the existing water pipeline network, mine processing plant and Tailings Storage Facility.

One previously recorded site (GT IS03) is located within 100m of the proposed dam and associated infrastructure (Figure 2).

Role of Lantern Heritage

Lantern Heritage has been engaged by R. W. Corkery, on behalf of the Applicant, to assess potential impacts to Aboriginal and Historic cultural heritage values of the proposed dam location and pipeline routes. The study area measures about 16ha which includes the 10ha of the proposed dam as well as location of ancillary infrastructure (eg construction laydown yard) and water pipelines. The study area is identified by an orange dashed line in Figure 2 with the pipelines represented by green and blue dashed lines.

A field survey will be completed by Lantern Heritage in early 2022 to identify any areas of Aboriginal or Historic heritage values within the study area. Survey will be conducted with representative/s of the Batemans Bay Local Aboriginal Land Council. The results of survey will be included in a preliminary constraints report to the Applicant. A final impact assessment report will be prepared and circulated to registered Aboriginal parties for review and comment.

What we'd like to know from you

Can you please let us know by 11 February 2022 if you would like to continue to be consulted on this project? Could you also nominate any cultural knowledge holders who many not have previously registered for this project?

If you have any questions, or require any additional information, please do not hesitate to contact me.

Yours Sincerely,

Bec Parkes BA Hons, PhD
Director/Principal Archaeologist
Lantern Heritage Pty Ltd

Figure 1: General location of Dargues Gold Mine

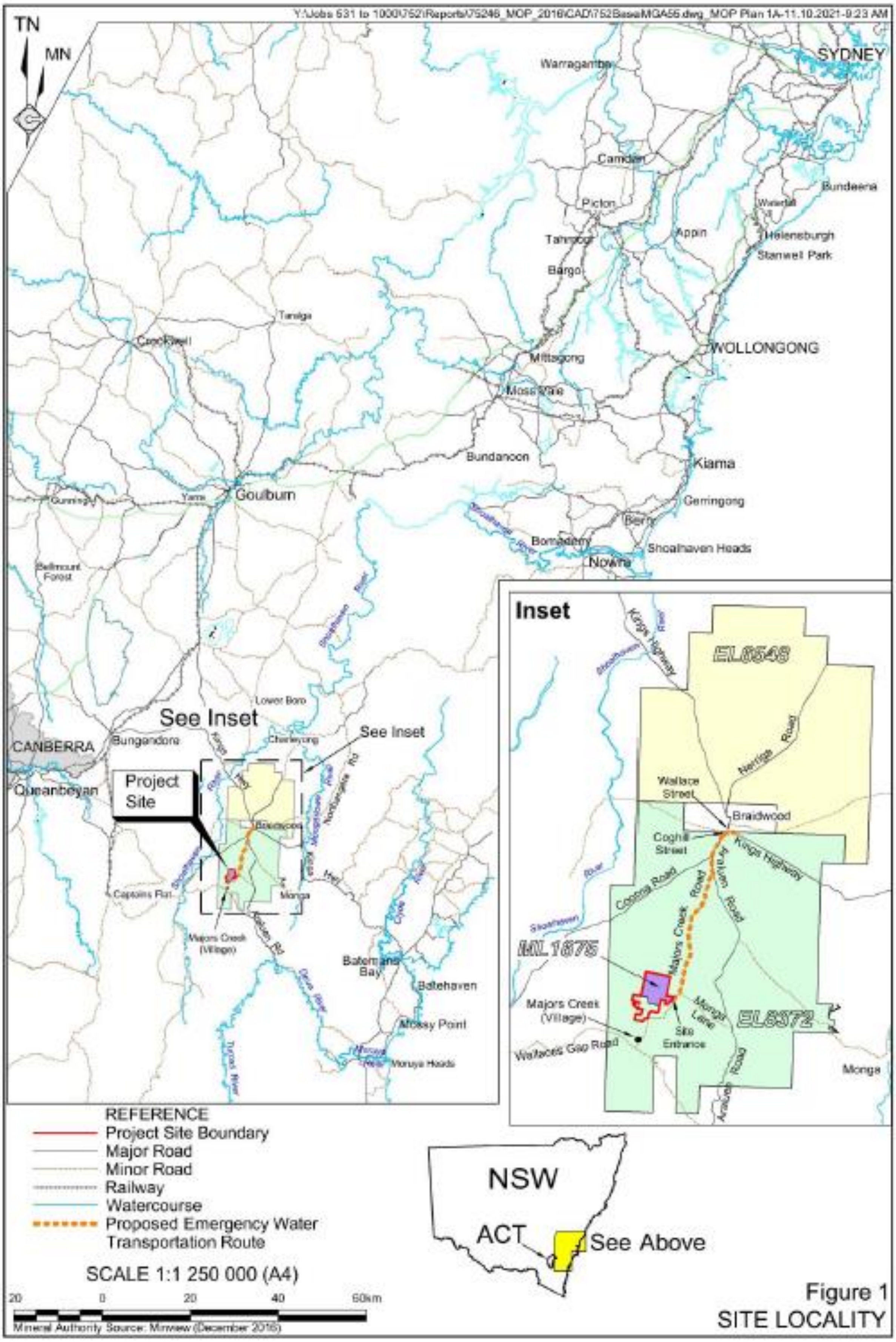


Figure 2: Location of previously recorded Aboriginal cultural heritage sites

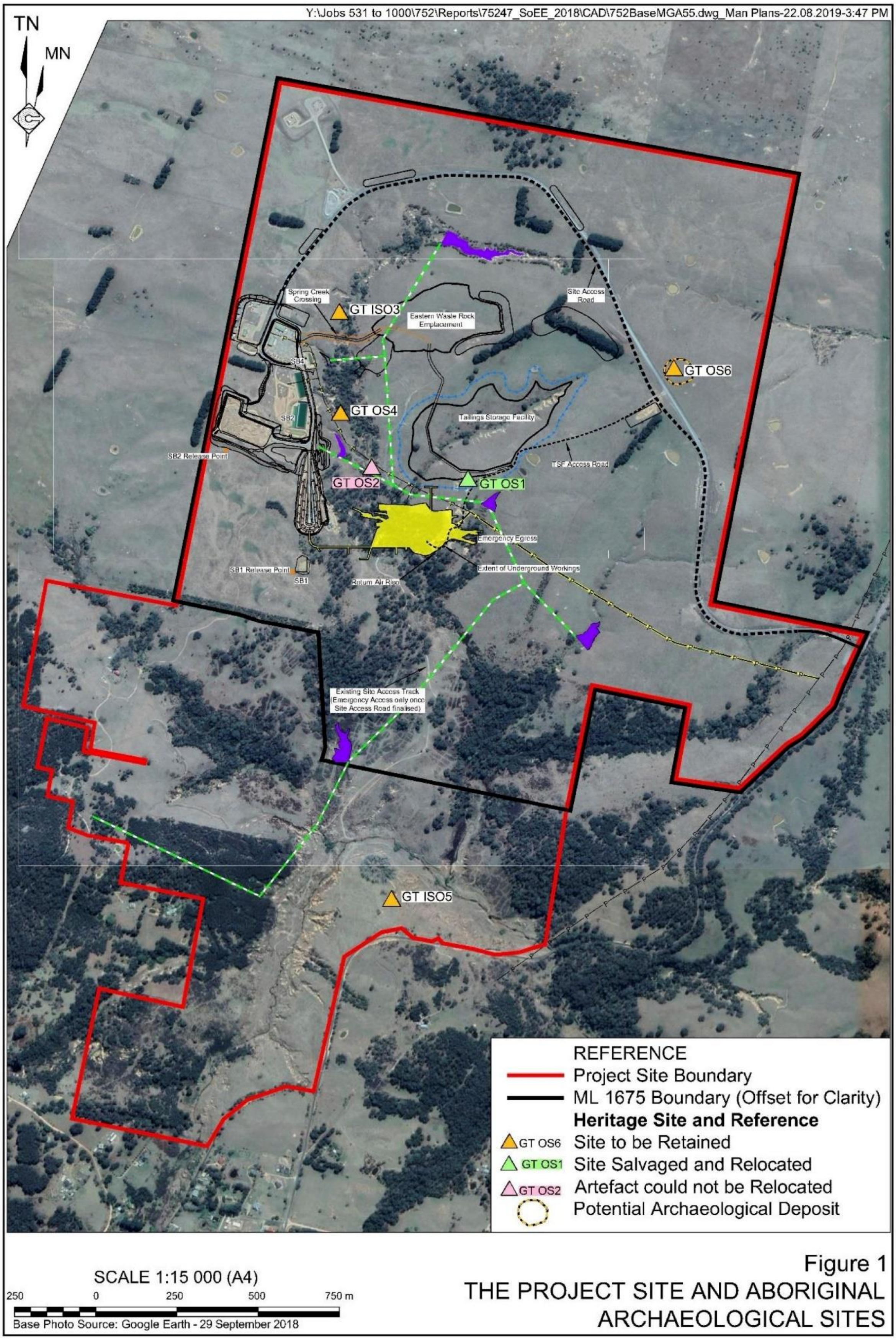
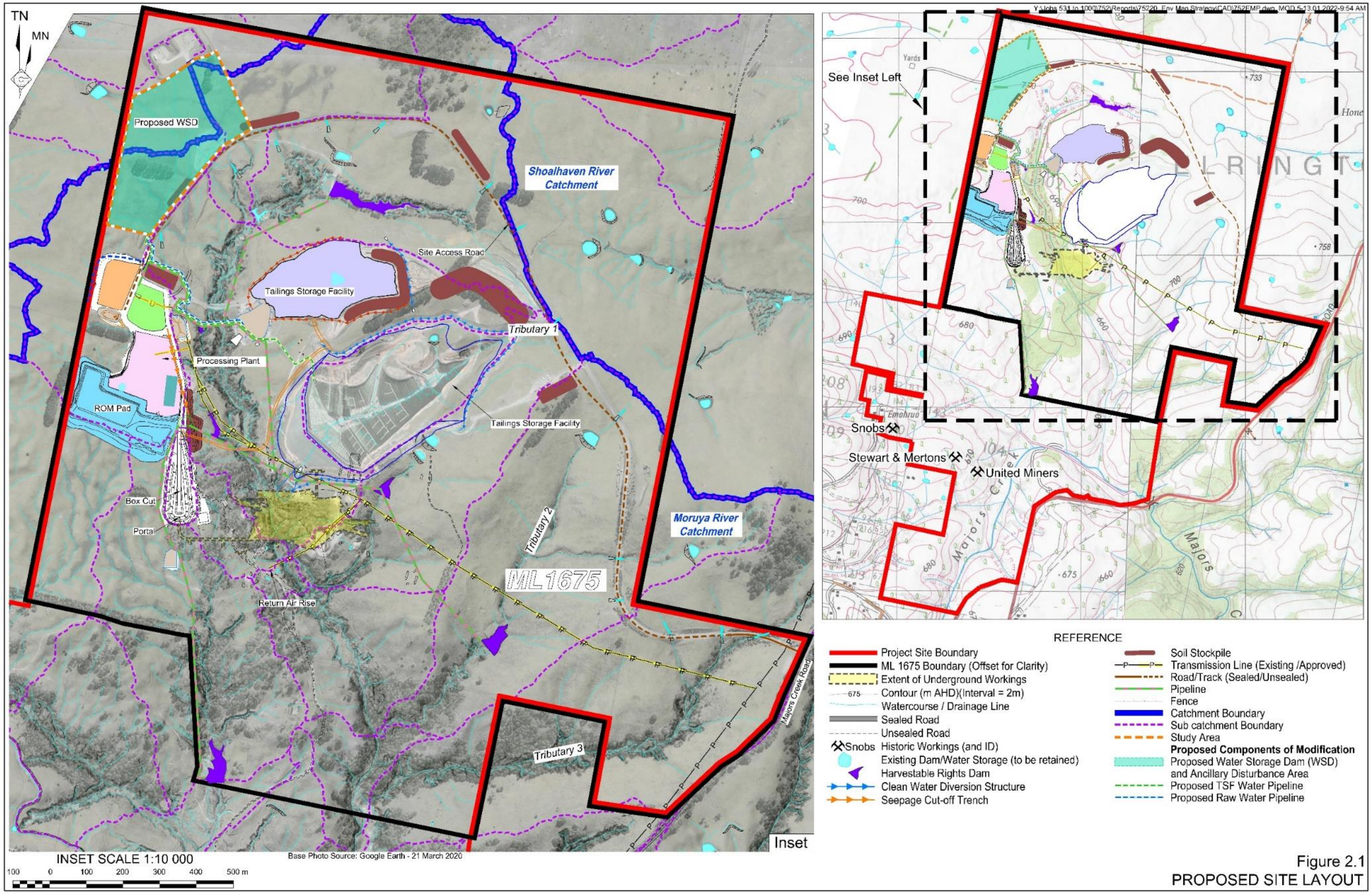


Figure 3: Location of MOD5 study area



Invitation to participate in field survey day 1

Christine Gant-Thompson

From:	Christine Gant-Thompson
Sent:	Tuesday, 22 February 2022 12:02 PM
To:	moqolalc1@bigpond.com; bblalc@bigpond.com
Cc:	Glenn van der Kolk; 'Enzo Guarino'; Jack Flanagan
Subject:	Dargues Gold Mine field survey - Wednesday 9 March

Dear Linda & Jayde

As discussed on the phone, a field survey of a new water containment area at Dargues Gold Mine is being organised by Lantern Heritage for Wednesday 9 March.

We would like one representative from your LALC to attend.

We will be meeting onsite at 9am. The entry to Dargues Gold Mine is 920 Majors Creek Road – shown on attached map. On arrival at the entry boom gate, please call the shift supervisor (phone number listed at the gate) and let them know you are there to meet Enzo Guarino (Environmental Officer). From the boom gate, make your way down the road to the site offices to park near the Green site office.

To participate on the day your representative will need:

- Hard hat
- Steel cap boots
- Glasses
- High Vis long pants and long sleeved shirts or high vis vest
- Food and water for the day

Can you please provide us with the following paperwork:

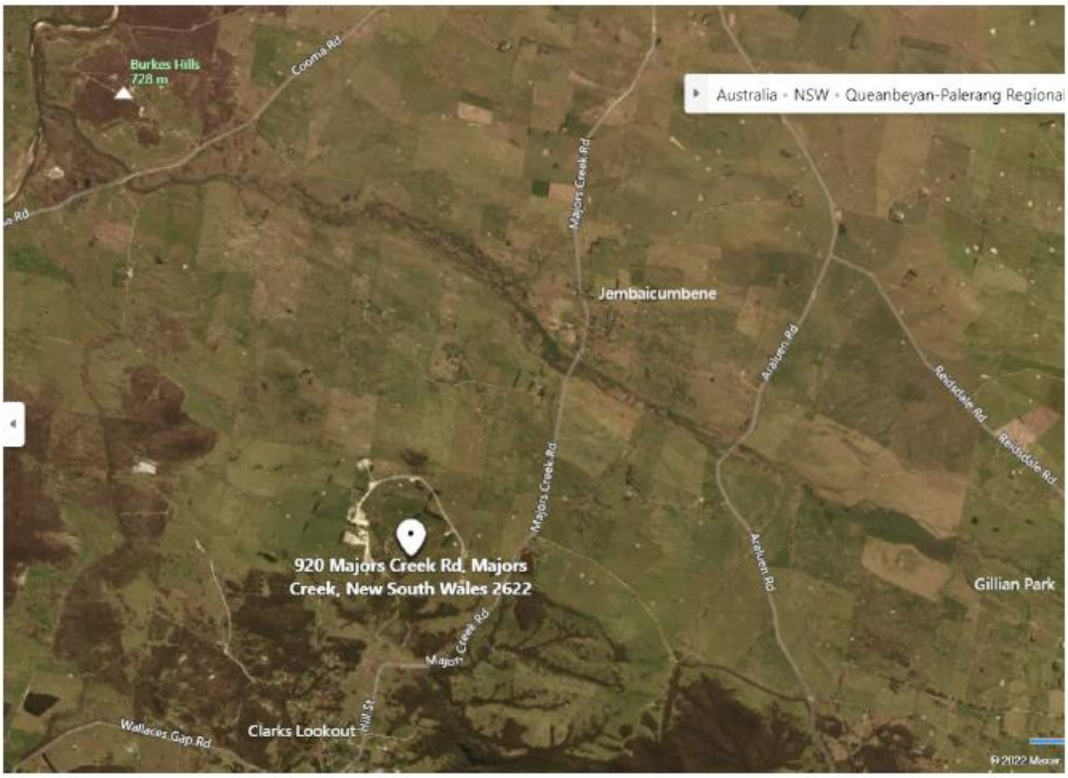
- Schedule of rates
- Public liability
- Certificate of currency.

All hours and disbursements to be invoiced to Big Island Mining Pty Ltd c/o R.W. Corkery & Co. Pty. Limited.

Can you please confirm that a representative from your LALC will be attending?

Thanks,

Christine



Christine Gant-Thompson MA(Hons)
Senior Archaeologist

Work days: Monday to Thursday

Lantern Heritage Pty Ltd
PO Box 7039, TATHRA NSW 2550
Shop 3/15 Bega St, TATHRA NSW 2550
m: 0411 296 777
e: christine@lanternheritage.com.au
w: www.lanternheritage.com.au

Lantern Heritage
shining a light on people and place

Invitation to participate in field survey day 2

Field officer required for survey next Monday 28 or Thursday 31 March

CG Christine Gant-Thompson
To mogolalc1@bigpond.com
Cc Glenn van der Kolk

Reply | Reply All | Forward | ...

Tue 22/03/2022 4:48 PM

Hi Linda,

I left a message on your voice mail earlier today, however as I am heading out on fieldwork for the next two days I thought I would follow up with an email.

The proposed location of works at Dargues Gold Mine has been revised and we need to return to do another survey. Would you have a field officer available to join us on the survey either next Monday 28 or Thursday 31 March?

Either day works for us, so please nominate a day based on what suits the LALC.

We will meet at 9am again at the gate off Majors Creek Road.

Can you please confirm your preferred day with my colleague Glenn van de Kolk either by email (cc'd above) or by calling him on 0434 346 342.

Regards,

Christine

Christine Gant-Thompson MA(Hons)
Senior Archaeologist

Work days: Monday to Thursday

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PO Box 7039, TATHRA NSW 2550
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Invitation to RAPs to review MOD 5 Aboriginal and Historic Heritage Assessment

Dargues Gold Mine MOD 5 assessment for you review and comment

Christine Gant-Thompson

To Consultation

Reply | Reply All | Forward

Tue 7/06/2022 5:04 PM

Bcc Lantern Heritage; mogolalc1@bigpond.com; Yurwang.Gundana.C.H.S@outlook.com; walbell@bigpond.net.au; Ngunawal Heritage Aboriginal Corporation; Samuel Rosek; Jack Flanagan

Dear stakeholder,

Thank you for your ongoing registration of interest in the Dargues Gold Mine MOD 5 project.

Lantern Heritage has completed the below Aboriginal cultural heritage and Historic heritage report for your review and comment. Can you please provide any comments back to Lantern Heritage by **Wednesday 6 July 2022.**

The report can be accessed from the link below:
https://www.dropbox.com/s/wsrfqbm88c3q8dm/Dargues%20Gold%20Mine_MOD%205_ACH%20and%20Hist%20assessment_ver%202.0_7June2022.pdf?dl=0

Please get in touch if you have any questions.

Regards,

Christine

Christine Gant-Thompson MA(Hons)
Senior Archaeologist

Work days: Monday to Thursday

Lantern Heritage Pty Ltd
PO Box 7039, TATHRA NSW 2550
Shop 3/15 Bega St, TATHRA NSW 2550
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shining a light on people and place

RAP consultation log – Dargues Gold Mine MOD5 expansion project

Date	Organisation	Contact Name/s	Consultation Type / Comment	Method
25/01/2022	Lantern Heritage Pty Ltd - Glenn Merrick (A/Business Manager)	King Brown Tribal Group, Ngunnawal Elders Corporation, Batemans Bay LALC, Ngunnawal Heritage Aboriginal Corporation, Konanggo Aboriginal Cultural Heritage Services, Walbunja Aboriginal Corporation, Buru Ngunawal Aboriginal Corporation Traditional Carer Group, Little Gudgenby River Tribal Council, Ngarigo & Dijiringanj people, Yurwang Gundana Consultancy Cultural Heritage Services,Mogo LALC	A letter was sent to the RAPs identified in the Aboriginal Heritage Assessment (2010) and Aboriginal Heritage Management Plan (2019) declaring MOD 5 activities and asking whether they wish to continue to be consulted	email sent
27/01/2022	Yurwang Gundana C.H.S	Merekai Bell	Email saying they would like to continue to be consulted and has represenatives available for fieldwork	email received.
28/01/2022	Buru Ngunawal Aboriginal Corporation	Wally Bell	Email requesting that our organisation would like to continue to be consulted on this project. We would like to nominate cultural knowledge holders King Brown Tribal Group – Adrian Brown 0472 848 604 who may not have previously registered for this project. Lantern included Adrian Brown in original mail out to RAPs on 25 January 2022.	email received.
31/01/2022	Lantern Heritage	Mogo LALC	email letter sent	email sent
1/02/2022	Lantern Heritage	Dorothy Carroll	re-sent, wrong email address	email sent and records updated.
1/02/2022	Lantern Heritage	Little Gugenby River Tribal Council	Letter asking if they wished to continue to be consulted on Dargues gold mine sent by post.	Letter sent

Date	Organisation	Contact Name/s	Consultation Type / Comment	Method
7/02/2022	Mundawari Heritage Consultants (formerly NHAC)	Dean Delponte	Email requesting inclusion in ongoing consultation for Dargues and notification of change of business name from Ngunnawal Heritage Aboriginal Coporation to Mundawari Heritage Consultants. Email acknowledged by Lantern and records updated.	email received.
22/02/2022	Lantern Heritage Pty Ltd - Christine Gant-Thompson (Project Manger)	Mogo and Batemans Bay LALCs	Phone call to both Mogo and Batemans Bay LALC to request for field officer to participate in survey on 9 March 2022. Follow up email sent with meeting place and other details	Phone calls and email
24/02/2022	Yurwang Gundana Cultural Heritage Services	Merekai Bell	Email sent checking receipt of email and reiterating desire to be involved in fieldwork. Acknowledgement email sent from Lantern on 28 Feb 2022.	email received.
8/03/2022	Lantern Heritage Pty Ltd - Christine Gant-Thompson (Project Manger)	Mogo and Batemans Bay LALCs	Phone call to both Mogo and Batemans Bay LALC to see if they are sending site officer for field work on 9 March. Mogo LALC sent email confirming participation. Batemans Bay said that they no one was available.	Phone calls
22/03/2022	Lantern Heritage Pty Ltd - Christine Gant-Thompson (Project Manger)	Mogo LALC	Phone call and follow up email to arrange second day of site survey on 28 March 2022. Mogo LALC confirmed that they will send a site officer for this day.	Phone call and email

Date	Organisation	Contact Name/s	Consultation Type / Comment	Method
7/06/2022	Lantern Heritage Pty Ltd - Christine Gant-Thompson (Project Manger)	King Brown Tribal Group, Ngunnawal Elders Corporation, Batemans Bay LALC, Mundawari Heritage consultants (formerly NHAC), Konanggo Aboriginal Cultural Heritage Services, Walbunja Aboriginal Corporation, Buru Ngunawal Aboriginal Corporation Traditional Carer Group, Little Gudgenby River Tribal Council, Ngarigo & Dijiringanj people, Yurwang Gundana Consultancy Cultural Heritage Services,Mogo LALC	Email sent to RAPs inviting them to review and provide comment on the report via a Dropbox link. End of review period is 6 July 2022.	email sent
18/06/2022	Mundawari Heritage Consultants	Dean Delponte	Email supporting recommendations in the report, in particular requirement to conduct test excavation	email received.
21/07/2022	Lantern Heritage Pty Ltd - Christine Gant-Thompson (Project Manger)	Mogo LALC	Phone call to check if Mogo LALC has any comments on the report. Linda said that she will finish her review today and get back to me. No response received when report finalised on 22 July 2022.	phone call.

APPENDIX 3 – PROTOCOL FOR DISCOVERY OF ANCESTRAL REMAINS

In the event that human skeletal remains, or suspected ancestral remains are found during construction activities or any of the ongoing management procedures for work within the Dargues Gold Mine MOD 5 activity areas, the protocols and procedures listed below must be followed:

- **STOP** all work must in the vicinity of the remains;
- Leave the remains in place and protected from further harm or damage or unauthorised access through installation of a min 10m perimeter fence;
- If there is doubt, obtain specialist advice from a Forensic anthropologist to confirm that the bones are human;
- Where the material is determined to be of human origin, immediately notify NSW Police;
- Contact Heritage NSW if the remains are believed to be Aboriginal;
- Contact the relevant Aboriginal community or the RAPs to ensure they are aware remains have been found once remains have been confirmed to be Aboriginal;
- Not recommence work at the location until authorised in writing by Heritage NSW if the remains are considered by the Police and Heritage NSW to be Aboriginal;
- Record Aboriginal ancestral remains in a culturally appropriate manner in collaboration with Heritage NSW and the relevant Aboriginal community.

Appendix 7

Traffic Impact Assessment

prepared by

The Transport Planning Partnership Pty Ltd

(Total No. of pages = 51)

Dargues Gold Mine Modification 5

Traffic Impact Assessment

Prepared for:

Big Island Mining Pty Ltd

22 June 2022

The Transport Planning Partnership

E: info@ttpp.net.au

Dargues Gold Mine Modification 5

Traffic Impact Assessment

Client: Big Island Mining Pty Ltd

Version: Final

Date: 22 June 2022

TTPP Reference: 21462

Quality Record

Version	Date	Prepared by	Approved by	Signature
Final	22/06/2022	PJD	PJD	P Dalton

Table of Contents

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Figures

Appendices

References

Aurelia Metals (2022), https://www.aureliametals.com/projects/dargues/complaints-register

Austroads (2020a), *Guide to Traffic Management Part 3: Traffic Studies and Analysis Methods.*

Austroads (2020b), *Guide to Traffic Management Part 6: Intersections, Interchanges and Crossings Management.*

Dargues Gold Mine Pty Ltd and Big Island Mining Pty Ltd (2019), *Traffic Management Plan for the Dargues Gold Mine.*

NSW Government (2021), https://mpweb.planningportal.nsw.gov.au/major-projects

Transport and Urban Planning (2010), *Dargues Reef Gold Project Traffic Assessment.*

Transportation Research Board (2016), *Highway Capacity Manual.*

1 Introduction

This report has been prepared on behalf of Big Island Mining Pty Ltd to present the findings of an assessment of the road transport implications of a proposed modification (Modification 5) to the approved Dargues Gold Mine (the Mine). The Mine is located approximately 60 kilometres (km) southeast of Canberra, 13 km south of Braidwood, and immediately to the north of the village of Majors Creek as shown in Figure 1.1. The Mine consists of an underground gold mine, a run-of-mine (ROM) pad, temporary waste rock emplacement, processing plant, tailings storage facility (TSF), and associated infrastructure and ancillary activities. It operates under Modified Project Approval (MP) 10_0054 which permits mining activities until 30 June 2025. Modification 5 (the Modification) proposes adjustments to the conditions of MP10_0054 to clarify permissible transportation operations and regularise the development consent to account for minor changes to the Project Site.

The remainder of this report is set out as follows:

- Section 2 describes the existing and proposed operations at the Mine and its vehicular access and transportation arrangements;
- Section 3 describes the existing road transport environment, including traffic volumes, operational performance and road crash history.
- Section 4 reviews the future traffic conditions expected without the Modification, against which the Modification impacts can be assessed.
- Section 5 assesses the potential impacts of the Modification, including its peak traffic generation and the effects on operational performance and road safety on access routes. The need for measures to mitigate impacts of the Modification is discussed.
- Section 6 presents the conclusions of the study.

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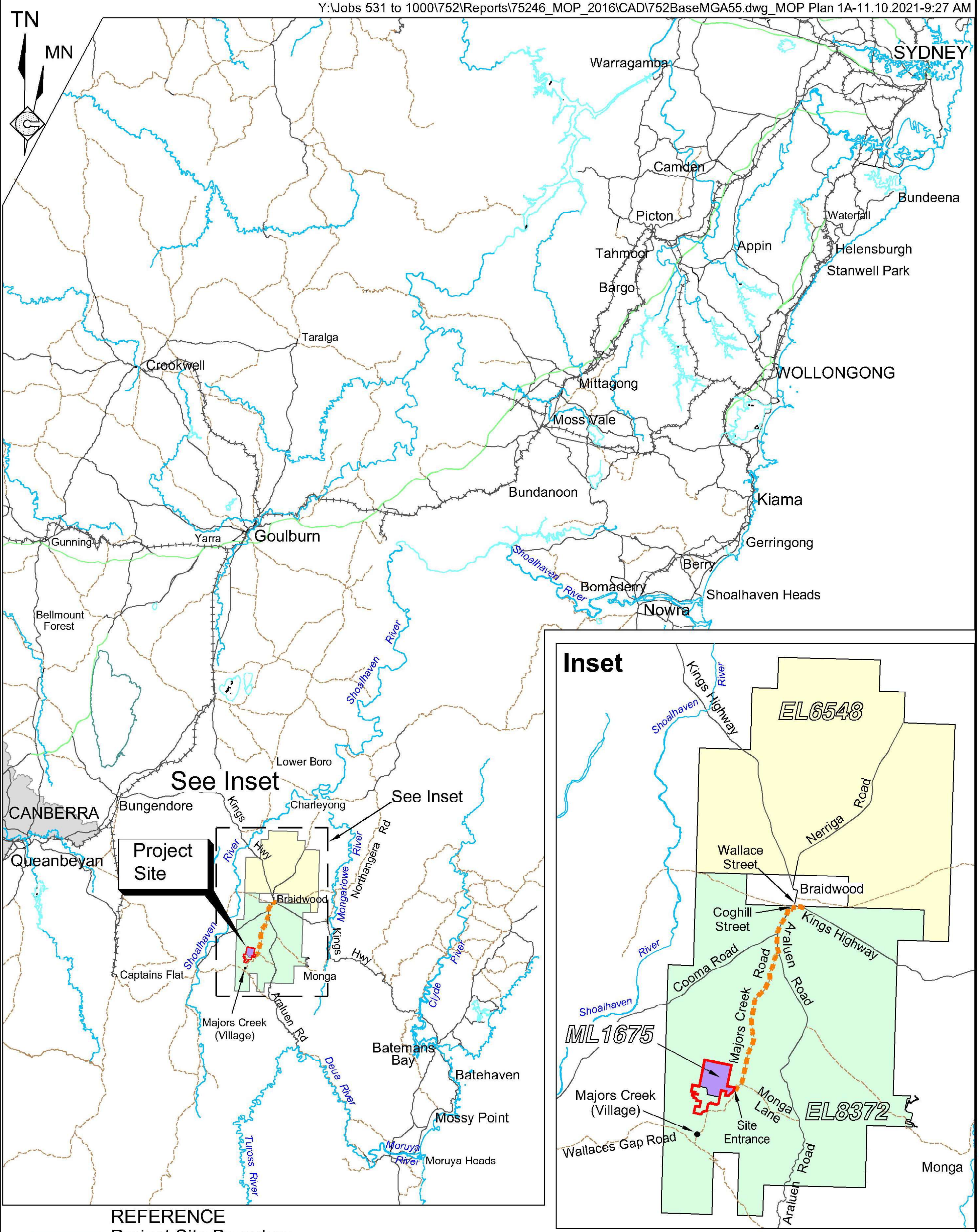
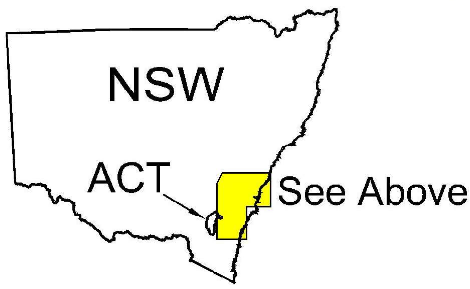


REFERENCE

- Project Site Boundary
- Major Road
- Minor Road
- Railway
- Watercourse
- Proposed Emergency Water Transportation Route



SCALE 1:1 250 000 (A4)

20 0 20 40 60km

Mineral Authority Source: Minview (December 2016)

Figure 1.1
Site Location

2 Dargues Gold Mine

2.1 Site Location

The Mine is located approximately 60 km southeast of Canberra, approximately 13 km south of Braidwood and immediately to the north of the village of Majors Creek (Figure 1.1), within the Queanbeyan-Palerang Regional Council local government area. The Project Site comprises 18 land titles, of which 17 are owned by the Applicant and one (Lot 193, DP755934) is Crown Land and is leased by the Applicant under Special Lease 132905. All mining-related activities are located within Mining Lease (ML) 1675 on land that is owned or controlled by the Applicant.

2.2 Mine Operations

Modified Project Approval MP10_0054 was granted on 7 February 2012, with subsequent modifications granted on:

- 12 July 2012 (MOD 1) – to permit the use of paste fill to back fill stopes and underground voids;
- 24 October 2013 (MOD 2) – to regularise the approved layout following minor changes during the detailed design phase of the Project;
- 10 August 2016 (MOD 3) – to allow the construction and use of the Eastern Waste Rock Emplacement, an enlarged Tailings Storage Facility and the Spring Creek crossing and to accommodate an extension to the mine life; and
- 23 May 2019 (MOD 4) – to permit relocation of the approved Spring Creek crossing, reinstatement of an alternate internal access road and administrative modifications to reflect changes in land ownership.

Mining activities at the Project Site are approved under MP10_0054 until 30 June 2025, and key activities include:

- extraction of waste rock and ore from the Dargues Gold Deposit using underground sublevel open stope mining methods;
- processing of up to 355,000 tonnes (t) of ore per year and up to 1.6 million tonnes (Mt) of ore over the life of the Mine;
- filling of voids created during underground mining using a combination of hydraulic fill and waste rock;
- construction and use of surface infrastructure required for the underground mine, including a box cut, portal and decline, magazines, fuel store, ventilation rises, back fill hole(s) and power and water supply;

- construction and use of a processing plant and office area, including an integrated run-of-mine (ROM) pad/temporary waste rock emplacement, crushing and grinding, gravity separation and flotation circuits, site offices, workshop, laydown area, ablution facilities, stores, car parking, and associated infrastructure;
- construction and use of a Tailings Storage Facility (TSF);
- construction and use of a water management system, including eight harvestable rights dams and an associated water reticulation system, to enable the harvesting and supply of water for environmental flows;
- construction and use of a site access road and intersection to allow site access from Majors Creek Road;
- transportation of gold concentrate from the Project Site through Braidwood via public roads surrounding the Project Site using covered semi-trailers;
- construction of the Spring Creek heavy vehicle crossing to permit direct access between the processing plant and the TSF; and
- construction and use of the Eastern Waste Rock Emplacement for the storage of waste rock.

2.3 Mine Transport

The trucks carrying concentrate travel from the Mine through Braidwood and then northwards, using the following public roads:

- Majors Creek Road;
- Araluen Road;
- Coghill Street;
- Wallace Street;
- Solus Street; and
- Kings Highway.

Empty trucks approach the Mine via the same route in the reverse direction.

With respect to the road transport operating conditions, Condition 41 of MP10_0054 stipulates that:

The Proponent shall ensure that:

(a) *a maximum of 4 concentrate trucks exit the site per hour;*

(b) *the dispatch of concentrate from the site is limited to between the hours of 7am to 10pm Monday to Saturday and 8am-10pm Sundays and Public Holidays;*

(c) *all heavy vehicle movements to or from the site are prohibited between the hours of 7am - 8.30am and 3pm-5pm on school days;*

(d) *a bus operates from Braidwood to offer mine workers transport to and from the site each day; and*

(e) *all reasonable and feasible measures are implemented to minimise the project's contribution to the traffic on Majors Creek Road, Araluen Flat Road, Captains Flat Road, Coghill Street and Wallace Street.*

The approved dispatch of up to four concentrate trucks per hour refers to trucks departing the Mine laden with concentrate. The four outbound laden trucks would be matched by an equivalent number of empty truck arrivals. Considering the practicalities of operations, the existing transportation limit of four concentrate truck departures per hour permitted by Condition 41(a) is therefore equivalent to a limit of eight truck trips[1] per hour, being four inbound and four outbound trips.

If the transportation of concentrate was undertaken at the approved maximum hourly rate continuously throughout the permitted hours, the Mine could generate a maximum of 120 truck trips per day (60 inbound empty and 60 outbound laden) Monday to Saturday during school holidays. This would be reduced to 92 truck trips per day (46 inbound empty and 46 outbound laden) on school days, and 112 truck trips (56 inbound empty and 56 outbound laden) on Sundays.

There is no limit on the number of trips generated by other trucks, such as those used for irregular product deliveries and mobile equipment, which includes both rigid and articulated heavy vehicles.

With respect to Condition 41(c), TTPP notes that for the purposes of registration of vehicles in New South Wales, a heavy vehicle is defined as a motor vehicle or trailer than has a Gross Vehicle Mass (GVM) greater than 4.5 t.

With respect to Condition 41(e), and with reference to the nomenclature adopted in Transport and Urban Planning (2010), the road names "Captains Flat Road" and "Araluen Flat Road" are assumed to refer to that part of Araluen Road between Majors Creek Road and Coghill Road[2].

Condition 40 of MP10_0054 requires that:

The Proponent shall:

(a) *keep accurate records of the:*

- *amount of concentrate transported from the site (on a monthly basis); and*
- *the date and time of loaded truck movements from the site; and*

(b) *provide the Secretary with a summary of these truck movements on a quarterly basis.*

TTPP has reviewed the records of concentrate dispatch over the approximately 14-month period from 17 April 2020 to 14 December 2021. Those records indicate that:

[1] Throughout this report, a trip is defined as a one way movement of a vehicle. A truck arriving at the Mine and then departing the Mine generates two trips.

[2] Road names adopted in this report are from NSW Government Spatial Services SIX Maps maps.six.nsw.gov.au

- an average of 2.4 truckloads of concentrate were dispatched per day;
- on average, each truck carried 25.85 t of concentrate; and
- each concentrate truck was on-site for an average of 37 minutes.

Based on average recovery and moisture rates provided by the operators, the approved processing of 355,000 tonnes per annum (tpa) of ore produces approximately 33,170 tpa of concentrate to be transported each year. On the basis of the current truck payloads, at the approved processing of the maximum permitted 355,000 tpa of ore, approximately 1,283 loads of concentrate would be dispatched in one year, or an average of approximately 3.5 loads per day. This would generate an average of seven vehicle trips per day with the arrivals of empty trucks.

2.4 Mine Access Intersection

Conditions 39 and 39A of MP10_0054 stipulate that:

The intersection of the site access road and Majors Creek Road shall be constructed to a BAR/BAL treatment for rural turn lanes in accordance with the RTA Road Design Guide and to the satisfaction of Council.

Prior to the commencement of transportation of ore from the site, the left hand road shoulder on Majors Creek Road between the entrance of the mine site and the top of the hill shall be strengthened to the satisfaction of Council.

TTPP notes that the intersection has been constructed to a standard that meets or exceeds the requirements of Condition 39. The intersection includes an auxiliary right turn (AUR) treatment and basic left turn (BAL) treatment in Majors Creek Road. A wide sealed shoulder is provided on the north-western corner of the intersection, which assists vehicles turning left out of the mine on to Majors Creek Road by forming a defacto acceleration lane. It is understood that this shoulder was strengthened to the satisfaction of Queanbeyan-Palerang Regional Council consistent with Condition 39A.

2.5 Traffic Management Plan

In accordance with Condition 43 of MP10_0054, a Traffic Management Plan (TMP) has been implemented for the Mine operations, focussing on traffic management along Majors Creek Road to minimise potential conflicts between road users and ensure that the intersection of the site access road and Majors Creek Road operates effectively. The TMP was prepared in consultation with Queanbeyan-Palerang Regional Council and the Community Consultative Committee, and approved by DPIE.

The TMP applies to the approved transportation route between the intersection of the site access road with Majors Creek Road, and the intersection of Wallace Street with Kings Highway. Key commitments in the TMP include:

- establishment of a 40 km/h speed limit on the Mine access road, and 20 km/h in the operational sections of the Project Site;
- development and enforcement of a Driver's Code of Conduct for all heavy vehicle drivers, stipulating safe driving practices and nominating that all Mine-generated heavy vehicles on Majors Creek Road be restricted to a maximum speed of 80 km/h.

The TMP includes requirements for reporting of incidents or complaints in relation to breaches of the Driver's Code of Conduct. Review of the online monthly complaints register (Aurelia Metals, 2022) for the months of April to December 2021 show no complaints relating to traffic aspects of the Mine operations, or breaches of the Driver's Code of Conduct. Review of the online historic log of complaints between February 2020 and April 2021 (Aurelia Metals, 2022) showed the following complaints with regard to traffic:

- *Caller advised that there is an increased amount of trucks driving through Majors Creek Road, and using their air brakes. Caller advised that the noise goes through the property and is really loud." – 26/05/2020 6:30*
- *Formal complaint regarding the additional heavy truck movements that are on the Majors Creek Rd" – 9/06/2020 11:43*
- *Caller would like to know the speed limit for the trucks that travel on Majors Creek Road – 6/07/2020 13:07.*

The complaints received with regard to traffic do not suggest that there is a notable history of breaches of the Driver's Code of Conduct.

2.6 Proposed Modification

With respect to the road transportation environment, the proposed modification seeks approval for:

- emergency trucking of water from appropriately licenced off-site sources, only where operational water requirements cannot be met by on-site water storage;
- up to 20 truck movements per day (10 arrivals and 10 departures) to facilitate the provision of emergency water; and
- transportation of the water to the Project Site via Kings Highway, Wallace Street, Coghill Street, Araluen Road and Majors Creek Road.

The modification also seeks approval for:

- construction and use of a Water Management Dam for the receipt and storage of supernatant water from the TSF; and
- an increase in the approved processing rate from 355,000 tpa to 415,000 tpa.

No changes are proposed to the total amount of ore processed over the life of the Mine (1.6 Mt), the existing hours for transportation of concentrate, or to the route used for transport of concentrate from the Mine. It is proposed that the emergency trucking of water would be subject to the same transportation hours and route used for the transport of concentrate.

Table 2.1 compares the key transportation-related aspects of the approved Mine operations and proposed Modification.

Table 2.1: Transport Aspects of Approved Mine and Proposed Modification

	Approved	Modification
Total Ore Processed	1.6 Mt	
Life of Mine	to 30 June 2025	
Maximum Annual Ore Processing	355,000 tpa	415,000 tpa
Water transportation	-	Maximum 10 loads per day when required
Concentrate truck movements	Maximum 4 concentrate trucks exit per hour	Maximum 4 trucks laden with concentrate or water enter or exit per hour
Water truck movements	-	
Concentrate transportation hours	7am to 10pm Monday to Saturday 8am to 10pm Sundays and public holidays	
Water transportation hours	-	7am to 10pm Monday to Saturday 8am to 10pm Sundays and public holidays
Heavy vehicle movements prohibited hours	7am to 8:30am and 3pm to 5pm on school days	

For the purpose of this assessment, it is assumed that water transportation would use articulated vehicles.

3 Existing Road Transport Environment

3.1 Road Network

The road network serving the Mine was observed by TTPP during fine weather in December 2021, and is described below. Additional photographs of typical features of the relevant routes are provided in Appendix A.

Kings Highway is a State road which provides a link between Batemans Bay and Queanbeyan (and Canberra) via Braidwood and Bungendore. Kings Highway is typically a sealed, two lane, two-way road, with wide sealed shoulders, centre linemarking, edgelines and raised reflective pavement markers (RRPMs). In the vicinity of Braidwood, Kings Highway has a posted speed limit of 80 kilometres per hour (km/h), reducing to 50 km/h within Braidwood. A 40 km/h school zone speed limit applies between McKellar Street and Wilson Street.

Within Braidwood, Kings Highway is also known as Lascelles Street and Wallace Street, and the highway follows a 90 degree turn between the east and north near the southern end of Braidwood. Through the Braidwood town centre, Wallace Street has nose-in 45-degree angle parking along both sides of the road, and two marked footcrossings with kerb blisters. TTPP observed that drivers experienced some short delays at the intersection of Wallace Street and Lascelles Street in Braidwood, with minor queues forming on the minor road approaches, most notably southbound on Wallace Street. At this intersection, the east-west road is the priority road, and the north-south road is the minor road, on which drivers must give way. The highest demand however appears to occur along the route between the north and east (Kings Highway) so the intersection layout does not inherently give priority to the highest demand flows.

Kings Highway north of and through Braidwood is an approved route for 25/26 m B-doubles. East of Wallace Street, Kings Highway is an approved route for 25/26 m B-doubles only between Wallace Street and Monkittee Street, which lies on the eastern edge of the town. East of Monkittee Street, Kings Highway is an approved route for 19 m B-doubles.

Figure 3.1: Kings Highway North of Braidwood

Figure 3.2: Kings Highway Braidwood

Wallace Street extends in a north-south direction through the town of Braidwood. North of Lascelles Street (Kings Highway), Wallace Street is part of the Kings Highway State road route described above. South of Lascelles Street, and north of Coghill Street, Wallace Street is a Regional road which together with Coghill Street, Araluen Road and Cooma Road provides a link between Braidwood and Cooma. Wallace Street is an approved route for 25/26 m B-doubles along its entire length.

Figure 3.3: Wallace Street (Kings Highway) Braidwood

Coghill Street extends in an east-west direction, and is a Regional road between Wallace Street and Araluen Road, forming part of the Regional road route between Braidwood and Cooma. Between Wallace Street and Araluen Road, Coghill Street has a posted speed limit of 50 km/h, a single travel lane in each direction, and is an approved route for 25/26 m B-doubles. East of Wallace Street, Coghill Street is a local road.

Figure 3.4: Coghill Street Braidwood

Araluen Road provides a north-south link between Araluen and Braidwood. North of Cooma Road, Araluen Road is a Regional road, forming part of the regional link between Braidwood and Cooma. South of Cooma Road, Araluen Road is a local road. Araluen Road has a posted speed limit of 60 km/h in Braidwood, increasing to 80 km/h approximately 1 km south of Coghill Street, and to 100 km/h south of Cooma Road.

Araluen Road is an approved route for 25/26 m B-doubles between Coghill Street and Cooma Road. South of Cooma Road, B-double access is permitted in daylight hours only, with no travel on weekends or public holidays.

Transport and Urban Planning (2010) suggested that the need for widening of the shoulder on Araluen Road at Majors Creek Road be investigated to achieve a basic right turn treatment, and under Modified Project Approval MP10_0054, contributions to upgrades of road infrastructure are made via a Planning Agreement with Queanbeyen-Palerang Regional Council. At the time of TTPP's site observations, no widening had been undertaken at that intersection, however significant roadworks were underway on Majors Creek Road adjacent to the intersection.

Figure 3.5: Araluen Road

Majors Creek Road is a local road providing a link between Araluen Road south of Braidwood and the village of Majors Creek. Majors Creek Road has a single travel lane in each direction with a posted speed limit of 80 km/h north of Jembaicumbene Creek, and 100 km/h south of Jembaicumbene Creek. At the time of TTPP's observations, major roadworks were underway over a length of approximately 1.3 km of Majors Creek Road from its intersection with Araluen Road.

The geometry and condition of Majors Creek Road varies along the length between Araluen Road and the Mine. A length of approximately 1 km south of the roadworks has gravel shoulders, guideposts and centre line marking as shown in Figure 3.6.

Figure 3.6: Majors Creek Road south of Roadworks

A length of approximately 2.5 km north of the bridge over Jembaicumbene Creek has been upgraded to provide sealed shoulders, edge marking, guideposts and centre line marking.

Figure 3.7: Majors Creek Road North of Jembaicumbene Creek

South of Jembaicumbene Creek, the sealed surface of Majors Creek Road narrows to approximately 5.5 to 6.0m wide, with unsealed shoulders, guideposts and centre line marking.

Figure 3.8: Majors Creek Road South of Jembaicumbene Creek

Transport and Urban Planning (2010) suggested that upgrades to Majors Creek Road be undertaken, including linemarking, pavement widening on curves and crests, and signage. Under Modified Project Approval MP10_0054, contributions to upgrades of road infrastructure are made via a Planning Agreement with Queanbeyen-Palerang Regional Council.

At its intersection with the **Dargues Mine Access Road**, Majors Creek Road widens to provide an auxiliary right turn treatment for southbound traffic to pass around a vehicle that has slowed to turn right in to the access road. A wide sealed shoulder is available on the north-western corner of the intersection, which assists vehicles turning left out of the mine on to Majors Creek Road by forming a defacto acceleration lane. It is understood that this shoulder was strengthened to the satisfaction of Queanbeyan-Palerang Regional Council prior to the commencement of transportation of ore from the site (Condition 39A of MP10_0054). Access to and from the Mine is controlled by gates located approximately 30m from Majors Creek Road.

Figure 3.9: Majors Creek Road at Dargues Mine Access

Figure 3.10: Dargues Mine Access Road Entry from Major Creek Road

Over approximately 850m from Majors Creek Road, the Dargues Mine Access Road has a sealed surface with a posted speed limit of 40 km/h, then transitions to a gravel surface.

Figure 3.11: Dargues Mine Access Road – Gravel Surface

Figure 3.12: Dargues Mine Access Road – Sealed Surface

3.2 Historic Traffic Volumes

Transport for New South Wales (TfNSW) collects and publishes traffic volume data at selected locations on its roads. Available data on roads in the vicinity of the Project Site were reviewed and collated, noting that only limited data is available in this region. The closest TfNSW count stations are located at the following locations:

- Wallace Street (Station ID: 94281) 90m north of Lascelles Street, Braidwood;

- Kings Highway (Station ID:94484) 940m east of Lascelles Street, Braidwood;
- Kings Highway (Station ID:94508) 2.35km south of Foxs Elbow Road, Larbert; and
- Cooma Road (Station ID:94807) 2.87km north of Wallaces Gap Road, Bendoura.

Data have not been collected at these stations in recent years, with most available data being more than ten years old, and pre-dating the construction and operation of the Mine. Notwithstanding, the available Annual Average Daily Traffic (AADT) data from the TfNSW survey program are presented in Table 3.1.

Table 3.1: TfNSW Annual Average Daily Traffic Volumes

Station Location (ID)	Data Year	Average Vehicles (two way)			
		Daily	Weekday	AM Peak 4hrs 6am to 10am	PM Peak 4hrs 3pm to 7pm
Wallace Street, Braidwood (94281)	2006	5,242	4,860	666	1,624
	2008	4,888	4,834	993	1,465
Kings Highway east of Braidwood (94484)	2006	2,732	2,367	290	819
	2008	2,300	2,106	402	652
Kings Highway north of Braidwood (94508)	2008	3,090	2,917	622	938
Cooma Road, Bendoura (94807)	2006	256	219	40	75
	2008	238	233	65	76

Reference: Transport for New South Wales

Data have also been collected from a survey program undertaken in February 2010, noting that these surveys pre-dated the construction and operation of the Mine, however some exploration work associated with the Mine was underway during the surveys.

Table 3.2: Traffic Volume Data February 2010

Survey Location	Composition	Vehicles per Day		Vehicles per Hour	
		Daily	Weekday	AM Peak Hour	PM Peak Hour
Majors Creek Road North of Dargues Mine	94.7% light 5.3% heavy	320	337	28	34
Araluen Road north of Majors Creek Road	90.4% light 9.6% heavy	655	695	67	66
Araluen Road north of Cooma Road	92.3% light 7.7% heavy	1,020	1,087	97	100
Coghill Street west of Wallace Street	91.3% light 8.7% heavy	982	1,091	73	105
Wallace Street north of Coghill Street	90.2% light 9.8% heavy	1,128	1,221	88	115

Reference: Transport and Urban Planning (2010)

Queanbeyan-Palerang Regional Council has also provided some traffic survey data. The surveys were conducted between April and June 2020, on Majors Creek Road west of Araluen Road and at Jembaicumbene between Jembaicumbene Creek bridge and Morgans Road.

Table 3.3: Traffic Volume Data April – June 2020

Survey Location	Composition	Average Vehicles (two way)			
		Daily	Weekday	Weekday AM Peak Hour	Weekday PM Peak Hour
Majors Creek Road west of Araluen Road	87.8% light 10.1% rigid 2.1% articulated	565	532	42	48
Majors Creek Road south of Morgans Road	83.9% light 13.2% rigid 2.9% articulated	491	519	40	45

Reference: QPRC

The 2020 data suggest that Majors Creek Road carries in the order of 40 to 50 vehicles per hour during weekday peak hours, and that articulated vehicles make up 2 to 3 percent of total traffic.

3.3 Project Traffic Surveys

To quantify existing conditions in the vicinity of the Mine and the contribution of the Mine to existing traffic, automatic tube counters were used to collect traffic data on:

- Mine Access Road; and
- Majors Creek Road north of Monga Lane.

The surveys were conducted over one week from Wednesday 2 February 2022 to Tuesday 8 February 2022 inclusive. The operators advised that the surveyed week was representative of normal operating conditions, which includes mill shutdowns every Wednesday.

3.3.1 Daily Traffic Volumes

The surveys collected details of the day-to-day variation in traffic and the composition of the traffic based on standard vehicle classifications. Table 3.4 presents a summary of the daily traffic volumes at the surveyed locations, being the total number of vehicles passing the surveyed location in both directions during each 24-hour period.

Table 3.4: Surveyed Two-Way Daily Traffic Volumes 2022 (vehicles per day)

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Mine Access Road	207	228	274	248	198	125	112
Majors Creek Road	652	592	716	762	675	433	425

The results in Table 3.4 demonstrate that traffic conditions on both the Mine access road and Majors Creek Road are notably different between weekdays and weekend days.

3.3.2 Traffic Composition

The tube count surveys collected details of the composition of the traffic based on the Austroads Vehicle Classification System. Under that system, light vehicles include motorcycles, cars, vans, four-wheel drives, and utilities (including those towing a trailer or caravan, and heavy vehicles include single unit trucks and buses, semi-trailers, rigid trucks with trailers, B-doubles and road trains where permitted. The surveyed composition of traffic based on the Austroads Vehicle Classification System is summarised in Table 3.5.

Table 3.5: Surveyed Average Daily Traffic Composition 2022 (percent)

Road and Location	Light Vehicles	Rigid Heavy Vehicles	Articulated Heavy Vehicles
Mine Access Road	81.7	13.2	5.1
Majors Creek Road north of Mine Access Road	83.9	13.9	2.2

Examination of the data indicates that the majority of the rigid vehicles on both of the surveyed roads were two-axle trucks/buses, which includes longer wheelbase utilities and 4WDs that are often used in mining and rural settings. Although identified as heavy vehicles by the Austroads Vehicle Classification System due to their longer wheelbase, many of these vehicles may have a Gross Vehicle Mass of below 4.5 t, and so are considered as light vehicles under NSW's vehicle registration definition. The surveyed rigid heavy vehicles also include buses provided in accordance with Condition 41(d) of MP10_0054, which transport workers between the Mine and Braidwood.

3.3.3 Mine-Generated Traffic

Table 3.6 summarises the two-way daily traffic volumes recorded on the Mine access road over the surveyed week.

Table 3.6: Surveyed Mine Access Road Daily Two-Way Traffic 2022 (vehicles per day)

	Light Vehicles	Rigid Heavy Vehicles	Articulated Heavy Vehicles	Total
Monday	173	24	10	207
Tuesday	189	23	16	228
Wednesday	208	53	13	274
Thursday	184	43	21	248
Friday	170	18	10	198
Saturday	106	18	1	125
Sunday	107	5	0	112
Average Day	**162**	**26**	**10**	**199**
Average Weekday	**185**	**32**	**14**	**231**

Note the classification of vehicles based on Austroads Vehicle Classification System

The surveys indicate that over the surveyed week, the Mine access road carried an average of 199 vehicles per day, including ten articulated vehicles per day (inbound and outbound combined). On weekdays, the Mine access road carried an average of 231 vehicles per day, including 14 articulated vehicles per weekday (inbound and outbound combined). Articulated vehicles include those vehicles used for transporting concentrate, and also for other general deliveries or activities at the Mine. As the average weekday volumes are consistently higher than those of the weekend days or average day, the average weekday has been adopted for the basis of this assessment.

TTPP has reviewed the records of concentrate dispatch over the seven days of the traffic surveys, which indicate that four trucks of concentrate were despatched on each of the surveyed weekdays. With the arrival of the empty trucks, the transport of concentrate therefore generated eight vehicle trips per weekday over the survey period. As concentrate transport uses articulated heavy vehicles, it follows that of the average 14 articulated vehicle trips per weekday, six trips per weekday (three inbound, three outbound) were generated by other general deliveries or activities, for which the conditions of MP10_0054 do not have any specific limits on daily or hourly trip generation. On this basis, Table 3.7 summarises the existing average weekday traffic generation of the Mine, with the number of articulated truck trips associated with the transport of concentrate separated from those of articulated trucks used for other deliveries.

Table 3.7: Surveyed Average Weekday Daily Mine-Generated Traffic (vehicles per day)

	Light	Rigid	Articulated Concentrate	Articulated Other	Total
Surveyed 2022	185	32	8	6	231

Table 3.7 indicates that during the traffic surveys, the transport of concentrate generated eight vehicle trips per day, which is one trip greater than the average day for the approved processing of the maximum 355,000 tpa of ore (Section 2.3).

Throughout the surveyed week, the morning peak hour for traffic on the Mine access road consistently occurred between 6:00am and 7:00am, and the evening peak hour occurred between 6:00pm and 7:00pm every day except Tuesday, when it occurred between 5:00pm and 6:00pm. Considering the morning and evening peak hourly volumes recorded each day, regardless of the hour during which they occurred, Table 3.8 presents the two-way peak hourly traffic volume recorded each day on the Mine access road.

Table 3.8: Surveyed Mine Access Road Peak Hour Traffic 2022 (vehicles per hour)

	AM Peak Hour				PM Peak Hour			
	Light	Rigid	Articulated	Total	Light	Rigid	Articulated	Total
Monday	44	6	0	50	33	4	0	37
Tuesday	58	2	0	60	42	3	2	47
Wednesday	51	8	1	60	36	4	0	40
Thursday	47	8	0	55	35	5	0	40
Friday	48	2	0	50	27	3	0	30
Saturday	30	2	0	32	29	1	0	30
Sunday	29	2	0	31	37	1	0	38
Average Day	**44**	**4**	**0**	**48**	**34**	**3**	**0**	**37**
Average Weekday	**50**	**5**	**0**	**55**	**35**	**4**	**0**	**39**

AM peak hour occurred 6:00am to 7:00am every day
PM peak hour occurred 5:00pm to 6:00pm or 6:00pm to 7:00pm

It is noted that the records of concentrate dispatch over the seven days of the traffic surveys do not allow TTPP to accurately identify the time at which all concentrate trucks arrived at and departed the site in order to quantify the number of articulated vehicle trips associated with concentrate transport and those associated with general deliveries. The available information however suggests that the majority of the articulated vehicle movements presented in Table 3.8 are likely to not be associated with the transport of concentrate, as the available data shows that throughout the surveyed week, concentrate truck arrivals to the site occurred between 8:45 am and 10:00 am, and between 8:30 pm and 10:00 pm, so did not coincide with the peak hours for Mine-generated traffic.

The Mine-generated traffic varies throughout the day due to the arrivals and departures of the workforce, and the permitted hours for concentrate transport and heavy vehicle movements. For the purpose of this assessment, TTPP has considered four periods throughout the day with respect to the Mine-generated traffic:

- AM peak hour (6:00am to 7:00am);
- Daytime hours (occurs between 7:00am and 5:00pm); and
- PM peak hour (occurs between 5:00pm and 7:00pm);
- Nighttime hours (occurs between 7:00pm and 10:00pm).

Table 3.9 presents the peak hourly two-way traffic volumes by vehicle type recorded on the Mine access road during each of the assessment periods over the average weekday.

Table 3.9: Average Weekday Surveyed Mine-Generated Peak Hour Traffic (vehicles per hour)

Assessment Period[A]	Light		Rigid		Articulated[B]		Total	
	Inbound	Outbound	Inbound	Outbound	Inbound	Outbound	Inbound	Outbound
AM Peak 6:00am to 7:00am	41	9	4	1	0	0	45	10
Daytime 7:00am to 5:00pm	10	1	1	1	0	0	12	2
PM Peak 5:00pm to 7:00pm	11	24	1	3	0	0	12	27
Nighttime 7:00pm to 10:00pm	1	4	1	0	1	0	2	4

[A] *Peak hour within the nominated assessment period*
[B] *includes trucks used for concentrate transport and general deliveries*

Comparison between the surveyed traffic volumes on the Mine access road and those on Majors Creek Road north of the Mine suggests that while the majority of Mine-generated traffic approaches and departs to and from the north, small numbers of non-articulated vehicles approach and depart to and from the south. All articulated vehicles on the Mine access road are also recorded on Majors Creek Road to the north of the Mine, consistent with the use of the approved route to/from the north only by trucks carrying concentrate.

Over the surveyed week, a maximum of two articulated vehicle departures (inclusive of concentrate transport and other deliveries) occurred during any one hour throughout the week. The surveyed conditions are consistent with the consent which allows a maximum of four departures by concentrate trucks in one hour. The number of articulated vehicle arrivals (inclusive of concentrate transport and other deliveries), which is not constrained by consent conditions, varied between zero and three arrivals during any one hour over the surveyed week.

3.4 Road Safety History

Road crash information was obtained from TfNSW across a five-year period between 1 January 2016 and 31 December 2020 for those roads forming the approved transport route for the Mine. This included Kings Highway within the built-up areas of Braidwood, on which a 50 km/h speed limit applies, as well as the route between Majors Creek and Braidwood. The data include crashes which conform to the national guidelines for reporting and classifying road vehicle crashes based on the following criteria:

- The crash was reported to the police.
- The crash occurred on a road open to the public.
- The crash involved at least one moving vehicle.
- The crash involved at least one person being killed or injured or at least one motor vehicle being towed away.

The review of the road crash history data found that 17 crashes were reported on the routes investigated, of which 11 crashes occurred in the 50 km/h speed limit areas. No crashes occurred at or near the intersection of Majors Creek Road with the Mine access road, nor at the intersection of Majors Creek Road with Araluen Road. The majority of the crashes occurred along the Kings Highway route in the urban area of Braidwood (inclusive of Wallace Street and Solus Street). Table 3.10 summarises the key features of the reported crashes.

Table 3.10: Crash Types on Project Access Routes (1 January 2016 to 31 December 2020)

Route	Pedestrian	Adjacent Approaches	Opposing Directions	Same Direction	U-turn/Parking	Overtaking	On-Path	Off-Path on Straight	Off-Path on Curve	Miscellaneous	Total
Total Crashes by Type	**1**	**2**	**1**	**3**	**-**	**1**	**1**	**4**	**4**	**-**	**17**
Route											
Majors Creek Road[A]	-	-	-	-	-	-	1	1	1	-	3
Araluen Road	-	-	-	1	-	1	-	-	-	-	2
Coghill Street	-	-	-	-	-	-	-	-	1	-	1
Kings Highway[B]	1	2	1	2	-	-	-	3	2	-	11
People Killed or Injured											
Fatalities	-	-	-	-	-	-	-	-	-	-	0
Serious Injuries	-	-	-	-	-	-	-	-	1	-	1
Moderate Injuries	1	1	-	-	-	-	1	2	1	-	6
Minor Injuries	-	1	1	-	-	-	-	-	-	-	2
Contributing Factors[C]											
Speeding Involved	-	-	1	-	-	-	1	-	4	-	6
Fatigue Involved	-	-	-	-	-	-	-	-	1	-	1
Speed Limit											
50 km/h speed limit	1	2	1	1	-	1	-	2	3	-	11
80 km/h speed limit	-	-	-	2	-	-	1	1	1	-	5
100 km/h speed limit	-	-	-	-	-	-	-	1	-	-	1
Road Surface Condition											
Sealed - wet	-	-	-	1	-	-	-	1	1	-	3
Sealed – dry	1	2	1	2	-	1	1	3	3	-	14
Natural Lighting											
Dawn	-	-	1	-	-	-	-	-	-	-	1
Daylight	1	1	-	3	-	-	-	4	1	-	10
Darkness	-	1	-	-	-	1	1	-	3	-	6
Weather											
Fine	1	2	-	2	-	-	-	3	2	-	10
Overcast	-	-	-	1	-	1	1	-	1	-	4
Fog or mist	-	-	1	-	-	-	-	1	-	-	2
Unknown	-	-	-	-	-	-	-	-	1	-	1

[A] *one crash on Majors Creek Road occurred south of the Mine, not on the approved transport route*
[B] *including Wallace Street and Solus Street*
[C] *more than one contributing factor can be identified for a single crash.*

4 Baseline Future Traffic Conditions

Regardless of the Modification, traffic conditions in the region may be altered as a result of other unrelated developments and non-specific background growth in traffic. These are discussed in this section.

4.1 Developments in the Region

Other state significant projects in the region may impact on traffic conditions on those roads serving the Modification. TTPP has reviewed the NSW Planning Portal's data for major projects to identify proposed or approved projects that may potentially interact with, or have potential cumulative impacts with, the Project.

There are no proposed or approved major projects in the region that would potentially interact with the Project, so no further assessment of cumulative impacts of other developments has been undertaken.

4.2 Baseline Mine-Generated Traffic

Without the proposed Modification, the Mine would be expected to continue to operate with its existing approval conditions until 30 June 2025. The volume of traffic generated by the Mine would continue at its existing levels, noting that during the surveys (Section 3.3), the number of articulated vehicle movements was below those permitted for the transport of concentrate under Condition 41 of MP10_0054.

To take into account that the surveys did not capture the maximum number of concentrate truck trips permitted under Condition 41, a "baseline" forecast of peak hourly traffic generation has been prepared which considers the potential peak hourly trip generation of the Mine under the existing approved conditions should the Modification not proceed. This robustly assumes that during each of the assessment periods described in Section 3.3.3, the following trips may coincide within the busiest hour of the assessment period:

- the surveyed peak hourly light and rigid heavy vehicle trips;
- up to four articulated vehicles laden with concentrate exiting the Mine, and four empty articulated vehicles entering the Mine ready to collect concentrate; and
- up to one articulated vehicle associated with general deliveries entering and exiting the Mine in one hour.

As the morning peak hour consistently occurs earlier than the departure of concentrate trucks is permitted, and earlier than the arrival or departure of heavy vehicles is permitted, the maximum number of concentrate truck departures cannot coincide with the morning peak hour for Mine-generated traffic.

Table 4.1 summarises the baseline traffic forecasts during the peak hour of each nominated assessment periods.

Table 4.1: Baseline Peak Hour Mine-Generated Traffic 2022 to 2025 (vehicles per hour)

Assessment Period[A]	Light		Rigid		Articulated Concentrate		Articulated Other		Total	
	Inbound	Outbound	Inbound	Outbound	Inbound	Outbound	Inbound	Outbound	Inbound	Outbound
AM Peak 6:00am to 7:00am	41	9	4	1	0	0	1	1	46	11
Daytime 7:00am to 5:00pm	10	1	1	1	4	4	1	1	16	7
PM Peak 5:00pm to 7:00pm	11	24	1	3	4	4	1	1	16	31
Nighttime 7:00pm to 10:00pm	1	4	1	0	4	4	1	1	6	8

[A] *Peak hour within the nominated assessment period*

At the approved maximum processing rate of 355,000 tpa, the Mine would generate an average of seven concentrate truck trips per day (inbound and outbound combined) for the transportation of concentrate (refer to Section 2.3). Table 4.2 presents the average weekday traffic expected to be generated by the Mine at the approved maximum ore processing rate of 355,000 tpa on an average day, and for a "maximum" weekday. The maximum day assumes conditions in which concentrate trucks arrive, are loaded and depart within one hour continuously throughout the permitted transportation hours on a school holiday weekday. This does not reflect the practicalities of loading and dispatching four vehicles per hour on an ongoing basis, nor the likelihood of the demand for such transportation, and so represents a speculative or theoretical maximum daily trip generation by the trucks used to transport concentrate. This is considered to overestimate the number of trips that would realistically occur on any one day.

Table 4.2: Baseline Daily Mine-Generated Traffic (vehicles per day)

	Light	Rigid	Articulated Concentrate	Articulated Other	Total
Surveyed 2022	185	32	8	6	231
Baseline 2022 to 2025 at 355,000 tpa[A]	185	32	7	6	230
Maximum Concentrate Transportation[B]	185	32	120	6	343

[A] *average daily concentrate transportation at maximum annual ore processing rate*
[B] *maximum hourly concentrate transport throughout the approved transportation hours on school holiday weekday*

The surveyed trip generation in 2022 is therefore generally consistent with the trip generation that would be expected for average daily concentrate transportation under the existing approved conditions.

4.3 Background Traffic Growth

Changes to existing traffic conditions can be expected to occur which are not directly attributable to any specific development. For the purpose of this assessment, an average growth rate of 2.0 per cent per annum has been assumed to occur on the approved transportation route in the future, increasing the background traffic volumes over time.

As a robust assessment, the Mine's contribution to surveyed average weekday traffic on Majors Creek Road has not been removed from the surveyed traffic volumes before growth has been calculated. This effectively assumes that the Mine-generated traffic on Majors Creek Road would also grow at the same rate as background traffic, which will result in an overestimate of future traffic.

4.4 Baseline Future Traffic Volumes

The traffic conditions at the surveyed locations have been estimated for the future baseline conditions assuming the Mine continues to operate according to its existing consent conditions until 2025. This study has focussed on the immediate vicinity of the Mine, being the Mine Access Road and Majors Creek Road, noting that these are the roads on which the mine-generated traffic has the greatest influence on traffic conditions.

Table 4.3 summarises the baseline daily traffic volumes in 2025 with ongoing operations under the existing approval conditions, with ore processing occurring at the maximum permitted rate of 355,000 tpa and background growth in traffic as discussed in Section 4.3.

Table 4.3: Baseline Daily Traffic Volumes 2025 (vehicles per day)

	Light	Rigid	Articulated Concentrate	Articulated Other	Total
Average Daily Transportation at 355,000 tpa[A]					
Mine Access Road	185	32	7	6	230
Majors Creek Road	597	105	7	11	720
Maximum Concentrate Transportation[B]					
Mine Access Road	185	32	120	6	343
Majors Creek Road	597	105	120	11	833

[A] *average daily concentrate transportation at maximum annual ore processing rate*
[B] *maximum hourly concentrate transport throughout the approved transportation hours on school holiday weekday*

The baseline peak hourly two-way traffic volumes on the Mine Access Road and Majors Creek Road are summarised in Table 4.4 for each of the assessment periods. This assumes that the maximum number of truck trips permitted for the transportation of concentrate coincides with the peak hour traffic during each of the periods of the day described in Section **Error! Reference source not found.**, with the exception of the AM peak hour, as concentrate haulage does not occur during that period.

Table 4.4: Baseline Peak Hour Traffic (vehicles per hour)

Assessment Period[A]	Light		Rigid		Articulated Concentrate		Articulated Other		Total	
	Inbound	Outbound	Inbound	Outbound	Inbound	Outbound	Inbound	Outbound	Inbound	Outbound
Baseline 2025 – Mine Access Road										
AM Peak 6:00am to 7:00am	41	9	4	1	0	0	1	1	46	11
Daytime 7:00am to 5:00pm	10	1	1	1	4	4	1	1	17	7
PM Peak 5:00pm to 7:00pm	11	24	1	3	4	4	1	1	17	32
Nighttime 7:00pm to 10:00pm	1	4	1	0	4	4	1	1	6	9
Baseline 2025 – Majors Creek Road North of Mine Access Road[B]										
AM Peak 6:00am to 7:00am	37	23	3	7	0	0	1	1	41	31
Daytime 7:00am to 5:00pm	18	25	3	7	4	4	1	2	26	38
PM Peak 5:00pm to 7:00pm	35	22	1	7	4	4	2	1	42	34
Nighttime 7:00pm to 10:00pm	10	6	1	2	4	4	2	1	17	13

[A] *Peak hour within the nominated assessment period*
[B] *On Majors Creek Road, inbound is southbound, outbound is northbound.*

4.5 Baseline Road Network Efficiency

4.5.1 Midblock Level of Service

The capacity of a road is defined as the maximum hourly rate at which vehicles can reasonably be expected to traverse a point or uniform section of a lane or roadway during a given time period under the prevailing roadway, traffic and control conditions. The capacity of a single traffic lane will be affected by factors such as the pavement width and restricted lateral clearances, the presence of heavy vehicles and grades.

Level of Service (LOS) is defined as a qualitative measure describing the operational conditions within a traffic stream as perceived by drivers and/or passengers. A LOS definition generally describes these conditions in terms of factors such as speed and travel time, freedom to manoeuvre, traffic interruptions, comfort, convenience and safety. LOS A provides the best traffic conditions, with no restriction on desired travel speed or overtaking. LOS B to D describes progressively worse traffic conditions. LOS E occurs when traffic conditions are at or close to capacity, and there is virtually no freedom to select desired speeds or to manoeuvre in the traffic stream. The service flow rate for LOS E is taken as the capacity of a lane or roadway. In rural situations, LOS C is generally considered to be acceptable. At LOS C, most vehicles are travelling in platoons, and travel speeds are curtailed. At LOS D, platooning increases significantly, and the demand for passing is high, but the capacity to do so is low. The LOS experienced by drivers on two-way rural roads is dependent on the drivers' expectations regarding the road.

Austroads (2020a) provides guidelines for the capacity and performance of two lane, two-way rural roads, which in turn, refers to the *Highway Capacity Manual* (HCM). The LOS experienced by drivers on two-way rural roads is dependent on the drivers' expectations regarding the road, and three classes of road are defined in the HCM.

Class I roads are those on which motorists expect to travel at relatively high speeds. They most often serve long-distance trips or provide connecting links between facilities that serve long-distance trips. Class II roads are those on which motorists do not necessarily expect to travel at high speeds, and may function as access routes to Class I facilities, serve as scenic or recreational routes or pass through rugged terrain. Class III roads serve moderately developed areas, and may be portions of a Class I or Class II highway that pass through small towns or developed recreational areas, where local traffic mixes with through traffic, and the density of unsignalised roadside access points increases.

The HCM method assumes a uniform speed limit for all vehicles on a length of road. As Mine-generated heavy vehicles travel at a reduced speed limit of 80 km/h, the method does not strictly apply to those parts of Majors Creek Road where the general speed limit is 100 km/h, due to the disparity between the general traffic speed limit and the Mine-generated heavy vehicle speed limit. Nevertheless, as a guide, the LOS on Majors Creek Way has been assessed for the surveyed and baseline future conditions assuming a 100 km/h speed limit for all vehicles.

The assessment considers Majors Creek Road as a Class II road, on which drivers do not necessarily expect to travel at relatively high speeds. On Class II roads, LOS is defined only in terms of Percent Time Spent Following (PTSF). The PTSF is a measure of the level of opportunities to overtake, and is estimated from the demand traffic volumes, the directional distribution of that traffic, and the percentage of no-passing zones. The LOS criteria for Class II two-lane two-way roads are as shown in Table 4.5.

Table 4.5: LOS Criteria for Class II Two-Lane Two-Way Roads

Level of Service	Percent Time Spent Following
A	≤ 40
B	> 40 – 55
C	> 55 – 70
D	> 70 – 85
E	≥ 85

Source: Austroads (2020a)

The resulting PTSF and LOS on Majors Creek Road are summarised in Table 4.6.

Table 4.6: Average Weekday Midblock Level of Service – Majors Creek Road North of Mine

Assessment Period	2022 Surveyed				Baseline 2025 at Maximum Concentrate Transportation			
	Inbound[A]		Outbound[A]		Inbound[A]		Outbound[A]	
	PTSF	LOS	PTSF	LOS	PTSF	LOS	PTSF	LOS
AM Peak 6:00am to 7:00am	34.2	A	25.6	A	34.1	A	26.2	A
Daytime 7:00am to 5:00pm	22.9	A	35.7	A	23.2	A	36.1	A
PM Peak 5:00pm to 7:00pm	33.1	A	26.0	A	33.2	A	26.8	A
Nighttime 7:00pm to 10:00pm	31.2	A	22.9	A	32.1	A	22.4	A

[A] Direction of travel relative to the Mine, inbound is southbound, outbound is northbound.
Note calculation method does not account for the effect of different speed limits for different vehicles.

The results indicate that the surveyed and baseline future traffic volumes on Majors Creek Road are expected to result in good levels of service, with the interaction between vehicles having negligible effect on the ability of drivers to select their desired travel speed.

4.5.2 Operation of Intersections

At unsignalised intersections with minor roads, where there are relatively low volumes of through and turning vehicles, capacity considerations are usually not significant, and detailed analysis of capacity is not warranted. As a guide, at volumes below the following combinations of maximum hourly volumes at a cross intersection with a two lane two-way road, capacity analysis is not warranted:

- major road 400 vehicles per hour, minor road 250 vehicles per hour;
- major road 500 vehicles per hour, minor road 200 vehicles per hour; and
- major road 650 vehicles per hour, minor road 100 vehicles per hour.

Comparing the surveyed and baseline peak hourly traffic volumes on Majors Creek Road and the Mine access road with the threshold volumes above, it is evident that the peak hourly volumes are well below the threshold volumes for analysis. As such, there are no capacity concerns regarding the operation of the intersection of the Mine access road with Majors Creek Road.

Similarly, the background traffic volumes on the other roads in the region and along the transportation route (Section 3.2) are sufficiently low that no issues are envisaged with intersection capacity or vehicle delays.

5 Impacts of the Modification

5.1 Traffic Generation

The Modification does not propose any change to the operational workforce at the Mine, thus would not result in any change to the existing light vehicle and workforce bus trip generation. It is also anticipated that the Modification would not result in any change in the number of trips generated for the purpose of general deliveries to the Mine.

The Modification does not propose any increase in the total amount of ore to be processed over the life of the Mine, but proposes that the maximum annual processing rate be increased from 355,000 tpa to 415,000 tpa. Thus, while the total number of truck trips generated by the transportation of concentrate over the life of the Mine would not be altered, the demand for concentrate transport in any one year would potentially increase with the Modification. As the total would be unaltered, any increase in transportation in one year as a result of the increased maximum processing rate would be offset by a decrease in another year.

With the Modification, the existing limit of dispatch of four concentrate trucks per hour permitted by Condition 41(a) would be modified to permit a maximum of four laden concentrate and/or water trucks combined to be despatched from or received at the Mine Site per hour. The limit would therefore apply to both laden concentrate truck departures and laden emergency water truck arrivals only.

Practically, each despatch of a concentrate transport truck would be matched by the arrival of an empty truck, and each arrival of a laden water truck at the Mine would be matched by the departure of an empty truck, all of which may occur within one hour. With four laden truck arrivals and/or departures for concentrate and water combined permitted in one hour, the practical limit for trips generated by concentrate and water trucks with the Modification would therefore remain the same as the existing practical limit for concentrate trucks only, at eight truck trips per hour, being four inbound and four outbound trips.

The existing limits on the hours during which the dispatch of concentrate is permitted would remain unchanged, and would also apply to the trucks transporting emergency water, i.e. both concentrate dispatch and water receival would be permitted only between the hours of 7:00am and 10:00pm Monday to Saturday and 8:00am to 10:00pm on Sundays and public holidays.

Consistent with the existing conditions, heavy vehicle movements to or from the site would remain prohibited between 7:00am and 8:30am, and 3:00pm to 5:00pm on school days. This would apply to the trucks transporting concentrate, the trucks transporting emergency water, and all heavy vehicles used for deliveries of miscellaneous equipment and consumables.

Table 5.1 summarises the peak hourly number of vehicle trips generated by the Mine under its currently approved conditions, and with the Modification, during the four assessment periods under consideration.

Table 5.1: Baseline and Modification Mine-Generated Peak Hour Traffic (vehicles per hour)

Assessment Period[A]	Light		Rigid		Articulated Concentrate and Water		Articulated Other		Total	
	Inbound	Outbound	Inbound	Outbound	Inbound	Outbound	Inbound	Outbound	Inbound	Outbound
Baseline at Maximum Hourly Concentrate Transportation 355,000 tpa										
AM Peak 6:00am to 7:00am	41	9	4	1	0	0	1	1	46	11
Daytime 7:00am to 5:00pm	10	1	1	1	4	4	1	1	16	7
PM Peak 5:00pm to 7:00pm	11	24	1	3	4	4	1	1	16	31
Nighttime 7:00pm to 10:00pm	1	4	1	0	4	4	1	1	6	8
Modification at Maximum Hourly Concentrate Transportation 415,000 tpa and Water Transportation										
AM Peak 6:00am to 7:00am	41	9	4	1	0	0	1	1	46	11
Daytime 7:00am to 5:00pm	10	1	1	1	4	4	1	1	16	7
PM Peak 5:00pm to 7:00pm	11	24	1	3	4	4	1	1	16	31
Nighttime 7:00pm to 10:00pm	1	4	1	0	4	4	1	1	6	8

[A] *Peak hour within the nominated assessment period*

Table 5.1 demonstrates that as the maximum number of vehicle movements generated in any one hour by the transport of concentrate and water with the Modification would be the same as with the existing transport of concentrate, with no change to the workforce and other delivery vehicle trips, the Modification would have no impact on the future peak hourly trips generated by the Mine during each of the four periods under consideration.

On the basis of the current truck loadings, with processing of the maximum proposed 415,000 tpa of ore, approximately 1,500 loads of concentrate would be dispatched in one year, or an average of approximately 4.1 loads per day. With the arrivals of empty vehicles, this would generate an average of 8.2 vehicle trips per day, and this assessment has rounded this up to nine vehicle trips per day on average.

The emergency transportation of up to 10 loads of water per day would generate up to 20 additional truck trips per day, only when required. It is anticipated that any required water transportation would take place on a campaign basis, occurring over distinct, short periods, rather than being an ongoing day-to-day activity. When considered over an extended period, the demand for water transportation is unlikely to increase the average daily number of articulated vehicle trips generated by the Mine.

The water transportation trips would be included in the existing hourly limits on concentrate transportation vehicle movements, thus over any day, the theoretical maximum number of trips generated by the transportation of concentrate and water combined would be the same as the maximum number of concentrate under the existing approval. The impact of the Modification on the daily traffic generated by the Mine compared with baseline conditions is summarised in Table 5.2.

Table 5.2: Baseline and Modification Mine-Generated Daily Traffic (vehicles per day)

	Light	Rigid	Articulated Concentrate and Water	Articulated Other	Total
Baseline at Maximum Ore Processing Rate 355,000 tpa					
Average Weekday[A]	185	32	7	6	230
Maximum Hourly Concentrate Transportation[B]	185	32	120	6	343
Modification at Maximum Ore Processing Rate 415,000 tpa					
Average Weekday[A]	185	32	9	6	232
Average Weekday[A] with Maximum Daily Water Transportation	185	32	29	6	252
Maximum Hourly Concentrate and Water Transportation[B]	185	32	120	6	343

[A] *average daily concentrate at maximum annual ore processing rate*
[B] *maximum hourly trips throughout approved transportation hours*

Table 5.2 demonstrates that the theoretical maximum daily trip generation of the Mine would remain unchanged by the Modification. On those occasions that emergency water transportation occurs, the number of trips generated by the Mine would increase by a maximum of 20 trips per day, being ten inbound and 10 outbound trips.

5.2 Traffic Distribution

The Modification would not impact the routes used for travel by the workforce, general deliveries, or ore concentrate transportation. Water would be transported using the same route on public roads as the ore concentrate trucks, with laden trucks approaching via:

- Kings Highway.
- Solus Street;
- Wallace Street;
- Coghill Street;
- Araluen Road; and
- Majors Creek Road.

Empty water trucks would depart using the same route in the reverse direction.

5.3 Future Traffic Volumes

The impact of the Modification on the peak hourly traffic volumes compared with the baseline conditions during each of the four periods of the day under investigation is summarised in Table 5.3. This assumes that the maximum permitted concentrate and water transportation may coincide with the busiest hour during each of those periods, with the exception of the AM peak hour, which occurs earlier than the approved hours for concentrate and water transportation.

Table 5.3: Impact of Modification on Peak Hourly Traffic Volumes 2025 (vehicles per hour)

Assessment Period[A]	Light		Rigid		Articulated Concentrate and Water		Articulated Other		Total	
	Inbound	Outbound	Inbound	Outbound	Inbound	Outbound	Inbound	Outbound	Inbound	Outbound
Mine Access Road – Baseline at Maximum Ore Processing Rate 355,000 tpa										
AM Peak 6:00am to 7:00am	41	9	4	1	0	0	1	1	46	11
Daytime 7:00am to 5:00pm	10	1	1	1	4	4	1	1	17	7
PM Peak 5:00pm to 7:00pm	11	24	1	3	4	4	1	1	17	32
Nighttime 7:00pm to 10:00pm	1	4	1	0	4	4	1	1	6	9
Mine Access Road – Modification at Maximum Ore Processing 415,000 tpa and Water Transportation										
AM Peak 6:00am to 7:00am	41	9	4	1	0	0	1	1	46	11
Daytime 7:00am to 5:00pm	10	1	1	1	4	4	1	1	17	7
PM Peak 5:00pm to 7:00pm	11	24	1	3	4	4	1	1	17	32
Nighttime 7:00pm to 10:00pm	1	4	1	0	4	4	1	1	6	9
Majors Creek Road North of Mine – Baseline at Maximum Ore Processing Rate 355,000 tpa[B]										
AM Peak 6:00am to 7:00am	37	23	3	7	0	0	1	1	41	31
Daytime 7:00am to 5:00pm	18	25	3	7	4	4	1	2	26	38
PM Peak 5:00pm to 7:00pm	35	22	1	7	4	4	2	1	42	34
Nighttime 7:00pm to 10:00pm	10	6	1	2	4	4	2	1	17	13
Majors Creek Road North of Mine – Modification at Maximum Ore Processing 415,000 tpa & Water Transportation[B]										
AM Peak 6:00am to 7:00am	37	23	3	7	0	0	1	1	41	31
Daytime 7:00am to 5:00pm	18	25	3	7	4	4	1	2	26	38
PM Peak 5:00pm to 7:00pm	35	22	1	7	4	4	2	1	42	34
Nighttime 7:00pm to 10:00pm	10	6	1	2	4	4	2	1	17	13

[A] *Peak hour within the nominated assessment period*
[B] *On Majors Creek Road, inbound is southbound, outbound is northbound.*

Table 5.3 demonstrates that as the workforce and delivery trips would be unchanged by the Modification, and the maximum number of articulated vehicle movements per hour generated by the transport of concentrate and water with the Modification would be the same as that generated by the approved transport of concentrate, the Modification would have no impact on the future peak hourly trips generated by the Mine during the four periods of the day under investigation.

Table 5.4 summarises the impact of the Modification on daily traffic volumes on the Mine access road and Majors Creek Road, compared with the baseline conditions.

Table 5.4: Impact of Modification on Daily Traffic Volumes 2025 (vehicles per day)

	Light	Rigid	Articulated Concentrate and Water	Articulated Other	Total
Mine Access Road – Baseline at Maximum Ore Processing Rate 355,000 tpa					
Average Weekday[A]	185	32	7	6	230
Maximum Hourly Concentrate Transportation[B]	185	32	120	6	343
Mine Access Road – Modification at Maximum Ore Processing Rate 415,000 tpa					
Average Weekday[A]	185	32	9	6	232
Average Weekday[A] with Maximum Daily Water Transportation	185	32	29	6	252
Maximum Hourly Concentrate and Water Transportation[B]	185	32	120	6	343
Majors Creek Road North of Mine – Baseline at Maximum Ore Processing Rate 355,000 tpa					
Average Weekday[A]	541	105	7	11	720
Maximum Hourly Concentrate Transportation[B]	597	105	120	11	833
Majors Creek Road North of Mine – Modification at Maximum Ore Processing Rate 415,000 tpa					
Average Weekday[A]	541	105	9	11	722
Average Weekday[A] with Maximum Daily Water Transportation	597	105	29	11	742
Maximum Hourly Concentrate and Water Transportation[B]	597	105	120	11	833

[A] *average daily concentrate at maximum annual ore processing rate and maximum daily water transportation*
[B] *maximum hourly trips throughout approved transportation hours*

5.4 Future Road Network Efficiency

5.4.1 Future Midblock Level of Service

As the Modification would not alter the maximum number of vehicle trips generated by the Mine in any one hour, formal analysis of the impact of the Modification on the midblock level of service experienced by drivers on the approved transportation route is not warranted. Nevertheless, Table 5.5 presents the calculated PTSF and LOS on Majors Creek Road North of the Mine in 2025 both with and without the Modification, using the HCM method described in Section 4.5.1.

Table 5.5: Future Average Weekday Midblock Level of Service – Majors Creek Road North

Assessment Period[A]	Baseline 2025 at Maximum Concentrate Transportation				Modification 2025 at Maximum Concentrate and Water Transportation			
	Inbound[B]		Outbound[B]		Inbound[B]		Outbound[B]	
	PTSF	LOS	PTSF	LOS	PTSF	LOS	PTSF	LOS
AM Peak 6:00am to 7:00am	34.1	A	26.2	A	34.1	A	26.2	A
Daytime 7:00am to 5:00pm	23.2	A	36.1	A	23.2	A	36.1	A
PM Peak 5:00pm to 7:00pm	33.2	A	26.8	A	33.2	A	26.8	A
Nighttime 7:00pm to 10:00pm	32.1	A	22.4	A	32.1	A	22.4	A

[A] Peak hour within the nominated assessment period
[B] Direction of travel relative to the Mine, inbound is southbound, outbound is northbound.
Note calculation method does not account for the effect of different speed limits for different vehicles.

The Level of Service experienced by drivers during the peak hours on Majors Creek Road would not be impacted by the Modification. The Levels of Service would remain good on the access routes, with drivers experiencing minimal delays due to interaction with other traffic.

5.4.2 Future Operation of Intersections

As the Modification would not alter the maximum number of vehicle trips generated by the Mine in any one hour, it would have no impact on peak hour conditions at any intersections along the transportation route. Comparing the future peak hour traffic volumes on the Mine access road and Majors Creek Road with the threshold volumes for intersection performance described in Section 4.5.2, it is evident that the future peak hourly volumes are expected to remain well below the threshold volumes for analysis, and as such, there is no capacity concern regarding the operation of the Mine access intersection.

Similarly, the background traffic volumes on the other roads in the region and along the transportation route (Section 3.2) are sufficiently low that no issues are envisaged with intersection capacity or vehicle delays, and the Modification would have no impact on the hourly traffic volumes at intersections.

5.5 Intersection Treatments

All Mine-generated heavy vehicles would use the existing intersection of Majors Creek Road with the Mine access road, hence its geometry has been reviewed. Austroads (2020b) sets out warrants for greenfields rural intersection treatments, which focus on safety performance outcomes and are based on the peak hourly number of turning and through vehicle movements at the intersection. Considering the peak hourly volumes during the four periods under investigation, and the likely distribution of traffic suggested by the traffic survey results, the existing and forecast peak hourly traffic volumes with the Modification warrant the minimum preferred treatments in Majors Creek Road at the Mine access road.

The general minimum preferred treatments at rural road intersections are Basic Auxiliary Left (BAL) and Basic Auxiliary Right (BAR) treatments. The existing layout of the intersection of Majors Creek Road with the Mine Access Road meets or exceeds the minimum treatments warranted, via the provision of auxiliary right turn (AUR) and basic left turn treatment (BAL) in Majors Creek Road. As required by Modified Project Approval MP10_0054, the intersection was constructed in accordance with the relevant standards and to the satisfaction of Queanbeyan-Palerang Regional Council.

Similarly, the majority of Mine-generated traffic uses the intersection of Majors Creek Road and Araluen Road to travel between the Mine Site and Braidwood. Mine-generated traffic turns right from Araluen Road to Majors Creek Road, and turns left from Majors Creek Road to Araluen Road. Based on the forecasts of peak hourly Mine-generated traffic and the background traffic on Araluen Road (Table 3.2) and allowing for growth over time, the minimum preferred treatment is also warranted at that intersection for the existing and forecast traffic demands based on the Austroads warrants for greenfields intersection design. At the time of TTPP's observations of that intersection, the road was under construction, and the intersection did not have a BAR treatment in Araluen Road. The Modification would not increase the number of vehicles turning right at that intersection during any one hour, so would not trigger a need to upgrade the intersection. The review of the road crash history (Section 3.4) found no crashes occurred at that intersection, so upgrading of the intersection is not warranted on the basis of a poor crash history.

The Modification would not change the maximum number of vehicles turning at any intersection during any one hour compared with the approved conditions. No alterations to the intersection layouts are warranted on the basis of either the Austroads guidelines or changed traffic demands.

5.6 Road Safety Implications

The review of the road crash history of the approved transportation route does not highlight any clustering of crashes that might suggest an inherent concern with the design of the road at that location with regard to road safety that could be exacerbated by the Modification.

5.7 Mitigation Measures

The Modification would not alter the maximum number of trips generated during any one hour, nor the total number of heavy vehicle trips generated over the life of the Mine for the transportation of concentrate. The transportation of water would generate a maximum of 20 heavy vehicle trips per day only when required, and no road or intersection upgrades are considered to be required as a result of the Modification.

As required by Modified Project Approval MP10_0054, contributions are made under a Planning Agreement with Queanbeyan-Palerang Regional Council for road infrastructure upgrades. As the Modification would not materially alter the total number of vehicle trips generated over the life of the Mine, and would not alter the maximum number of heavy vehicle trips permitted during any one hour, no amendments to the Planning Agreement are considered to be required.

It would be appropriate to review the Mine's TMP and Drivers' Code of Conduct should the Modification be approved. If required, the TMP and Drivers' Code of Conduct would be updated, and submitted to DPIE for approval.

6 Summary and Conclusion

This study has assessed the proposed Modification to the Modified Project Approval MP10_0054 for the Dargues Mine to permit up to 10 laden truck movements per day for emergency trucking of water from appropriately licenced off-site sources, using the same road route used by trucks transporting concentrate from the Mine.

At the approved maximum production rate of 355,000 tpa, the Mine would generate an average of seven truck trips per day for the transportation of concentrate. The approved operations permit up to four outbound vehicle trips per hour for the transport of concentrate. The four outbound laden truck trips would practically be matched by up to four inbound trips per hour. The approved transportation of concentrate may therefore be expected to generate a maximum of eight articulated vehicle trips per hour.

At the proposed maximum production rate of 415,000 tpa, the Mine would generate an average of 8.2 truck trips per day for the transportation of concentrate. The Modification would permit up to four inbound or outbound vehicle trips per hour by trucks loaded with concentrate or water. The four laden truck trips would practically be matched by up to four empty truck trips per hour travelling in the opposite direction. The proposed transportation of concentrate and water combined may therefore be expected to generate a maximum of eight articulated vehicle trips per hour.

The Modification would not change the maximum number of vehicles generated by the Mine during any hour, thus it would have no impact on the operation of the intersections or the midblock levels of service experienced by drivers.

No road or intersection upgrades are considered to be required as a result of the Modification, noting that contributions for road infrastructure upgrades have been made under a Planning Agreement.

It would be appropriate to review the Mine's TMP and Drivers' Code of Conduct and update if required.

Appendix A

Photographs

Majors Creek Road – December 2021 Roadworks

Majors Creek Road South of Jembaicumbene Creek

Majors Creek Road at Honeysuckle Creek

Advance Signage on Majors Creek Road for Trucks at Dargues Mine (southbound)

Advance Signage on Majors Creek Road for Trucks at Dargues Mine (northbound)

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Appendix 8

Noise Impact Assessment

prepared by

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(Total No. of pages = 47)

Noise Assessment

Modification 5 - Noise Impact Assessment
Dargues Gold Mine
Majors Creek, NSW.

Prepared for: Aurelia Metals Ltd

June 2022

MAC201092-03RP1V1

Document Information

Noise Assessment

Modification 5 – Noise Impact Assessment

Dargues Gold Mine

Majors Creek, NSW

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MAC201092-03RP1V1	2 June 2022	Rod Linnett		Oliver Muller	

CONTENTS

1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned RW Corkery & Co Pty Limited (RWC) on behalf of Aurelia Metals Ltd to prepare a Noise Assessment (NA) to quantify emissions from the proposed Modification to the approved Dargues Gold Mine (DGM) at Majors Creek, NSW.

The NA has quantified potential noise emissions from the operation and recommends reasonable and feasible noise controls where required.

This assessment has been undertaken in accordance with the following documents:

- NSW Department of Environment and Climate Change (DECCW) – NSW Interim Construction Noise Guideline (ICNG), July 2009;
- NSW Environment Protection Authority (EPA), Noise Policy for Industry (NPI) 2017;
- NSW Department of Environment, Climate Change and Water (DECCW) – NSW Road Noise Policy (RNP), March 2011;
- Australian Standard AS 1055:2018 - Acoustics - Description and measurement of environmental noise - General Procedures;
- International Organisation for Standardisation (ISO) 9613-1:1993 (ISO9613:1) - Acoustics - Attenuation of Sound During Propagation Outdoors - Part 1: Calculation of the Absorption of Sound by the Atmosphere;
- International Organisation for Standardisation (ISO) 9613-2:1996 (ISO9613:2) - Acoustics - Attenuation of Sound during Propagation Outdoors - Part 2: General Method of Calculation;
- ISO/TR 17534-3 - Acoustics — Software for the calculation of sound outdoors — Part 3: Recommendations for quality assured implementation of ISO 9613-2 in software according to ISO 17534-1.

A glossary of terms, definitions and abbreviations used in this report is provided in Appendix A.

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2 Project Description

Dargues Gold Mine (the 'project') is located 60km southeast of Canberra, approximately 13km south of Braidwood and immediately to the north of the village of Majors Creek, NSW (refer **Figure 1**) with all mining-related activities are located within Mining Lease (ML) 1675.

Figure 1 also shows surrounding receivers in relation to the project.

Modified Project Approval (MP) 10_0054 was granted by the Land and Environment Court on 7 February 2012, with most recent modification (MOD 4) granted on 23 May 2019. Mining activities are approved under MP_0054 until 30 June 2025. Key activities approved under MP_0054 include the following:

- Extraction of waste rock and ore from the Dargues Gold Deposit using underground sublevel open stope mining methods.
- Processing of up to 355 000t of ore per year and up to 1.6Mt of ore over the life of the Mine.
- Filling of voids created during underground mining using a combination of hydraulic fill and waste rock.
- Construction and use of surface infrastructure required for the underground mine, including a box cut, portal and decline, magazines, fuel store, ventilation rises, back fill hole(s) and power and water supply.
- Construction and use of a processing plant and office area, including an integrated run-of-mine (ROM) pad/temporary waste rock emplacement, crushing and grinding, gravity separation and flotation circuits, site offices, workshop, laydown area, ablution facilities, stores, car parking, and associated infrastructure.
- Construction and use of a Tailings Storage Facility.
- Construction and use of a water management system.
- Construction and use of a site access road and intersection to allow site access from Majors Creek Road.
- Transportation of gold concentrate through Braidwood via public roads surrounding the project site using covered semi-trailers.
- Construction of the Spring Creek heavy vehicle crossing to permit direct access between the processing plant and the Tailings Storage Facility.
- Construction and use of the Eastern Waste Rock Emplacement for the storage of waste rock.

Table 1 presents the approved operating hours for the project.

Table 1 Approved Activities & Operating Hours	
Activity	Operating Hours/ Conditions[1]
Vegetation clearing, topsoil stripping, construction of the box cut and rehabilitation	Daytime
Remainder of construction operations	Day / Evening / Night
Mining, paste filling, maintenance and processing operations	Day / Evening / Night
Crushing operations (including operation of front-end-loader)[2]	7am – 7pm, 7 days per week
Transportation[3]	Day / Evening
Surface blasting	9am – 5pm Monday – Friday, excluding public holidays
Underground blasting	Anytime

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

Note 2: Crushing operations may be undertaken outside of these hours on a maximum of 20 days per year.

Note 3: Condition 3(41) of MP10_0054 MOD 4 stipulates the following:

- The dispatch of concentrate from the site is limited to between the hours of 7am to 10pm Monday to Saturday and 8am – 10pm Sundays and Public Holidays; and
- All heavy vehicle movements to or from the site are prohibited between the hours of 7am – 8.30am and 3pm – 5pm on school days.

2.1 Proposed Modification

The proposed modification is being sought as DGM has identified a number of adjustments that are required to maximise the efficiency of mining activities tailings residue management, clarification of permissible transportation operations and to regularise the development consent to account for minor changes to the project site. Key changes associated with the modification are summarised below.

2.1.1 Construction and use of a Water Storage Dam (WSD)

Construction and use of a Water Storage Dam (WSD) with a capacity of approximately 180ML for the receipt and storage of supernatant water from the Tailings Storage Facility (TSF), water pumped from underground workings and raw water from other on-site sources. The WSD is also required to enable storage of water for use during periods of reduced rainfall or drought. The proposed WSD would be constructed using cut and fill methods, with embankment construction materials sourced from the WSD footprint.

2.1.2 Increased Processing Rate

Increase the approved processing rate under Condition 6(a) of MP10_0054 from 355,000tpa to 415 000tpa (i.e. an increase of approximately 17%).

Mining operations at the Mine are approved until 30 June 2025 and up to 1.6Mt of ore may be processed at the Mine under Conditions 5 and 6 of MP10_0054 respectively. The proposed processing rate increase would not require any changes to the existing processing plant or the approved TSF and would not increase the total amount of ore processed over the life of the Mine (1.6Mt).

It is anticipated that transportation of gold concentrate generated as a result of the proposed processing rate increase would be accommodated within existing transportation limits for the Mine.

2.1.3 Emergency Transportation of Water

Condition 41(a) of MP10_0054 specifies that a maximum of four concentrate trucks may be despatched from the Mine per hour. Approval is sought for emergency trucking of water to the Project Site from off-site sources (**Figure 1**). Approval is sought for a combined maximum of four laden concentrate trucks and/or water trucks to exit the Project Site per hour between 7am and 10pm to facilitate the provision of emergency water when required.

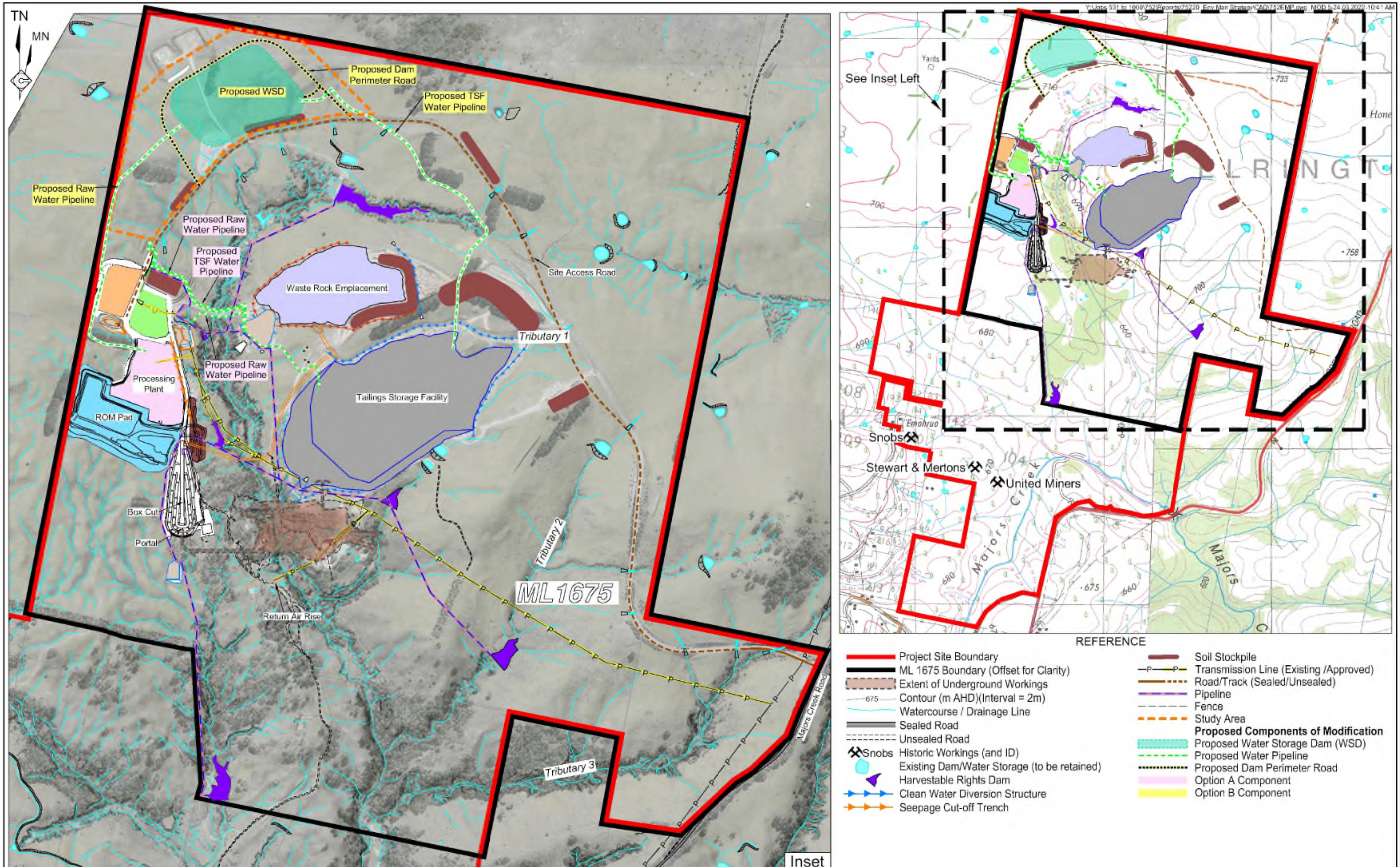

Figure 1
PROPOSED SITE LAYOUT

3 Noise Policy and Guidelines

3.1 Noise Policy for Industry

The EPA released the Noise Policy for Industry (NPI) in October 2017 which provides a process for establishing noise criteria for consents and licenses enabling the EPA to regulate noise emissions from scheduled premises under the Protection of the Environment Operations Act 1997.

The objectives of the NPI are to:

- provide noise criteria that is used to assess the change in both short term and long-term noise levels;
- provide a clear and consistent framework for assessing environmental noise impacts from industrial premises and industrial development proposals;
- promote the use of best-practice noise mitigation measures that are feasible and reasonable where potential impacts have been identified; and
- support a process to guide the determination of achievable noise limits for planning approvals and/or licences, considering the matters that must be considered under the relevant legislation (such as the economic and social benefits and impacts of industrial development).

The policy sets out a process for industrial noise management involving the following key steps:

1. Determine the Project Noise Trigger Levels (PNTLs) (ie criteria) for a development. These are the levels (criteria), above which noise management measures are required to be considered. They are derived by considering two factors: shorter-term intrusiveness due to changes in the noise environment; and maintaining the noise amenity of an area.

2. Predict or measure the noise levels produced by the development with regard to the presence of annoying noise characteristics and meteorological effects such as temperature inversions and wind.

3. Compare the predicted or measured noise level with the PNTL, assessing impacts and the need for noise mitigation and management measures.

4. Consider residual noise impacts - that is, where noise levels exceed the PNTLs after the application of feasible and reasonable noise mitigation measures. This may involve balancing economic, social and environmental costs and benefits from the proposed development against the noise impacts, including consultation with the affected community where impacts are expected to be significant.

5. Set statutory compliance levels that reflect the best achievable and agreed noise limits for the development.

6. Monitor and report environmental noise levels from the development.

3.1.1 Project Noise Trigger Levels (PNTL)

The policy sets out the procedure to determine the PNTLs relevant to an industrial development. The PNTL is the lower (ie, the more stringent) of the **Project Intrusiveness Noise Level** (PINL) and **Project Amenity Noise Level** (PANL) determined in accordance with Section 2.3 and Section 2.4 of the NPI.

3.1.2 Rating Background Level (RBL)

The Rating Background Level (RBL) is a determined parameter from noise monitoring and is used for assessment purposes. As per the NPI, the RBL is an overall single figure background level representing each assessment period (day, evening and night) over the noise monitoring period.

3.1.3 Project Intrusiveness Noise Level (PINL)

The PINL ($L_{Aeq(15min)}$) is the RBL + 5dB and seeks to limit the degree of change a new noise source introduces to an existing environment. Hence, when assessing intrusiveness, background noise levels need to be measured.

3.1.4 Project Amenity Noise Level (PANL)

The PANL is relevant to a specific land use or locality. To limit continuing increases in intrusiveness levels, the ambient noise level within an area from all combined industrial sources should remain below the recommended amenity noise levels specified in Table 2.2 (of the NPI). The NPI defines two categories of amenity noise levels:

- **Amenity Noise Levels (ANL)** – are determined considering all current and future industrial noise within a receiver area; and
- **Project Amenity Noise Level (PANL)** – is the recommended level for a receiver area, specifically focusing the project being assessed.

Additionally, Section 2.4 of the NPI states: “to ensure that industrial noise levels (existing plus new) remain within the recommended amenity noise levels for an area, a project amenity noise level applies for each new source of industrial noise as follows”:

PANL for new industrial developments = recommended **ANL** minus 5dBA.

The following exceptions apply when deriving the PANL:

- areas with high traffic noise levels;
- proposed developments in major industrial clusters;
- existing industrial noise and cumulative industrial noise effects; and
- greenfield sites.

The recommended amenity noise levels as per Table 2.2 of the NPI are reproduced in **Table 2**.

Table 2 Amenity Noise Levels

Receiver Type	Noise Amenity Area	Time of day	Recommended amenity noise level dB LAeq(period)
Residential	Rural	Day	50
		Evening	45
		Night	40
	Suburban	Day	55
		Evening	45
		Night	40
	Urban	Day	60
		Evening	50
		Night	45
Hotels, motels, caretakers' quarters, holiday accommodation, permanent resident caravan parks.	See column 4	See column 4	5dB above the recommended amenity noise level for a residence for the relevant noise amenity area and time of day
School Classroom	All	Noisiest 1-hour period when in use	35 (internal) 45 (external)
Hospital ward - internal - external	 All All	 Noisiest 1-hour Noisiest 1-hour	 35 50
Place of worship - internal	All	When in use	40
Passive Recreation	All	When in use	50
Active Recreation	All	When in use	55
Commercial premises	All	When in use	65
Industrial	All	When in use	70

Notes: The recommended amenity noise levels refer only to noise from industrial noise sources. However, they refer to noise from all such sources at the receiver location, and not only noise due to a specific project under consideration. The levels represent outdoor levels except where otherwise stated.

Types of receivers are defined as rural residential; suburban residential; urban residential; industrial interface; commercial; industrial – see Table 2.3 and Section 2.7 of the NPI.

Note: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

3.1.5 Maximum Noise Assessment Trigger Levels

The potential for sleep disturbance from maximum noise level events from a project during the night-time period needs to be considered. The NPI considers sleep disturbance to be both awakenings and disturbance to sleep stages.

Where night-time noise levels from a development/premises at a residential location exceed the following criteria, a detailed maximum noise level event assessment should be undertaken:

- $L_{Aeq(15min)}$ 40dB or the prevailing RBL plus 5dBA, whichever is the greater, and/or
- L_{Amax} 52dB or the prevailing RBL plus 15dBA, whichever is the greater.

A detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the rating background noise level, and the number of times this happens during the night-time period.

Other factors that may be important in assessing the impacts on sleep disturbance include:

- how often the events would occur;
- the distribution of likely events across the night-time period and the existing ambient maximum events in the absence of the development;
- whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods); and
- current understanding of effects of maximum noise level events at night.

3.2 Voluntary Land Acquisition and Mitigation Policy

The Voluntary Land Acquisition and Mitigation Policy (VLAMP, November 2018) describes the NSW Government's policy for voluntary mitigation and land acquisition actions undertaken to address noise impacts from State significant mining, petroleum and extractive industry developments. It aims to provide a balance between economic development and protecting the health, preserve amenity and control intrusive noise where potential impacts are identified.

The VLAMP provides guidance for consent authorities as to when voluntary mitigation or voluntary acquisition rights are to be applied to reduce operational noise impacts from a development on privately owned land. The policy does not apply to construction noise impacts, impacts from the public road or rail network or modifications to existing developments with legacy noise issues.

The VLAMP outlines methods to determine the significance of potential exceedances of relevant noise assessment criteria and identifies potential treatments for those exceedances (VLAMP Table 1) and has been reproduced in Table 3.

Voluntary Mitigation Rights

A consent authority should only apply voluntary land mitigation rights where, even with the implementation of best practice management at the mine site:

- the noise generated by the development would meet the requirements of Table 1 (VLAMP) such that the impacts would be characterised marginal, moderate or significant at any residence or privately owned land; or
- the development would increase the total industrial noise level at any residence on privately owned land by more than 1dBA and noise levels at the residence are already above the recommended amenity noise levels in Table 2.2 of the NPI; or
- the development includes a private rail line and the use of that private rail line would cause exceedances of the recommended acceptable levels in Table 6 of Appendix 3 of the RING by greater than or equal to 3dBA at any residences on privately owned land.

Table 3 Characterisation of Noise Impacts and Potential Treatments (VLAMP Table 1)			
If the predicted noise level minus the project noise trigger level is:	And the total cumulative industrial noise level is:	Characterisation of impacts:	Potential treatment:
All time periods 0-2dBA	Not applicable	Impacts are considered to be negligible	The exceedances would not be discernible by the average listener and therefore would not warrant receiver based treatments or controls
All time periods 3-5dBA	< recommended amenity noise level in Table 2.2 of the NPI; or > recommended amenity noise level in Table 2.2 of the NPI, but the increase in total cumulative industrial noise level resulting from the development is >1dB	Impacts are considered to be marginal	Provide mechanical ventilation / comfort condition systems to enable windows to be closed without compromising internal air quality / amenity.
All time periods 3-5dBA	> recommended amenity noise level in Table 2.2 of the NPI, and the increase in total cumulative industrial noise level resulting from the development is >1dB	Impacts are considered to be moderate	As for marginal impacts but also upgraded facade elements like windows, doors or roof insulation, to further increase the ability of the building facade to reduce noise levels.
Day and evening >5dBA	< recommended amenity noise levels in Table 2.2 of the NPI	Impacts are considered to be moderate	As for marginal impacts but also upgraded facade elements like windows, doors or roof insulation, to further increase the ability of the building facade to reduce noise levels.
Day and evening >5dBA	> recommended amenity noise levels in Table 2.2 of the NPI	Impacts are considered to be significant	Provide mitigation as for moderate impacts and see voluntary land acquisition provisions above.
Night >5dBA	Not applicable	Impacts are considered to be significant	Provide mitigation as for moderate impacts and see voluntary land acquisition provisions above.

Voluntary Acquisition Rights

A consent authority should only apply voluntary land acquisition rights where, even with the implementation of best practice management at the mine site:

- the noise generated by the development would be characterised as significant, according to Table 1 (VLAMP), at any residence on privately owned land; or
- the noise generated by the development would contribute to exceedances of the acceptable noise levels plus 5dB in Table 2.2 of the NPI on more than 25% of any privately owned land where there is an existing dwelling or where a dwelling could be built under existing planning controls; or
- the development includes a private rail line and the use of that private rail line would cause exceedances of the recommended maximum criteria outlined in Table 6 of Appendix 3 of the RING by greater than or equal to 3dBA at any residences on privately owned land.

Impacts would be classified as significant where:

- During the **daytime** and **evening** periods, noise levels from the project are >5dBA above the PNTLs and the total cumulative industrial noise level is greater than the recommended amenity noise levels in Table 2.2 of the NPI; or
- During the **night time** period, noise levels from the project are >5dBA above the PNTLs.

3.3 Road Noise Policy

The road traffic noise criteria are provided in the Road Noise Policy (RNP), 2011. The policy sets out noise criteria applicable to different road classifications for the purpose of quantifying traffic noise impacts. Road noise criteria relevant to this assessment are presented in detail in **Section 4.4**.

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4 Noise Assessment Criteria

Background noise monitoring has not been conducted for this project and hence, the minimum assumed Rating Background Levels (RBL) of 35dBA for the daytime period and 30dBA for the evening and night time periods have been adopted in accordance with NPI methodology.

4.1 Background Noise Levels

The assessment has adopted the minimum assumed Rating Background Noise Levels (RBLs) outlined in Section 2.3 of the Noise Policy for Industry (NPI, 2017) and are reproduced in **Table 4**.

Table 4 Default RBLs

Period[1]	Adopted RBL, dB L_{A90}
Day	35
Evening	30
Night	30

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

4.2 Operational Noise Criteria

4.2.1 Project Intrusiveness Noise Levels

The PINLs for the project are presented in **Table 5** and have been determined based on the RBLs +5dBA.

Table 5 Project Intrusiveness Noise Levels

Receiver	Period[1]	Adopted RBL dB $L_{A90(period)}$	PINL dB $L_{Aeq(15min)}$
All Residential Receivers	Day	35	40
	Evening	30	35
	Night	30	35

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

4.2.2 Project Amenity Noise Levels

The PANL for residential receivers and other receiver types (ie non-residential) potentially affected by the project are presented in **Table 6**.

Table 6 Amenity Noise Levels and Project Amenity Noise Levels					
Receiver Type	Noise Amenity Area	Assessment Period[1]	Recommended ANL dB LAeq(period)	ANL dB LAeq(period)[2]	PANL dB LAeq(15min)[3]
Residential	Rural	Day	50	50	53
		Evening	45	45	48
		Night	40	40	43
Residential	Suburban	Day	55	55	58
		Evening	45	45	48
		Night	40	40	43
Residential	Urban	Day	60	60	63
		Evening	50	50	53
		Night	45	45	48
Hotels Motels	Rural/Urban/ Suburban	Day	ANL +5dB	ANL +5dB	ANL +5dB
		Evening	ANL +5dB	ANL +5dB	ANL +5dB
		Night	ANL +5dB	ANL +5dB	ANL +5dB
Educational		When in use	35 (internal 1 hr)	30 (internal 1 hr)	33 (internal 1 hr) 43 (external 1 hr)[4]
Hospital Wards		When in use	35 (internal 1 hr) 50 (external 1 hr)	30 (internal 1 hr) 45 (external 1 hr)	33 (internal 1 hr) 48 (external 1 hr)
Place of worship		When in use	40 (internal)	35 (internal 1 hr)	38 (internal 1 hr) 48 (external 1 hr)[4]
Passive Recreation		When in use	50	50	53
Active Recreation		When in use	55	55	58
Commercial		When in use	65	65	68
Industrial		When in use	70	70	73
Industrial Interface		When in use	ANL +5dB	ANL +5dB	ANL +5dB

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.
Note 2: Project Amenity Noise Level equals the Amenity Noise Level as there is no other industry in the area.
Note 3: Includes a +3dB adjustment to the amenity period level to convert to a 15-minute assessment period as per Section 2.2 of the NPI.
Note 4: External level based on 10dB loss through partially open window.

4.2.3 Project Noise Trigger Levels

The PNTLs are the lower of either the PINLs or the PANLs. **Table 7** presents the derivation of the PNTLs in accordance with the methodologies outlined in the NPI. For this assessment the night time PNTL of 35dB LAeq(15min) is the limiting criteria for residential receivers.

Table 7 Project Noise Trigger Levels

Catchment	Assessment Period[1]	PINL dB LAeq(15min)	PANL dB LAeq(15min)	PNTL dB LAeq(15min)
Residential Receivers (Rural)	Day	40	53	40
	Evening	35	48	35
	Night	35	43	35

Note 1: Day - the period from 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening - the period from 6pm to 10pm; Night - the remaining periods.

4.3 Maximum Noise Assessment Trigger Levels

The maximum noise trigger levels shown in **Table 8** are based on night time RBLs and trigger levels as per Section 2.5 of the NPI. The trigger levels will be applied to transient noise events that have the potential to cause sleep disturbance.

Table 8 Maximum Noise Trigger Level

Residential Receivers	
52dB LAmax or RBL + 15dB	
Trigger	52
RBL 30+15dB	45
Highest	**52**

Note: Monday to Saturday; Night 10pm to 7am. On Sundays and Public Holidays Night 10pm to 8am.
Note: NPI identifies that maximum of the two values is to be adopted which is shown in bold font.

4.4 Road Traffic Noise Criteria

It is acknowledged that the functional classification of roads connecting to arterial roads such as major highways are 'Collector Roads' in accordance with the Roads and Maritime Noise Criteria Guideline (April 2015). However, the Road Noise Policy does not provide separate noise criteria for Collector Roads but applies the sub-arterial category to all roads that are not classified as local roads and hence, the 'sub arterial road' category has been adopted for Majors Creek Road. The relevant road traffic noise criteria are provided in the RNP and are presented in **Table 9** for residential receivers.

Table 9 Road Traffic Noise Assessment Criteria

Road category	Type of project/development	Assessment Criteria – dBA	
		Day (7am to 10pm)	Night (10pm to 7am)
Freeways/arterial/ sub-arterial Roads	Existing residences affected by additional traffic on freeways/arterial/sub-arterial roads generated by land use developments	60dB LAeq(15hr)	55dB LAeq(9hr)
Local roads	Existing residences affected by additional traffic on local roads generated by land use developments	55dB LAeq(1hr)	50dB LAeq(1hr)

Additionally, the RNP states where existing road traffic noise criteria are already exceeded, any additional increase in total traffic noise level should be limited to 2dBA, which is generally accepted as the threshold of perceptibility to a change in noise level.

5 Modelling Methodology

A computer model was developed to quantify project noise emissions to neighbouring receivers using DGMR (iNoise, Version 2022.Rev1) noise modelling software. iNoise is an intuitive and quality assured software for industrial noise calculations in the environment. 3D noise modelling is considered industry best practice for assessing noise emissions from projects.

The model incorporated a three-dimensional digital terrain map giving all relevant topographic information used in the modelling process. Additionally, the model uses relevant noise source data, ground type, attenuation from barrier or buildings and atmospheric information to predict noise levels at the nearest potentially affected receivers. Where relevant, modifying factors in accordance with Fact Sheet C of the NPI have been applied to calculations.

The model calculation method used to predict noise levels was in accordance with ISO 9613:1 and ISO 9613:2 including corrections for meteorological conditions using CONCAWE[1]. The ISO 9613 standards are the most used noise prediction method worldwide. Many countries refer to ISO 9613 in their noise legislation. However, the ISO 9613 standard does not contain guidelines for quality assured software implementation, which leads to differences between applications in calculated results. In 2015 this changed with the release of ISO/TR 17534-3. This quality standard gives clear recommendations for interpreting the ISO 9613 method. iNoise fully supports these recommendations. The models and results for the 19 test cases are included in the software.

5.1 Assessment Scenarios

The assessment has adopted the following noise modelling scenario to quantify noise emissions associated with the Project.

Normal Operations - processing and extraction operations 24 hours per day as per the approved operating hours in **Table 1** at an increased rate plus the construction activities associated with the WSD during the daytime period.

[1] Report no. 4/18, "the propagation of noise from petroleum and petrochemical complexes to neighbouring communities", Prepared by C.J. Manning, M.Sc., M.I.O.A. Acoustic Technology Limited (Ref.AT 931), CONCAWE, Den Haag May 1981

5.2 Sound Power Levels

Table 10 presents the sound power level for each noise source modelled in noise assessment. It is noted that sound power levels were sourced from direct measurement of the (operations) plant and equipment on the project site (March 2022). Sound power levels for the construction related equipment were sourced from MAC's database or from in-field measurements for similar projects.

Table 10 Acoustically Significant Sources - Sound Power Levels dBA (re 10^{-12} Watts)

Item and quantity (per 15 minutes)	Sound Power Level (per item) dB LAeq	Total Modelled Sound Power Level dB LAeq(15min)	Source Height
WSD Construction - Daytime			
CAT D8 Bulldozer (x1)	111	111	1.5m
Scraper (x1)	110	110	1.5m
Front End Loader (x1)	104	104	2m
40t Artic Haul Truck (x2)	107	110	1.5m
Vibratory Roller	112	112	1.5m
Light Service Vehicle (x1)	76	76	1.5m
Operations – All Periods			
Jaw Crusher	111	111	3m
Secondary Crush & Screen Plant	102	102	3m
Ball Mills & Flotation Circuit	102	102	3m
Compressed Air Plant	98	98	1.5m
Backfill Batching Plant	95	95	3m
Mobile Feeder	100	100	2m
Front End Loader	104	104	2m
Haul Truck Portal to ROM (x2)	104	104	1.5m
Mine Ventilation Fan Evase – 83%	93	93	2m
Mine Ventilation Fan Evase – 100%	96	96	2m

Table 11 presents the sound power level for the maximum noise level assessment. Sound power levels were sourced from MAC's database or from in-field measurements for similar projects.

Table 11 Maximum Noise Level Assessment (L_{Amax}), Night time periods (10pm to 7am)

Item and quantity	Sound Power Level (per item)	Source Height[1]
Impact Noise – Processing Area	120	1.5m
Impact Noise – ROM	120	1.5m

Note 1: Height above the relative ground or building below source.

5.3 Environmental Noise Measurement, Site Validation and Model Calibration

To quantify near-field site emissions an intermediate noise monitoring location was selected. Section 7.1 of the NPI states:

> *'Where direct measurement of noise at a compliance location is not practical because of poor signal-to-noise ratios (that is, extraneous noise is louder than the noise under investigation), or where access to the location has been denied or is unavailable, measurements at intermediate locations between the source and the receiver location, where signal-to-noise ratios are higher, may be a viable option. For this approach to be effective there needs to be well-established theoretical and/or empirical relationships between the intermediate location and the receiver location in terms of noise exposure. Noise modelling may be one option to establish this relationship. The techniques under the above section 'Direct measurement at a receiver location' would also be relevant in terms of quantifying the level of noise from the source at the intermediate location(s).'*

Measurements were conducted during a planned shutdown during the night time on 16 March 2022 to determine the magnitude and contribution of sources on the project site at a 'Reference Location' (Refer Figure 1) – a location that is close enough to the mine that noise sources are audible (ie good signal to noise ratio), whilst far enough from the plant to be able to propagate noise emissions to more distant receiver locations. Measurements at the Reference Location were used to calibrate the site noise model, allowing for a quantitative evaluation of potential operational changes, effects of meteorology and noise mitigation measures if required.

5.3.1 NPI Modifying Factors & Corrections for Annoying Noise Characteristics

Detailed spectral analysis of the measured noise levels at the Reference Location (presented in Appendix B) indicates that received noise levels are not tonal in accordance with the NPI assessment methodology and do not exceed the low frequency thresholds and hence, the tonal penalty and low frequency penalty are not applicable.

5.4 Meteorological Analysis

Noise emissions can be influenced by prevailing weather conditions. Light stable winds (<3m/s) and temperature inversions have the potential to increase noise at a receiver.

Fact Sheet D of the NPI provides two options when considering meteorological effects:

- adopt the noise enhancing conditions for all assessment periods without an assessment of how often the conditions occur – a conservative approach that considers a source to receiver winds for all receivers and F class temperature inversions with wind speeds up to 2m/s at night; or

- determine the significance of noise enhancing conditions. This requires assessing the significance of temperature inversions (F and G Class stability categories) for the night time period and the significance of light winds up to 3m/s for all assessment periods during stability categories other than E, F or G.

Standard meteorological conditions and noise-enhancing meteorological conditions as defined in Table D1of the NPI are reproduced in **Table 12**.

Table 12 Standard and Noise-Enhancing Meteorological Conditions

Meteorological Conditions	Meteorological Parameters
Standard Meteorological Conditions	Day/evening/night: stability categories A–D with wind speed up to 0.5m/s at 10m AGL.
Noise Enhancing Meteorological Conditions	Daytime/evening: stability categories A–D with light winds (up to 3 m/s at 10m AGL). Night-time: stability categories A–D with light winds (up to 3m/s at 10m AGL) and/or stability category F with winds up to 2m/s at 10 m AGL.

A detailed analysis of the significance of noise enhancing conditions has not been undertaken and hence, the NPI noise enhancing meteorological conditions have been applied to the noise modelling assessment are presented in **Table 13**.

Table 13 Modelled Meteorological Parameters

Assessment Condition[1]	Temperature	Wind Speed[2]/ Direction	Relative Humidity	Stability Class[2]
Day	20°C	3m/s all directions	50%	D
Evening	10°C	3m/s all directions	50%	D
Night	10°C	2m/s all directions	50%	F

Note 1: Day 7am to 6pm Monday to Saturday or 8am to 6pm on Sundays and public holidays; Evening 6pm to 10pm; Night - the remaining periods.

Note 2: Implemented using CONCAWE meteorological corrections.

5.5 NPI Very Noise Enhancing Conditions

Fact Sheet D of the NPI also states:

'Noise limits derived for consents and licences will apply under the meteorological conditions used in the environmental assessment process, that is, standard or noise-enhancing meteorological conditions. For 'very noise-enhancing meteorological conditions' (see glossary[2]) a limit is set based on the limit derived under standard or noise-enhancing conditions (whichever is adopted in the assessment) plus 5dB. In this way a development is subject to noise limits under all meteorological conditions.'

Essentially, this means a limiting criterion of PNTL +5dB is applicable for meteorological conditions outside that adopted in the assessment. In the context of the project, this means that the operation would need to comply with PNTL +5dB for any prevailing wind or temperature inversion conditions.

2 Meteorological conditions outside of the range of either standard or noise-enhancing meteorological conditions as adopted in the noise impact assessment following the procedures in Fact Sheet D.

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6 Noise Assessment Results

6.1 Operational Noise Assessment

The modelling results for the assessment are presented as noise contours and are shown in Figure 2 to Figure 4.

The assessment assumed that the maximum number of plant and equipment are operating simultaneously and at their typical operating noise emission level. In practice, such operating scenarios would rarely occur and hence, noise predictions are conservative. Noise emissions from all sources are predicted to be below 35dB $L_{Aeq(15min)}$ at all receivers for all assessment periods, satisfying the relevant PNTLs at all receivers in proximity to the project.

6.1.1 Maximum Noise Level Assessment

In assessing maximum noise events, typical L_{Amax} noise levels from transient events were assessed at the nearest residential receivers. Predicted noise levels L_{Amax} events are predicted to be below 40dB L_{Amax} and 35dB $L_{Aeq(15min)}$ at all receivers for the night time period, satisfying the maximum noise trigger levels at all assessed receivers and are presented in Figure 5.

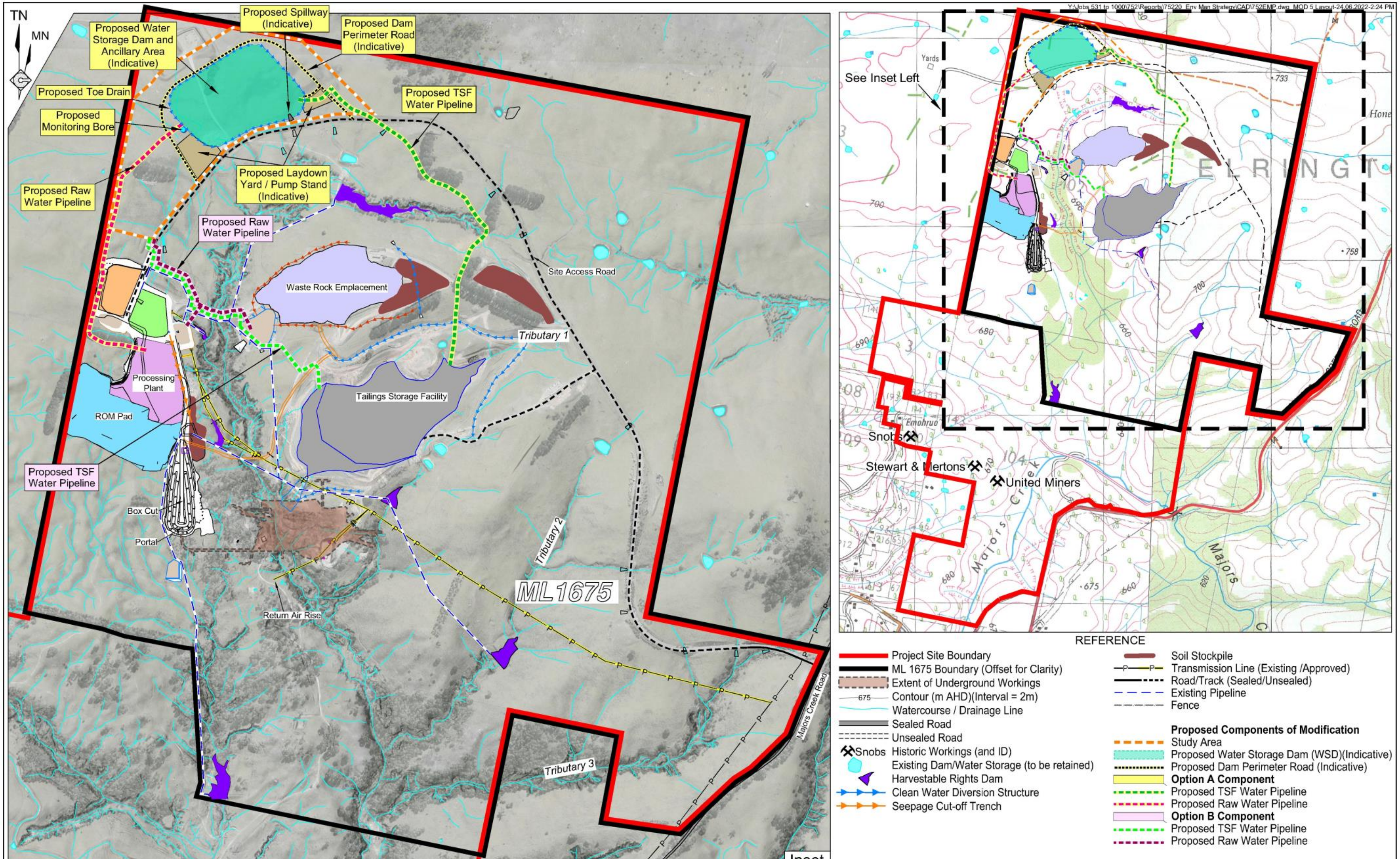

Figure 1

PROPOSED PROJECT SITE LAYOUT

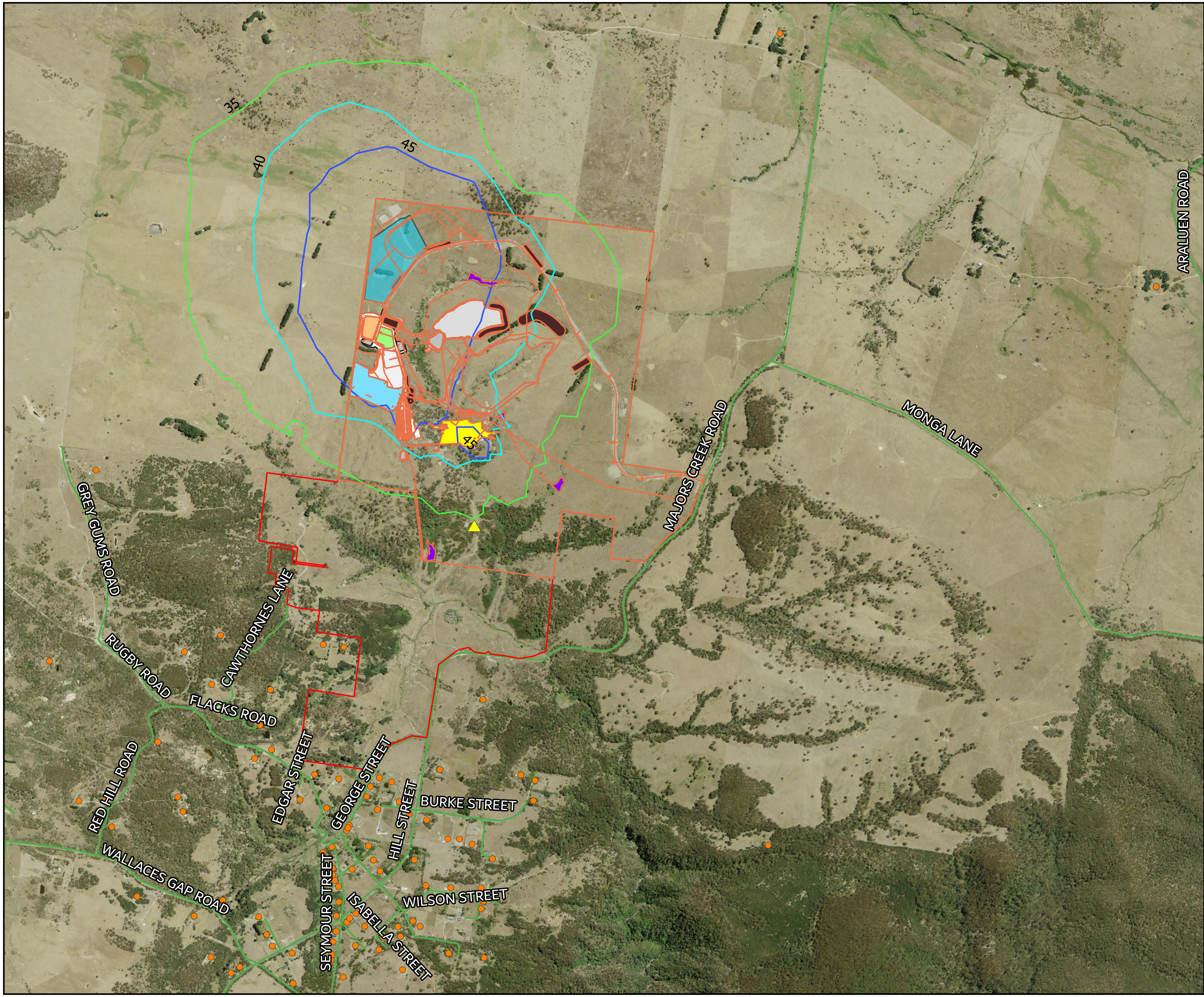

FIGURE 2

Predicted Noise Levels -

Normal Operations

Daytime

MAC201092-03

Dargues Gold Mine

Modification 5

KEY

Noise Sources

Receiver/ Measurement Locations

Reference Location

Proposed WSD

Project Boundary

Predicted Noise Level

dB LAeq(15min)

35

40

45

0 200 400 600 800 1000 m

N

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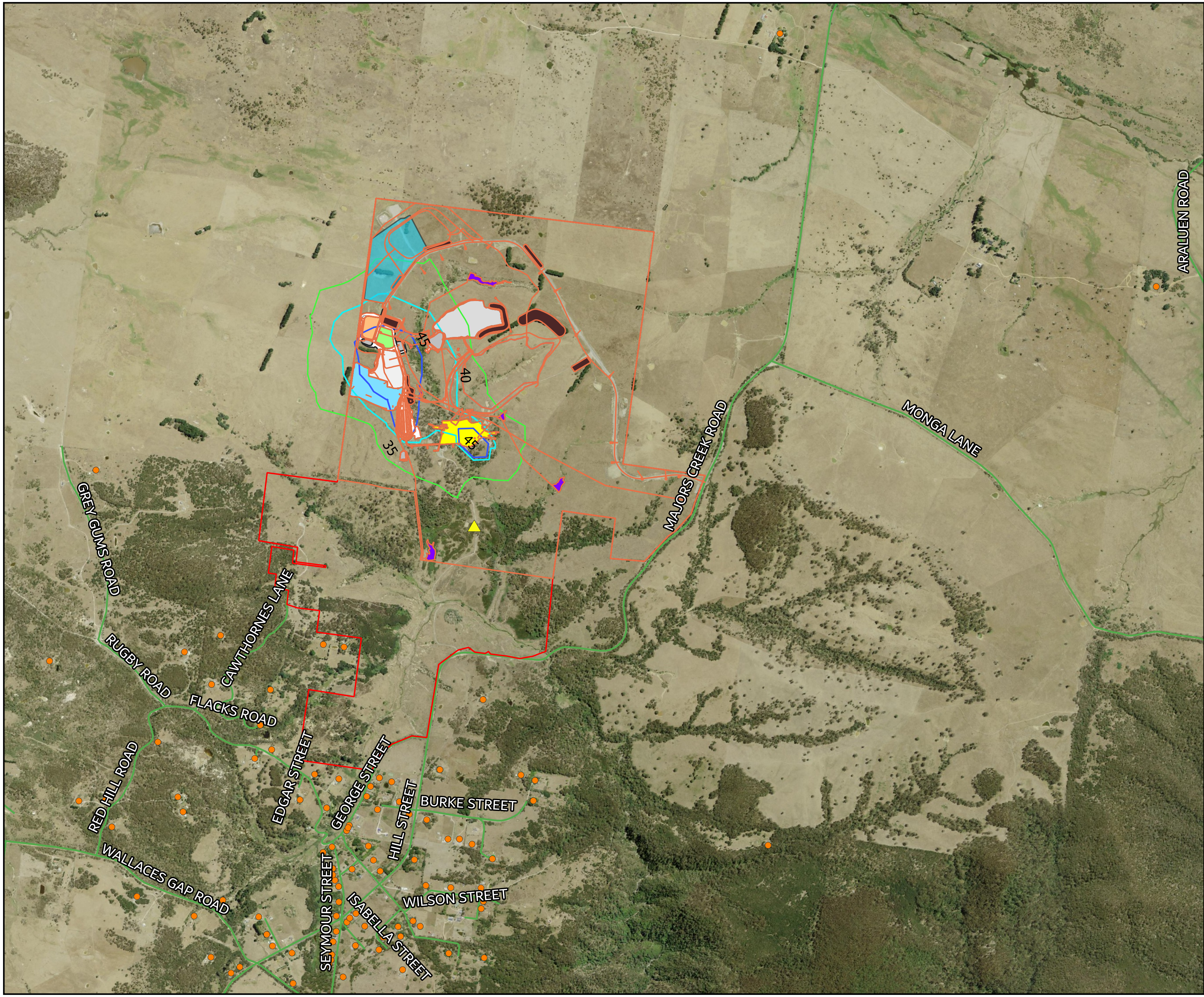

FIGURE 3

Predicted Noise Levels - Normal Operations Evening & Night Time - Prevailing 3m/s Wind

MAC201092-03

Dargues Gold Mine Modification 5

KEY

- Noise Sources
- Receiver/ Measurement Locations
- Reference Location
- Proposed WSD
- Project Boundary

Predicted Noise Level dB LAeq(15min)

- 35
- 40
- 45

0 200 400 600 800 1000 m

N

MAC Muller Acoustic Consulting

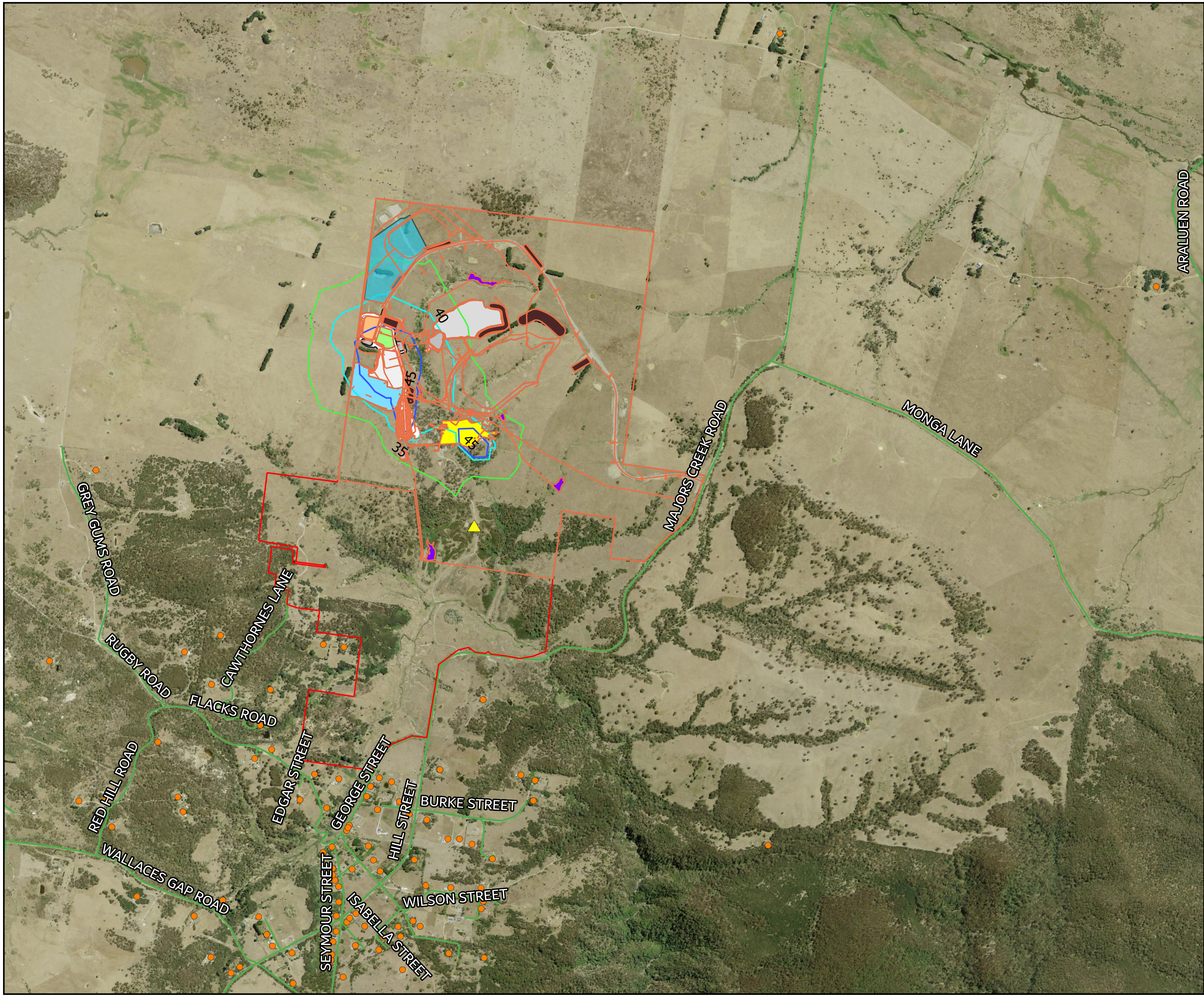

FIGURE 4

Predicted Noise Levels - Normal Operations

Evening & Night Time - F Class Stability + 2m/s Wind

MAC201092-03

Dargues Gold Mine

Modification 5

KEY

Noise Sources

Receiver/ Measurement Locations

Reference Location

Proposed WSD

Project Boundary

Predicted Noise Level dB LAeq(15min)

35

40

45

0 200 400 600 800 1000 m

N

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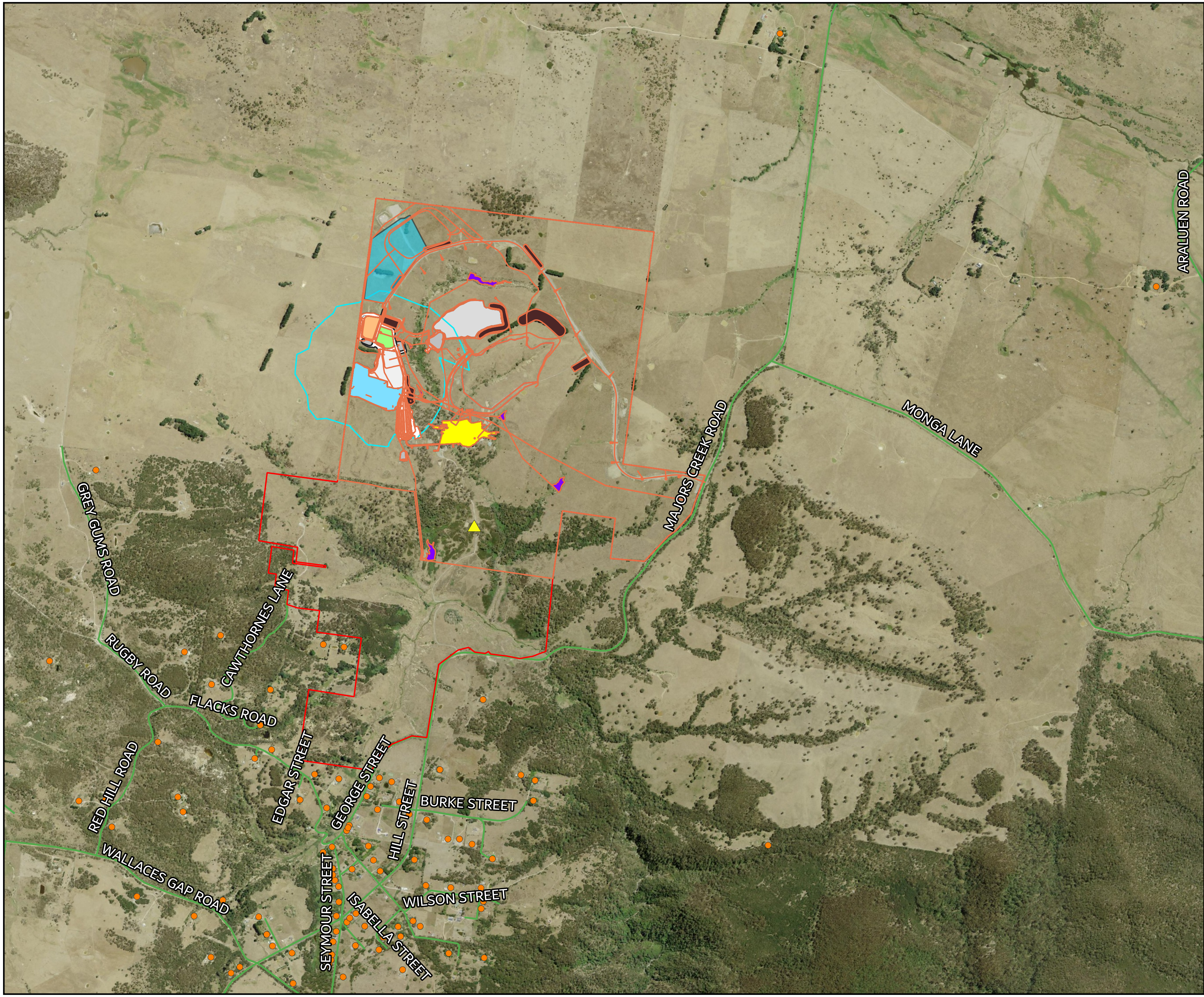

FIGURE 5

Predicted Maximum Noise Levels - Normal Operations Night Time - F Class Stability + 2m/s Wind

MAC201092-03

Dargues Gold Mine Modification 5

KEY

Noise Sources

Receiver/ Measurement Locations

Reference Location

Proposed WSD

Project Boundary

Predicted Noise Level dB LAMax

52

0 200 400 600 800 1000 m

N

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6.2 VLAMP Assessment

A review of noise contours demonstrates that predicted project noise levels do not exceed the VLAMP criteria (40dB $LA_{eq(15min)}$ daytime or 35dB $LA_{eq(15min)}$ night time) at any receiver location. Additionally, predicted project noise levels do not exceed the VLAMP criteria (50dB LAeq(period) daytime and 40dB $LA_{eq(period)}$ night time) on any privately owned vacant lands. Hence, mitigation and/or acquisition rights are not applicable.

6.3 Road Traffic Noise Assessment

Predicted noise levels from project related traffic at the nearest receiver (15m from Majors Creek Road) has been calculated using the United States Department of Transport, Federal Highway Administration Traffic Noise Model (TNM) Low Volume Calculation Tool. The results presented in **Table 14** show the calculated noise levels as $LA_{eq(15hr)}$ for up to four (4) laden trucks (96 daily movements) per hour between 7am and 10pm.

Table 14 Predicted Road Traffic Noise Levels at 15m from Road

Road Type/Name	Predicted Noise Level	RTN Criteria Daytime	Compliance Achieved
Majors Creek Road, Araluen Road	49.4dB LAeq(15hr)	60dB LAeq(15hr)	✓

The proposed modification does not change the overall amount of truck movements to and from the project site, only that the consented four trucks per hour may consist of both concentrate and/or water trucks. Therefore, the results demonstrate that project traffic noise levels would comply with the relevant RNP criteria and that the proposed modification will not change road traffic noise levels.

7 Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has completed a Noise Assessment to quantify emissions from the proposed Modification to the approved Dargues Gold Mine (DGM) at Majors Creek, NSW.

The proposed modification consists of construction of a new Water Management Dam, an increase in processing of ore via efficiency improvements, and a change in the consist of road transportation to include water transportation.

The results of the Noise Assessment demonstrate that emissions from the project would satisfy the relevant PNTLs at all assessed receivers. Furthermore, sleep disturbance is not anticipated, as emissions from impact noise are predicted to satisfy the EPA maximum noise trigger levels. Additionally, there road traffic noise levels will continue to satisfy the RNP criteria as there is no change to the number of trucks entering and leaving the project site.

Based on the Noise Assessment results, the proposed modification satisfies the relevant requirements of the Noise Policy for Industry, Voluntary Land Acquisition and Mitigation Policy and the Road Noise Policy and supports the proposed modification.

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Appendix A – Glossary of Terms

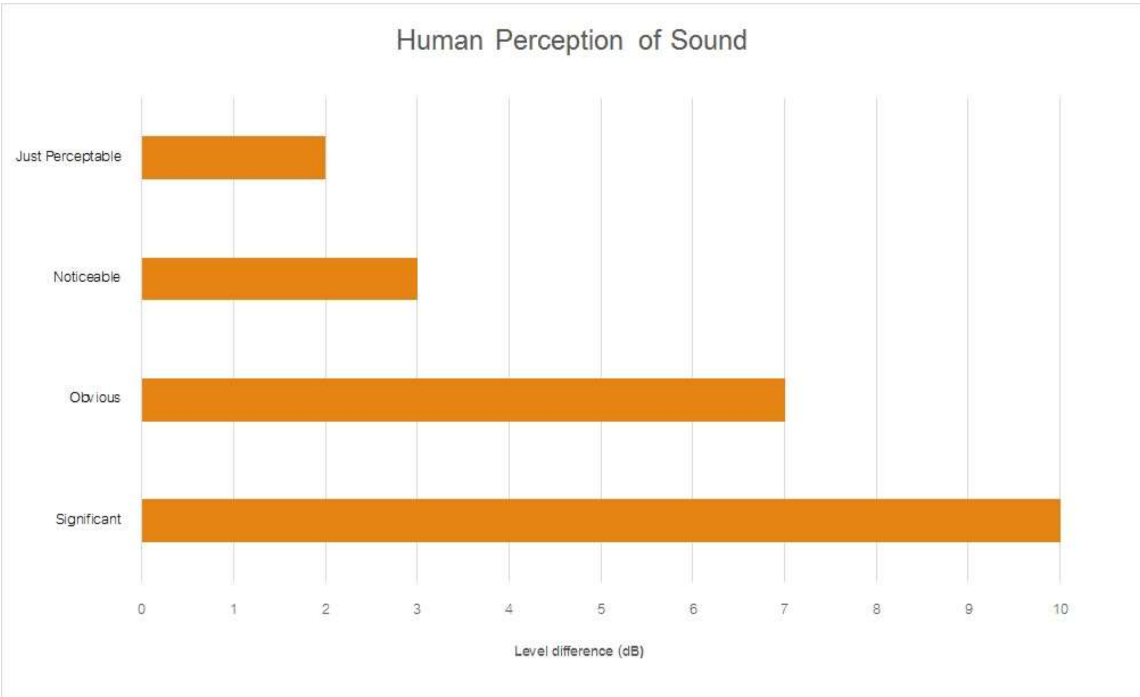
A number of technical terms have been used in this report and are explained in **Table A1**.

Table A1 Glossary of Acoustical Terms	
Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the NPI as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured L90 statistical noise levels.
Ambient Noise	The total noise associated with a given environment. Typically, a composite of sounds from all sources located both near and far where no particular sound is dominant.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to sound.
Background Noise	The underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is removed. This is usually represented by the LA90 descriptor
dBA	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
dB(Z), dB(L)	Decibels Z-weighted or decibels Linear (unweighted).
Extraneous Noise	Sound resulting from activities that are not typical of the area.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
LA10	A sound level which is exceeded 10% of the time.
LA90	Commonly referred to as the background noise, this is the level exceeded 90% of the time.
LAeq	Represents the average noise energy or equivalent sound pressure level over a given period.
LAmax	The maximum sound pressure level received at the microphone during a measuring interval.
Masking	The phenomenon of one sound interfering with the perception of another sound. For example, the interference of traffic noise with use of a public telephone on a busy street.
RBL	The Rating Background Level (RBL) as defined in the NPI, is an overall single figure representing the background level for each assessment period over the whole monitoring period. The RBL, as defined is the median of ABL values over the whole monitoring period.
Sound power level (Lw or SWL)	This is a measure of the total power radiated by a source in the form of sound and is given by 10.log10 (W/Wo). Where W is the sound power in watts to the reference level of 10^{-12} watts.
Sound pressure level (Lp or SPL)	the level of sound pressure; as measured at a distance by a standard sound level meter. This differs from Lw in that it is the sound level at a receiver position as opposed to the sound 'intensity' of the source.

Table A2 provides a list of common noise sources and their typical sound level.

Table A2 Common Noise Sources and Their Typical Sound Pressure Levels (SPL), dBA	
Source	Typical Sound Pressure Level
Threshold of pain	140
Jet engine	130
Hydraulic hammer	120
Chainsaw	110
Industrial workshop	100
Lawn-mower (operator position)	90
Heavy traffic (footpath)	80
Elevated speech	70
Typical conversation	60
Ambient suburban environment	40
Ambient rural environment	30
Bedroom (night with windows closed)	20
Threshold of hearing	0

Figure A1 – Human Perception of Sound



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Appendix B – Annoying Characteristics Assessment

B1 Requirements to Address Annoying Characteristics

Fact Sheet C of the NPI provides guidelines for applying 'modifying factors' adjustments to account for annoying noise characteristics such as low frequency, tonality, intermittent noise, irregular or noise of short duration. A review of modifying factors in accordance with Fact Sheet C of the NPI has been completed and identified that the tonal and low frequency penalties are not applicable.

B1.1 Low Frequency Noise

In accordance with Table C1 of the NPI, the low-frequency noise correction applies when the C-weighted level minus the A-weighted level is 15dB or more, and:

- Where any of the one-third octave noise levels in Table C2 (reproduced in **Table B1**) are exceeded by up to and including 5dB and cannot be mitigated, a 2dBA positive adjustment to the measured/predicted A-weighted levels applies for the evening/night period; or
- Where any of the one-third octave noise levels in Table C2 are exceeded by more than 5dB and cannot be mitigated, a 5dBA positive adjustment to measured/predicted A-weighted levels applies for the evening/night period and a 2dBA positive adjustment applies for the daytime period.

Table B1 One-Third Octave Low-Frequency Noise Thresholds (from Table C2 of NPI)

Frequency (Hz)	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
dB(Z)	92	89	86	77	69	61	54	50	50	48	48	46	44

The measured noise contribution from the mine at the Reference Location is below the 35dB $LA_{eq(15min)}$ criteria, inferring that compliance would also be achieved at receivers in Majors Creek which are at a considerable distance to the south of the Reference Location.

Typically, for assessments, a comparison of the modelled C-A noise levels for receivers nearest to the project is completed. However, as in field measurements have been conducted at the Reference Location, in the applicable frequency range (10Hz to 160Hz) analysis of the measured levels, presented in **Table B2** was undertaken to determine whether the 1/3 octave noise levels in Table C2 of the NPI (**Table B1**) are exceeded.

Table B2 Low Frequency Noise Assessment (from Table C2 of NPI)													
Frequency (Hz)	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
dBZ	92	89	86	77	69	61	54	50	50	48	48	46	44
Reference Location dBZ													
Meas 1 (16/03/22)	38	40	41	41	45	39	37	40	39	40	30	26	30
Meas 2 (17/03/22)	42	40	38	38	38	41	45	45	44	45	35	31	30
Meas 3 (17/03/22)	49	44	40	40	41	45	47	46	44	45	39	33	34
Meas 4 (17/03/22)	46	42	40	40	40	43	46	45	44	46	36	31	29

The results of the analysis of low frequency noise thresholds found that received levels at the Reference Locations do not exceed the thresholds in **Table B1** and would therefore also satisfy the low frequency noise thresholds at receivers more distant from the project. Hence, the low-frequency correction is not applied to received noise levels for this assessment.

B1.2 Tonality

In addition to low frequency noise, a review of modifying factors for tonality have been completed. In accordance with Table C1 of the NPI, a correction for tonal noise applies when the level of 1/3 octave band exceeds the level of the adjacent band on both sides by:

- 5dB or more if the centre frequency of the band containing the tone is in the range 500-10kHz;
- 8dB or more if the centre frequency of the band containing the tone is in the range 16-400Hz; or
- 15dB or more if the centre frequency of the band containing the tone is in the range 25-125Hz.

Table B3 presents the results of the tonality assessment for noise levels measured at the Reference Location. The results of the analysis indicate that noise levels measured at the Reference Location are not tonal in accordance with the NPI methodology and would imply satisfying the tonality test at more distant receivers.

Notwithstanding, predicted noise levels at representative receiver locations based on the calibrated noise inputs are presented in **Table B4**. The results of the analysis indicate that noise levels measured at the Reference Location are not tonal in accordance with the NPI methodology and hence, a correction for tonality is not applicable to received noise levels for this assessment.

Table B3 Tonality Assessment – Reference Location

	1/3 Octave Band Centre Frequency (Hz)																										
Meas #	**25**	**31.5**	**40**	**50**	**63**	**80**	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1k**	**1.25k**	**1.6k**	**2k**	**2.5k**	**3.15k**	**4k**	**5k**	**6.3k**	**8k**	**10k**
Meas 1	45	39	37	40	36	40	30	28	30	22	22	26	25	25	23	22	23	21	21	25	28	18	14	15	14	14	9
Meas 2	38	41	45	45	42	44	35	33	30	33	25	30	33	28	27	25	26	25	24	26	31	19	16	18	17	15	11
Meas 3	41	45	47	46	43	44	39	35	34	28	30	35	35	35	33	30	31	31	29	28	31	21	20	22	20	17	13
Meas 4	40	43	46	45	44	44	36	34	29	32	27	30	33	31	28	26	26	25	25	27	32	23	17	18	17	14	11

Table B4 Tonality Assessment – Representative Receiver Locations

	1/3 Octave Band Centre Frequency (Hz)																										
Rec	**25**	**31.5**	**40**	**50**	**63**	**80**	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1k**	**1.25k**	**1.6k**	**2k**	**2.5k**	**3.15k**	**4k**	**5k**	**6.3k**	**8k**	**10k**
R34	-19	-12	-9	-4	0	5	1	3	6	6	5	2	4	6	5	4	1	-3	-11	-23	-40	-68	-115	--	-19	-12	-9
R29	-16	-9	-6	-1	4	9	5	6	10	9	8	4	7	8	8	7	6	3	-1	-8	-19	-38	-64	-107	-16	-9	-6
R27	-10	-3	0	6	11	16	8	10	14	13	12	8	14	16	16	17	15	12	8	1	-9	-26	-50	-87	-10	-3	0
R20	-13	-6	-3	2	7	13	4	6	10	9	8	5	11	12	12	12	9	6	1	-9	-23	-45	-77	--	-13	-6	-3

Note: "- -" indicates level is below limit of prediction method.

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Appendix 9

Air Quality Impact Assessment

prepared by

Northstar Air Quality Pty Ltd

(Total No. of pages = 69)

This document has been prepared for **R.W. Corkery & Co. Pty Limited** on behalf of **Big Island Mining Pty Ltd** by:

Northstar Air Quality Pty Ltd,
Suite 1504, 275 Alfred Street, North Sydney, NSW 2060

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Dargues Gold Mine – MOD5

Air Quality Impact Assessment

Addressee(s):	Big Island Mining Pty Ltd
Site Address:	Majors Creek, NSW
Report Reference:	22.1053.FR1V1
Date:	27 June 2022
Status:	Final

Quality Control

Study	Status	Prepared by	Checked by	Authorised by
INTRODUCTION	Final	Northstar Air Quality	MD, GCG	MD
THE MINE	Final	Northstar Air Quality	MD, GCG	MD
LEGISLATION, REGULATION AND GUIDANCE	Final	Northstar Air Quality	MD, GCG	MD
EXISTING ENVIRONMENT	Final	Northstar Air Quality	MD, GCG	MD
APPROACH TO ASSESSMENT	Final	Northstar Air Quality	MD, GCG	MD
IMPACT ASSESSMENT	Final	Northstar Air Quality	MD, GCG	MD
MITIGATION AND MONITORING	Final	Northstar Air Quality	MD, GCG	MD
CONCLUSION	Final	Northstar Air Quality	MD, GCG	MD

Report Status

Northstar References		Report Status	Report Reference	Version
Year	Job Number	(Draft: Final)	(R*x*)	(V*x*)
22	1053	Final	R1	V1
Based upon the above, the specific reference for this version of the report is:				22.1053.FR1V1

Final Authority

This report must by regarded as draft until the above study components have been each marked as final, and the document has been signed and dated below.

Martin Doyle **27 June 2021**

Non-Technical Summary

R.W. Corkery & Co. Pty Limited, on behalf of Big Island Mining Pty Ltd has engaged Northstar Air Quality Pty Ltd to perform an air quality impact assessment for a proposed modification to the currently approved site layout and conditions of operation. This air quality impact assessment forms part of the Environmental Impact Statement (EIS) prepared to accompany the modification application for the Mine under Part 4 of the *Environmental Planning and Assessment Act* (1979).

The air quality impact assessment has used a quantitative dispersion modelling approach, performed in accordance with the relevant NSW guidelines. The results of the assessment are presented as predicted incremental change, and as a cumulative impact accounting for the prevailing background air quality conditions.

The assessment indicates that minor exceedances of the annual average $PM_{2.5}$ criteria may be experienced at all nearby sensitive receptors during the proposed modification activities, although this is dominated by the already exceeding background concentrations. The contribution of the proposed modification in itself is shown to be negligible at all receptor locations and no additional exceedances of the impact assessment criteria are predicted at any locations under all modelled scenarios.

No further air quality monitoring is considered to be required to facilitate effective day-to-day air quality management emissions from the project site, and the measures outlined in the current Air Quality Management Plan are considered appropriate to manage any air quality impacts associated with the proposed modification.

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TABLE OF FIGURES

TABLE OF TABLES

1. INTRODUCTION

Big Island Mining Pty Ltd (the Applicant) owns the Dargues Gold Mine (the Mine), which is located approximately 60 kilometres (km) southeast of Canberra, and approximately 13 km south of Braidwood and immediately to the north of the village of Majors Creek, NSW (the Mine Site), as illustrated in Figure 1.

Modified Project Approval (MP) 10_0054 was granted by the Land and Environment Court on 7 February 2012, with subsequent modifications granted on:

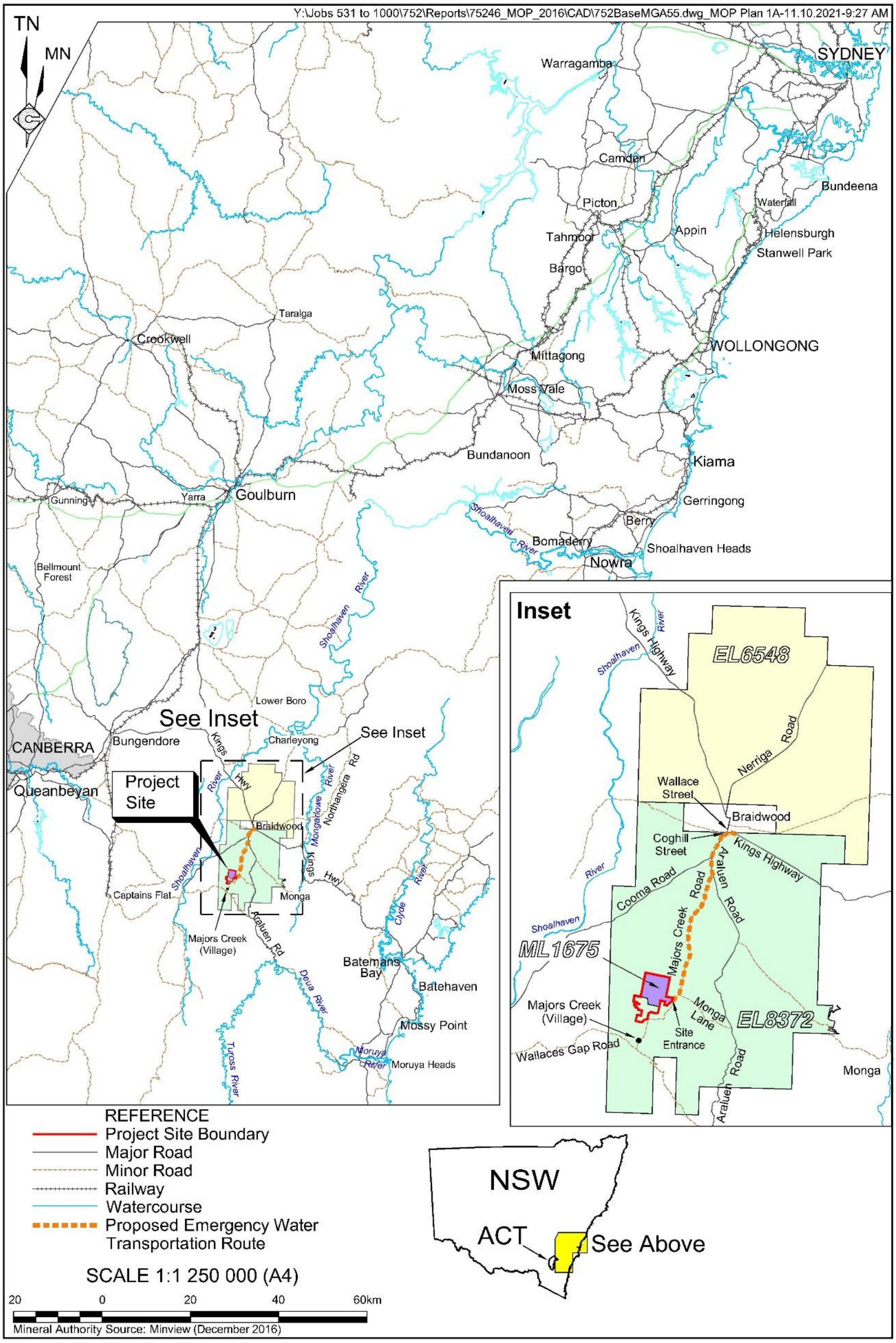
- 12 July 2012 (MOD 1) – to permit the use of paste fill to back fill stopes and underground voids;
- 24 October 2013 (MOD 2) – to regularise the approved layout following minor changes during the detailed design phase of the Project;
- 10 August 2016 (MOD 3) – to allow the construction and use of the Eastern Waste Rock Emplacement, an enlarged Tailings Storage Facility and the Spring Creek crossing, and to accommodate an extension to the mine life; and
- 23 May 2019 (MOD 4) – to permit relocation of the approved Spring Creek crossing, reinstatement of an alternate internal access road and administrative modifications to reflect changes in land ownership.

The Applicant has identified a number of adjustments to the approved site layout and conditions of MP10_0054 operations which are required to maximise the efficiency of mining activities and tailings residue management, clarify permissible transportation operations and regularise the development consent to account for minor changes to the Mine. As a result, the Applicant is proposing a modification (MOD 5) to the Mine (the Proposal).

R.W. Corkery & Co. Pty Limited (RWC) has engaged Northstar Air Quality Pty Ltd (Northstar) on behalf of the Applicant to perform an air quality impact assessment (AQIA) for the Proposal. This AQIA forms part of the Environmental Impact Statement (EIS) prepared to accompany the modification application for the Mine under Part 4 of the *Environmental Planning and Assessment Act* (1979).

The AQIA has used a quantitative dispersion modelling approach, performed in accordance with the relevant NSW guidelines. The results of the assessment are presented as predicted incremental change, and as a cumulative impact accounting for the prevailing background air quality conditions.

Figure 1 Location of the Mine



Source: R.W. Corkery & Co Pty Ltd

2. THE MINE

The following describes the approved operation of the Mine, the Proposed Modification, and describes previous assessments of air quality performed for the original and modified approvals.

2.1. Approved Project

Mining activities at the Project Site are approved under MP_0054 until 30 June 2025. Key activities approved under MP_0054 include the following.

- Extraction of waste rock and ore from the Dargues Gold Deposit using underground sublevel open stope mining methods.
- Processing of up to 355 000 tonnes (t) of ore per year and up to 1.6 million tonnes (Mt) of ore over the life of the Mine.
- Filling of voids created during underground mining using a combination of hydraulic fill and waste rock.
- Construction and use of surface infrastructure required for the underground mine, including a box cut, portal and decline, magazines, fuel store, ventilation rises, back fill hole(s) and power and water supply.
- Construction and use of a processing plant and office area, including an integrated run-of-mine (ROM) pad/temporary waste rock emplacement, crushing and grinding, gravity separation and flotation circuits, Applicant and mining contractor site offices, workshop, laydown area, ablution facilities, stores, car parking, and associated infrastructure.
- Construction and use of a Tailings Storage Facility (TSF).
- Construction and use of a water management system, including eight harvestable rights dams and an associated water reticulation system, to enable the harvesting and supply of water for environmental flows.
- Construction and use of a site access road and intersection to allow site access from Majors Creek Road.
- Transportation of gold concentrate from the Project Site through Braidwood via public roads surrounding the Project Site using covered semi-trailers.
- Construction of the Spring Creek heavy vehicle crossing to permit direct access between the processing plant and the TSF.
- Construction and use of the Eastern Waste Rock Emplacement for the storage of waste rock.

Table 1 presents the approved operating hours for the Mine.

Table 1 Approved Operating Hours

Activity	Operating Hours[1]
Vegetation clearing, topsoil stripping, construction of the box cut andrehabilitation	Day
Remainder of construction operations	Day / evening / night
Mining, paste filling, maintenance and processing operations	Day / evening / night
Crushing operations (including operation of front-end-loader)[2]	7am – 7pm, 7 days per week
Transportation[3]	Day / evening
Surface blasting	9am – 5pm Monday – Friday,excluding public holidays
Underground blasting	Anytime

Note 1: Day: period from 7:00am to 6:00pm on Monday to Saturday, and 8:00am to 6:00pm on Sundays and Public Holidays.
Night: period from 10:00pm to 7:00am on Monday to Saturday, and 10:00pm to 8:00am on Sundays and Public Holidays.

Note 2: Crushing operations may be undertaken outside of these hours on a maximum of 20 days per year.

Note 3: Condition 3(41) of MP10_0054 MOD 4 stipulates the following:

(i) The dispatch of concentrate from the site is limited to between the hours of 7am to 10pm Monday to Saturday and 8am – 10pm Sundays and Public Holidays; and

(ii) All heavy vehicle movements to or from the site are prohibited between the hours of 7am – 8.30am and 3pm – 5pm on school days.

2.1.1. Previous Assessments of Air Quality

A detailed AQIA was performed to support the original approval of the Mine (PAEHolmes, 2010) which concluded that air quality impacts would not exceed the assessment criteria at any of the surrounding sensitive receptors or non-Project related receptors. The AQIA predicted the following maximum incremental particulate concentrations, at any receptor location, during Year 3 of operations (which included mining and processing at maximum anticipated rates):

- Maximum 24-hour average PM_{10} concentration: 9 $\mu g{\cdot}m^{-3}$
- Maximum annual average PM_{10} concentration: 1.1 $\mu g{\cdot}m^{-3}$
- Maximum annual average TSP concentration: 1.3 $\mu g{\cdot}m^{-3}$
- Maximum annual average dust deposition rate: 0.11 $g{\cdot}m^{-2}{\cdot}month^{-1}$

Note: $PM_{2.5}$ criteria were not in force at the time of submission of the original AQIA

The addition of existing background air quality concentrations did not result in any exceedances of the relevant cumulative assessment criteria.

A further assessment of air quality was performed to support MOD3 to MP10_0054 (PEL, 2015). A qualitative assessment was provided, which examined the likely incremental change in TSP emissions resulting from MOD3, when compared to the AQIA performed to support the original approval. That assessment concluded that an increase in TSP emissions of 6.7 % would be associated with MOD3 activities which would result in negligible differences to predicted impacts and would be unlikely to materially change the conclusions of the original AQIA.

2.2. Proposed Modification

Following the granting of MP10_0054 (MOD 4) on 23 May 2019 and the commencement of ore processing operations at the Mine in May 2020, the Applicant has continued to review and refine site practices, management strategies and production targets based on experience with on-site ore processing and tailings management activities. Additionally, experiences during extended drought conditions at the Mine Site in 2019 and 2020 have informed the need to clarify the permissibility of emergency transportation of water to site to support the continuation of operations.

Consequently, the Applicant has identified a number of adjustments to the approved Mine Site layout and conditions of MP10_0054 which are required to maximise the efficiency of mining activities and tailings residue management, clarify permissible transportation operations and regularise the development consent to account for minor changes to the Project Site. In summary, the Applicant anticipates that MOD 5 would include the following.

2.2.1. Water Storage Dam

Construction and use of a turkey nest-style Water Storage Dam (WSD) with no natural catchment and a capacity of approximately 180 million litres (ML) for the receipt and storage of supernatant water from the TSF, water pumped from underground workings, and raw water from other on-site sources. Additional on-site water storage, and the capacity to store supernatant water from the TSF in particular, is required to ensure that excess water generated at the Mine can be safely and effectively managed and to maximise the efficient use of TSF for tailings residue storage. The WSD is also required to enable storage of water for use during periods of reduced rainfall or drought.

The proposed WSD would be constructed using cut and fill methods, with embankment construction materials sourced from the WSD footprint. Ancillary infrastructure including an access road, pump stand / laydown area and surface water diversion bunds would also be constructed adjacent to the proposed WSD.

Information provided by the Applicant indicates that 75 100 m^3 of material (180 240 t, assuming a bulk density of 2.4 $t{\cdot}m^{-3}$) would be required to be removed to allow construction of the WSD, with 68 400 m^3 (164 160 t) of that used in the construction, as fill. A surplus of 6 700 m^3 (16 080 t) would be required to be stored onsite.

2.2.2. Increased Processing Rate

The Applicant proposes to increase the approved processing rate under Condition 6(a) of MP10_0054 from 355 000 tonnes per year ($t{\cdot}yr^{-1}$) to 415 000 $t{\cdot}yr^{-1}$ which is an increase of 60 000 $t{\cdot}yr^{-1}$ and approximately 17 %.

This increase would allow for the more efficient use of existing processing plant and would reflect increased efficiencies in ore processing as a result of ongoing refinements and improvements to the Mine's mining and processing operations.

Mining operations at the Mine are approved until 30 June 2025 and up to 1.6 Mt of ore may be processed at the Mine under Conditions 5 and 6 of MP10_0054 respectively. The proposed processing rate increase would not require any changes to the existing processing plant or the approved TSF and would not increase the total amount of ore processed over the life of the Mine (1.6 Mt). Based on forecast production rates, it is not anticipated that the proposed processing rate increase would reduce the life of the Mine. Additionally, it is anticipated that transportation of gold concentrate generated as a result of the proposed processing rate increase would be accommodated within existing transportation limits for the Mine.

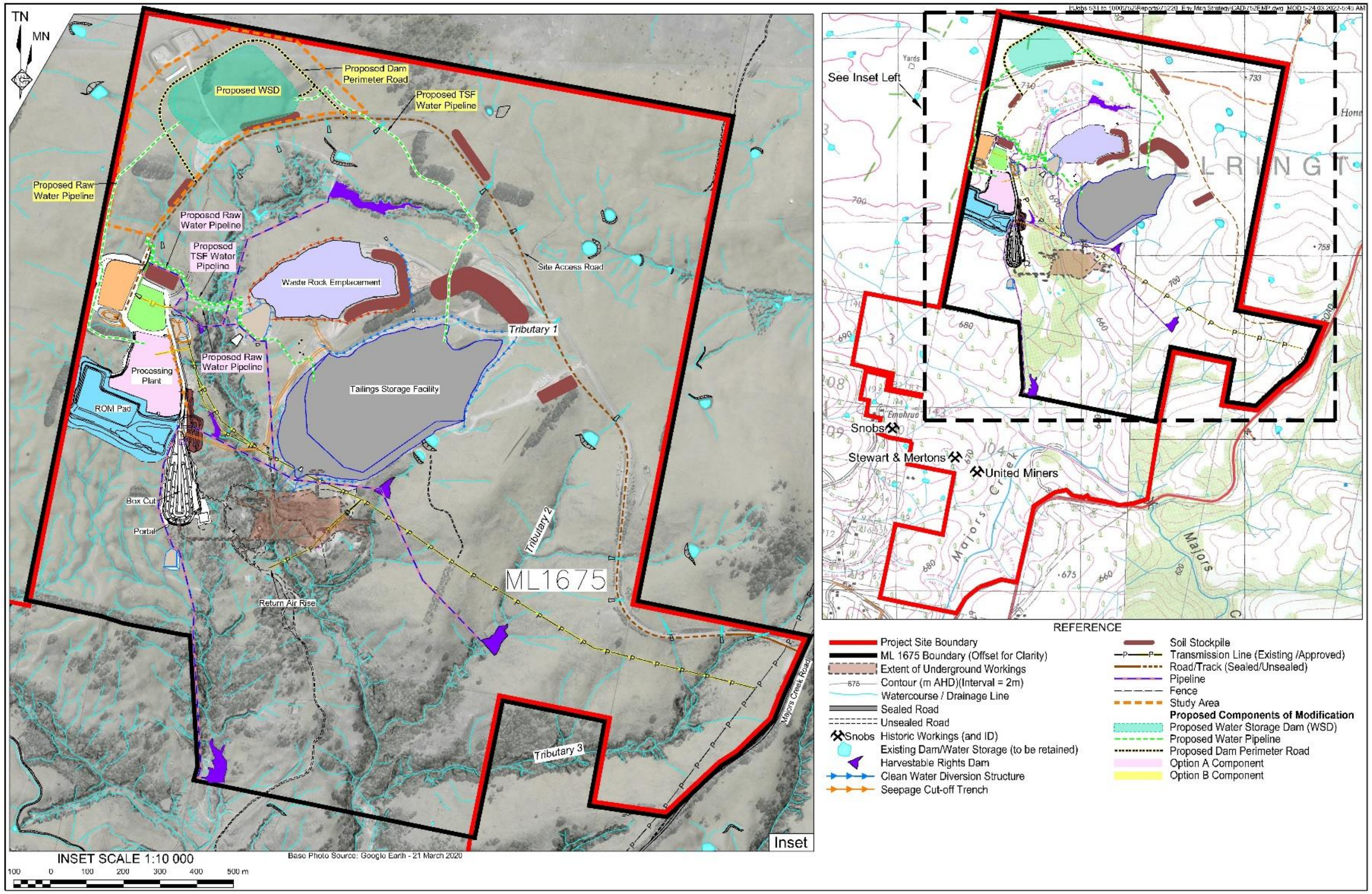
2.2.3. Emergency Transportation of Water

The Applicant is seeking development consent for emergency trucking of water to the Project Site from off-site sources via the Kings Highway, Wallace Street and Coghill Street, Araluen Road and Majors Creek Road. Approval is sought for up to 10 laden truck movements per day to facilitate the provision of emergency water. Emergency trucking of water would only be undertaken where operational water requirements cannot be met by on-site water storages. Water would be sourced from an appropriately licenced source under a commercial arrangement.

Condition 41(a) of MP10_0054 specifies that a maximum of four concentrate trucks may be despatched from the Mine per hour. The Applicant proposes to modify this condition to require that no more than four laden trucks (i.e., concentrate trucks and water trucks) are despatched from or received at the Project Site per hour, thereby clarifying the inclusion of water trucks without increasing the approved laden truck movement rate. Additionally, water trucks movements would be limited to those times specified under Condition 41(b) and would not occur during the periods outlined under Condition 41(c) of MP10_0054.

The proposed site layout resulting from the changes to the approved Project is presented in Figure 2.

Figure 2 Proposed Mine Site layout



Source: R.W. Corkery & Co Pty Ltd

2.3. Identified Potential for Emissions to Air

The processes which may result in the additional emission of pollutants to air as a result of the Proposed Modification would be anticipated to include:

- Transport of an additional 60 000 $t \cdot yr^{-1}$ of ore from underground workings to the ROM pad;
- Unloading and rehandling of additional ore;
- Processing of additional ore; and
- Unloading of additional concentrate to stockpiles and loading to vehicles for offsite transport.
- Movement of additional heavy vehicles transporting concentrate offsite.

Additional emissions from other activities, including wind erosion are not anticipated.

With regards to the construction of the Water Storage Dam, the following processes would be anticipated to result in emissions of pollutants to air:

- Vegetation clearing and soil stripping;
- Movement of material around the WSD footprint to create embankments;
- Loading of trucks with surplus materials, and transport to onsite storage area; and
- Wind erosion of disturbed areas.

The specific air pollutants of interest associated with those activities are:

- Total suspended particulate (TSP);
- Particulate matter with an aerodynamic diameter of 10 microns (PM_{10}); and
- Particulate matter with an aerodynamic diameter of 2.5 microns ($PM_{2.5}$).

No significant additional emissions associated with the emergency transportation of water are anticipated, given that the inclusion of water trucks would not result in an increase in the approved laden truck movement rate. This part of the Proposed Modification is not considered further within this report.

3. LEGISLATION, REGULATION AND GUIDANCE

3.1. NSW EPA Approved Methods

State air quality guidelines adopted by the NSW EPA are published in the *'Approved Methods for the Modelling and Assessment of Air Quality in NSW'* (the Approved Methods (NSW EPA, 2016)) which has been consulted during the preparation of this assessment report.

The Approved Methods lists the statutory methods that are to be used to model and assess emissions of criteria air pollutants from stationary sources in NSW. Section 7.1 of the Approved Methods clearly outlines the impact assessment criteria to be applied.

The criteria listed in the Approved Methods are derived from a range of sources (including National Health and Medical Research Council [NHMRC], National Environment Protection Council [NEPC], Department of Environment [DoE], and World Health Organisation [WHO]).

The criteria specified in the Approved Methods are the defining ambient air quality criteria for NSW. The standards adopted to protect members of the community from health impacts in NSW are presented in Table 2.

Table 2 NSW EPA air quality standards and goals

Pollutant	Averaging period	Units	Criterion	Notes
Particulates (as PM_{10})	24 hours	$\mu g \cdot m^{-3}$ (a)	50	Numerically equivalent to the Ambient Air Quality National Environment Protection Measure (AAQ NEPM)(b) standards and goals.
	1 year	$\mu g \cdot m^{-3}$	25	
Particulates (as $PM_{2.5}$)	24 hours	$\mu g \cdot m^{-3}$	25	
	1 year	$\mu g \cdot m^{-3}$	8	
Particulates (as total suspended particulate [TSP])	1 year	$\mu g \cdot m^{-3}$	90	
Deposited dust	1 year	$g \cdot m^{-2} \cdot month^{-1}$(c)	2	Assessed as insoluble solids as defined by AS 3580.10.1
		$g \cdot m^{-2} \cdot month^{-1}$(d)	4	

Notes: (a): micrograms per cubic metre of air
(b): National Environment Protection (Ambient Air Quality) Measure
(c): grams per square metre per month, as the maximum increase in deposited dust level
(d): grams per square metre per month as the maximum total deposited dust level

3.2. Protection of the Environment (Clean Air) Regulation 2021

The Protection of the Environment Operations (POEO) (Clean Air) Regulation (2021) sets standards of concentration for emissions to air from both scheduled and non-scheduled activities. For the activities performed at the Mine, the POEO (Clean Air) Regulation provides general standards of concentration for scheduled premises which are presented in Table 3 for the pollutants of relevance to this assessment.

Table 3 POEO (Clean Air) Regulation – General standards of concentration

Air Impurity	Activity	Standard of Concentration (Group 6)[1]
Solid particles (total)	Any activity or plant (except as listed below)	50 $mg \cdot m^{-3}$
	Any crushing, grinding, separating or materials handling activity	20 $mg \cdot m^{-3}$

Note: (1) Group 6 – pursuant to application made on or after 1 September 2005

Further to the requirements in Table 3, Part 4 Clause 15 of the POEO (Clean Air) Regulation requires that motor vehicles do not emit excessive air impurities which may be visible for a period of more than 10-seconds when determined in accordance with the relevant standard.

All vehicles, plant and equipment to be used either at the Mine Site or to transport materials to and from the Mine Site will be maintained regularly and in accordance with manufacturers' requirements, where these vehicles are under the operational control of the Applicant.

4. EXISTING ENVIRONMENT

4.1. Surrounding Land Sensitivity

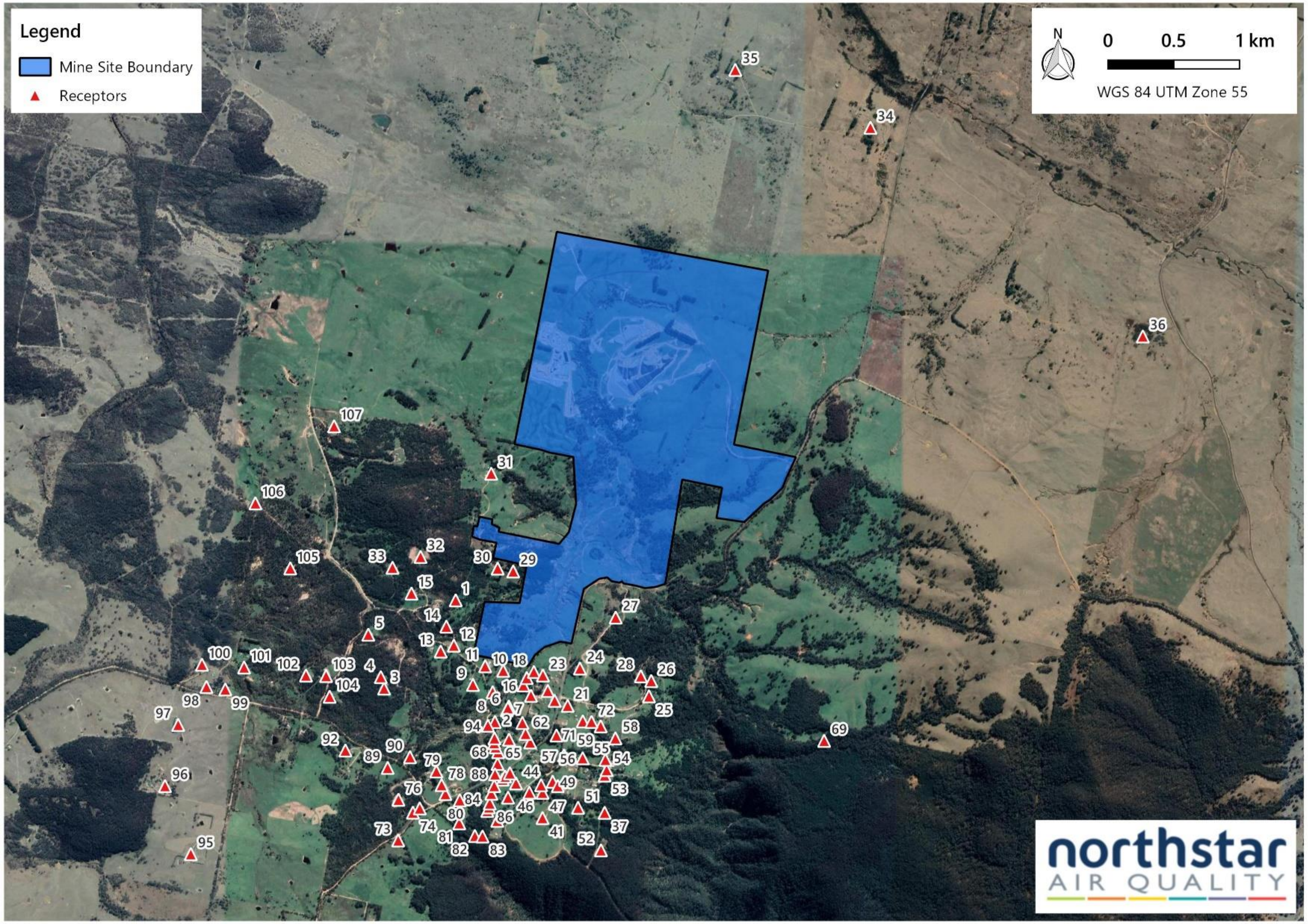
4.1.1. Discrete Receptor Locations

Air quality assessments typically use a desk-top mapping study to identify 'discrete receptor locations', which are intended to represent a selection of locations that may be susceptible to changes in air quality. In broad terms, the identification of sensitive receptors refers to places at which humans may be present for a period representative of the averaging period for the pollutant being assessed. Typically, these locations are identified as residential properties although other sensitive land uses may include schools, medical centres, places of employment, recreational areas or ecologically sensitive locations.

It is noted that in addition to the identified 'discrete' receptor locations, the entire modelling area is gridded with 'uniform' receptor locations (see Section 4.1.2) that are used to plot out the predicted impacts, and as such the accidental non-inclusion of a location sensitive to changes in air quality does not render the AQIA invalid, or otherwise incapable of assessing those potential risks.

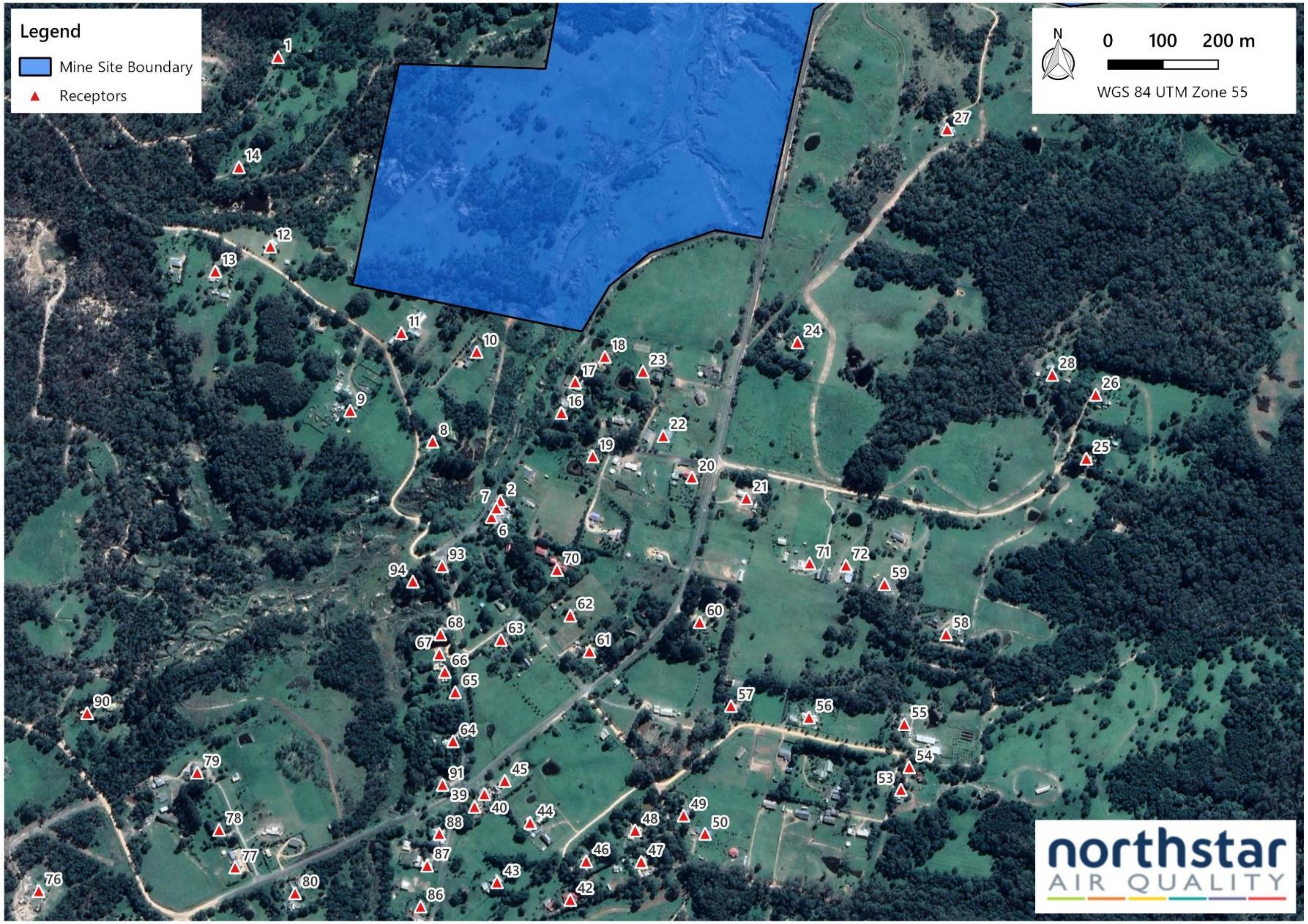
A number of residential locations surrounding the Mine Site have been identified and these receptors have been adopted for use within this AQIA as presented in Appendix C. It is noted that these receptor locations are consistent with those adopted within the original AQIA and subsequent modifications, where relevant.

Figure 3 Sensitive receptors surrounding the Mine Site (1 of 2)



Source: Northstar Air Quality

Figure 4 Sensitive receptors surrounding the Mine Site (2 of 2)



Source: Northstar Air Quality

4.1.2. Uniform Receptor Locations

Additional to the sensitive receptors identified in Section 4.1.1, a grid of uniform receptor locations has been used in the AQIA to allow presentation of contour plots of predicted impacts.

4.2. Meteorology

In accordance with the requirements of the NSW EPA Approved Methods, the AQIA is required to describe and account for the influence of the prevailing meteorological conditions.

The meteorology experienced within an area can govern the generation (in the case of wind dependent emission sources), dispersion, transport and eventual fate of pollutants in the atmosphere. The meteorology of the area surrounding the Mine Site has been examined using data collected by the Australian Government Bureau of Meteorology (BoM) at the Braidwood Racecourse Automatic Weather Station (AWS), which is approximately 13.5 km north of the Mine Site. Meteorological data is also collected by the Applicant at an on-site weather station (refer Figure 5). Braidwood Racecourse AWS, at which data is fully validated via an independent source, has been selected to be the primary source of data for use in this study to avoid any perceived bias. Consequently, Braidwood Racecourse AWS is considered the most representative station for the area surrounding the Mine Site and has been used to select a representative year.

To provide a characterisation of the meteorology which would be expected at the Mine Site, a meteorological modelling exercise has been performed.

Data from the year 2017 has been selected for use in the AQIA to provide an approximation of 'representative' conditions surrounding the Mine. This year has been selected through examination of meteorology and background air quality conditions for the five-year period 2016 to 2020. The year 2017 was selected as being most representative as wind speed and direction measured at Braidwood Racecourse AWS in 2017 were considered to be most representative of the five-year period examined.

A summary of the inputs and outputs of the meteorological modelling assessment, including model validation, is presented in Appendix A. This analysis includes a discussion of data availability and variability.

4.3. Air Quality

The air quality experienced at any location will be a result of emissions generated by natural and anthropogenic sources on a variety of scales (local, regional and global). The relative contributions of sources at each of these scales to the air quality at a location will vary based on a wide number of factors including the type, location, proximity and strength of the emission source(s), prevailing meteorology, land uses and other factors affecting the emission, dispersion and fate of those pollutants.

When assessing the impact of any particular source of emissions on the potential air quality at a location, the impact of all other sources of an individual pollutant should also be assessed. This 'background' (sometimes called 'baseline') air quality will vary depending on the pollutants to be assessed and can often be characterised by using representative air quality monitoring data.

The closest air quality monitoring stations (AQMS) to the Mine Site are located within the ACT and operated by the ACT Government. However, these AQMS are located in highly urbanised areas and would not be representative of the air quality environment surrounding the Mine Site, which is more likely to be impacted by sources such as agricultural activity and solid wood fired heaters, rather than road traffic and other urban-related emissions sources. The NSW Department of Planning and Environment (DPE) operate three AQMS within a 240 km radius of the Mine Site, which are summarised in Appendix B. Whilst these AQMS are less proximate than the AQMS operated in ACT, they are located in areas considered to be more representative of the environment surrounding the Mine Site.

The Applicant has operated a High-Volume Air Sampler (HVAS) for the measurement of PM_{10} on a 1-in-6 day cycle, at a location approximately 1.3 km south-west of the portal, since September 2018 (HVAS-1), as shown on Figure 5. These measurements are appropriate to demonstrate the impact of the Mine, and all other sources of particulate emissions, on the air quality environment of that particular area. The measurements are not appropriate for use within an AQIA however, as they do not provide a continuous daily measurement which can be used to determine the cumulative impact of the Proposed Modification, as per the requirements of the Approved Methods. Continuous 24-hour measurements as collected by NSW DPE at the Albury, Bathurst and Wagga Wagga North AQMS, which have been reviewed in conjunction with site specific data to determine the most appropriate data for use within this AQIA.

A review of annual average and daily maximum PM_{10} concentration measurements at the HV-1, Albury, Bathurst, and Wagga Wagga North AQMS has been performed, and presented in Appendix B. This indicates that the annual average PM_{10} concentrations measured at the HV-1 location are all significantly lower than the annual averages measured at the NSW DPE AQMS. Furthermore, when examining the maximum 24-hour average PM_{10} concentrations, the measurements at HV-1 are significantly lower than those measured at Albury, Bathurst, and Wagga Wagga North, (acknowledging the lower number of measurements at HV-1 when compared to NSW DPE AQMS).

Of the three NSW DPE AQMS, concentrations of PM_{10} measured at the Wagga Wagga North AQMS are consistently higher than those measured at either Albury or Bathurst and is also the closest NSW DPE AQMS to the Mine Site. Data from Wagga Wagga North AQMS has therefore been adopted to conservatively represent the air quality environment surrounding the Mine Site.

An assessment of the most representative year for adoption in modelling has been performed using a statistical approach, as presented in Appendix B. That assessment indicates that data collected in the year 2017 at the Wagga Wagga AQMS is statistically most representative of the 5-year dataset (2016-2020). The elevated PM_{10} concentrations measured across NSW in 2018, 2019, and 2020 were predominantly due to the intense drought conditions and bushfires that occurred during this time (NSW DPIE, 2021).

$PM_{2.5}$ concentrations are measured at the Albury, Bathurst and Wagga Wagga North AQMS, and to maintain consistency with the PM_{10} data selected for adoption, $PM_{2.5}$ data from Wagga Wagga North AQMS have also been adopted as a representation of background air quality at the Mine Site. Annual average and maximum 24-hour $PM_{2.5}$ concentrations measured at Wagga Wagga North are also shown to be generally higher than those measured at either Albury or Bathurst and are therefore likely to provide a conservative representation of the $PM_{2.5}$ environment at the Mine Site (see Appendix B).

It is noted that none of the AQMS operated by NSW DPE measure concentrations of TSP. Other sources of data have been adopted to allow representation of the TSP environment in the area surrounding the Proposal, and a full discussion is provided in Appendix B.

Dust deposition is monitored by the Applicant at five locations surrounding the Mine Site, as shown on refer Figure 5. The annual average deposited dust levels across all dust gauges between FY2013 and FY2020 was 1.1 $g{\cdot}m^{-2}{\cdot}month^{-1}$, with the maximum at any dust gauge in all years monitored being 2.1 $g{\cdot}m^{-2}{\cdot}month^{-1}$, significantly less than the 4 $g{\cdot}m^{-2}{\cdot}month^{-1}$ criterion. For the purposes of this assessment, a background dust deposition rate of 2.1 $g{\cdot}m^{-2}{\cdot}month^{-1}$ has been adopted, which is highly conservative. A summary of the air quality monitoring data used in this assessment is presented in Table 4.

Table 4 Summary of background air quality used in the AQIA

Pollutant	Ave Period	Measured Value	Notes
Particles (as TSP)	Annual $\mu g{\cdot}m^{-3}$	48.2	Estimated on a TSP:PM_{10} ratio of 2.3404 : 1
Particles (as PM_{10})	24-hour $\mu g{\cdot}m^{-3}$	Daily Varying	The 24-hour maximum PM_{10} in 2017 at Wagga Wagga North was measured to be 171.6 $\mu g{\cdot}m^{-3}$
	Annual $\mu g{\cdot}m^{-3}$	20.6	
Particles (as $PM_{2.5}$)	24-hour $\mu g{\cdot}m^{-3}$	Daily Varying	The 24-hour maximum $PM_{2.5}$ in 2014 at Wagga Wagga North was measured to be 32.5 $\mu g{\cdot}m^{-3}$
	Annual $\mu g{\cdot}m^{-3}$	8.1	
Dust deposition	Annual $g{\cdot}m^{-2}{\cdot}month^{-1}$	2.1	Maximum annual average measured at any DDG

Note: Reference should be made to Appendix B

Figure 5 Location of air quality and meteorological monitoring surrounding the Mine Site

This AQIA has been performed to provide confidence that the Proposed Modification can be operated without giving rise to additional exceedances of the air quality criteria as outlined in Section 3, particularly noting the conservative background air quality assumptions discussed above.

4.4. Topography

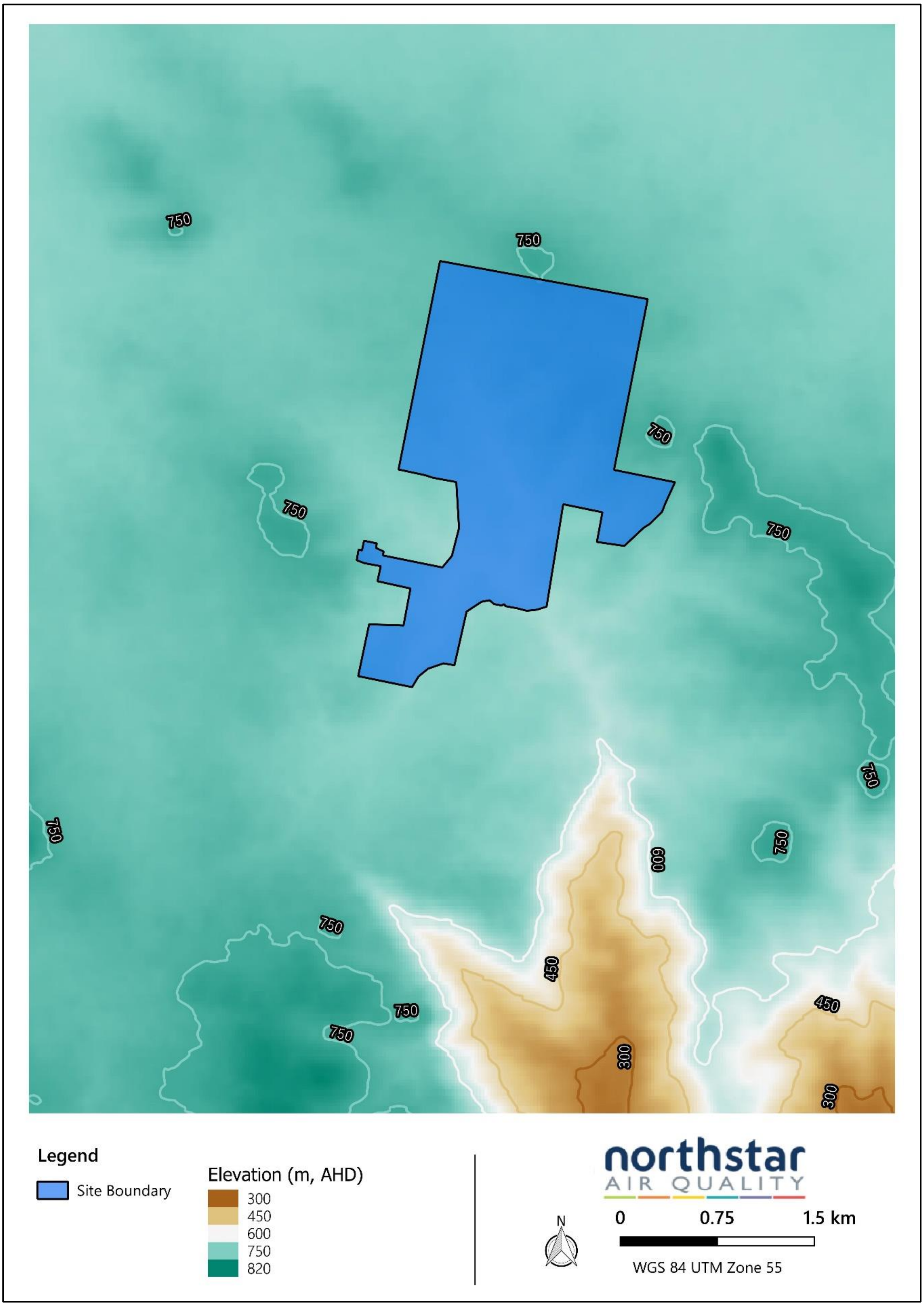
The Mine site is located in an area of undulating hills located between two north – south trending ridgelines. The western ridgeline, located between approximately 15 km and 20 km to the west to the Mine Site is a section of the Great Dividing Range with maximum elevations of approximately 1 346 m AHD and 1 359 m Australian Height Datum (AHD) at Mount Lowden (approximately 15 km to the west-northwest of the Mine site) and Mount Cowagerong (approximately 23 km to the southwest of the Mine site) respectively (refer Figure 6). The topography of the area, and the locations of surrounding receptors in relation to the Proposal and surrounding topography has informed the approach to meteorological modelling (refer Section 4.2 and Appendix A).

4.5. Potential for Cumulative Impacts

The area surrounding the Mine Site is generally agricultural in nature, with no significant sources of particulate matter that may impact cumulatively with the Mine on nearby sensitive receptors. The inclusion of the background air quality data as described in Section 4.3 would appropriately account for any potential cumulative impacts associated with surrounding land uses.

The adopted background air quality data has been shown to provide a conservative representation of 'existing' air quality, which includes the current operation of the Mine.

Figure 6 Topography surrounding the Mine site



Source: Northstar Air Quality

5. APPROACH TO ASSESSMENT

5.1. Broad Approach

The AQIA performed to support the original approval for the Mine (PAEHolmes, 2010) included a detailed dispersion modelling exercise which assessed the potential air quality impacts associated with activities such as:

- Topsoil removal, movement to soil stockpiles, and emplacement;
- Loading and movement of waste rock from the WRE to underground workings;
- Movement, unloading and processing ore from underground workings;
- Loading and movement of concentrate offsite; and
- Wind erosion.

Given that the Proposed Modification would result in changes to the activity rates for a limited number of the activities above and given that incremental impacts predicted as part of the original AQIA were shown to be minor (refer Section 2.1.1), a limited dispersion modelling assessment has been performed.

The approach to assessment includes a quantification of the predicted incremental increase in particulate concentrations which might be anticipated to result from the operation of the Proposed Modification, specifically the increased processing rate:

- Movement, unloading and processing ore from underground workings at a rate of 60 000 $t{\cdot}yr^{-1}$; and
- Loading and movement of concentrate offsite at a rate of 5 700 $t{\cdot}yr^{-1}$ (or 9.5 % of the raw feed).

Note that these activity rates represent the additional activity rates anticipated above those approved.

Furthermore, activities associated with the construction of the Water Storage Dam have been quantified and subject to dispersion modelling:

- Excavation of material at a rate of 180 240 $t{\cdot}yr^{-1}$;
- Replacement of material and shaping of embankments at a rate of 164 160 $t{\cdot}yr^{-1}$;
- Relocation of 16 080 $t{\cdot}yr^{-1}$ of surplus material to adjacent soil stockpile; and
- Wind erosion of the WSD prior to use.

For the purposes of this assessment, construction of the WSD has been assumed to be performed over one year and be coincidental with increased processing activities. This provides a worst-case assessment, as following construction of the WSD, impacts would be limited to those associated with increased processing activities only. The results presented in this report differentiate the potential impact associated with each discrete element of the Proposed Modification.

To the modelled incremental impacts is added the background air quality data as outlined and discussed in Section 4.3.

A review of the air quality monitoring data collected close to the Mine Site confirms that the concentrations measured at Wagga Wagga North AQMS are significantly higher than those measured near to the Mine, which include the contribution from the Mine operating at the approved throughput (please refer to Section 4.3 and Appendix B for a full discussion). The use of air quality data collected at Wagga Wagga North AQMS is therefore conservative to represent the impacts of the Mine operating at those approved throughputs, and the approach to modelling (i.e., modelling the proposed incremental increase in emissions due to the Proposed Modification) is appropriate.

5.2. Dispersion Modelling

A dispersion modelling assessment has been performed using the NSW EPA approved CALPUFF atmospheric dispersion model. The modelling has been performed in CALPUFF 3-dimensional (3-D) mode, adopting a 'No-Obs' meteorological modelling simulation, in accordance with NSW DPE guidance (Barclay & Scire, 2011) (please refer to Appendix A for further information). This approach allows the inclusion of topographical features which are present in the area surrounding the Mine, as discussed in Section 4.4.

An assessment of the impacts of the operation of activities associated with the Proposed Modification has been performed which characterises the likely day-to-day operation, approximating average operational characteristics which are appropriate to assess against longer term (annual average) criteria for particulate matter. The likely peak activities associated with the Proposed Modification have been assumed to be closely related to the average operational characteristics and have been adopted to allow comparison of potential impacts against shorter term (24-hour) criteria for particulate matter.

The following provides a description of the determination of appropriate emissions of air pollutants resulting from the operation of the Mine.

5.3. Emissions Estimation

The estimation of emissions from a process is typically performed using direct measurement or through the application of factors which appropriately represent the processes under assessment. This assessment has adopted emission factors for materials handling processes, movement of trucks on unpaved site roads, crushing and screening, and wind erosion contained within the US EPA AP-42 emission factor compendium (US EPA, 1995 and updates) to represent the emission of particulate matter resulting from the operations occurring as part of the Proposed Modification as described in Section 2.3. These factors are appropriate for adoption in Australia and are routinely adopted in the assessment of operations of this nature.

A full description of the emission sources included in the assessment, and the emission factors and assumptions adopted are presented in Appendix D.

5.4. Emissions Controls

Emissions controls will be employed as part of the Proposed Modification, as they are currently. Air quality management measures are outlined in the Air Quality Management Plan (AQMP) for the Mine (Big Island Mining Ltd, 2019), which are reproduced below in Table 5.

Table 5 Summary of air quality management measures adopted as part of Mine operation

Source	Emission control method
Wind-blown dust	
Areas disturbed by mining	• Disturb only the minimum area necessary for mining operations. • Stabilise the face of the waste rock emplacement/ROM Pad, Tailings Storage Facility embankment and other disturbed sections of the Project Site that are not required for mining operations as soon as practicable following construction.
Ore handling areas / stockpiles	• Maintain ore handling areas / stockpiles in a moist condition as required using water carts to minimise wind-blown and traffic-generated dust.
Stockpiles	• Have available water sprays/water carts on stockpiles to minimise the generation of dust.
Mine design and construction	
Transport of ore	• Use the largest practicable truck size to reduce the number of movements necessary to transport ore material. • Use conveyors within the processing plant to transport crushed ore material. • Establish and use water sprays on key transfer points within the processing plant.
Waste Rock Emplacement	• Profile all surfaces to reduce surface wind speed. • Contour the final landform shape to avoid strong wind flows and smooth gradients to reduce turbulence at surface.
Revegetation	• Complete as soon as practical after disturbance. • Apply vegetation as widely as practical.
Mine generated dust	
Roads	• All roads and trafficked areas will be watered as required using water trucks to minimise the generation of dust. • Enforce a speed limit of 40km/h or less on all roads within the Project Site. • All roads will have edges clearly defined with marker posts or equivalent to control their locations. • Development of minor roads will be limited and the locations of these clearly defined. • Obsolete roads will be ripped and re-vegetated. • Ensure that all concentrate vehicles leaving the Project Site are covered to prevent concentrate material blowing from the truck.
Topsoil stripping	• Access tracks used by topsoil stripping equipment during their loading and unloading cycle will be watered.
Topsoil stockpiling	• Long term topsoil stockpiles will be re-vegetated.

Source	Emission control method
Processing	• Establish and use water sprays on key transfer points within the processing plant. • Minimise drop heights from the ROM bin to the primary crusher.
Blasting operations	• Ensure that all surface blasts are appropriately designed to minimise emission of particulate matter.
Cement use and storage	• Ensure that a reverse pulse dust collector, as well as overpressure and vacuum sensors, are fitted to the cement storage silo and are operational to prevent dust emissions. • Deliver cement in bulk and pneumatically unload directly into the storage silo.

Source: from Table 6.1 of (Big Island Mining Ltd, 2019)

Although these emission controls are applied at all times during the Mine operation, only a number would be applicable to the Proposed Modification, and only a number of those have quantifiable emission reduction efficiencies reported in the literature, which can be used in the dispersion modelling exercise.

In relation to the assessment of the increased processing rate, the following emission controls have been applied in modelling (consistent with (PAEHolmes, 2010):

- 100 % control associated with ball milling (wet process); and
- 50 % control associated with watering of haulage routes.

In relation to the assessment of the construction of the Water Storage Dam, the following emission control has been applied in modelling:

- 50 % control associated with watering of haulage routes associated with the construction of the WSD.

Full emissions inventories are presented in Appendix D.

6. IMPACT ASSESSMENT

The broad approach adopted to assess the potential impacts of the Proposed Modification is discussed in Section 5.1. This section presents the results of the dispersion modelling assessment and uses the following terminology:

- Increased Processing Rate – relates to the incremental concentrations predicted as a result of the increased processing rate in isolation.
- WSD impact – relates to the incremental concentrations predicted as a result of the construction of the Water Storage Dam in isolation.
- Cumulative impact – relates to the incremental concentrations predicted as a result of the increased processing rate PLUS the construction of the WSD PLUS the background air quality concentrations discussed in Section 4.3.

The results are presented in this manner to allow examination of the likely impact of the Increased processing rate and construction of the WSD in isolation, and the contribution to air quality impacts in a broader sense.

It is noted that the cumulative impact associated with the increased processing rate and WSD construction are anticipated to occur concurrently for a maximum period of one year. The cumulative impacts at the concentrations presented are therefore anticipated to be lower during ongoing operations.

In the presentation of results, the tables included shaded cells which represent the following:

Model prediction	Pollutant concentration / deposition rate less than the relevant criterion	Pollutant concentration / deposition rate equal to, or greater than the relevant criterion

6.1. Particulate Matter – Annual Average PM_{10} and $PM_{2.5}$

The predicted annual average particulate matter concentrations (as TSP, PM_{10} and $PM_{2.5}$) resulting from the Proposed Modification are presented in Table 6.

The results indicate that predicted incremental concentrations of TSP, PM_{10} and $PM_{2.5}$ at sensitive receptor locations are low, and represent as a maximum (for impacts associated with both the increased processing rate, and WSD construction):

- 0.2 % of the annual average TSP criterion;
- < 0.1 % of the annual average PM_{10} criterion; and
- < 0.1 % of the annual average $PM_{2.5}$ criterion.

Background concentrations of $PM_{2.5}$ are noted to be in exceedance of the relevant criterion, without the addition of any incremental impact. Background $PM_{2.5}$ concentrations measured at Wagga Wagga North AQMS were adopted as a representation of background air quality at the Project Site. Annual average and maximum 24-hour $PM_{2.5}$ concentrations measured at Wagga Wagga North are shown to be generally higher than those measured at other nearby stations and are therefore likely to provide a conservative representation of the $PM_{2.5}$ environment at the Mine Site.

The addition of existing background concentrations and those associated with the construction of the WSD, to the increased processing rate (refer Section 4.3) results in predicted concentrations representing, as a maximum:

- 53.8 % of the annual average TSP criterion;
- 82.8 % of the annual average PM_{10} criterion; and
- 102.0 % of the annual average $PM_{2.5}$ criterion, noting the background $PM_{2.5}$ concentration is (by itself) 101.3 % of the criterion.

The modelling results indicate that the increase to annual average $PM_{2.5}$ concentrations resulting from the Proposed Modification would be negligible.

Table 6 Predicted annual average TSP, PM_{10} and $PM_{2.5}$ concentrations

Receptor	Annual Average Concentration (µg·m⁻³)											
	TSP				PM_{10}				$PM_{2.5}$			
	Increased Processing Rate	Construction of WSD	Background	Cumulative Impact	Increased Processing Rate	Construction of WSD	Background	Cumulative Impact	Increased Processing Rate	Construction of WSD	Background	Cumulative Impact
Criterion	90				25				8			
Max. % of criterion	0.2	<0.1	53.6	53.8	<0.1	<0.1	82.4	82.8	<0.1	<0.1	101.3	102.0
R1	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R2	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R3	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R4	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R5	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R6	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R7	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R8	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R9	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R10	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R11	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R12	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R13	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R14	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2

Receptor	Annual Average Concentration (µg·m⁻³)											
	TSP				PM_{10}				$PM_{2.5}$			
	Increased Processing Rate	Construction of WSD	Background	Cumulative Impact	Increased Processing Rate	Construction of WSD	Background	Cumulative Impact	Increased Processing Rate	Construction of WSD	Background	Cumulative Impact
R15	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R16	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R17	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R18	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R19	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R20	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R21	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R22	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R23	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R24	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R25	0.1	<0.1	48.2	48.4	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R26	0.1	<0.1	48.2	48.4	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R27	0.2	<0.1	48.2	48.4	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R28	0.1	<0.1	48.2	48.4	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R29	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R30	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R31	0.1	<0.1	48.2	48.4	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R32	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R33	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R34	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R35	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R36	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R37	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R38	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R39	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R40	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R41	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R42	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R43	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R44	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R45	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R46	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R47	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R48	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R49	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R50	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R51	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2

Receptor	Annual Average Concentration (µg·m-3)											
	TSP				PM_{10}				$PM_{2.5}$			
	Increased Processing Rate	Construction of WSD	Background	Cumulative Impact	Increased Processing Rate	Construction of WSD	Background	Cumulative Impact	Increased Processing Rate	Construction of WSD	Background	Cumulative Impact
R52	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R53	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R54	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R55	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R56	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R57	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R58	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R59	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R60	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R61	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R62	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R63	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R64	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R65	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R66	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R67	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R68	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R69	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R70	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R71	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R72	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R73	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R74	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R75	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R76	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R77	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R78	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R79	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R80	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R81	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R82	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R83	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R84	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R85	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R86	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R87	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R88	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2

Receptor	Annual Average Concentration (µg·m^{-3})											
	TSP				PM_{10}				$PM_{2.5}$			
	Increased Processing Rate	Construction of WSD	Background	Cumulative Impact	Increased Processing Rate	Construction of WSD	Background	Cumulative Impact	Increased Processing Rate	Construction of WSD	Background	Cumulative Impact
R89	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R90	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R91	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R92	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R93	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R94	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R95	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R96	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R97	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R98	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R99	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R100	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R101	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R102	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R103	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R104	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R105	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R106	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2
R107	<0.1	<0.1	48.2	48.3	<0.1	<0.1	20.6	20.7	<0.1	<0.1	8.1	8.2

No contour plots of annual average TSP, PM_{10} or $PM_{2.5}$ are presented, given the minor predicted contribution from the operation of the Proposed Modification at the nearest relevant sensitive receptors.

The performance of the Proposed Modification does not result in any additional exceedances of the annual average TSP, PM_{10} and $PM_{2.5}$ impact assessment criteria at the identified sensitive receptor locations.

6.2. Particulate Matter – Annual Average Dust Deposition Rates

Table 7 presents the annual average dust deposition rates predicted as a result of the Proposed Modification. The results indicate that predicted incremental levels of dust deposition at sensitive receptor locations are low.

An assumed background dust deposition of 2.1 $g \cdot m^{-2} \cdot month^{-1}$ is presented in Table 7. The increased processing rate is predicted to result in incremental increases of dust deposition < 0.1 $g \cdot m^{-2} \cdot month^{-1}$ which represents < 5.0 % of the incremental criterion at the sensitive receptors. Addition of the predicted incremental annual average of dust deposition resulting from the construction of the WSD, plus an assumed background dust deposition of 2.1 $g \cdot m^{-2} \cdot month^{-1}$ results in predicted dust deposition at all receptors being < 53.8 % of the criterion.

No contour plots of annual average dust deposition are presented, given the minor predicted contribution from the Proposed Modification at the nearest sensitive receptors.

Table 7 Predicted annual average dust deposition

Receptor	Annual Average Dust Deposition ($g \cdot m^{-2} \cdot month^{-1}$)			
	Increased Processing Rate	Construction of WSD	Background	Cumulative Impact
Criterion	2	2	-	4
Max. % of criterion	5.0	5.0	-	53.8
R1	<0.1	<0.1	2.1	2.2
R2	<0.1	<0.1	2.1	2.2
R3	<0.1	<0.1	2.1	2.2
R4	<0.1	<0.1	2.1	2.2
R5	<0.1	<0.1	2.1	2.2
R6	<0.1	<0.1	2.1	2.2
R7	<0.1	<0.1	2.1	2.2
R8	<0.1	<0.1	2.1	2.2
R9	<0.1	<0.1	2.1	2.2
R10	<0.1	<0.1	2.1	2.2
R11	<0.1	<0.1	2.1	2.2
R12	<0.1	<0.1	2.1	2.2
R13	<0.1	<0.1	2.1	2.2
R14	<0.1	<0.1	2.1	2.2
R15	<0.1	<0.1	2.1	2.2
R16	<0.1	<0.1	2.1	2.2
R17	<0.1	<0.1	2.1	2.2
R18	<0.1	<0.1	2.1	2.2
R19	<0.1	<0.1	2.1	2.2
R20	<0.1	<0.1	2.1	2.2
R21	<0.1	<0.1	2.1	2.2
R22	<0.1	<0.1	2.1	2.2
R23	<0.1	<0.1	2.1	2.2
R24	<0.1	<0.1	2.1	2.2
R25	<0.1	<0.1	2.1	2.2
R26	<0.1	<0.1	2.1	2.2
R27	<0.1	<0.1	2.1	2.2
R28	<0.1	<0.1	2.1	2.2
R29	<0.1	<0.1	2.1	2.2
R30	<0.1	<0.1	2.1	2.2
R31	<0.1	<0.1	2.1	2.2
R32	<0.1	<0.1	2.1	2.2
R33	<0.1	<0.1	2.1	2.2
R34	<0.1	<0.1	2.1	2.2
R35	<0.1	<0.1	2.1	2.2
R36	<0.1	<0.1	2.1	2.2

Receptor	Annual Average Dust Deposition ($g{\cdot}m^{-2}{\cdot}month^{-1}$)			
	Increased Processing Rate	Construction of WSD	Background	Cumulative Impact
R37	<0.1	<0.1	2.1	2.2
R38	<0.1	<0.1	2.1	2.2
R39	<0.1	<0.1	2.1	2.2
R40	<0.1	<0.1	2.1	2.2
R41	<0.1	<0.1	2.1	2.2
R42	<0.1	<0.1	2.1	2.2
R43	<0.1	<0.1	2.1	2.2
R44	<0.1	<0.1	2.1	2.2
R45	<0.1	<0.1	2.1	2.2
R46	<0.1	<0.1	2.1	2.2
R47	<0.1	<0.1	2.1	2.2
R48	<0.1	<0.1	2.1	2.2
R49	<0.1	<0.1	2.1	2.2
R50	<0.1	<0.1	2.1	2.2
R51	<0.1	<0.1	2.1	2.2
R52	<0.1	<0.1	2.1	2.2
R53	<0.1	<0.1	2.1	2.2
R54	<0.1	<0.1	2.1	2.2
R55	<0.1	<0.1	2.1	2.2
R56	<0.1	<0.1	2.1	2.2
R57	<0.1	<0.1	2.1	2.2
R58	<0.1	<0.1	2.1	2.2
R59	<0.1	<0.1	2.1	2.2
R60	<0.1	<0.1	2.1	2.2
R61	<0.1	<0.1	2.1	2.2
R62	<0.1	<0.1	2.1	2.2
R63	<0.1	<0.1	2.1	2.2
R64	<0.1	<0.1	2.1	2.2
R65	<0.1	<0.1	2.1	2.2
R66	<0.1	<0.1	2.1	2.2
R67	<0.1	<0.1	2.1	2.2
R68	<0.1	<0.1	2.1	2.2
R69	<0.1	<0.1	2.1	2.2
R70	<0.1	<0.1	2.1	2.2
R71	<0.1	<0.1	2.1	2.2
R72	<0.1	<0.1	2.1	2.2
R73	<0.1	<0.1	2.1	2.2
R74	<0.1	<0.1	2.1	2.2
R75	<0.1	<0.1	2.1	2.2
R76	<0.1	<0.1	2.1	2.2

Receptor	Annual Average Dust Deposition ($g \cdot m^{-2} \cdot month^{-1}$)			
	Increased Processing Rate	Construction of WSD	Background	Cumulative Impact
R77	<0.1	<0.1	2.1	2.2
R78	<0.1	<0.1	2.1	2.2
R79	<0.1	<0.1	2.1	2.2
R80	<0.1	<0.1	2.1	2.2
R81	<0.1	<0.1	2.1	2.2
R82	<0.1	<0.1	2.1	2.2
R83	<0.1	<0.1	2.1	2.2
R84	<0.1	<0.1	2.1	2.2
R85	<0.1	<0.1	2.1	2.2
R86	<0.1	<0.1	2.1	2.2
R87	<0.1	<0.1	2.1	2.2
R88	<0.1	<0.1	2.1	2.2
R89	<0.1	<0.1	2.1	2.2
R90	<0.1	<0.1	2.1	2.2
R91	<0.1	<0.1	2.1	2.2
R92	<0.1	<0.1	2.1	2.2
R93	<0.1	<0.1	2.1	2.2
R94	<0.1	<0.1	2.1	2.2
R95	<0.1	<0.1	2.1	2.2
R96	<0.1	<0.1	2.1	2.2
R97	<0.1	<0.1	2.1	2.2
R98	<0.1	<0.1	2.1	2.2
R99	<0.1	<0.1	2.1	2.2
R100	<0.1	<0.1	2.1	2.2
R101	<0.1	<0.1	2.1	2.2
R102	<0.1	<0.1	2.1	2.2
R103	<0.1	<0.1	2.1	2.2
R104	<0.1	<0.1	2.1	2.2
R105	<0.1	<0.1	2.1	2.2
R106	<0.1	<0.1	2.1	2.2
R107	<0.1	<0.1	2.1	2.2

The performance of the Proposed Modification does not result in any exceedances of the annual average dust deposition impact assessment criteria at the identified sensitive receptor locations.

6.3. Particulate Matter - Maximum 24-hour Average

Presented in Table 8 are the maximum 24-hour average PM_{10} and $PM_{2.5}$ concentrations predicted to occur at the sensitive receptors as a result of the Proposed Modification (i.e. the increased processing rate and the construction of the WSD). No background concentrations are included within this table. Maximum concentrations at sensitive receptors are highlighted in **bold** as these data are used in the subsequent assessment.

Table 8 Predicted maximum incremental 24-hour PM_{10} and $PM_{2.5}$ concentrations

Receptor	Maximum 24-hour average concentration ($\mu g \cdot m^{-3}$)			
	PM_{10}		$PM_{2.5}$	
	Increased Processing Rate	Construction of WSD	Increased Processing Rate	Construction of WSD
Criterion	50	50	25	25
Max. % of criterion	1.6	2.1	<0.1	0.7
R1	0.2	0.6	<0.1	<0.1
R2	0.2	0.5	<0.1	<0.1
R3	0.2	0.3	<0.1	<0.1
R4	0.2	0.3	<0.1	<0.1
R5	0.3	0.4	<0.1	<0.1
R6	0.2	0.5	<0.1	<0.1
R7	0.2	0.5	<0.1	<0.1
R8	0.2	0.5	<0.1	<0.1
R9	0.1	0.4	<0.1	<0.1
R10	0.3	0.6	<0.1	0.1
R11	0.3	0.6	<0.1	0.1
R12	0.1	0.4	<0.1	<0.1
R13	0.1	0.4	<0.1	<0.1
R14	0.2	0.5	<0.1	<0.1
R15	0.3	0.5	<0.1	<0.1
R16	0.3	0.5	<0.1	<0.1
R17	0.4	0.5	<0.1	<0.1
R18	0.4	0.5	<0.1	<0.1
R19	0.3	0.5	<0.1	<0.1
R20	0.4	0.3	<0.1	<0.1
R21	0.3	0.2	<0.1	<0.1
R22	0.4	0.3	<0.1	<0.1
R23	0.4	0.4	<0.1	<0.1
R24	0.2	0.4	<0.1	<0.1
R25	0.3	0.4	<0.1	<0.1
R26	0.4	0.4	<0.1	<0.1

Receptor	Maximum 24-hour average concentration ($\mu g \cdot m^{-3}$)			
	PM_{10}		$PM_{2.5}$	
	Increased Processing Rate	Construction of WSD	Increased Processing Rate	Construction of WSD
R27	0.4	0.4	<0.1	<0.1
R28	0.3	0.4	<0.1	<0.1
R29	0.8	0.7	<0.1	0.1
R30	0.5	1.0	<0.1	0.2
R31	**0.8**	**1.1**	**<0.1**	**0.2**
R32	0.5	0.7	<0.1	0.1
R33	0.3	0.6	<0.1	<0.1
R34	0.3	0.6	<0.1	0.1
R35	0.5	0.9	<0.1	0.1
R36	0.2	0.6	<0.1	0.1
R37	0.1	0.2	<0.1	<0.1
R38	<0.1	0.2	<0.1	<0.1
R39	<0.1	0.3	<0.1	<0.1
R40	<0.1	0.3	<0.1	<0.1
R41	0.2	0.5	<0.1	<0.1
R42	0.1	0.4	<0.1	<0.1
R43	0.1	0.3	<0.1	<0.1
R44	0.1	0.4	<0.1	<0.1
R45	0.1	0.4	<0.1	<0.1
R46	0.2	0.5	<0.1	<0.1
R47	0.2	0.5	<0.1	<0.1
R48	0.2	0.5	<0.1	<0.1
R49	0.3	0.5	<0.1	<0.1
R50	0.3	0.4	<0.1	<0.1
R51	0.2	0.2	<0.1	<0.1
R52	0.1	0.2	<0.1	<0.1
R53	0.1	0.3	<0.1	<0.1
R54	0.1	0.3	<0.1	<0.1
R55	0.2	0.3	<0.1	<0.1
R56	0.2	0.2	<0.1	<0.1
R57	0.3	0.3	<0.1	<0.1
R58	0.2	0.3	<0.1	<0.1
R59	0.2	0.3	<0.1	<0.1
R60	0.3	0.3	<0.1	<0.1
R61	0.3	0.5	<0.1	<0.1
R62	0.2	0.5	<0.1	<0.1
R63	0.2	0.4	<0.1	<0.1

Receptor	Maximum 24-hour average concentration ($\mu g{\cdot}m^{-3}$)			
	PM_{10}		$PM_{2.5}$	
	Increased Processing Rate	Construction of WSD	Increased Processing Rate	Construction of WSD
R64	0.1	0.3	<0.1	<0.1
R65	0.1	0.3	<0.1	<0.1
R66	0.1	0.3	<0.1	<0.1
R67	0.1	0.3	<0.1	<0.1
R68	0.1	0.3	<0.1	<0.1
R69	0.4	0.3	<0.1	<0.1
R70	0.2	0.5	<0.1	<0.1
R71	0.2	0.3	<0.1	<0.1
R72	0.2	0.3	<0.1	<0.1
R73	<0.1	0.1	<0.1	<0.1
R74	<0.1	0.1	<0.1	<0.1
R75	<0.1	0.1	<0.1	<0.1
R76	0.1	0.2	<0.1	<0.1
R77	<0.1	0.1	<0.1	<0.1
R78	<0.1	0.1	<0.1	<0.1
R79	<0.1	0.1	<0.1	<0.1
R80	<0.1	0.2	<0.1	<0.1
R81	<0.1	0.2	<0.1	<0.1
R82	<0.1	0.2	<0.1	<0.1
R83	<0.1	0.2	<0.1	<0.1
R84	<0.1	0.2	<0.1	<0.1
R85	<0.1	0.2	<0.1	<0.1
R86	<0.1	0.2	<0.1	<0.1
R87	<0.1	0.2	<0.1	<0.1
R88	0.1	0.3	<0.1	<0.1
R89	0.1	0.2	<0.1	<0.1
R90	0.1	0.2	<0.1	<0.1
R91	0.1	0.3	<0.1	<0.1
R92	0.1	0.2	<0.1	<0.1
R93	0.1	0.4	<0.1	<0.1
R94	0.1	0.3	<0.1	<0.1
R95	0.1	0.1	<0.1	<0.1
R96	<0.1	0.2	<0.1	<0.1
R97	<0.1	0.3	<0.1	<0.1
R98	0.1	0.3	<0.1	<0.1
R99	0.1	0.3	<0.1	<0.1
R100	0.1	0.3	<0.1	<0.1

Receptor	Maximum 24-hour average concentration ($\mu g \cdot m^{-3}$)			
	PM_{10}		$PM_{2.5}$	
	Increased Processing Rate	Construction of WSD	Increased Processing Rate	Construction of WSD
R101	0.1	0.3	<0.1	<0.1
R102	0.1	0.3	<0.1	<0.1
R103	0.3	0.3	<0.1	<0.1
R104	0.2	0.2	<0.1	<0.1
R105	0.3	0.4	<0.1	<0.1
R106	0.3	0.5	<0.1	<0.1
R107	0.5	1.0	<0.1	0.2

Maximum incremental PM_{10} and $PM_{2.5}$ impacts associated with the increased processing rate are predicted to be 0.8 $\mu g \cdot m^{-3}$ and < 0.1 $\mu g \cdot m^{-3}$ at receptor R31. These maximum incremental impacts represent 1.6 % and < 0.4 % of the relevant criteria.

Maximum incremental PM_{10} and $PM_{2.5}$ impacts associated with the construction of the WSD are predicted to be 1.1 $\mu g \cdot m^{-3}$ and 0.2 $\mu g \cdot m^{-3}$ also at receptor R31. These maximum incremental impacts represent 2.1 % and 0.7 % of the relevant criteria.

Table 9 and Table 10 present the predicted maximum 24-hour average PM_{10} and $PM_{2.5}$ concentrations resulting from the Proposed Modification, with background included.

Results are presented for the sensitive receptors at which the highest PM_{10} and $PM_{2.5}$ impacts associated with the increased processing rate have been predicted (receptor R31) and also for the sensitive receptor at which the highest cumulative impacts (increment from Proposed Modification as a whole, plus background) have been predicted, which are indicated within each table (receptor R69 for PM_{10} and receptor R35 for $PM_{2.5}$).

The left side of the tables show the predicted concentration on days with the highest cumulative impacts (typically driven by the days of the highest contemporaneous background), and the right side shows the total predicted cumulative impact on days with the highest predicted incremental concentrations.

The analysis identifies 10 days that are predicted to exceed the 24-hour PM_{10} criterion, but these are driven by background concentrations already exceeding the criterion. Predicted changes to existing concentrations as a result of the Proposed Modification are relatively immeasurable.

The analysis identifies 5 days that are predicted to exceed the 24-hour $PM_{2.5}$ criterion, but again, this is also driven by the background concentration already exceeding the criterion. The analysis indicates that no additional exceedances of the 24-hour average impact assessment criteria for $PM_{2.5}$ are likely to occur as a result of the Proposed Modification at the sensitive receptor locations. The conservative assumption regarding background air quality assumptions discussed in Section 4.3 should additionally be considered as added assurance.

Contour plots of the incremental contribution of the increased processing rate, construction of the WSD and Proposed Modification (increased processing rate plus the construction of the WSD) to the 24-hour average PM_{10} concentrations are presented in Figure 7, Figure 8 and Figure 9.

The performance of the Proposed Modification does not result in any additional exceedances of the maximum 24-hour average PM_{10} and $PM_{2.5}$ impact assessment criteria at the identified sensitive receptor locations.

Table 9 Summary of contemporaneous impact and background – PM_{10}

Date	24-hour average PM_{10} concentration ($\mu g \cdot m^{-3}$) – Receptor R69				Date	24-hour average PM_{10} concentration ($\mu g \cdot m^{-3}$) – Receptor R31			
	Increased Processing Rate	Construction of WSD	Background	Cumulative Impact		Increased Processing Rate	Construction of WSD	Background	Cumulative Impact
31/03/2017	<0.1	<0.1	171.6	171.7	18/05/2017	0.8	<0.1	25.4	26.2
17/01/2017	<0.1	<0.1	75.3	75.4	19/05/2017	0.7	1.1	12.8	14.6
29/03/2017	<0.1	<0.1	66.1	66.2	19/11/2017	0.5	0.3	9.9	10.7
19/12/2017	<0.1	<0.1	61.2	61.3	28/11/2017	0.4	<0.1	10.0	10.4
30/01/2017	<0.1	<0.1	57.2	57.3	3/02/2017	0.4	<0.1	33.3	33.7
18/04/2017	<0.1	<0.1	54.5	54.6	1/09/2017	0.4	<0.1	22.7	23.1
13/01/2017	<0.1	<0.1	53.8	53.9	28/02/2017	0.4	0.1	16.3	16.8
14/12/2017	<0.1	<0.1	52.6	52.7	5/11/2017	0.4	<0.1	16.0	16.4
12/03/2017	<0.1	<0.1	52.5	52.6	26/05/2017	0.3	0.1	17.1	17.5
31/01/2017	0.1	<0.1	50.2	50.3	17/05/2017	0.3	<0.1	30.6	30.9
17/04/2017	<0.1	0.2	49.2	49.4	14/10/2017	0.3	<0.1	13.0	13.3
These data represent the highest Cumulative Impact 24-hour PM_{10} predictions (outlined in red) as a result of the operation of the Proposal.					These data represent the highest Incremental Impact 24-hour PM_{10} predictions (outlined in blue) as a result of the operation of the Proposal.				

Note: Where values are less than the limit of reporting (LOR) (<0.1 µg·m^{-3}) the corresponding value used in the calculation of the cumulative impact has been assumed to be 50 % of the LOR. The value representing the calculated cumulative impact may be marginally different to the aggregate of the reported incremental values due to rounding.

Table 10 Summary of contemporaneous impact and background – $PM_{2.5}$

Date	24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) – Receptor R35				Date	24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$) – Receptor R31			
	Increased Processing Rate	Construction of WSD	Background	Cumulative Impact		Increased Processing Rate	Construction of WSD	Background	Cumulative Impact
16/05/2017	<0.1	<0.1	32.5	32.6	18/05/2017	<0.1	<0.1	16.1	16.2
12/05/2017	<0.1	<0.1	28.3	28.4	19/05/2017	<0.1	0.2	10.1	10.3
11/05/2017	<0.1	<0.1	28.0	28.1	19/11/2017	<0.1	<0.1	2.6	2.7
3/06/2017	<0.1	<0.1	26.9	27.0	28/11/2017	<0.1	<0.1	4.4	4.5
12/06/2017	<0.1	<0.1	25.0	25.1	3/02/2017	<0.1	<0.1	6.4	6.5
13/05/2017	<0.1	<0.1	24.5	24.6	1/09/2017	<0.1	<0.1	10.1	10.2
11/06/2017	<0.1	<0.1	23.6	23.7	28/02/2017	<0.1	<0.1	4.9	5.0
17/05/2017	<0.1	<0.1	22.1	22.2	5/11/2017	<0.1	<0.1	3.9	4.0
2/06/2017	<0.1	<0.1	21.3	21.4	26/05/2017	<0.1	<0.1	8.7	8.8
4/05/2017	<0.1	<0.1	20.3	20.4	17/05/2017	<0.1	<0.1	22.1	22.2
These data represent the highest Cumulative Impact 24-hour $PM_{2.5}$ predictions (outlined in red) as a result of the operation of the Proposal.					These data represent the highest Incremental Impact 24-hour $PM_{2.5}$ predictions (outlined in blue) as a result of the operation of the Proposal.				

Note: Where values are less than the limit of reporting (LOR) (<0.1 $\mu g \cdot m^{-3}$) the corresponding value used in the calculation of the cumulative impact has been assumed to be 50 % of the LOR. The value representing the calculated cumulative impact may be marginally different to the aggregate of the reported incremental values due to rounding.

Figure 7 Incremental 24-hour PM_{10} concentrations – Increased Processing Rate

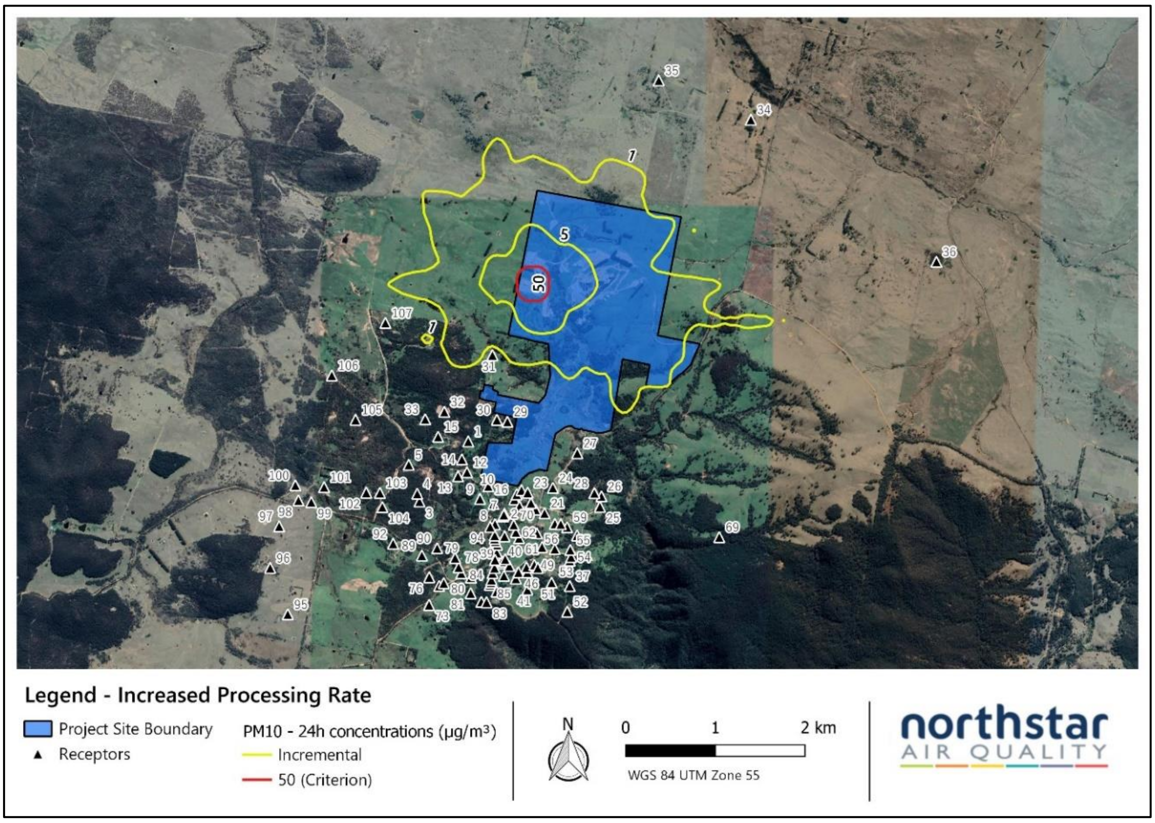


Figure 8 Incremental 24-hour PM_{10} concentrations – Construction of WSD

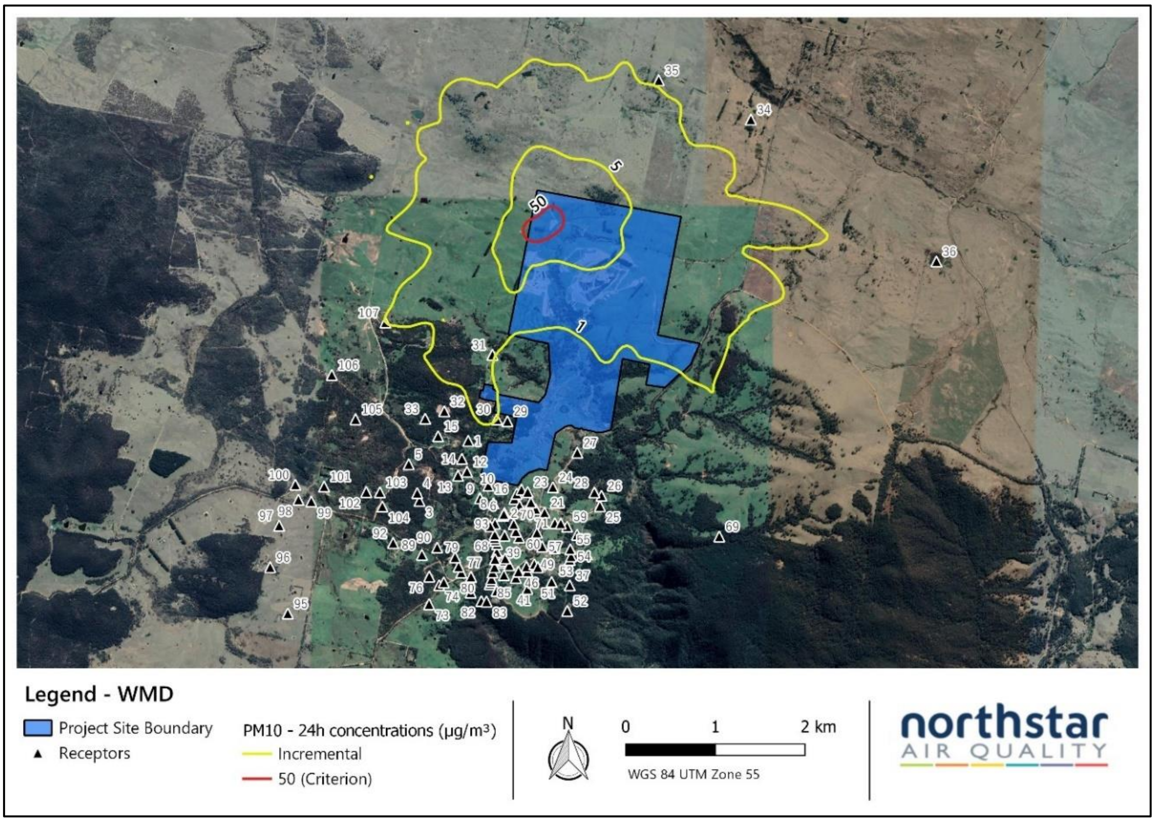
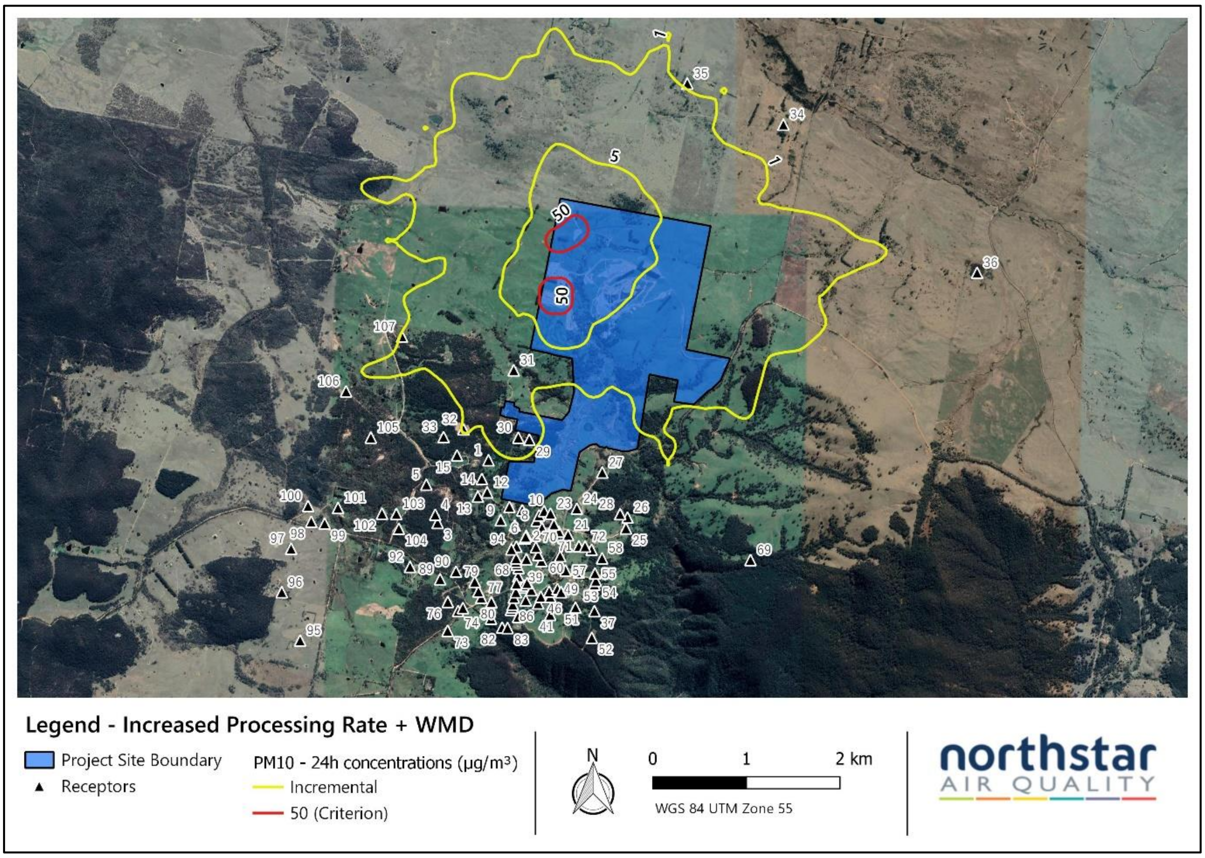


Figure 9 Incremental 24-hour PM_{10} concentrations – Proposed Modification



7. MITIGATION AND MONITORING

Based on the findings of the dispersion modelling assessment presented in Section 6, the Proposed Modification is not anticipated to result in any additional exceedances of the relevant air quality criteria at any sensitive receptor location. These concentrations are anticipated to be reduced following the construction of the Water Storage Dam, and compliance with the air quality criteria is anticipated to continue.

No further air quality monitoring is considered to be required to facilitate effective day-to-day air quality management of emissions from the Mine, and the measures outlined in the AQMP are appropriate to manage any air quality impacts associated with the Proposed Modification.

8. CONCLUSION

RWC has engaged Northstar on behalf of the Applicant to perform an AQIA for the Proposed Modification to approved operations at the Dargues Gold Mine, Majors Creek NSW.

This AQIA forms part of the documentation to accompany the development modification for the Project under Part 4 of the *Environmental Planning and Assessment Act* (1979).

The AQIA has been performed in accordance with the NSW EPA Approved Methods document and includes a detailed description of the activities to be performed as part of the Proposed Modification and includes a description of the management measures that will be employed to minimise air pollutant generation. The locations of surrounding sensitive receptor locations, a description of existing air quality and meteorology, and a description of the method used to assess potential impacts are also provided.

The potential air quality impacts at all the identified receptor locations are presented in Section 6. The AQIA indicates that minor exceedances of the annual average $PM_{2.5}$ criteria may be experienced at all nearby sensitive receptors during the Proposed Modification activities, although this is dominated by the already exceeding $PM_{2.5}$ concentration (101.3 % of the criterion, without the impact of the Proposed Modification added). The contribution of the Proposed Modification to this annual average $PM_{2.5}$ concentration is shown to be negligible at all receptor locations and no additional exceedances of the maximum 24-hour average PM_{10} and $PM_{2.5}$ concentrations are predicted at any receptor location. All other air quality criteria are predicted to be easily achieved.

The impacts of the Proposed Modification are presented separately, as the impacts associated with the WSD construction are not anticipated to be experienced for more than one year. After that time, the impacts associated with the increased processing rate have been shown to not result in any exceedances of the air quality criteria, save for the already exceeding background concentrations, not due to the Project.

A number of particulate matter controls would be employed during all Proposed Modification activities, through the continuing implementation of an AQMP.

No additional air quality monitoring is required to adequately report on the impact of the operation of the Mine, either currently, or should the Proposed Modification be approved.

APPENDIX A

Meteorology

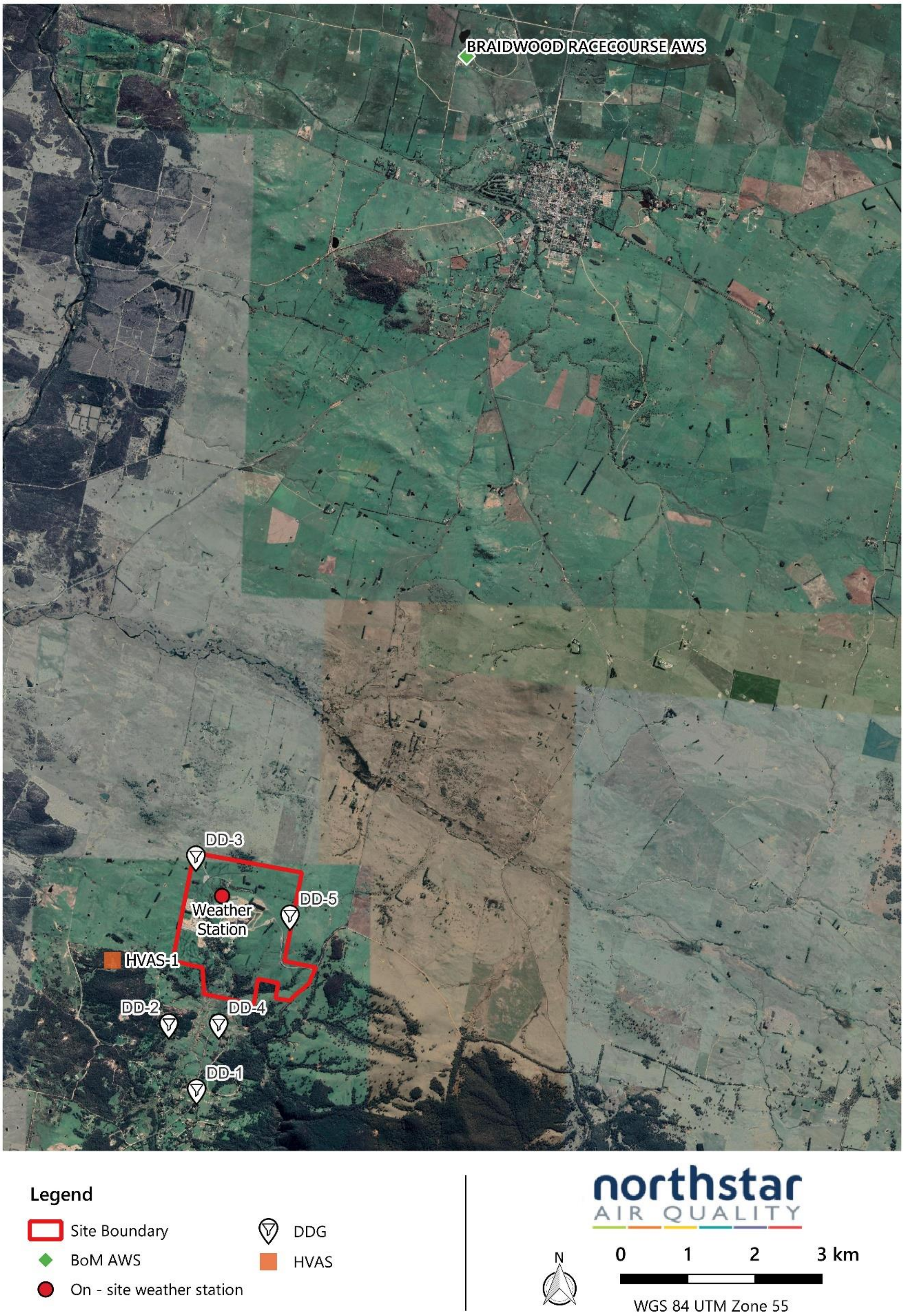
As discussed in **Section 4.2** a meteorological modelling exercise has been performed to characterise the meteorology of the Mine Site. The meteorological modelling has been based on measurements taken at Braidwood Racecourse automatic weather station (AWS) operated by the Australian Government Bureau of Meteorology (BoM) and an on-site weather station operated by the Applicant.

A summary of the relevant AWS is provided in **Table A1** and also displayed in **Figure A1**.

Table A1 Details of the meteorological monitoring surrounding the Proposal site

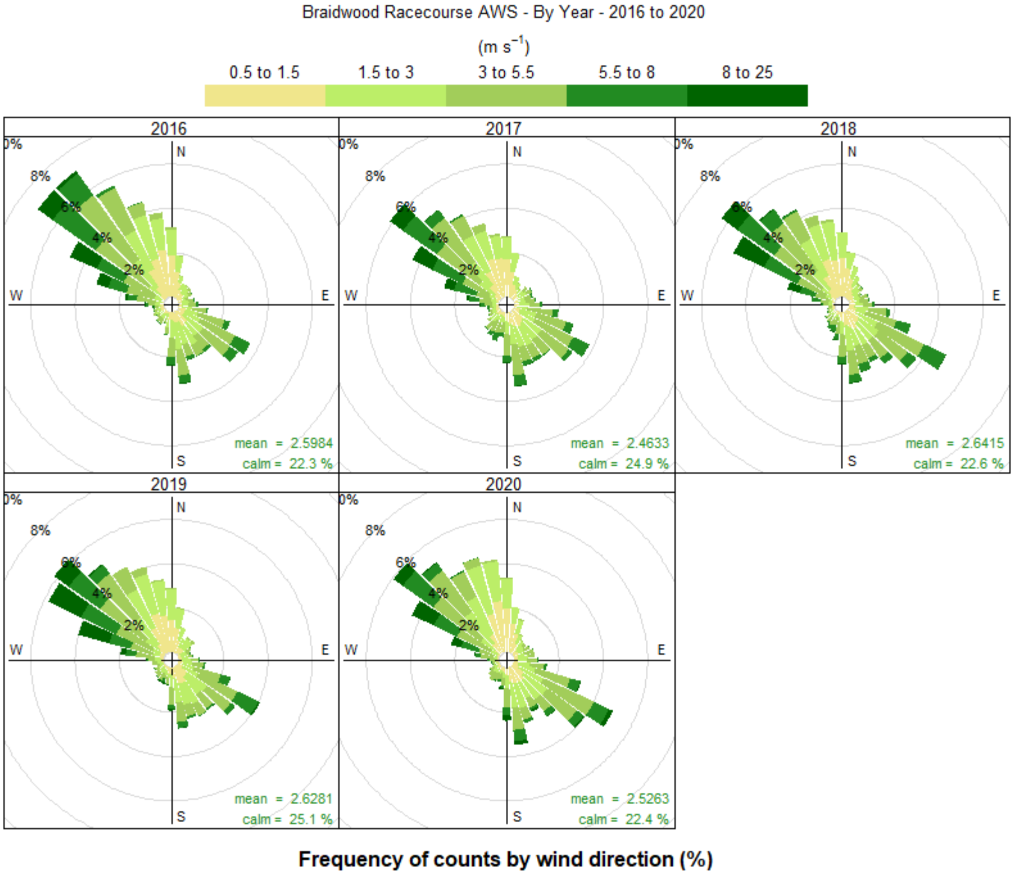
Site Name	Source	Approximate Location (UTM)		Approximate Distance
		mE	mS	km
Braidwood Racecourse AWS #069132	BoM	752 695	6 076 244	13.5
On-site weather station	Applicant	749 064	6 063 703	-

Figure A1 Meteorological and air quality monitoring surrounding the Mine Site



Meteorological conditions at Braidwood Racecourse AWS have been examined to determine a 'typical' or representative dataset for use in dispersion modelling. Annual wind roses for the most recent years of data (2016 to 2020) are presented in **Figure B2**.

Figure A2 Annual wind roses 2016 to 2020, Braidwood Racecourse AWS



The wind roses indicate that from 2016 to 2020, winds at Braidwood Racecourse AWS shows a predominant east south-easterly and north-westerly component to the wind direction.

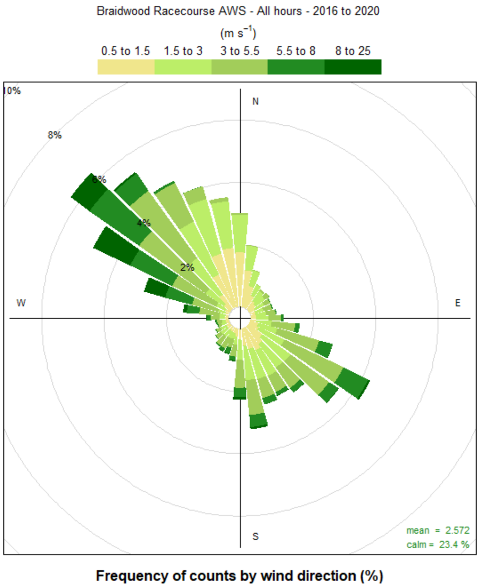
The majority of wind speeds experienced at Braidwood Racecourse AWS over the 5-year period, 2016 to 2020 are generally in the range < 1.5 metres per second (m·s^{-1}) to 5.5 m·s^{-1} with the highest wind speeds (greater than 8 m·s^{-1}) occurring from a north-westerly, although winds of this speed are also observed from the south-easterly direction. Winds of this speed are not frequent, occurring during approximately 3.4 % of the observed hours over the 5-year period at Braidwood Racecourse AWS. Calm winds (< 0.5 m·s^{-1}) occur during 23.4 % of hours on average across the 5-year period.

Given the wind distributions across the years examined, data for the year 2017 has been selected as being appropriate for further assessment, as it best represents the general trend across the 5-year period studied.

Presented in **Figure A3** are the annual wind rose for the 2016 to 2020 period and the year 2017 and in **Figure B4** the annual wind speed distribution for Braidwood Racecourse AWS. These figures indicate that the distribution of wind speed and direction in 2017 is very similar to that experienced across the longer-term period.

It is concluded that conditions in 2017 may be considered to provide a suitably representative dataset for use in dispersion modelling.

Figure A3 Annual wind roses 2016 to 2020, and 2017 Braidwood Racecourse AWS



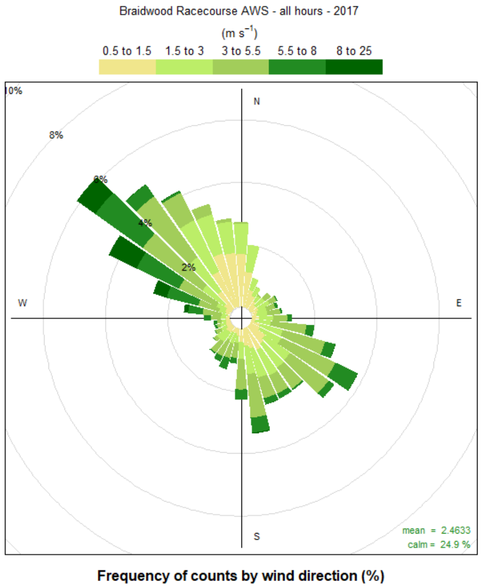
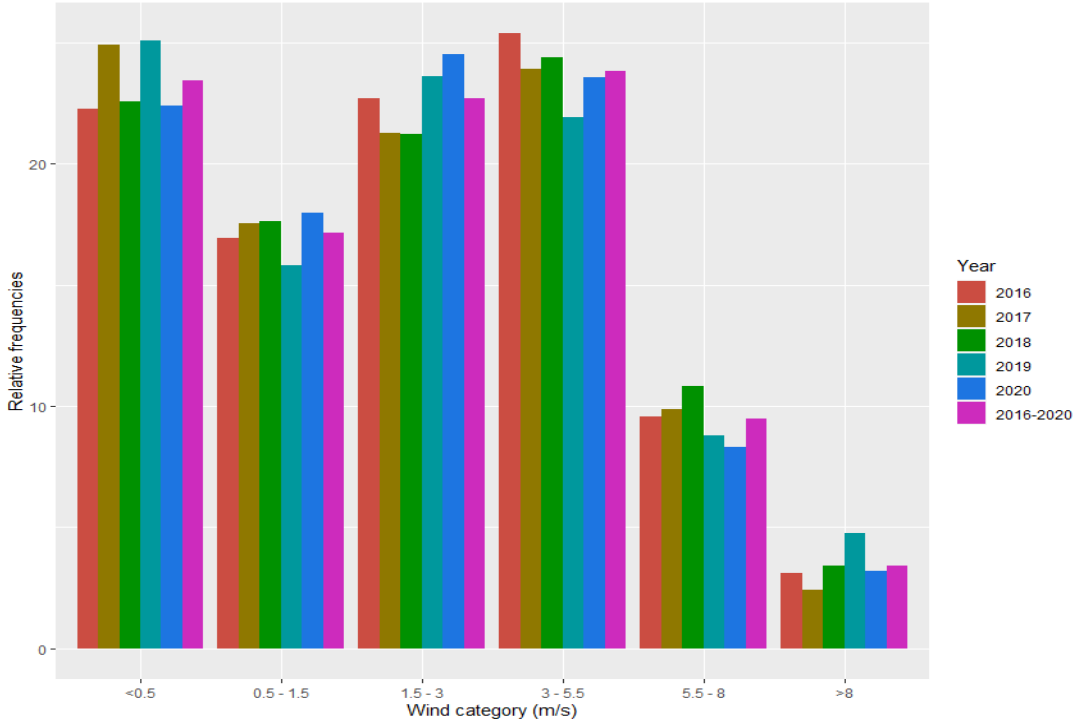


Figure A4 Annual wind speed distribution – Braidwood Racecourse AWS



Meteorological Modelling

The BoM data adequately covers the issues of data quality assurance, however it is limited by its location compared to the Mine Site. To address these uncertainties, a multi-phased assessment of the meteorological data has been performed.

Site representative meteorological data for this Mine was generated using the CALMET meteorological model in a format suitable for using in the CALPUFF dispersion model (refer Section 5.2.

CALMET is a meteorological model that develops wind and temperature fields on a three-dimensional gridded modelling domain. Associated two-dimensional fields such as mixing height, surface characteristics, and dispersion properties are also included in the file produced by CALMET. The interpolated wind field is then modified within the model to account for the influences of topography, as well as differential heating and surface roughness associated with different land uses across the modelling domain. These modifications are applied to the winds at each grid point to develop a final wind field and thus the final wind field reflects the influences of local topography and current land uses.

In this study, CALMET has been run in no-observations (no-obs) mode using gridded prognostic data generated by The Air Pollution Model (TAPM, v 4.0.5), developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO).

TAPM is a prognostic model which predicts wind speed and direction, temperature, pressure, water vapour, cloud, rainwater and turbulence. The program allows the user to generate synthetic observations by referencing databases (covering terrain, vegetation and soil type, sea surface temperature and synoptic scale meteorological analyses) which are subsequently used in the model input to generate site-specific hourly meteorological observations at user-defined levels within the atmosphere.

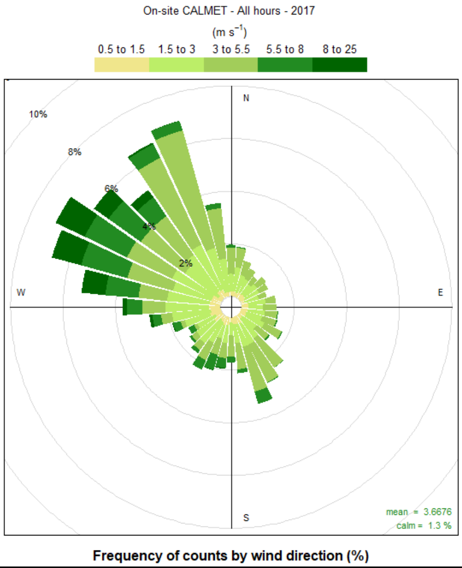
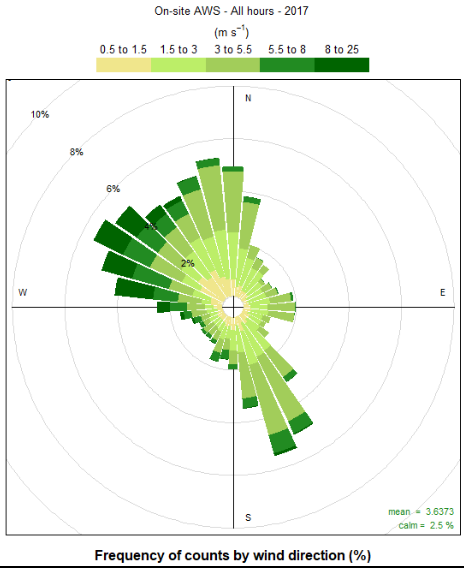
The parameters used in TAPM and CALMET modelling are presented in **Table B2**. It is noted that an initial TAPM modelling run provided wind roses which did not validate well against observations at Braidwood Racecourse AWS. Given the poor validation, that initial TAPM modelling run has not been used in this AQIA. Subsequently, a second TAPM run was performed which used observations at Braidwood Racecourse AWS to 'nudge' model predictions towards those observations, and this has been used in this AQIA. To validate model outputs, a comparison of the CALMET generated meteorological data, and that observed at the On-site weather station has been performed and is presented in Figure A5.

Table B2 Meteorological parameters used for this study

TAPM v 4.0.5	
Modelling period	1 January 2017 to 31 December 2017
Centre of analysis	751 240 mE, 6 070 066 mS (UTM Coordinates)
Number of grid points	30 x 30 x 25
Number of grids (spacing)	4 (30 km, 10 km, 3 km, 1 km)
Terrain	AUSLIG 9 second DEM

Data assimilation	Braidwood Racecourse
CALMET	
Modelling period	1 January 2017 to 31 December 2017
South-West corner of analysis	740 700 mS, 6 055 000 mS (UTM Coordinates)
Meteorological grid domain (resolution)	16 km x 16 km (0.2 km)
Vertical resolution (cell heights)	10 (0 m, 20 m, 40 m, 80 m, 160 m, 320 m, 640 m, 1200 m, 2000 m, 3000 m, 4000 m)
Data assimilation	No-obs approach using TAPM – 3D.DAT file

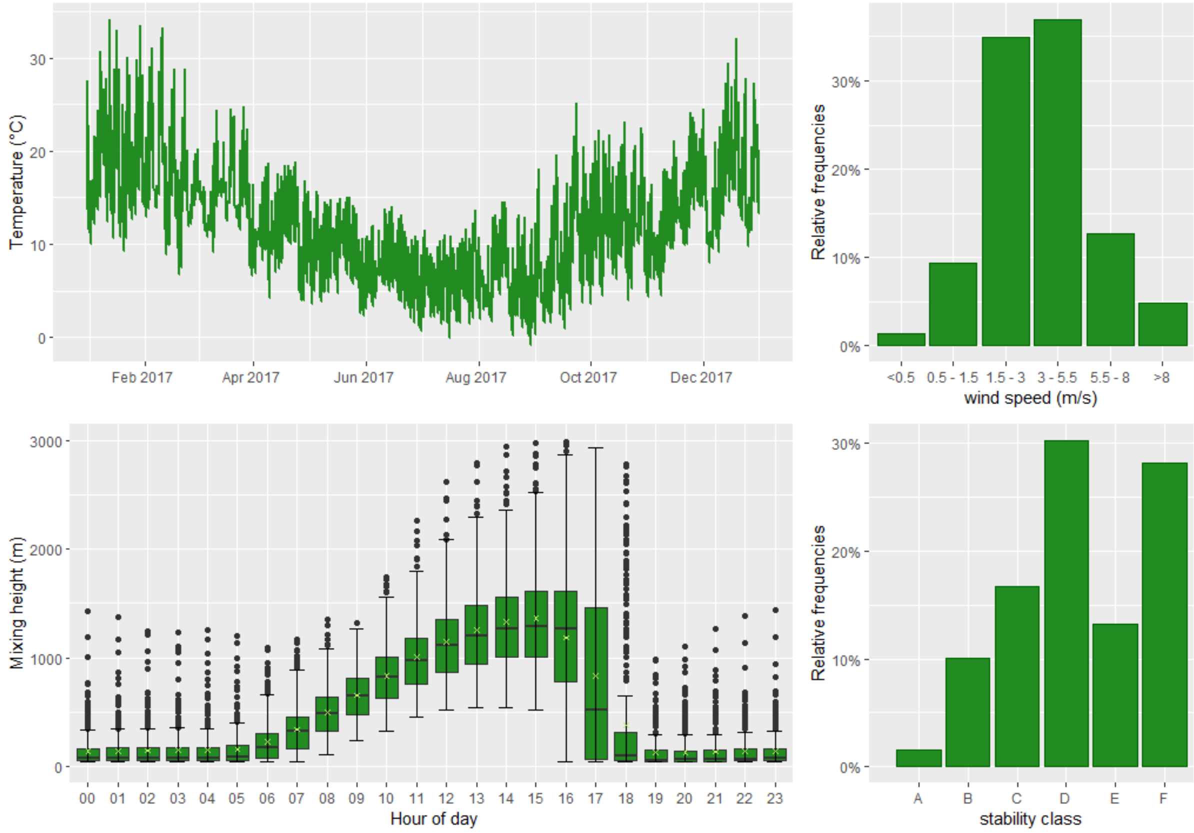
Figure B5 Modelled and observed meteorological data – On-Site, 2017

On-site CALMET generated windrose	Observations at On-site weather station
	

As generally required by the NSW EPA the following provides a summary of the modelled meteorological dataset. Given the nature of the pollutant emission sources at the Mine Site, detailed discussion of the humidity, evaporation, cloud cover, katabatic air drainage and air recirculation potential of the Mine Site has not been provided. Details of the CALMET predictions of wind speed and direction, mixing height, temperature and stability class at the Mine Site are provided in **Figure B6**.

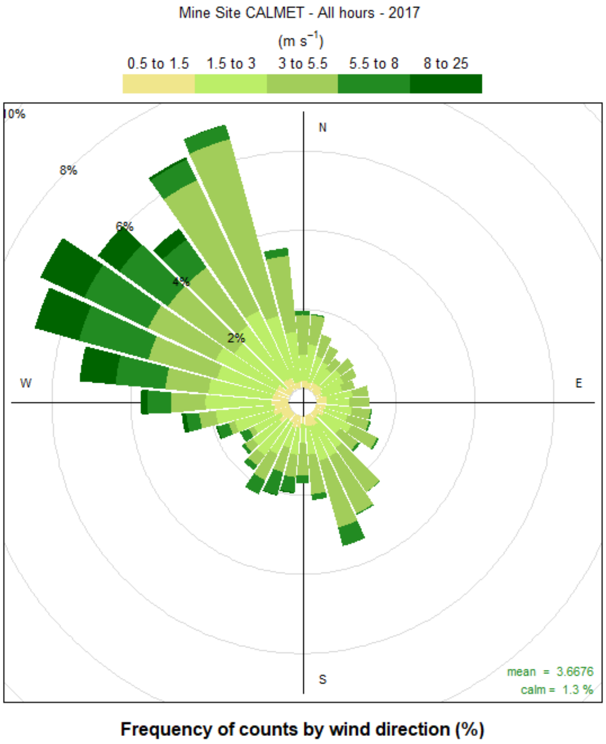
Diurnal variations in maximum and average mixing heights during the 2017 period shows that, as expected, an increase in mixing height during the morning is apparent, arising due to the onset of vertical mixing following sunrise. Maximum mixing heights occur in the mid to late afternoon, due to the dissipation of ground-based temperature inversions and growth of the convective mixing layer.

Figure B6 Predicted temperature, mixing height and wind speed frequency – Mine Site 2017



The modelled wind speed and direction at the Mine Site during 2017 are presented in **Figure B8**.

Figure B7 Predicted wind speed and direction – Mine Site 2017



APPENDIX B

Air Quality Data

An air quality monitoring program is currently being operated for the Mine to monitor for PM_{10} using a High-Volume Air Sample (HVAS) located south west of the Mine site as presented in Figure A1.

PM_{10} monitoring data has been provided for the period 21 September 2018 to 31 December 2021 (the monitoring period). Summary statistics for the PM_{10} data are provided in Table B1 and a figure presenting the daily varying concentrations is illustrated in Figure B1.

Figure B1 indicates that periodic exceedances of the NSW EPA criterion for PM_{10} occurred at the HVAS during the monitoring period, particularly towards the end of 2019 and the beginning of 2020. Many air quality monitoring stations (AQMS) across NSW recorded PM exceedances during this period predominantly due to the intense drought conditions and bushfires that occurred during this time (NSW DPIE, 2021).

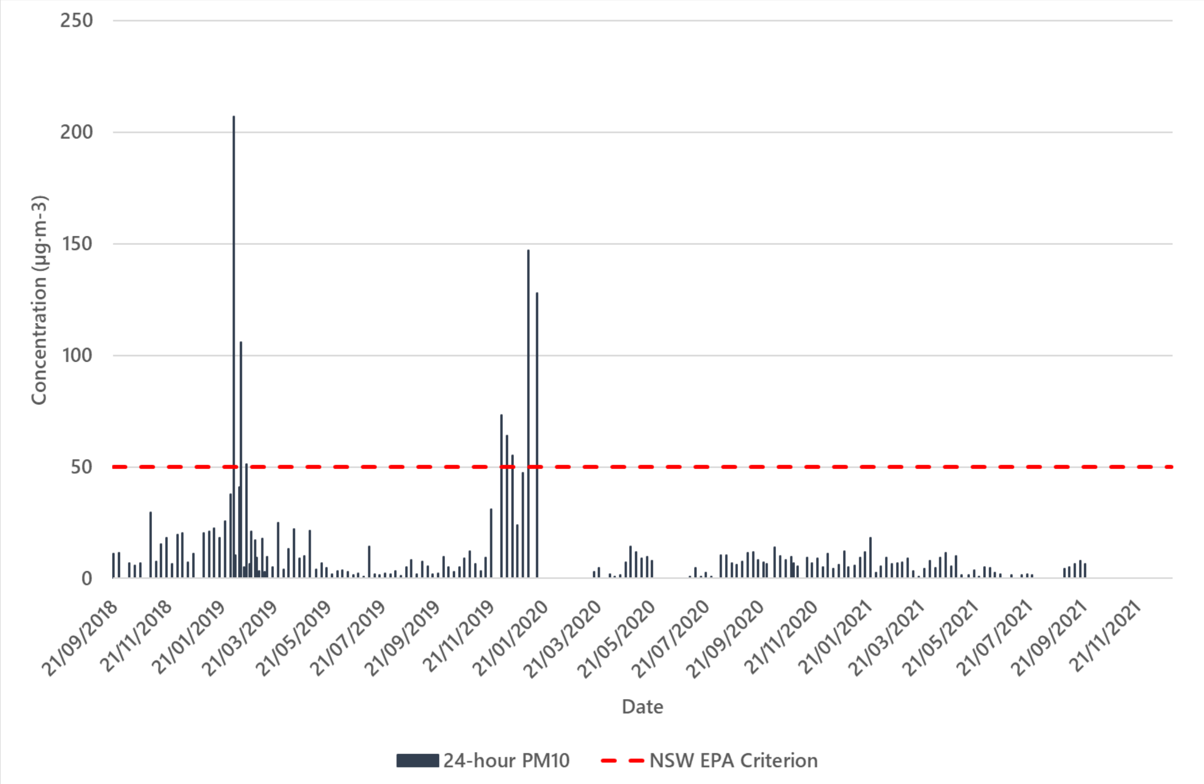
Table B1 Summary of onsite monitoring data

Pollutant	PM_{10} (µg·m^{-3})
Averaging Period	**24-Hour**
Data Points (number)	162
Mean	13.4
Standard Deviation	24.8
Skew1	5.1
Kurtosis2	30.9
Minimum	0.0
Percentiles (µg·m^{-3})	
1	1.0
5	1.3
10	1.7
25	3.7
50	6.9
75	11.6
90	22.6
95	47.0
97	65.6
98	98.8
99	135.4
Maximum	207.0
Data Capture (%)	13.5

Notes: 1: Skew represents an expression of the distribution of measured values around the derived mean. Positive skew represents a distribution tending towards values higher than the mean, and negative skew represents a distribution tending towards values lower than the mean. Skew is dimensionless.

2: Kurtosis represents an expression of the value of measured values in relation to a normal distribution. Positive skew represents a more peaked distribution, and negative skew represents a distribution more flattened than a normal distribution. Kurtosis is dimensionless.

Figure B1 Onsite PM_{10} measurements



It is noted that only 13.5 % of days over the monitoring period recorded 24-hour averages. Correspondingly, the data cannot be used for dispersion modelling to calculate the daily cumulative impacts of the Mine to the background air quality. Therefore, data from a representative AQMS must be adopted for use within the dispersion modelling assessment. A summary of identified AQMS that may potentially represent the air quality environment surrounding the Proposal site is provided in Table B1.

It is noted that AQMS more proximate to the Proposal site were identified, however, the air quality characteristics of those locations are driven more by metropolitan and coastal conditions. Correspondingly, AQMS that may reflect the air quality conditions at the Proposal site more closely have been analysed for this study.

Table B1 Summary of identified AQMS

AQMS	Distance to site (km)
Wagga Wagga North	222
Bathurst	237
Albury	255

Table B2 and Table B3 show a comparison of annual average and maximum 24-hour averages between the onsite monitoring station and the identified AQMS summarised in Table B1.

Table B2 Comparison of annual average PM_{10} concentrations

Year	Monitoring stations			
	HV-1	Wagga Wagga North	Bathurst	Albury
2016	-	20.6	13.3	15.1
2017	-	20.6	14.1	15.8
2018	12.7 (14)	27.4	21.4	19.8
2019	18.1 (67)	35.3	27.4	23.4
2020	13.2 (43)	23.2	17.0	20.1
2021	5.5 (37)	17.7	11.3	14.3

Note: Values in parentheses indicate the number of measurements in each year at HV-1

Table B3 Comparison of maximum 24-hour average PM_{10} concentrations

Year	Monitoring stations			
	HV-1	Wagga Wagga North	Bathurst	Albury
2016	-	114.7	34.1	51.0
2017	-	171.6	49.9	48.8
2018	29.7 (14)	127.2	274.1	107.8
2019	207.0 (67)	251.7	296.6	222.4
2020	147.0 (43)	295.3	320.4	298.3
2021	18.4 (37)	69.1	29.2	52.3

Note: Values in parentheses indicate the number of measurements in each year at HV-1

Table B4 Comparison of annual average $PM_{2.5}$ concentrations

Year	Monitoring stations			
	HV-1	Wagga Wagga North	Bathurst	Albury
2016	-	7.4	5.9	-
2017	-	8.1	6.1	7.3
2018	-	8.4	7.0	7.3
2019	-	11.3	11.3	10.1
2020	-	10.7	7.6	11.1
2021	-	6.3	5.1	7.3

Table B5 Comparison of maximum 24-hour average $PM_{2.5}$ concentrations

Year	Monitoring stations			
	HV-1	Wagga Wagga North	Bathurst	Albury
2016	-	28.1	15.0	-
2017	-	32.5	17.5	18.7
2018	-	21.6	40.5	30.4
2019	-	239.6	199.5	167.1
2020	-	559.5	207.3	275.2
2021	-	25.4	13.8	24.6

Figure 10 Statistical analysis of PM10 concentrations at Wagga Wagga North, 2016 to 2020

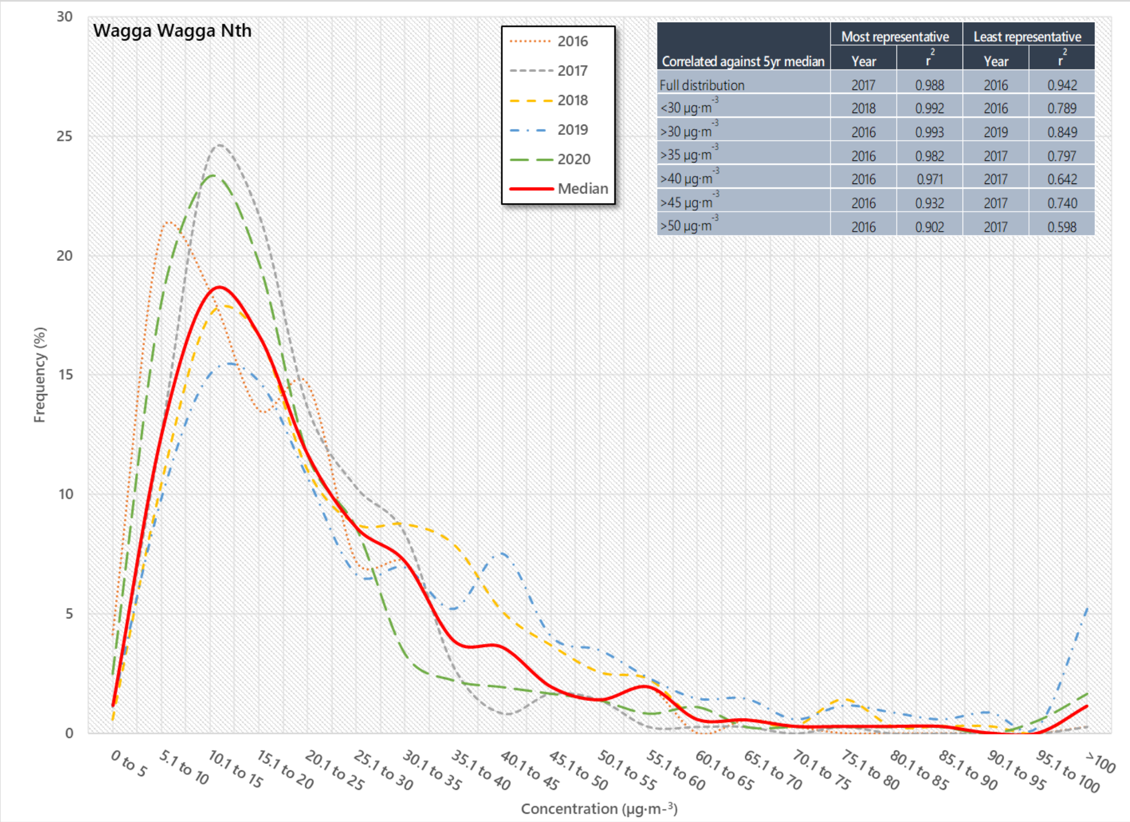


Table B5 Summary of deposited dust measurements

Year	Dust Deposition Gauge					
	DD-1	DD-2	DD-3	DD-4	DD-5	Average
2013-2014	1.9	1.3	0.8	0.7	1.0	1.1
2014-2015	1.3	0.6	1.0	1.0	0.4	0.9
2015-2016	1.5	0.5	1.9	1.1	0.7	1.1
2016-2017	1.2	0.8	1.6	2.1	1.4	1.4
2017-2018	0.9	0.7	0.5	0.8	1.5	0.9
2018-2019	1.1	1.0	0.6	1.1	0.9	0.9
2019-2020	1.1	1.1	1.0	1.0	1.3	1.1
Average	1.3	0.8	1.1	1.1	1.0	1.1

APPENDIX C

Sensitive Receptor Locations

Table C1 Discrete sensitive receptor locations used in the study

Residence	Easting (MGA)	Northing (MGA)	Residence	Easting (MGA)	Northing (MGA)	Residence	Easting (MGA)	Northing (MGA)
1	747879	6061551	37	749011	6059938	73	747442	6059728
2	748283	6060745	38	748195	6059877	74	747554	6059939
3	747335	6060881	39	748236	6060190	75	747606	6059971
4	747310	6060968	40	748254	6060213	76	747444	6060037
5	747215	6061290	41	748539	6059898	77	747801	6060080
6	748267	6060716	42	748410	6060021	78	747772	6060148
7	748276	6060732	43	748277	6060053	79	747732	6060252
8	748160	6060853	44	748337	6060161	80	747910	6060033
9	748010	6060909	45	748291	6060237	81	747906	6059858
10	748240	6061016	46	748439	6060091	82	748025	6059762
11	748103	6061050	47	748539	6060090	83	748083	6059758
12	747865	6061207	48	748528	6060147	84	748119	6059952
13	747765	6061162	49	748616	6060174	85	748132	6059979
14	747808	6061351	50	748655	6060141	86	748138	6060009
15	747543	6061602	51	748809	6059976	87	748150	6060083
16	748394	6060905	52	748983	6059653	88	748172	6060141
17	748419	6060961	53	749011	6060221	89	747362	6060279
18	748473	6061007	54	749026	6060262	90	747532	6060360
19	748451	6060826	55	749017	6060340	91	748178	6060230
20	748631	6060788	56	748844	6060352	92	747041	6060411
21	748730	6060750	57	748702	6060373	93	748177	6060627
22	748579	6060863	58	749093	6060503	94	748124	6060599
23	748542	6060980	59	748981	6060594	95	745866	6059624
24	748823	6061033	60	748645	6060525	96	745670	6060141
25	749348	6060822	61	748445	6060472	97	745770	6060605
26	749365	6060938	62	748410	6060537	98	745985	6060893
27	749095	6061420	63	748284	6060493	99	746128	6060874
28	749286	6060974	64	748197	6060309	100	745951	6061062
29	748316	6061770	65	748201	6060398	101	746271	6061041
30	748198	6061792	66	748182	6060435	102	746741	6060980
31	748149	6062512	67	748172	6060467	103	746894	6060976
32	747612	6061880	68	748174	6060503	104	746921	6060819
33	747399	6061798	69	750679	6060484	105	746622	6061793
34	751031	6065138	70	748386	6060620	106	746357	6062287
35	750004	6065577	71	748845	6060632	107	746955	6062872
36	753101	6063554	72	748911	6060628			

APPENDIX D

Emissions Inventory

Construction of Water Storage Dam

Description	Emission Factor	Emission rate						Emission Controls	Controlled emission (kg/yr)		
		TSP	PM10	PM2.5	Units	Activity Rate	Units		TSP	PM10	PM2.5
Cut - WMD 3a	AP-42 - Batch drop - Section 13.2.4.3	6.4E-04	3.0E-04	4.6E-05	kg/t	180,240	t		115.9	54.8	8.3
Fill - WMD 3a	AP-42 - Batch drop - Section 13.2.4.3	6.4E-04	3.0E-04	4.6E-05	kg/t	164,160	t		105.5	49.9	7.6
Dozer	AP-42 - Bulldozing (Overburden) - Table 11.9-2	2.0E-01	2.0E-02	2.0E-03	kg/hr	2,738	hr		547.5	54.8	5.5
Loading surplus to trucks	AP-42 - Batch drop - Section 13.2.4.3	6.4E-04	3.0E-04	4.6E-05	kg/t	16,080	t		10.3	4.9	0.7
Unloading surplus at soil stockpile	AP-42 - Batch drop - Section 13.2.4.3	6.4E-04	3.0E-04	4.6E-05	kg/t	16,080	t		10.3	4.9	0.7
Hauling surplus to soil stockpile	AP-42 Unpaved roads - Section 13.2.2	1.8E+00	4.1E-01	4.1E-02	kg/VKT	290	VKT	Watering (50%)	254.4	59.0	5.9
WE - WSD empty	AP-42 - Wind erosion of exposed areas - annual - Table 11.9-4	8.5E+02	4.3E+02	6.4E+01	kg/ha/yr	10.6	ha		8,991.2	4,495.6	674.3
								TOTAL	**10,035.3**	**4,723.9**	**703.1**

Increased Processing Rate

Description	Emission Factor	Emission rate						Emission Controls	Controlled emission (kg/yr)		
		TSP	PM10	PM2.5	Units	Activity Rate	Units		TSP	PM10	PM2.5
Ore - Unloading ROM to stockpile	AP-42 - Batch drop - Section 13.2.4.3	1.7E-03	8.0E-04	1.2E-04	kg/t	60,000	t		101.8	48.1	7.3
Ore - Wheeled loader rehandle ore to ROM bin	AP-42 - Batch drop - Section 13.2.4.3	1.7E-03	8.0E-04	1.2E-04	kg/t	60,000	t		101.8	48.1	7.3
Ore - Primary crushing	AP-42 - Primary crushing - Table 11.19.2.1	2.0E-01	2.0E-02	2.0E-03	kg/tonne	60,000	tonnes		12,000.0	1,200.0	120.0
Ore - Ball milling	AP-42 - Secondary crushing - Table 11.19.2.1	2.7E-03	1.2E-03	2.2E-04	kg/tonne	48,000	tonnes	Wet Process (100%)	-	-	-
Ore - Screening	AP-42 - Screening - Table 11.19.2.1	1.3E-02	4.3E-03	3.0E-04	kg/tonne	60,000	tonnes		750.0	258.0	18.1
Ore - Unloading of crushed / processed ore (concentrate) to stockpile	AP-42 - Batch drop - Section 13.2.4.3	3.6E-04	1.7E-04	2.6E-05	kg/t	5,700	t		2.1	1.0	0.1
Ore - Wheeled loader loading from concentrate stockpile to vehicles	AP-42 - Batch drop - Section 13.2.4.3	3.6E-04	1.7E-04	2.6E-05	kg/t	5,700	t		2.1	1.0	0.1
Ore - Hauling ROM ore to ROM pad	AP-42 Unpaved roads - Section 13.2.2	1.8E+00	4.1E-01	4.1E-02	kg/VKT	1,133	VKT	Watering (50%)	993.6	230.5	23.1
Ore - Hauling concentrate offsite	AP-42 Unpaved roads - Section 13.2.2	1.8E+00	4.1E-01	4.1E-02	kg/VKT	713	VKT	Watering (50%)	625.8	145.2	14.5
								TOTAL	**14,577.2**	**1,932.0**	**190.5**