Table17.3 DPI Water's assessment requests

Recommendation	Section addressed
Landform rehabilitation (including final void management) Where significant modification to landform is proposed, the EIS must include:	Figure 17.1.
• Justification of the proposed final landform with regard to its impact on local and regional surface and groundwater systems.	A significant change in the landform is not proposed, given the underground nature of the mine and no permanent surface emplacements.
• A detailed description of how the site would be progressively rehabilitated and integrated into the surrounding landscape.	Section 17.6
• Outline of proposed construction and restoration of topography and surface drainage features if affected by the project.	Chapter 2 (description of construction) and Figure 17.1 (final landform).
• The measures to be put in place to ensure that sufficient resources are available to implement the proposed rehabilitation.	Appendix O, Section 17.7.1
• The measures that would be established for the long-term protection of local and regional aquifer systems and for the ongoing management of the site following the cessation of the project.	Appendix E (refer to the groundwater report within the water assessment report), Section 17.6.3i.

In addition to the SEARs and government agency recommendations, the closure and rehabilitation strategy was prepared following the appropriate guidelines, policies and industry requirements, including:

- *Guideline for mineral exploration drilling; drilling and integrity of petroleum exploration and production wells* (NSW Department of Industry, Skills and Regional Development - Division of Resources and Energy 2016);
- *MDG 6001 – Guideline for the Permanent Filling and Capping of Surface Entries to Coal Seams, February, 2012* (Mine Safety Operations 2012);
- *ESG3 – Mining Operations Plan (MOP) Guidelines, September 2013* (Environmental Sustainability Unit – Mineral Resources 2013);
- *The Strategic Framework for Mine Closure* (ANZMEC and MCA 2000);
- *Mine Closure and Completion - Leading Practice Sustainable Development Program for the Mining Industry* (Australian Government Department of Industry, Tourism and Resources 2006a); and
- *Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry* (Australian Government Department of Industry, Tourism and Resources 2006b).

17.2 Decommissioning and rehabilitation objectives

The overriding objective of rehabilitation activities at the mine will be to return disturbed land to a condition that is stable, and supports the proposed post-mining land use, which is grazing on improved pasture. The main surface infrastructure area is on land currently used for agriculture, and it is therefore anticipated that the rehabilitated land will be incorporated back into the operating farm. Specifically, the rehabilitation goals are:

- to remove all project-related infrastructure not required by the final land use;
- to restore a safe and stable landform;
- to reinstate the soil profile and function, creating landforms that are compatible with the surrounding topography; and
- to establish a landscape that permits the land use of livestock grazing on improved pasture.

17.3 Final landform and land use

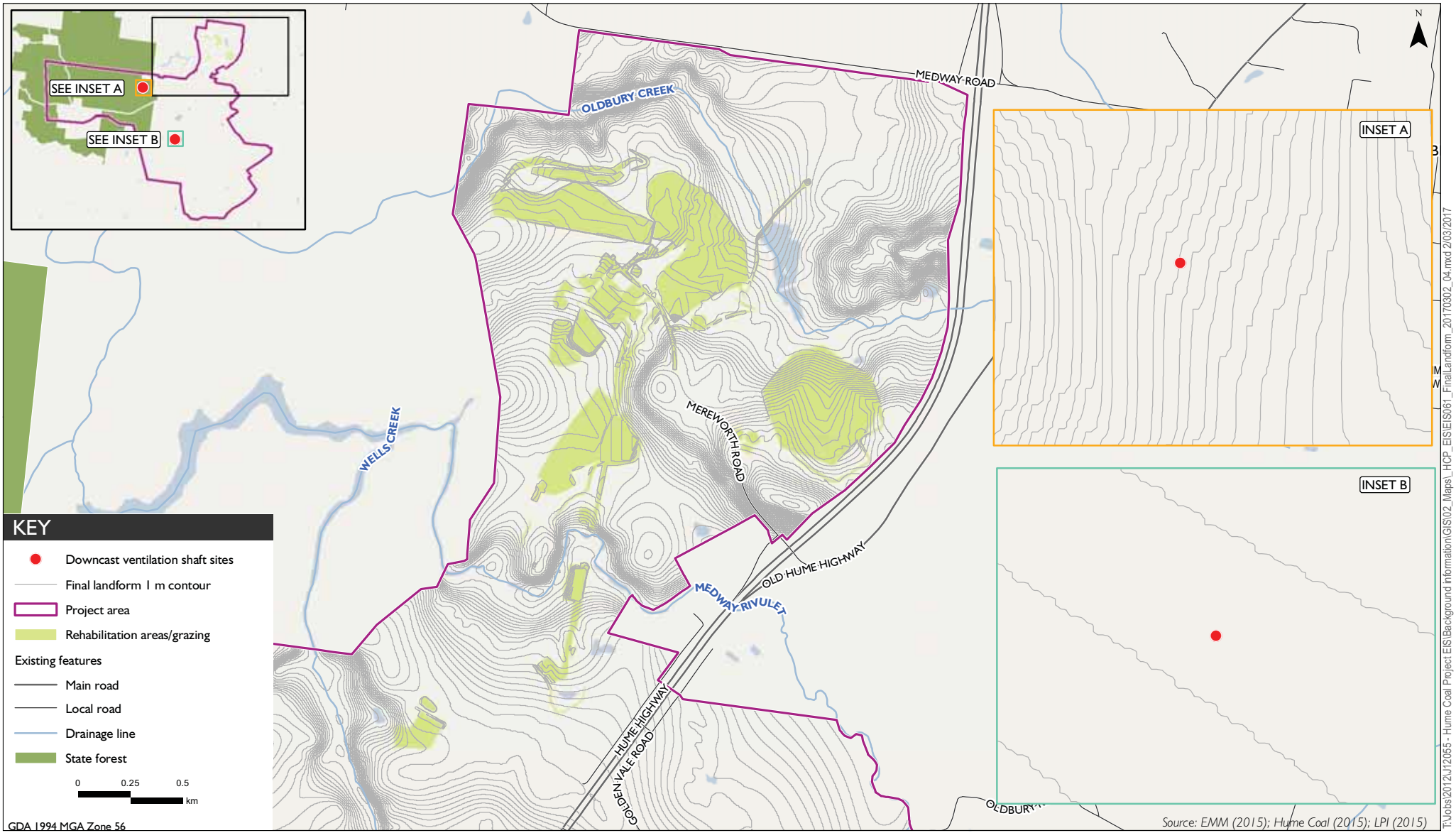
Post-mining, the land and soil capability class (LSC class) for the vast majority of the project area (ie 4,993 ha) will remain unchanged due to the underground nature of the project and the first workings mining method, with negligible associated subsidence, to be employed. Only around 2% of the project area (117 ha) will be disturbed for the construction of surface infrastructure. Upon closure of the mine, these areas, including the pit top, water management infrastructure and ventilation shafts, will be regraded to a similar topography to its pre-mining state and without any unnecessary dams.

The majority of land disturbed by surface infrastructure will be rehabilitated to land with an LSC class of 6. Class 6 land is suited to a limited set of land uses (grazing, forestry and nature conservation), and rehabilitation will allow the pre-disturbance land use of grazing on improved pastures to be reinstated.

Of the 117 ha to be disturbed, 59 ha will be rehabilitated back to the original LSC class, as the soil profile will not be significantly altered. There will be a change to the land and soil capability class over 58 ha of land disturbed by the surface infrastructure area and water management areas. The original land class of these areas (3 ha of Class 3, 37 ha of Class 4 and 18 ha of Class 5) will change to Class 6 due mainly to a change in the rehabilitated soil profile. However, Class 6 land will still be suitable for grazing and improved pasture, allowing the recommencement of an agricultural land-use post-mining, as it is now.

Disturbed areas will be rehabilitated to enable sustainable livestock grazing to occur at carrying densities equivalent to that pre-mining. These densities will be higher than what has historically been the case, due to leading farm management practices that have been implemented by Hume Coal upon purchasing the land containing the project surface disturbance footprint. Further details on post-mining soil and land capability are in Chapter 8 (soil resources).

The conceptual post-mining landform is shown in Figure 17.1, and a comparison between the pre-mining and post-mining landform is show in Figure 17.2.



Conceptual final landform

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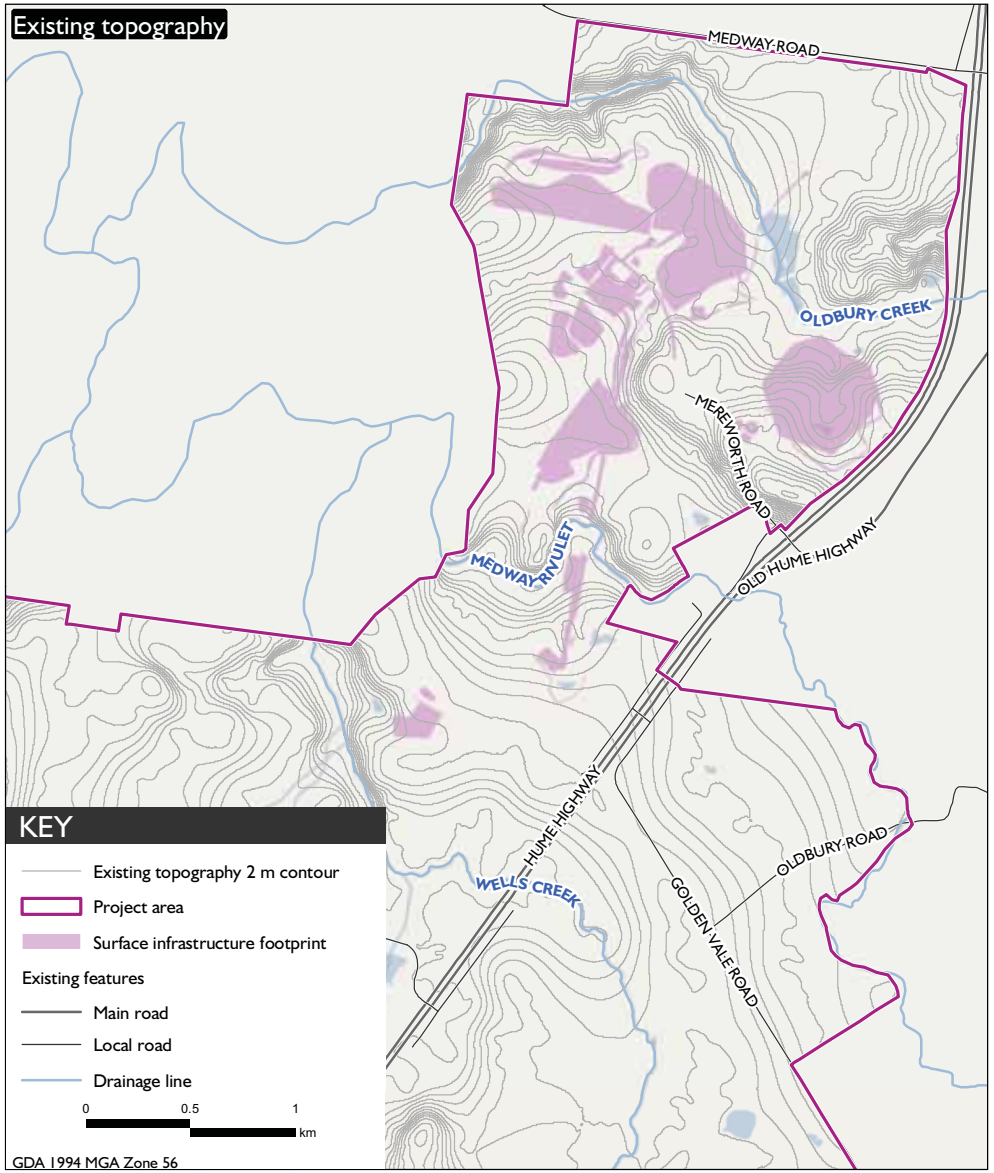
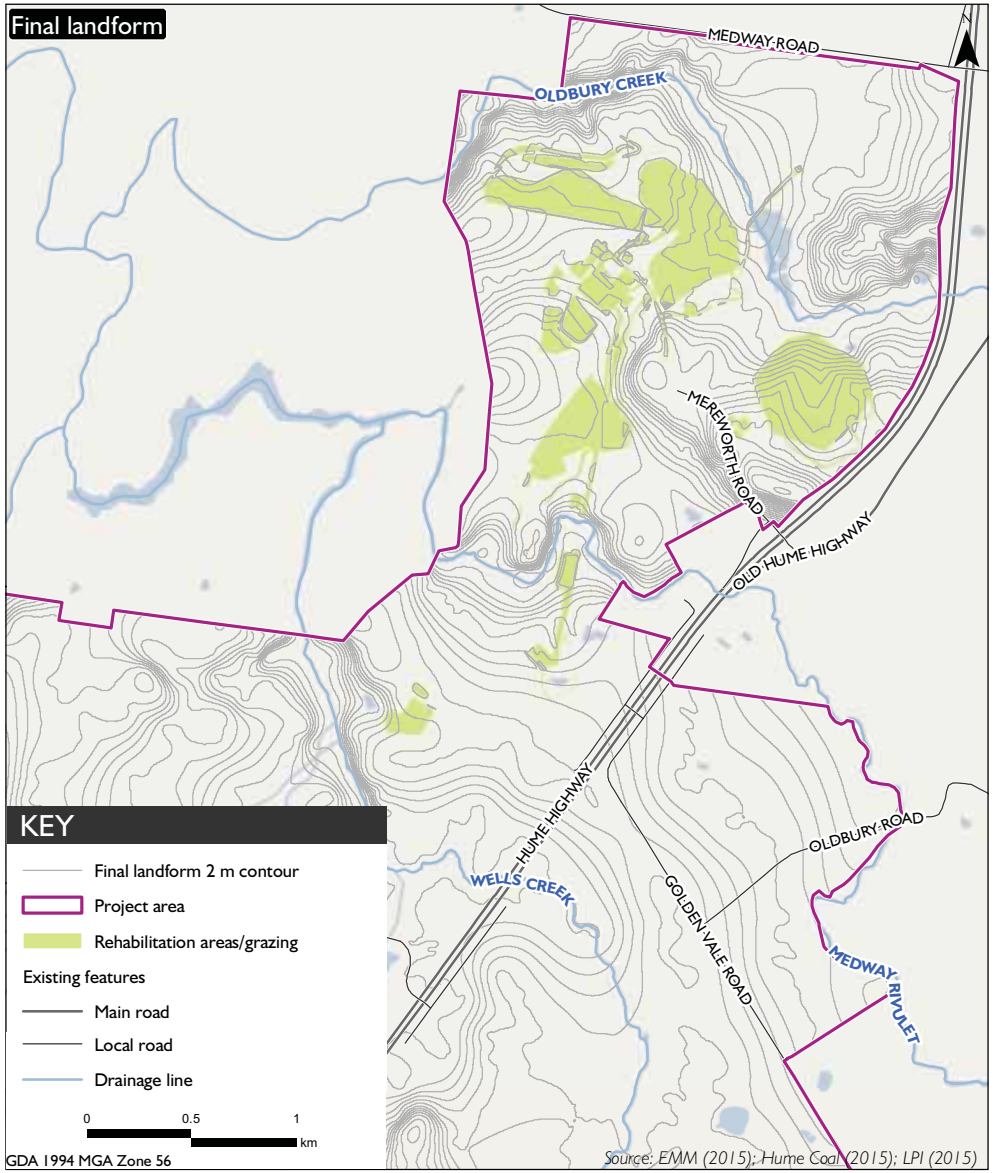
Figure 17.1





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Existing topography and indicative final rehabilitated landform

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Figure 17.2

17.4 Rehabilitation domains

The project area has been divided into a series of domains, with each domain having similar bio-physical characteristics. These domains have been assigned in accordance with the requirements of the MOP guidelines, so that they can be easily transferred into the MOP when prepared.

17.4.1 Primary domains

Primary domains are based on land management units within the project area, usually with a unique operational and functional purpose during operation, and therefore have similar characteristics for managing environmental issues. The primary domains form the basis of rehabilitation planning. The primary domains that have been identified for the project, consistent with the categories in the MOP guidelines, are:

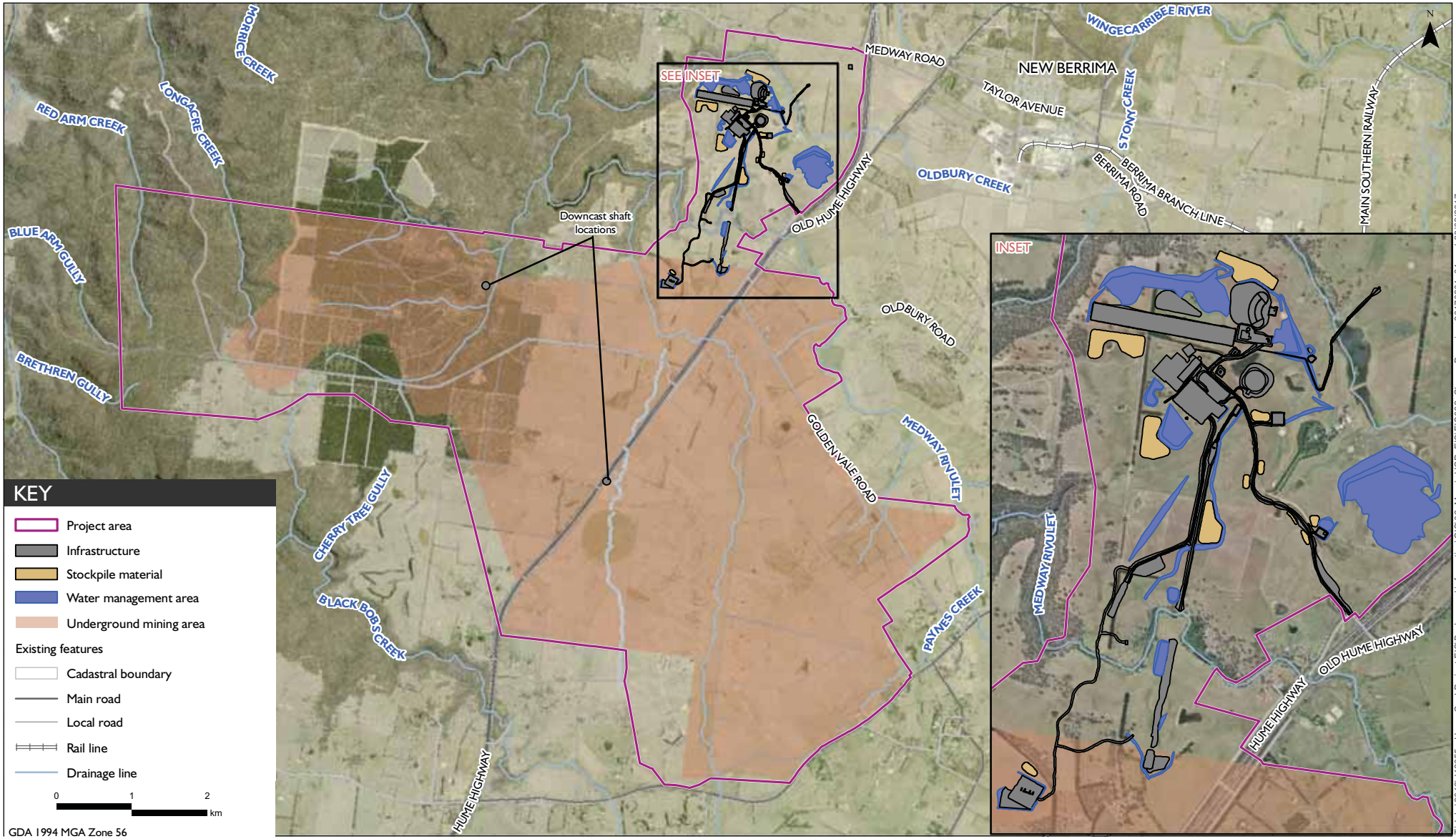
- infrastructure area;
- water management area;
- stockpiled material; and
- underground mining area.

These domains are described further in Table 17.3, and are illustrated in Figure 17.3.

Table 17.3 Surface Infrastructure disturbance by primary domain

Primary domain	Project element
Infrastructure area	Mining infrastructure (drifts, ventilation shafts)
	Coal handling infrastructure (ROM and product coal overland conveyor system, coal preparation plant, and coal loading facility)
	General infrastructure (access roads, offices, bathhouse, car parking, temporary accommodation and construction facilities, workshop and utilities)
Water management area	Primary water dam, stormwater basins and sediment control dams
Stockpiled material	ROM coal stockpile, product coal stockpiles, temporary coal reject stockpile, topsoil stockpiles and drift spoil stockpile.
Underground mining area (SMP[1])	Minor access tracks to exploration sites and environmental monitoring equipment etc.

Notes: 1. SMP – Subsidence Management Plan as per coding for primary (operational) domains in the MOP guidelines.



Primary rehabilitation domains

Hume Coal Project
Environmental Impact Statement

Figure 17.3

17.4.2 Secondary domains

Secondary domains are defined as land management units characterised by a similar post-mining land use objective (DRE 2013). All of the primary domains have been assigned a secondary domain (post-mining land use) of 'D – Rehabilitation Area – Pasture,' based on the rehabilitation objective of returning disturbed land within the project area to a minimum of LSC class 6.

17.5 Preliminary completion criteria

The secondary domains form the basis of performance criteria used for measuring rehabilitation and closure success. Preliminary completion criteria have been developed based on experience with other comparable mine rehabilitation projects in Australia, and in the case of the underground voids, the actions needed to achieve the water quality and availability criteria specified for the project, as well as safety criteria.

The preliminary completion criteria are presented in Table 17.4.

Table 17.4 Interim completion criteria at each phase of decommissioning and rehabilitation

Objective	Primary Domain	Completion criteria	Indicator
Phase 1– Decommissioning (ie removal of equipment and infrastructure)			
All infrastructure that is not to be used as part of the future intended land use will be removed to ensure the site is safe, free from hazardous materials, and will not pose a threat of environmental harm.	Infrastructure	Removal of all above ground services (power, water, communications) that have been connected on site as part of the project and that will have no future use. Decommissioning and removal of all plant, equipment and associated surface infrastructure. All access roads and tracks not required for the future intended land use are removed and rehabilitated.	Certification by a suitably qualified person
	Water management area	Removal of all water management infrastructure (including pumps, pipes and power).	Certification by a suitably qualified person
	Underground management area	All exploration drill holes undertaken on the mining lease have been rehabilitated or converted to water bores.	Certification by a suitably qualified person
There is no residual contamination of soil or water on site that is incompatible with the intended land use or that poses a threat of environmental harm.	Infrastructure	No stockpiled materials of coal product or coal reject to remain on the surface of the project area. Any hazardous material or potential sources of contamination have been isolated, remediated or removed.	Certification by a suitably qualified person
Underground workings are sealed and present no safety risks for humans and animals now and in the long-term.	Underground management area	Sealing and backfilling of drifts and ventilation shafts in accordance with approved design and relevant guidelines.	Certification by a suitably qualified person
	Infrastructure	Where risk mitigation measures include bunds, safety fences and warning signs, these have been erected in accordance with relevant guidelines and Australian Standards.	Certification by a suitably qualified person
Phase 2–Landform Establishment (ie earthworks)			
The rehabilitated land is suitable for the planned land use and compatible with the surrounding landscape.	Infrastructure, Water management area, stockpiles	Rehabilitated land is contoured in similar forms to the existing and/or surrounding topography.	Rehabilitated land surveyed for extent, height and slope
The rehabilitated land is stable and does not present a risk of environmental harm downstream of the site or a safety risk to the public/ stock/ native fauna.	Infrastructure, Water management area, stockpiles	If engineered structures to control water flow are required (eg contour banks, channel linings, surface armour, engineered drop structures and other required measures), they are installed and functioning.	Certification by a suitably qualified person
		Rehabilitated land does not exhibit any signs of continued erosion greater than that exhibited at a comparable reference site (with similar chemical and physical characteristics including slope to the rehabilitated site).	Certification by a suitably qualified person
		Dimensions and frequency of occurrence of erosion of rills and gullies are no greater than that on a comparable reference site.	Rate of soil loss; certification by a suitably qualified person

Table 17.4 Interim completion criteria at each phase of decommissioning and rehabilitation

Objective	Primary Domain	Completion criteria	Indicator
Phase 3–Growth Medium Development (ie topsoil spreading)			
Returned soil on the rehabilitated land is able to support the planned land use.	Infrastructure, Water management area, stockpiles	Soil thickness is adequate to support growth of pasture species suitable for desired land-use.	Soil depths
		Site soil characteristics (eg pH, salinity, nutrient content, sodium content, rockiness, depth of soil, wetness and plant available water capacity) are able to support growth of pasture species suitable for desired land-use.	Soil testing of relevant physical properties
Phase 4–Ecosystem and Land Use Establishment (ie vegetation establishment)			
Vegetation establishment is adequate and able to support the desired land use.	Infrastructure, Water management area, stockpiles	Vegetation growth parameters (eg biomass, percentage of cover, height and vigour of plant species) are no less than that exhibited at a comparable reference site.	Biomass, percentage of cover, height and vigour of plant species
		The abundance of declared plants (weeds) identified in rehabilitated areas is no greater than that exhibited at comparable reference sites.	Percentage of weed cover
Phase 5–Ecosystem and Land Use Sustainability (ie established vegetation is able to support post-mining land use)			
The rehabilitated land is stable and does not present a risk of environmental harm downstream of the site or a safety risk to the public/ stock/ native fauna	Infrastructure, Water management area, stockpiles	Rehabilitated land does not exhibit any signs of continued erosion greater than that exhibited at a comparable reference site (with similar chemical and physical characteristics including slope to the rehabilitated site).	Rate of soil loss; certification by a suitably qualified person
		Dimensions and frequency of occurrence of erosion of rills and gullies are no greater than that exhibited at a comparable reference site.	Certification by a suitably qualified person
Phase 6–Land Relinquishment			
The rehabilitated land is sustainable for the long-term and only requires maintenance that is consistent with the final land use.	Infrastructure, Water management area, stockpiles	The re-established topsoil/subsoil is capable of supporting the targeted pasture regime on a sustained basis.	Physical and chemical soil properties.
		Pasture establishment is consistent with the range of species suitable for the targeted pasture regime.	Pasture species present
		Pasture establishment is in good health and provides adequate cover.	Ground cover, biomass, etc
Runoff water quality is similar to, or better than, the pre-disturbance runoff water quality.	Infrastructure, Water management area, stockpiles	Downstream surface water quality at monitoring locations is not negatively impacted when trends indicated by results from baseline monitoring and the five years previous to closure are compared to monitoring results for the rehabilitated landform.	Surface water quality
Ground level and surface stability are not impacted by the presence of the underground workings.	Underground management area	Mining has been undertaken generally in accordance with designs and tolerances that provide for long-term geotechnical stability. Where land access can reasonably be obtained, no evidence of perceptible surface impacts are evident in the area above underground operations.	Mine survey plans are developed by a registered mine surveyor as mining progresses and provided to DRE annually and following completion of mining.

The preliminary completion criteria will be reviewed during the preparation of the MOP and associated rehabilitation management plans. The criteria will also be periodically reviewed in consultation with relevant stakeholders as required when the MOP is updated, and progress on rehabilitation will be reported in the form of annual environmental management reports.

17.6 Rehabilitation and decommissioning activities

17.6.1 Overview

Rehabilitation works will be carried out as described in detail in Appendix O and summarised in this section. There will be limited opportunities for progressive rehabilitation throughout the operational phase of the project, being an underground mine. However, where possible disturbed areas no longer required for mining activities will be progressively rehabilitated. This will include drill pads and access tracks. In addition, areas disturbed during the construction phase that are not required during mining, such as the temporary construction accommodation village (refer to Figure 2.3), will be dismantled and the land rehabilitated.

The main rehabilitation activities to be undertaken in each primary domain are described in Section 17.6.2. Rehabilitation methods, such as landform re-profiling and soil respreading, that will be applied across all domains are described in Section 17.7.

17.6.2 Infrastructure domain

i General infrastructure

Following cessation of mining, surface infrastructure will be safely decommissioned. Infrastructure items will be dismantled or demolished (depending on whether they will be re-used or recycled). Services will be disconnected and removed, and all concrete footings will be removed to 1 m below ground level. The disturbed areas will be cleared of any remaining coal, and the ground surface will be selectively assessed against background criteria for:

- pH, EC, TDS, acidity and alkalinity;
- major anions (sulphate, chloride) and major cations (calcium, magnesium, sodium and potassium); and
- analysis of soluble metals (aluminium, arsenic, antimony, boron, cadmium, chromium, cobalt, copper, fluoride, iron, lead, manganese, molybdenum, nickel, selenium and zinc).

If any contamination is found then the area will be appropriately remediated so that it is suitable for the agreed future land use of grazing.

Once disturbed areas are deemed to be free of materials and contamination, they will be deep ripped where required to ameliorate the effects of compaction as a result of operational activities. The areas will then be spread with approximately 0.1 m to 0.3 m of soil and treated with ameliorants such as gypsum, if necessary. Finally, the areas will be revegetated, primarily by direct seeding of improved pasture species.

Surface water management controls will be installed during the rehabilitation process, so as to control overland flow to minimise soil erosion. This will be achieved by:

- re-shaping the area as required, generally returning it to its pre-mining topography (refer to Figure 19.1), where practicable;
- deep ripping of any compacted surfaces to minimise the effects of compaction and maximise infiltration following rainfall; and
- installing diversion banks/channels (where necessary) to safely convey overland flow.

ii Drifts

The two drifts will be decommissioned and sealed with consideration of the relevant guidelines at the time, which are currently *MDG 6001 – Guideline for the Permanent Filling and Capping of Surface Entries to Coal Seams* (Mine Safety Operations 2012).

Upon closure, the following activities will be undertaken to backfill and seal the drifts:

- Any structures or plant and equipment within the drift containing oils or greases will be removed or drained.
- Pipes and conveyor structure will be removed from the part of the drift to be filled with material, if it is safe to do so.
- A substantial bulk head that has been designed and certified by a suitably qualified engineer will be constructed in a location that is deeper than at least 30 m of cover, and located within the part of the drift that is excavated in rock, with a septum (wall that dives a cavity) of solid rock above the drift of at least 15 m. The design of this bulkhead will also take into account the potential for gas build-up, noting that there is a very low likelihood of gas building up due to the fact that the coal seam has a very low measured gas content. Nonetheless, if gas is assessed to be a potential risk prior to sealing the underground mine, the bulkhead will be designed accordingly.
- The remainder of the drift, including the cut and cover section will be filled with material either excavated from the drift originally, or otherwise determined to be geochemically benign and suitable as fill. The geochemistry of the drift spoil has been assessed as non acid-forming (refer to Appendix E), and therefore there will not be an on-going potential for acid mine drainage (AMD). The drift spoil will be also placed and shaped in a way that limits the potential for rainfall infiltration and the accumulation of water in the backfilled drifts.
- The concrete floor and arch sections will be removed to a depth of at least 1 m below the final ground level.
- The remaining fill material will be placed and compacted and covered with topsoil at least 0.3 m deep. The area will then be seeded with improved pasture species.

The location of the drifts may be durably marked with a plaque or similar device, subject to the outcomes of a risk assessment as part of the preparation of the detailed closure plan within five years of closure.

iii Ventilation shafts

The ventilation shafts will also be decommissioned and sealed generally in accordance with the relevant guidelines at the time, which are currently *MDG 6001 – Guideline for the Permanent Filling and Capping of Surface Entries to Coal Seams* (Mine Safety Operations 2012).

The objective of decommissioning the ventilation shafts will be to remove the potential for access to the underground workings and to make the area safe long-term. Following the cessation of mining, the ventilation shafts and associated infrastructure such as fans and services will be removed. In the case of buried services they will be excavated to a depth of 1 m below ground level with the excavation then backfilled.

A retaining structure will be designed and constructed in the connecting roadways at the base of each ventilation shaft to prevent backfill from flowing into any unfilled voids. Once the retaining structures have been built the ventilation shafts will be filled with drift spoil or other suitable borrow material.

At the ground surface a suitably designed and engineer certified concrete plug will be used to permanently seal the top of the ventilation shafts. The concrete plug will be keyed into the ventilation shaft collar, which will be designed and constructed so that it is founded on hard rock, and is of appropriate geometry to allow the final plug to be permanently keyed in place by the use of pockets, wedge shape or other mechanical system.

Where practicable the shaft collars/plugs will remain uncovered, and the location of the shafts durably marked with a plaque or similar device displaying the sealing detail.

17.6.3 Water management domain

i Panel sealing

As underground mining progresses, the mined-out voids will be progressively sealed, enabling the progressive emplacement of rejects underground, and assisting with groundwater management by allowing water injection as well as natural recharge to occur. Figure 2.7 illustrates the progression of the mine, including progressive panel sealing, over time.

When mining is completed in each panel, the panel will be sealed through the installation of water-retaining rated bulkhead seals, in accordance with the requirements of *Work Health and Safety (Mines and Petroleum sites) Regulation 2014*, and *MDG 6001 – Guideline for the Permanent Filling and Capping of Surface Entries to Coal Seams, February 2012* (Mine Safety Operations 2012), or relevant guidelines at the time.

ii Groundwater bores

All groundwater bores and associated infrastructure installed as part of the project will be permanently decommissioned, except as otherwise agreed with the landholder and DPI Water, and in accordance with relevant guidelines, including any relevant make good provisions.

iii Mine water dams and stormwater retention structures

All water management structures (primary water dam, stormwater dams, sediment dams) and associated infrastructure (refer to Figure 2.10) will be rehabilitated once no longer required. Decommissioning and rehabilitation of these water management structures will include the following steps:

- any remaining water in storages will be tested to determine if water quality criteria are met, and if not, then water will be treated to remove any contaminants before discharging, or pumped into the underground voids. Water will be treated to a standard that meets the assessment criteria established as part of the water assessment, so that NorBE is met (refer to Chapter 7);
- dam walls will be pushed down and the area re-shaped to be generally consistent with the surface of the surrounding land;
- deep ripping of the compacted base of the dams to facilitate rainfall infiltration and minimise the potential adverse effects of soil compaction; and
- spreading of soil and seeding.

17.6.4 Stockpiled material domain

Various materials will be stockpiled over the life of the mine:

- topsoil stripped during construction activities;
- spoil from construction of the two drifts;
- coal reject that was stockpiled on the surface prior to the commencement of underground emplacement; and
- ROM and product coal.

No stockpiled material will remain on the ground surface after rehabilitation is completed. Drift spoil and coal rejects will be used to fill in the drifts and ventilation shafts. Any residual coal will be removed from the product and ROM coal stockpile pads, and if there is no commercial value it will be returned to the underground workings.

As noted in Section 17.6.2 ii and Appendix O, the drift spoil is non acid forming. Similarly, the risk of AMD is low (Appendix E). Notwithstanding, to make sure that no contamination remains, once stockpiled material is removed the soil under the drift spoil, reject and coal stockpiles will be selectively assessed against background criteria for:

- pH, EC, TDS, acidity and alkalinity;
- major anions (sulphate, chloride) and major cations (calcium, magnesium, sodium and potassium); and
- analysis of soluble metals (aluminium, arsenic, antimony, boron, cadmium, chromium, cobalt, copper, fluoride, iron, lead, manganese, molybdenum, nickel, selenium and zinc).

If any contamination is found then the area will be appropriately remediated so that it is suitable for the agreed future land use of grazing. The former stockpile areas will then be deep ripped and seeded as per the methodology outlined in Section 17.7.

17.6.5 Underground mining area

The underground mine will remain predominately as voids at the end of the mine life, with the exception of about 36% which will be backfilled with coal rejects. Groundwater will be managed progressively through the mine life by the installation of bulkheads. Upon closure, entry to the underground mine will be managed by sealing and partial backfilling of the drifts and shafts with drift spoil, as described in Section 17.6.2.

As there will be negligible subsidence, it is expected that there will be no requirements to remediate areas above the underground workings.

If drill pads from exploration remain at the time of closure then they will be rehabilitated in accordance with the relevant guidelines at the time, currently *Guideline for mineral exploration drilling; drilling and integrity of petroleum exploration and production wells* (DRE 2016).

17.7 Rehabilitation methods

17.7.1 Soil management

The stripping of topsoil and subsoil during construction and subsequent stockpiling is an important factor in achieving successful rehabilitation outcomes through the use of suitable soils.

Accordingly, the soil stripping procedure will be designed to maximise the salvage of suitable materials so pastures can be reinstated to a condition that will support pre-mining livestock carrying densities. These measures will be consistent with leading practice and incorporate the full range of reasonable and feasible mitigation methods for soil stripping, with the goal of minimising the degradation of soil nutrients and micro-organisms. Topsoil and subsoil will be stripped to varying depths across the disturbance footprint as identified in Chapter 8 (land and soil resources). There is no plan to retain tree hollows, logs, and native seed because the disturbance footprint is occupied by improved pasture and will be returned to this land use.

Topsoil and subsoil will be stockpiled separately with stockpiles designed and located to prevent contamination, development of anaerobic conditions, and to avoid erosion and dust generation. The stockpiles will be seeded with grasses so that they remain stable and will be regularly inspected for weeds.

17.7.2 Landform re-profiling

Disturbed land will be re-profiled once surface structures are removed by re-instating depressions which were filled for mine development, removing dams and bunds so that water is not permanently retained and deep ripping of compacted areas.

17.7.3 Soil spreading

Soil will be applied to provide sufficient depth for plant growth in a manner which minimises any degradation of soil characteristics. A soil balance plan will be prepared prior to spreading, which will show the depths and volume of soils to be reapplied in particular areas. Topsoil and subsoil will be applied at a thickness appropriate to support the intended land capability (generally 0.3 m). The soil will then be lightly scarified on the contour and seeded with improved pasture grass species.

Pasture grass species will be chosen to suit the chosen grazing strategy, as well as species that are suitable for fast establishment of an initial cover crop.

17.7.4 Public safety

Access controls will be implemented to protect public safety, including fencing around any potentially dangerous areas and notices alerting the public to any safety risks.

17.8 Rehabilitation trials, monitoring and post-closure maintenance

The project will be an underground mine which will not result in extensive ground disturbance. Therefore, unlike an open-cut mine, there will not be extensive areas requiring rehabilitation. Appendix O and this chapter demonstrate that Hume Coal has carefully considered the necessary actions for successful rehabilitation of disturbed areas; describing protocols for soil stripping depths, soil stockpile management, erosion and sedimentation control and re-application of soil once surface infrastructure is removed at the conclusion of mining. These are standard rehabilitation techniques which have proven successful in other mining and infrastructure applications.

There will be limited opportunities for progressive rehabilitation as the majority of surface disturbance will be for the surface infrastructure area which will be required for the life of the project. Notwithstanding, areas disturbed to enable construction will be rehabilitated as soon as they are no longer required. Given that surface disturbance will not be extensive, proven standard rehabilitation techniques will be used and that there will be limited opportunities for progressive rehabilitation, and thus rehabilitation trials, it will not be necessary to conduct rehabilitation research or trials for the project.

Rehabilitation will be monitored against the completion criteria in Table 17.4 and regularly (at least on an annual basis) inspected for the following aspects:

- evidence of any erosion or sedimentation;
- success of initial establishment of vegetation;
- the extent of weed infestation (primarily noxious weeds, but also other weeds that may be inhibiting native vegetation or pasture restoration);
- the integrity of graded banks, diversion drains, waterways and sediment control structures;
- the general stability of the rehabilitation areas; and
- all water quality and availability criteria specified in approval conditions.

If rehabilitation is not progressing satisfactorily towards achieving completion criteria, further measures will be adopted such as re-seeding and/or application of fertilisers. Depending on the progress of rehabilitation monitoring after the initial three years, monitoring may become less frequent and be limited to a smaller range of criteria. This will only occur in a way that will ensure continued compliance with approval conditions.

A specific rehabilitation monitoring program to be implemented post-closure will be outlined in a detailed closure plan, to be prepared within five years of closure.

17.9 Conclusion

The entire disturbance footprint of the mine will be rehabilitated once mining is complete, with the overarching goal of rehabilitation to restore the land to its pre-mining land use; that is, an agricultural land use comprising grazing on improved pasture. Being an underground mine, disturbed areas on the surface requiring rehabilitation upon closure of the mine will be limited, with the disturbance footprint comprising about 2% of the entire project area.

Underground voids will be progressively partially backfilled as mining progresses. This will assist in groundwater recovery, as well as eliminating the need for large surface reject emplacements that would otherwise require rehabilitation at mine closure. There is a negligible risk of subsidence-related impacts occurring above the underground mine, due to the first workings mining method which retains pillars of coal to support the overlying strata. As there will be negligible subsidence, it is expected that there will be no requirement to remediate areas above the underground workings. However, regular inspections will be carried out to monitor sensitive features above the underground mining area where land access can be obtained, and remedial actions identified at the time, if required.

Progress on rehabilitation will be monitored annually and the results will be reported within the annual environmental management report (annual review). Final rehabilitation and project closure requirements will ultimately be developed as part of a detailed closure plan, which will be produced within five years of closure in consideration of input from key government agencies, relevant stakeholders (including the nearby community) and applicable guidelines and standards at the time.

18 Hazards and risk

18.1 Introduction

A hazard and risk assessment (HRA) of the project was conducted to address relevant SEARs and thereby determine:

- if it would be a hazardous or offensive development under State Environmental Planning Policy No. 33 (Hazardous and Offensive Development) (SEPP 33);
- the general risks from the project to people, property and the environment;
- potential risks associated with subsidence; and
- risks associated with bushfires ignited on, or adjacent to, Hume Coal owned land.

The risks of encountering contaminated land are also considered in this chapter.

Subsidence related risks were summarised from the Subsidence Assessment Report, with the full report given in Appendix L.

The assessment found that the project will not be hazardous or offensive industry and that it will not pose a significant risk to people, property or the environment.

This chapter summarises the HRA, with the full report provided in Appendix P.

18.1.1 Assessment requirements and guidelines

The SEARs require an assessment of potential hazards and risks associated with the project. The requirements and EIS sections where they are addressed are in Table 18.1.

Table 18.1 Noise and vibration-related SEARs

Requirement	Section addressed
Include an assessment of the:	
likely risks to public safety;	Section 18.3.4
paying particular attention to potential subsidence risks;	Section 18.4
bushfire risks; and	Section 18.6
the handling of any dangerous goods	Section 18.3.2

To inform preparation of the SEARs, DP&E invited other government agencies to recommend matters to be addressed in the EIS. These matters were taken into account by the Secretary for DP&E when preparing the SEARs. Copies of the government agencies' advice to DP&E were attached to the SEARs and no agencies raised matters relevant to the hazard and risk assessment.

The following guidelines were referenced during preparation of the HRA:

- DP&E's qualitative risk assessment criteria in *Hazardous Industry Planning Advisory Paper No 4: Risk Criteria for Land Use Safety Planning* (DoP 2011a). This advisory paper provides criteria to guide assessments of the acceptability of public safety risks from a development.
- *Applying SEPP 33* (DoP 2011b).
- *Australian/New Zealand Standard International Organisation for Standardisation 31000:2009 Risk Management – Principles and guidelines* (AS/NZS ISO 31000:2009).

18.2 Hazardous and offensive development

The HRA considered if the project will be a hazardous or offensive development under SEPP 33. This was determined by comparing the quantities of hazardous materials to be stored and used on site to the threshold quantities of dangerous goods given in DoP (2011b). As transportation of hazardous materials to and from a proposed development may also be hazardous, quantity screening thresholds for transport of materials given in DoP (2011b) were also examined.

The bulk hazardous materials that will be used by the project are diesel, flammable liquids (petrol, oil, grease, degreaser, paints, cleaning and coal processing substances), gases (liquid petroleum gas (LPG), acetylene) and minor quantities of explosives.

All of these materials will be either kept in sufficiently small quantities or stored far enough away from public areas to prevent the project from qualifying as hazardous development. The materials and their SEPP 33 thresholds are described below.

18.2.1 Hydrocarbons

Petrol, paints, cleaning and coal processing substances, oil, grease and degreaser will be stored in accordance with *Australian Standard 1940-2004 The Storage and Handling of Flammable and Combustible Liquids* (AS 1940-2004). Also, these materials will be stored and used on the project in smaller quantities than their SEPP 33 thresholds.

Small quantities of petrol will be stored in the fuel tanks of light vehicles, jerry cans and some hand tools and other small equipment such as chainsaws and lawn mowers. The other hydrocarbons will be stored in the workshop and storage warehouse near the centre of the surface infrastructure area. This area will also be approximately 800 m inside the boundary of Hume owned land, which is approximately 650 m more than the SEPP 33 'potentially hazardous region' threshold. The arrow on Figure 18.1 shows that the storage distance is beyond the potentially hazardous region.

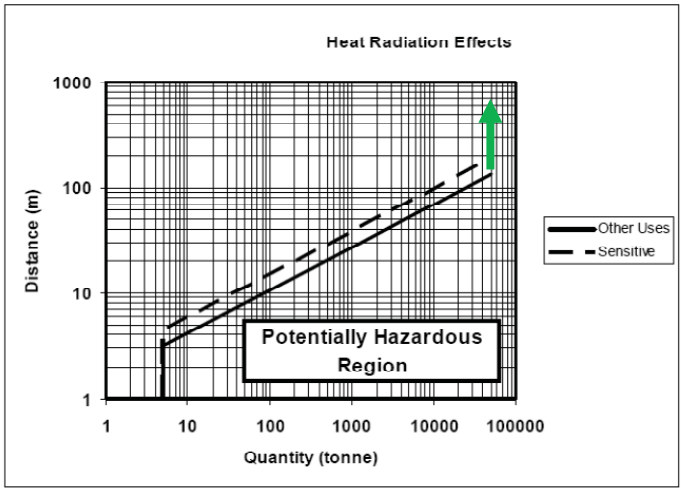


Figure 18.1 SEPP 33 criteria for Class 3PGII & III flammable liquids (DoP 2011b)

Diesel is not classified as a dangerous good (for transport purposes) under *Australian Code for the Transport of Dangerous Goods by Road and Rail Edition 7.3* (NTC 2014) as its flash point is above 60°C. Therefore, its storage and use on-site will not qualify the project as potentially hazardous or offensive development.

Coal processing substances will be used at the CPP for coal washing and processing. The substances to be used will be selected closer to the start of operations; however, substances predicted to be used at this stage are not dangerous according to their safety data sheets.

18.2.2 Gases

The following gases are proposed to be stored and used at the project:

- An LPG tank with a capacity of 5 m^3 (Class 2.1 flammable gas).
- Up to five small capacity (approximately 1 m3) acetylene cylinders during construction and one or two 4.1 m3 to 8.7 m3 capacity acetylene cylinders (up to 0.02 t) during operations.

The screening threshold for LPG stored above ground is 16 m^3, which is more than the 5 m^3 proposed storage capacity at the project.

The potentially hazardous region for 0.02 t of Class 2.1 flammable gases other than LPG is 15 m and less from public areas. However, the flammable gas storage area will be approximately 800 m from the boundary of Hume owned land. Therefore, the storage of LPG and acetylene will be less than the SEPP 33 thresholds and will not qualify the project as potentially hazardous.

LPG will be stored in accordance with *Australian Standard/New Zealand Standard 1596:2008 The Storage and Handling of LP Gas* and acetylene will be stored in accordance with AS 1940:2004.

18.2.3 Explosives

Up to 5 t of detonators and packaged emulsion explosives will be stored separately on-site for use during construction of the drifts and shaft pre-sink. NTC (2014) classifies detonators as Class 1.1 explosives.

Up to 400 kg of packaged emulsion explosives with electric detonators may be stored on-site to assist with excavation on the infrequent occasions where mechanical mining is not practical.

The explosives storage will be designed and constructed in accordance with *Australian Standard 2187.1 - 1998 Explosives – Storage, Transport and Use: Storage.* Ammonium nitrate will be stored in a low sensitivity state (ie without impurities or additives) and separate to initiating explosives.

The potentially hazardous buffer zone for 5 t of explosives is 240 m and for 400 kg of explosives is up to 150 m assuming no public access is allowed in the buffer zone (Figure 18.2). The explosives storage will be approximately 290 m from the nearest boundary of Hume owned land. These distances are outside the potentially hazardous region.

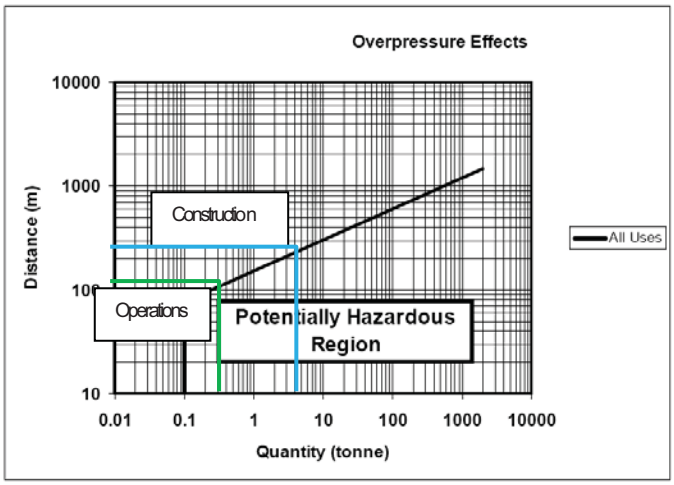


Figure 18.2 SEPP 33 criteria for Class 1.1 explosives (DoP 2011b)

18.2.4 Radioactive material

Minute quantities of radioactive material (Coal Scan and lasers) will be housed on-site in purpose built canisters on the conveyors or in the CPP, which will be approximately 780 m from the boundary of Hume owned land. The transport of radioactive material by contractors will be guided by Australian Radiation Protection and Nuclear Safety Agency (2008), *Code of Practice – Safe Transport of Radioactive Material.* Storage and handling of radioactive materials will be guided by Australian Radiation Protection and Nuclear Safety Agency (2012), *Holistic Safety Guidelines v1.*

18.2.5 Coal dust

Appendix 3 of DoP (2011b) lists industries that may be potentially hazardous, which includes coal handling due to the potential for coal dust explosions to occur. The main potential initiators of a coal dust explosion in an underground coal mines are a methane explosion or detonation of explosives. Due to the following factors, a coal dust explosion is unlikely:

- An effective ventilation system will be in operation so that excessive amounts of coal dust do not accrue.
- The Wongawilli Seam, which is proposed to be mined, has a low gas content (typically less than 0.5 m^3/t).
- Explosives will be used sparingly in controlled circumstances and only involve minor amounts.

Procedures for use of explosives underground typically involve the liberal application of stone dust (an explosion suppressant dust) in the immediate area beforehand. Furthermore, the regular application of stone dust to all accessible areas of the mine is a statutory requirement, along with regular sampling of coal dust and stone dust concentrations throughout the mine, to provide for reapplication of stone dust before the coal dust can reach potentially explosive concentrations. These measures in combination mean a coal dust explosion is extremely unlikely to occur.

Furthermore, the exits of the personnel and materials drift and conveyor drift will face north, away from the Hume Highway to the east and private property to the west, so that any blast from an uncontrolled underground explosion, should one make it to the surface, would be directed away from publicly accessible areas.

The risk of a coal dust explosion related to handling of coal in the CPP is very unlikely as coal is not proposed to be pulverised at the CPP. Therefore, handling of coal will not qualify the project as a potentially hazardous or offensive development.

18.2.6 Transport

Transportation of the above hazardous materials to the project area will not qualify the project as a hazardous or offensive industry as annual truck movements of goods will be well below the thresholds in DoP (2011b) for vehicle movements (Table 18.2).

Table 18.2 Transport screening thresholds

Substance	Dangerous good class	Annual truck movements	Quantity per load	Annual SEPP 33 threshold truck movements	SEPP 33 threshold minimum quantity (bulk)
Chlorine	2.3	12	200 L	>100	1 t
Oxy acetylene	2.1	52	15 bottles, less than 2 t	>500	5 t (if in bottles rather than a bulk tank)
LPG	2.1	17	5 m^3	>500	2 t (if in a bulk tank)
Coal processing reagents	3PGIII	12	0.5 t	>1000	10 t

Notes: *1.* Refrigerant gas is not included as Class 2.2 gases and therefore do not have safe transport thresholds.

2. Transport of radioactive material by contractors will be guided by *Australian Radiation Protection and Nuclear Safety Agency 2008 Code of practice for transport of radioactive material* and explosives will be transported in accordance with *Workplace Relations Minister's Council 2009 Australian code for the transport of explosives by road and rail third edition. Australian Government.*

18.2.7 Offensive development

SEPP 33 states that a potentially offensive industry is a development which, if it were to operate without employing any measures to reduce or minimise its impact in the locality or on the existing or likely future development on other land, would emit a polluting discharge in a manner which would have a significant adverse impact in the locality or on the existing or likely future development on other land.

Without the implementation of management measures, the project would have potential to emit noise, dust and water pollution that would affect the locality and existing or future development of adjacent land. However, these emissions can be prevented or reduced to acceptable levels with the implementation of management measures (refer to Chapters 7 (water resources), 11 (noise) and 12 (air quality)).

DoP (2011b) states that compliance with NSW EPA requirements should be sufficient to demonstrate that a proposal is not an offensive industry. The project will be required to apply for an environment protection licence from the EPA as it is a scheduled activity (mining for coal) under Schedule 1 of the NSW POEO Act. Therefore, if the EPA deems that a licence can be granted, which is likely given that potential impacts of the project can be prevented or suitably managed, the project will not be an offensive industry.

18.2.8 Will the project be hazardous or offensive?

The project will not be a potentially hazardous or offensive development, as defined by SEPP 33, because:

- hazardous materials will not be stored or used within the hazardous buffer zones or threshold quantities detailed in DoP (2011b);
- annual truck movements of goods will be well below the thresholds in DoP (2011b) for vehicle movements; and
- emissions from the project will be prevented or reduced to acceptable levels with the implementation of management measures and Hume Coal will apply for an environment protection licence from the EPA for the project and comply with its provisions.

18.3 Risks from the project

18.3.1 Risk assessment method

The HRA considered hazard scenarios for possible events, such as accidents, which could occur during normal operation of the project to people, property and the environment in accordance with the risk assessment method in *Australian/New Zealand Standard International Organisation for Standardisation 31000:2009 – Risk Management – Principles and Guidelines* (AS/NZS ISO 31000:2009).

The risk assessment comprised:

- dividing the project into a series of domains which have common risk characteristics, that is public roads, mine area including drifts and ventilation shafts, surface infrastructure area, CPP, water infrastructure (dams and pipelines) and public infrastructure (gas pipeline);
- identifying potential hazards and incident types (leaks/spills, fire/explosion, safety loss, property damage, groundwater contamination, impacts to native wildlife and security breaches);
- identifying scenarios that could present a risk to individuals, society and/or the environment;
- identifying potential controls; and
- determining the consequences and likelihoods of each scenario assuming appropriate engineering and administrative controls are in place.

The resulting risk table, including the scenarios identified and the associated risk ratings, is given in full in Appendix P and is summarised below.

18.3.2 Preliminary risk assessment results

Thirty seven scenarios were identified and these resulted in the following risks:

- 22 level 3 (low) risks;
- 15 level 2 (moderate) risks; and
- no level 1 (high) risks.

The level 3 risks are not considered further in this chapter as they have low risk ratings and can be effectively managed with proven controls. The necessary controls will be put in place during the project's detailed design.

The level 2 risks and the project components with which they were associated are as follows:

- eight were associated with transport (materials or workers) on public roads;
- five were associated with fires and explosions in the surface infrastructure area; and
- two were associated with spills/leaks and unauthorised entry to the water infrastructure.

The level two risks are discussed below.

i Road transport

The road transport risks are generally consistent with the societal risks associated with road transport.

The risk of traffic accidents involving vehicle roll-overs and/or collisions resulting in injuries, spills, fire or explosion will be minimised through a range of administrative controls (including selection of appropriate contractors and transport management systems).

The risk of traffic accidents as a result of fatigue and/or intoxication will be controlled during construction by the use of a construction accommodation village that will house the majority of the construction workforce in close proximity to the worksites. Administration controls will also be applied during construction and operations including the consideration of fatigue when designing the shift rosters; implementation of drug and alcohol testing programs; and the requirement for operations phase employees to live within 45 minutes travel time to the mine.

While the above control measures will be implemented and are expected to be effective, road transport risks are likely to remain level 2 risks as the prospects of a major injury and/or fatality cannot be eliminated.

ii Fire and explosions

The risks associated with fires and explosions in the surface infrastructure area/CPP will be minimised by transporting and storing explosives in compliance with relevant legislation, codes of practice and Australian Standards. This includes appropriate construction of storage areas and provision of adequate buffers between storages and publicly accessible areas. Further, the explosives magazine will be fully bunded to contain any explosive force and there will be a fire fighting system throughout the mine infrastructure area and CPP.

However, these risks are likely to remain level 2 risks as a fatality, major injury or major property damage is still a potential consequence of fire or explosions.

iii Unauthorised entry to mine area and mine infrastructure area

The risk resulting from unauthorised entry by people not associated with the mine, for example for theft and malicious use of combustibles, could result in major injury or fatality. Measures to control access to the mining and infrastructure areas will be devised during detailed design. The measures initially implemented will be re-assessed and refined as necessary to reflect changes to the operation over time.

iv Dam failure

If the primary water or other large dam fails the resulting release of water could damage property and the environment. Dam design and maintenance will be within accordance of ANCOLD (2003) which will reduce the likelihood of a dam failure. However, the consequences of a dam failure will remain high as the risk of an uncontrolled rush of water cannot be eliminated and can be destructive.

18.3.3 Hazard and risk criteria

Potential risks from the project were compared to the qualitative risk criteria in DoP (2011a), which is used to guide decision makers on the acceptability of public safety risks from a development.

Comparison of the risks associated with the project to the DoP (2011a) risk criteria showed that the project generally represents a low risk. However, where there are elevated risks associated with parts of the project, these risks will be managed to achieve acceptable outcomes through the application of substitution, engineering and administrative controls. In addition, more specific and detailed risk assessments will be conducted during the project design and construction phases to ensure the level of risk identified in the HRA is at least maintained or, if possible, reduced throughout the life of the project.

18.3.4 Assessment conclusions

Overall risks from the project are low because:

- no major hazards associated with the materials that will be used have been identified;
- the consequences of potential risks will generally be contained within Hume Coal owned land. Exceptions are bushfires and risks associated with road transport. These risks will be minimised to be as low as reasonably practical via a range of controls; and
- a potential incident at the project will not impact other potentially hazardous or offensive industries as the project will not be next to any existing or proposed hazardous or offensive developments.

The identified risks from the project will be further examined as part of detailed project design and reassessed in the ongoing hazard assessment process to ensure risks are kept as low as reasonably practical.

18.4 Subsidence risks

Subsidence impacts are described in detail in Appendix L, with impacts summarised below to demonstrate that subsidence presents a low risk to people, property and the environment.

A first workings mining method has been adopted for the project as it offers the maximum level of protection to both the overlying strata and to surface features. As no secondary extraction will be undertaken, no caving of the roof strata from wide unsupported voids will occur.

Findings relative to man-made and natural surface features are summarised in Table 18.3.

Table 18.3 Summary of subsidence impacts

Feature	Description	Impact
Man-made		
Buildings	The maximum predicted tilt for the project is 0.26 mm/m, which is less than the tilt (5 mm/m) above which remedial work may be required on buildings.	Negligible
Roads	The mine plan has specifically taken into account the presence of the Hume Highway transecting the project area, with the extent of mine workings under the highway limited to intermittent crossings to provide first working access headings. There are local examples of roads and highways being successfully undermined with no significant impact and at significantly higher vertical settlement, tilt and horizontal strain values than those predicted for this project.	Negligible
Bridges	A number of bridges and culverts are present in the wider project area but subsidence levels due to mining have been found to be negligible (ie less than 20 mm of surface lowering).	No impacts

Table 18.3 Summary of subsidence impacts

Feature	Description	Impact
Transmission towers	The most significant structures are the 130 kV and 330 kV transmission lines in the southern portion of A349, which are well outside of the underground mining area. Problematic subsidence impacts relative to transmission lines, which include power pole instability and cable issues, commence at tilt levels in the order of 20 mm/m, however, the maximum predicted tilt for the project is 0.26 mm/m.	No impacts
Gas pipelines	The Moomba to Sydney natural gas pipeline passes through the underground mining footprint. Gas pipelines have previously been successfully undermined with no loss of utility where maximum vertical subsidence values fall in the range of 760 mm to 1000 mm, but in this case the predicted maximum subsidence from the project is 20 mm, well below the potential damage threshold.	No impacts
Water pipelines, telecommunication cables and optical fibre cables	There is local and regional water supply infrastructure in the project area including the Highlands water source pipeline, however, this pipeline is outside the proposed mining area. Evidence shows that the predicted maximum values of maximum vertical subsidence, tilt and horizontal strain for this project will not give rise to mining subsidence that has the potential to damage, or impede the utility of, any of this infrastructure.	No impacts
Wire fences	Fences are tolerant of tilts up to 10 mm/m and strains to 5 mm/m without significant impacts occurring. In this case the maximum predicted tilt is 0.26 mm/m.	No impacts
Vineyards	There are two small vineyards in the project area. There are many examples of vineyards occurring above long wall mining operations in Australia, which have far greater subsidence impacts than those predicted for the project. In addition, given that subsidence from the project will be imperceptible to negligible, subsidence impacts on vines such as shearing of roots and local ponding will not occur.	Negligible
Aboriginal items	Aboriginal items above the mining areas are unlikely to be impacted by subsidence given the predicted negligible to imperceptible levels of subsidence.	No impacts
Historic items	All known historic features are outside the mining area.	No impacts
Natural		
Cliffs	The types of cliffs and steep rock exposures identified within the project area do not conform to any of the characteristics of cliff lines requiring protection from pillar or longwall extraction (ie greater than 50 m high, overhanging and may have Aboriginal significance, or contain hanging swamps).	Negligible
Flora and fauna	Given that subsidence from the project will be imperceptible to negligible, subsidence impacts on vegetation such as shearing of roots and local ponding will not occur.	No impacts
Water resources	Given that subsidence from the project will be imperceptible to negligible, subsidence impacts on surface water features such as realignment of drainage lines, bed scouring and cracking of stream beds will not occur.	No impacts

18.5 Contamination risks

18.5.1 Overview

SEPP 55 provides a state wide planning approach to promote the remediation of contaminated land for the purpose of reducing the risk of harm to human and environmental health.The potential for the project to disturb potentially contaminated land was assessed in accordance with SEPP 55.

Clause 7(3) of SEPP 55 requires the applicant to carry out an investigation where a change in land use is proposed. The main objective of the investigation is to identify any past or present potentially contaminating activities that could pose a risk to the intended future land uses. This then allows a decision to be made whether the site is suitable for the proposed use or whether the proposed use will exacerbate potential contaminated land issues.

The areas comprising the direct and construction disturbance footprints were assessed for contamination potential, comprising the following lots and DPs:

- DP 1138694/Lot 2 (Mereworth property);
- DP 839314/Lot 200 (Mereworth property);
- DP 751251/Lots 2 and 3 (Evandale property); and
- DP 1009075/Lot 2 (Evandale property).

The proposed disturbance areas in these lots are zoned E3 Environmental Management (Figure 3.2), with extensive agriculture (such as the grazing undertaken in the project area) permitted in this zone without consent.

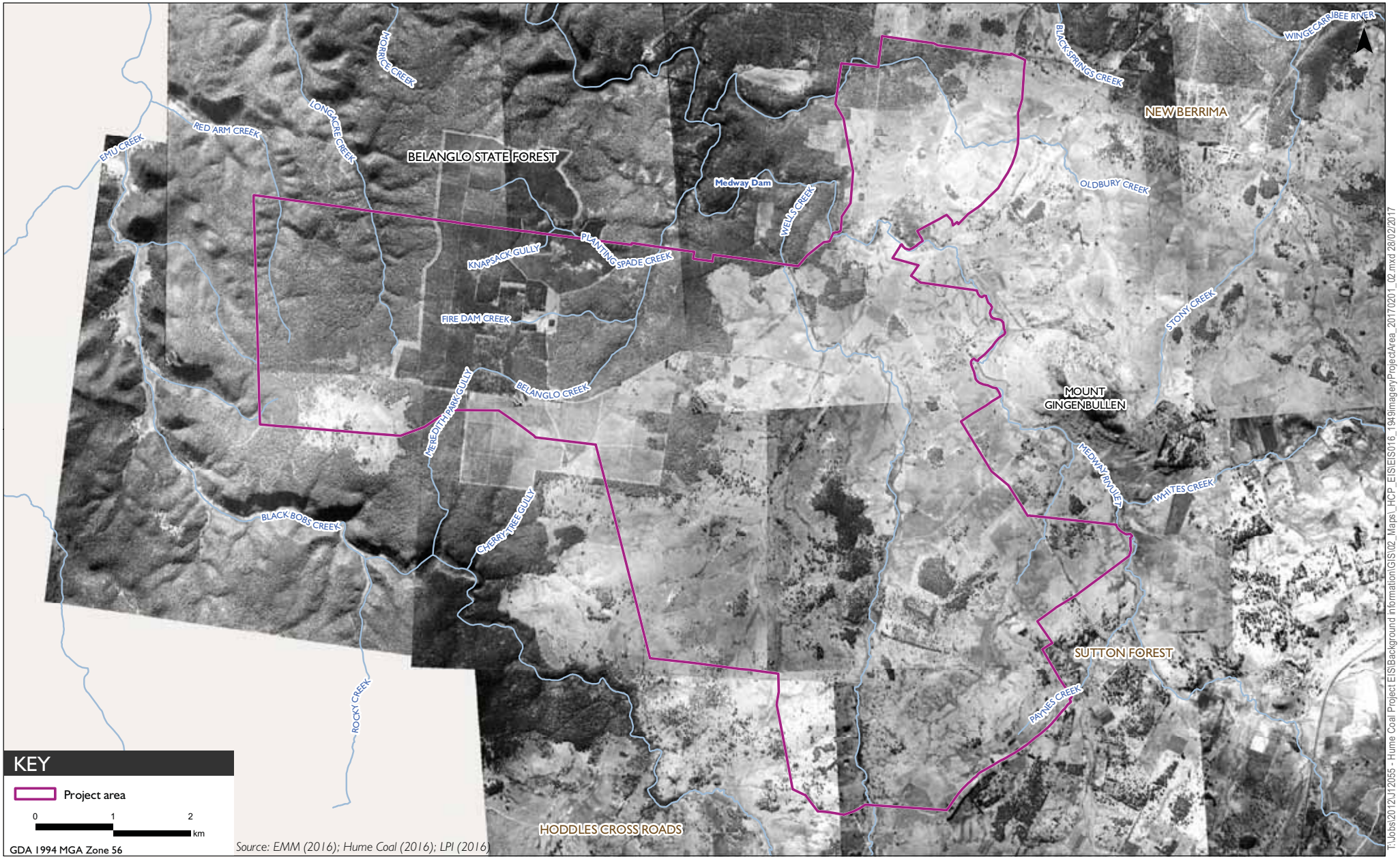
18.5.2 Historic land use

Proposed disturbance areas were inspected and farm managers interviewed about historic and current land uses in November 2015. The inspection, interviews and review of aerial imagery of the project area indicates that the main land use in the proposed disturbance areas has historically been, and is currently, grazing on pasture with occasional cultivation (refer to Figure 9.1).

Aerial photographs from 1949 and 1997 are in Figures 18.3 and 18.4 respectively and are described in Table 18.2.

Table 18.2 Review of historical aerial imagery

Year	Observations
1949	The Mereworth and Evandale homesteads are visible, with the surrounding area predominately cleared and used for agricultural practices. Native vegetation to the west, associated with Medway Rivulet and tributaries is dense, and extends to the Evandale property. Medway Road, Golden Vale Road and the Hume Highway are present, along with minor arterial roads.
1997	The location of the Mereworth and Evandale homesteads is unchanged. The ratio of cleared native vegetation and rural land is unchanged. The Berrima Cement Works has again increased in size and ponds associated with the Sewage Treatment Works are visible.
2015	Observations are unchanged from above, with the exception of the addition of small unsealed roads in the north-west corner.



Historic aerial imagery 1949 - Project area

Hume Coal Project

Environmental Impact Statement

Figure 18.3

EMM HUMECOAL

Historic aerial imagery 1997 - part of project area

Hume Coal Project

Environmental Impact Statement

Figure 18.4

18.5.3 Potential for contamination to occur

Clause 7(4) of SEPP 55 specifies categories of land that have the potential to be contaminated via reference to Table 1 of the contaminated land planning guideline, *Managing Land Contamination Planning Guidelines: SEPP 55 – Remediation of Land* (Department of Urban Affairs and Planning 1998). Agricultural land use is listed in Table 1 and is known to be undertaken in the proposed disturbance areas. Therefore, the land use in the proposed disturbance areas does not preclude the potential for contamination to be present.

The following development controls and registers were reviewed to determine if contamination has been reported for the subject lots.

i Development controls and planning policies

The planning certificates for the lots and DPs listed above, issued under section 149 of the EP&A Act, did not report any contamination issues, management orders, maintenance orders or audits.

There are no issues for the study area relating to contamination in the Wingecarribee LEP (2010).

ii NSW EPA contaminated land: record of notices

NSW EPA's contaminated land public record of notice, under Section 58 of the CLM Act 1997, contains a list of sites for which the EPA has issued regulatory notices under the CLM Act, and includes the details of current and former regulatory notices issued. A search of this register did not return any reported contamination or any regulatory notices issued for the above lots or the surrounding 2 km.

iii NSW EPA contaminated land: sites notified

NSW EPA's list of contaminated sites notified to the EPA under Section 60 of the CLM Act provides an indication of the management status of contaminated sites. A search of this public register (dated 4 May 2015) did not return any information on reported contamination or any regulatory notices for the above lots or Berrima, Sutton Forest and Medway.

The Coles Service Station at the intersection of Sallys Corner Road and the Hume Highway is under assessment for contamination, which is approximately 7 km south-east of the proposed disturbance areas.

iv NSW EPA: environment protection licences

The NSW EPA's public register under the POEO Act contains information on environment protection licences. An EPL typically includes conditions that relate to pollution prevention, monitoring and reporting.

The most recent register (version dated July 2015) was searched for the Wingecarribee Local Government Area and there were no listings of EPLs that could relate to chemical manufacture, storage and/or use in the project area.

Berrima Colliery to the west of the proposed disturbance areas is listed as a coal works/coal mining activity. To the east of the study area (and identified in the aerial imagery) is the Berrima Sewage Treatment System and Berrima Cement Works.

18.5.4 Evidence of contamination

The proposed disturbance areas were inspected for indications of potential contamination on 23 November 2015. The farm managers at Evandale (Graham Fahy) and Mereworth (Michael Straw) were interviewed. Graham and Michael have worked on these properties for 16 and 20 years respectively.

Hume Coal noted that 40 L of hydraulic oil was spilt during exploration drilling in the Belanglo State Forest in 2013. The oil was captured and disposed at a licensed waste facility.

i Evandale

Evandale is an operating sheep and feeder crop farm, with some cattle and occasionally pigs. Potential contaminating activities at Evandale are isolated to the main homestead and adjacent sheds, and comprise:

- refuelling and fuel storage at two above ground fuel tanks: one unleaded petrol (the larger of the two and holds approximately 600 L) and one diesel (above a bunded tank);
- storage of agricultural chemicals (ie round-up, Taskforce, lubricants, oils, lime, animal health products, insecticides, paints) in a registered chemical storage shed;
- an old, brick lined arsenic sheep dip that has not been used for 50 years;
- three septic tanks that are serviced and cleaned annually; and
- use of asbestos in structures built prior to the 1980s.

The dumping of rubbish on the property ceased in the 1970s with the introduction of the municipal tip. Crops are not routinely sprayed, rather there is targeted application of pesticides on rare occasions (ie every four or so years), typically for serrated tussock. Soil testing in 2014 for metals and nutrients reported moderate total nitrogen (mean 1,048 mg/kg) and total phosphorus (mean 194 mg/kg).

ii Mereworth

Mereworth is an operating cattle and feeder crop farm. Like Evandale the potential contaminating activities are near the main homestead and adjacent sheds, and comprise:

- refuelling and fuel storage at three below ground fuel tanks: one unleaded petrol (the largest and 500 – 600 L) and one diesel near the sheds, and one diesel tank near the main house for the water boiler;
- storage of agricultural chemicals (ie round-up, Taskforce, lubricants, oils, lime, animal health products, insecticides, paints) in a registered chemical storage shed;
- an old, concrete lined arsenic dip that has not been used for 20 years;
- three septic tanks, occasionally used as the residential properties are vacant; and
- bi-annual fertilisation of crops.

The dumping of rubbish on the property ceased 15 years ago, prior to this there was an old tip to the north of the homestead. This likely included dead cattle, empty drums and chemical containers. This tip has since been covered up and there is no evidence of the tip in the historical aerial imagery, suggesting it was small in size and/or infrequently used.

The volume of flammable liquids (petrol, diesel and agricultural chemicals) stored at both properties is too low to warrant notification to the NSW WorkCover database of bulk chemical storages.

18.5.5 Contamination characterisation

No activities with potential to significantly contaminate soils and water such as petrol stations, industrial activities or services, or intensive livestock agriculture have occurred at the proposed disturbance areas. Therefore, any potential contamination will be highly localised and likely associated with spills and leaks of hydrocarbons or dumping.

The dumping of waste has not occurred at Evandale for a minimum 15 years. The suspected old tip is not near any proposed surface infrastructure. However, if waste materials were discovered during excavations the unexpected finds protocol will be implemented (Section 22.5.3iv).

The above ground fuel tanks at Mereworth were not observed to be leaking, nor was there any nearby hydrocarbon staining. There is potential for the below ground tanks at Evandale to have leaked. However, this would comprise a small amount only as fuel records are maintained, which do not indicate any loss of fuels.

The depth to the water table is between 15-20 m below ground level, likely deeper than the pits and tanks. Therefore, the above activities are not considered to be significant contamination sources.

Chemicals are stored in registered sheds, with impervious surfaces, and are used sparingly and in accordance with the manufacturer's instructions. Residual, point source chemical contamination could be expected in the vicinity of the animal dips. However the animal dips have not been used for a minimum 20 years.

There is the potential for asbestos contamination to occur during building demolition. However, no construction or building waste was observed to be present on the site from previous demolition activities. Any asbestos within the study area is currently bonded and within existing buildings.

18.5.6 Suitability of the mine

The preliminary site contamination investigation concludes there is no material evidence of wide spread or ongoing contamination activities and/or contamination sources, and hence no contamination constraints for the project are evident. Accordingly, it is considered that the site is likely to be uncontaminated and is suitable for the proposed uses.

Nevertheless, more detailed investigations will be undertaken of those parts of the site where people will work or reside and where project activities could expose excavated materials to the environment. The preliminary investigation has shown that any materials likely to be present on the site are capable of being remediated either by removal, isolation or treatement. Therefore, even if some unexpected contamination is founds, the site could be made suitable for the proposed uses.

Two further safeguards will occur; if evidence of contamination is encountered during the construction phase of works (for example, stained or odorous soil, or buried waste material), work in the area will cease and advice will be sought from an appropriately qualified environmental consultant.

In addition, the construction phase of works will be managed to ensure that no contamination is introduced to the study area via adherence with the EMS. This will be particularly relevant to any demolition of buildings, which could contain asbestos material. Management of asbestos will be guided by WSC's asbestos management protocols, and a hazardous materials survey undertaken if building demolition is required.

18.6 Bushfire risks

18.6.1 Overview

The SEARs require bushfire risks to be assessed. Only the far western section of the stockpile pad and water dam of the CPP will be within the 100 m of vegetation buffer surrounding Vegetation Category 1 on the Wingecarribee bushfire prone land map. No CPP, surface infrastructure area or accommodation village structures will be on bushfire prone land. Therefore, a bushfire hazard assessment in accordance with the NSW Rural Fire Service (RFS) and Department of Planning's (2006), *Planning for Bush Fire Protection – A Guide for Councils, Planners, Fire Authorities and Developer,* is not needed.

The upcast ventilation shaft will be in an area of pine plantation in the Belanglo State Forest. The shaft will be designed to be able to be isolated from the underground workings if there is a bushfire near the shaft's inlet.

18.6.2 Environmental management

As with all rural settings, there is a risk that bushfires could occur in the area. As such, there is a risk that a bushfire could damage project infrastructure. The potential for project-related activities to ignite a bushfire also needs to be considered. A bushfire management plan will be prepared that will contain measures to minimise the risk of bushfire damaging the project or the project initiating a bushfire.

A fire or explosion in the surface infrastructure area or CPP could initiate a bushfire. The risk of this occurring will be reduced by implementation of the following measures:

- vehicle refuelling will be confined to designated refuelling bays (there will not be any vegetation in these areas);
- fire extinguishers will be provided in buildings, vehicles and refuelling areas;
- there will be no smoking in the project area; and
- spill response kits will be available should there be a spill of flammable substances.

In addition, the severity of fires will be reduced by implementing the following:

- a bushfire management plan will be prepared and implemented as part of the mine's operating procedures;
- risk reduction, such as slashing, will be undertaken where appropriate, such as along fence-lines; and
- the RFS will be contacted if there is a fire.

The project will be in the Southern Highlands RFS district, with the nearest brigades being at Berrima and Moss Vale. Hume Coal will participate with RFS in bushfire risk assessments for the area surrounding the project and will contribute to bushfire risk reduction works in the area.

18.6.3 Impacts

Management measures will be used to: prevent a fire or explosion in the surface infrastructure areas initiating a bushfire; reduce the severity of an existing bushfire through fire breaks and by fighting fires with mine resources. Therefore, the project is unlikely to be damaged by, initiate or contribute to the severity of a bushfire. Further, the project will strengthen community bushfire-fighting capabilities thus decreasing the overall bushfire risk in the area.

18.7 Conclusions

The detailed HRA determined that the project will not involve transport, storage and use of hazardous materials at sufficient quantities and/or distances to public areas to qualify it as hazardous industry under SEPP 33. It also determined that the project will not qualify as offensive industry under SEPP 33 as it is likely an EPL will be granted for the project and all licence requirements will be complied with.

The HRA determined that overall risks from the project will be low. However, there will be some elevated risks associated with road use; injury from unauthorised entry into the project area; fires and explosions; and failures of dams. The project has been designed to minimise the occurrence of these risks and/or their consequences. These risks will be further examined as part of detailed project design and re-assessed in an ongoing hazard assessment process to ensure that risks are kept as low as reasonably and practically possible.

The subsidence assessment (Appendix L) determined that subsidence will be imperceptible to negligible. Therefore, subsidence related risks to man-made and natural surface features will be negligible.

With the implementation of management measures, the risk of a fire on Hume Coal owned land initiating a bush fire which moves onto adjacent properties will be effectively controlled.

19 Economic assessment

19.1 Introduction

The project will develop, operate and rehabilitate an underground coal mine and associated infrastructure over an estimated 23-year timeframe, including constructing a rail spur that is the subject of a separate development application (see Appendix D), the Berrima Rail Project. While the rail works and use are subject to a separate development application, from an economic perspective the benefits that NSW and the local community would gain as a result of both projects would happen jointly. That is, the coal project would not be developed without the Berrima Rail Project and, conversely, the rail project would not be developed without the coal mine.

Other key aspects of the project from an economic perspective are that its annual production will be 3 Mtpa of coal; total operating expenditure will be about $643 million in net present value (NPV); and the peak construction and operational workforces for the Hume Coal Project (414 and 300) and Berrima Rail Project (40 and 16) give a combined total of 454 and 316 workers respectively.

The project will result in a total benefit (net of economic costs) to NSW of $368 million which includes a total net benefit to the local area of $128 million (including both direct and indirect benefits).

19.2 Assessment guidelines and requirements

The SEARs state the EIS for the project must address the following economic components:

- an assessment of the likely economic impacts of the development, paying particular attention to:
    - the significance of the resource;
    - economic benefits of the project for the State and region; and
    - the demand for the provision of local infrastructure and services, having regard to Wingecarribee Shire Council's requirements (see Attachment 2).

Although Wingecarribee Shire Council has not provided any assessment recommendations, the demands for local infrastructure and services are dealt with in the Social Impact Assessment (Appendix R) and the Traffic and Transport Assessment (Appendix M).

In addressing the SEARs the economic assessment followed various guidelines published by the NSW Government, in particular the 'Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals' (2015b, 'the 2015 Guidelines'). The 2015 Guidelines require a cost-benefit analysis (CBA) to assess the net benefit of the project to the NSW community. They also require a 'local effects analysis' (LEA) to assess the project's likely impacts on the local economy.

Given that the benefits and costs of the Hume Coal and Berrima Rail Projects are inextricably linked, the CBA and LEA incorporate the combined effects of both projects.

The net benefits to NSW and the local community identified in this chapter are a result of the project, including the Berrima Rail Project component. This approach is consistent with the guidelines set out in NSW Treasury (2007 p.33), which state that:

> Project interdependencies may arise in which the costs or benefits of one project are dependent on whether or not a second project or group of projects, goes ahead. The appropriate response is to evaluate projects as a single project…

The approach that has been applied is also fully consistent with that recommended by the European Commission (1997, pp.16–17), which similarly requires an integrated analysis of projects that are mutually dependent.

The 2015 Guidelines for an LEA require proponents to adopt a study area that should match a SA3 geographical definition. In the case of the project, the relevant SA3 region is the Southern Highlands (Figure 19.1). The figure also shows the Southern Highlands SA3 Region's six component Statistical Area Level 2 (SA2) sub-regions – Hill Top/Colo Vale, Mittagong, Bowral, Moss Vale/Berrima, Robertson/Fitzroy Falls and Southern Highlands. The project is located in the Southern Highlands SA2 sub-region, although it is important to note that the term 'Southern Highlands' is more generally used to describe the broader region encompassing Bowral, Mittagong, Moss Vale, Bundanoon and Berrima. The Southern Highlands SA3 region largely aligns with the Wingecarribee LGA as shown in Figure 19.1, and is therefore referred to as such (or as the region) for simplicity throughout this chapter, and the subject SA2 area is referred to as the sub-region or the local area.

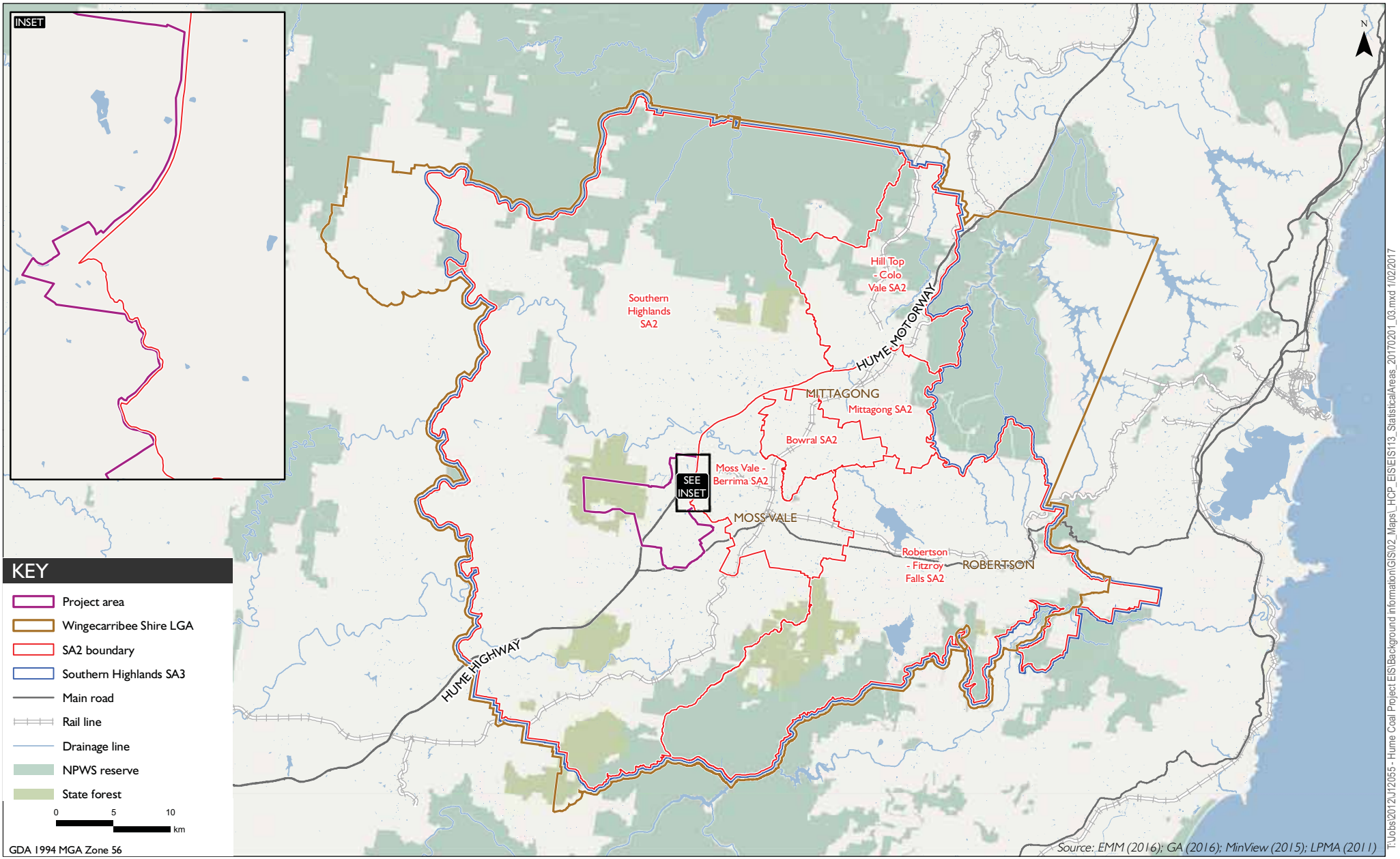
19.3 Costs and benefits of the project

19.3.1 Analytical framework

Cost-benefit analysis (CBA) assesses the economic merits of an initiative or course of action (such as investing in a mine) from the perspective of society as a whole. A CBA compares all costs and benefits attributable to the initiative, discounted to a common point in time, to arrive at an overall assessment of whether the initiative is a 'net beneficial' scenario, that is, whether society will benefit from its implementation.) A project is net beneficial if its benefits exceed its costs measured in today's values (known as net present value or NPV).

19.3.2 Alternative and project scenarios

A CBA compares the economic merits of a project to a valid counterfactual situation. The CBA prepared for this project considers the net effect that would arise if the project were approved, referred to as the 'project scenario', relative to a do nothing alternative, whereby the land owned by Hume Coal and required for the project would continue to be used for agriculture.



Project area within the context of statistical area boundaries

Hume Coal Project

Environmental Impact Statement

Figure 19.1

19.3.3 Net benefits of the project for NSW

The 2015 Guidelines state a CBA is used to estimate the net benefits of a proposed development for the State of NSW. From an economic perspective, the extent to which a project contributes to the welfare of a country or state differs from a private benefit calculation as the latter focuses on consumer and producer surpluses. The public benefit of a project is measured with reference to 'value added'. Value added is the additional value of goods and services that are newly created in an economy and that are available for domestic consumption or for export.

Gross value added is the difference between output and intermediate inputs (the value created by production), and equals the contribution of labour and capital to the production process (ABS 2013b). Subject to adjustments that need to be made so that valuations are internally consistent by accounting for various taxes and subsidies, the sum of gross value added across all industries in a country or state equals gross domestic product (GDP) or GSP respectively.

The project's economic impacts have been evaluated for its contribution to the GSP of NSW. The focus on value added is based on an internally consistent economic framework that reflects standard public accounting rules (United Nations 2003, Pearce and Mourato 2006). This avoids double counting so the factors that constitute a public cost or benefit, and those that do not, can all be clearly defined.

The project's contributions to GSP fall into three broad categories, namely:

- the additional salaries and wages paid to the NSW workforce, that is the additional disposable income gained by workers and the state's share of personal income taxes and Medicare contributions paid to the Australian government;
- the share of the project's gross operating surplus attributable to NSW, including coal royalties, the state's share of Australian government income taxes and the share of the project surplus that would be gained by NSW residents who are shareholders in the proponent company; and
- the additional payroll and land taxes payable to the NSW Government and the additional rates and levies payable to Wingecarribee Shire Council.

Further details of factors comprising GSP are given below.

i Project and alternative employment and wages

If approved, the project would be a source of additional employment and income paid to the workforce. However, only a share of the added income gained by the NSW workforce is strictly 'additional'. If the project was not developed, it is likely a share of the workforce would still be employed elsewhere in NSW at an 'alternative wage'.

In this analysis the income benefits gained by NSW have been reduced by the proportion of the workforce that are assumed would have found alternative employment in NSW at an alternative wage. This is assumed to be 80% in the project scenario modelled for the CBA. The remaining 20% may remain unemployed or leave the NSW workforce, for instance, by retiring or moving interstate.

The second consideration is that those in alternative employment would be paid an alternative wage. The 2015 Guidelines do not provide clear guidance on how to estimate both the wages paid to the workforce of a proposed project and the alternative wage. They state the economic benefit to workers (or 'wage premium') is the difference between the wage paid by a mining project and the minimum (reservation) wage that the workers would accept for working elsewhere in the mining sector. According to the 2015 Guidelines, an appropriate starting assumption should be that workers on a proposed mining project will not receive a wage premium; rather the correct position is they will be paid wages that generally reflect the mining sector.

In this analysis the project wage was determined by using market rates for all of the skills required by the project, which were provided by Hume Coal. The alternative wage was the median (that is the middle of the range) employee income for NSW (for the CBA) and the median for the Wingecarribee LGA for the LEA. The estimated wages do not incorporate any premiums and so are considered consistent with the 2015 Guidelines.

ii Disposable income

The gross wages that would be paid to the project workforce and the alternative wage have been further adjusted to derive incremental disposable income. The disposable incomes per person for both scenarios were derived by taking average gross wages and deducting superannuation payments, income taxes and Medicare payments.

iii Income taxes and Medicare payments

Workers in both the project and alternative scenarios would make personal income tax and Medicare payments to the Commonwealth, a share of which can be attributed to NSW. To avoid overstating personal income tax and Medicare benefits, the same approach has been applied as for deriving disposable income benefits. That is, incremental tax and Medicare benefits were derived by subtracting the taxation and Medicare payments that would be made by the share of the workforce that would be employed elsewhere in the absence of the project.

19.3.4 Gross operating surplus attributable to NSW

One of the key components of the increase in gross operating surplus (GOS) that would go to NSW from the project is the share of its gross state product that can be attributed to NSW. The GOS is the portion of the income derived from production that is earned by the capital invested in the project. GOS is calculated as output valued at producer prices (gross mining revenues), after deducting intermediate consumption (operating expenditures), employee compensation and taxes on production (ABS 2013b). NSW only gains a portion of the incremental GOS associated with the project, namely the:

- coal royalties paid by Hume Coal to the NSW Government;
- share of company taxes paid by Hume Coal to the Commonwealth Government gained by NSW; and
- share of any surplus generated by Hume Coal gained by NSW residents who are shareholders in the proponent company.

An explanation of how these three components of GOS have been used in the CBA is given below.

i Royalties

Incremental royalty payments that NSW would gain were derived by multiplying gross mining revenues, after deducting allowable deductions for coal beneficiation and estimated levies with the relevant underground royalty rate of 7.2% applied to the net disposal value[1].

Gross mining revenues were estimated by multiplying the product coal production schedules provided by Hume Coal with projected coal prices. The projected coal prices reflect the Wood Mackenzie forecast for thermal export coal and hard coking coal as of the first half of 2016. In real US$ terms, Wood Mackenzie forecasts that thermal export coal prices will increase from around US$55 per tonne in 2020 to around US$73 by 2040, and hard coking coal prices will increase from around US$93 per tonne in 2020 to around US$119 by 2040. These benchmark prices were adjusted by a price premium (discount) to reflect coal quality variations from the benchmark, and converted into Australian dollars using a US$/AU$ exchange rate of 0.77.

The sensitivity of the results of the CBA to variations in these coal price and exchange rate assumptions is considered in the detailed economic assessment (Appendix Q).

ii Company income tax payments

Aggregate, that is total, Commonwealth company income tax payments were derived by deducting operating expenditures, royalty and tax payments, and nominal depreciation from the gross mining revenue to derive taxable income. The inflation adjustment was made to account for the fact that depreciation is determined on the basis of nominal asset values (nominal means their monetary value without allowing for inflation over time). The company tax rate of 30% was then applied to derive nominal company tax payments. Real (2016) company tax payments were derived by adjusting for inflation, assumed to be 2.5% a year over the forecasting timeframe in line with the Reserve Bank of Australia's 2–3% inflation target, on average, for its monetary policy. As required in the 2015 Guidelines, the share of incremental company income taxes paid as a result of the project that NSW gains was determined on the basis of NSW's share of the Australian population (32%).

iii Share of GOS accruing to NSW residents

Hume Coal's ultimate parent company, POSCO, is listed on Korean and US stock exchanges. Whilst it is possible that NSW residents own shares in POSCO (both directly and via superannuation funds and index funds), this information is not available, and the profits attributable to residents of NSW arising from the project are not likely to be material in the scope of the CBA. For the purpose of this analysis, it has therefore been assumed that no share of project profits would accrue to NSW residents.

[1] The value of an asset or belonging where it can be sold or disposed of without suffering any loss.

19.3.5 Other taxation benefits attributable to NSW

Payroll taxes are a tax on production but make a contribution to NSW GSP. The 2015 Guidelines note that payroll taxes may be recognised as a benefit, provided these taxes are shown to be additional and would not be offset by lower taxation payments elsewhere in the economy from a movement of workers to a new project. Therefore this analysis has estimated payroll taxes in a way that parallels that adopted to derive disposable income benefits gained by NSW. That is, the additional payroll taxes gained by NSW have been derived by:

- estimating the payroll taxes that would be paid in the project scenario; and
- subtracting the payroll taxes that would be paid for the share of the workforce assumed to find alternative employment in NSW at an alternative wage.

i Local government rates

Local government rates are a tax on production but also make a contribution to NSW GSP. It is estimated Hume Coal will pay local government rates of around $150,000 a year in the project scenario over the operating life of the project.

In the absence of the project, the site of the proposed development would continue to be used for agriculture, and corresponding rate payments would accrue to Wingecarribee Shire Council. Estimated local government rate payments of around $90,000 a year have therefore been deducted from Hume Coal's estimated rate payments to arrive at a full opportunity cost calculation.

ii Land taxes

Land taxes also constitute a tax on production but make a contribution to NSW GSP. It has been assumed Hume Coal would pay land taxes of around $114,000 a year over the operating life of the project, which would be gained by the State of NSW.

In the absence of the project, the site of the proposed development would continue to be used for agriculture. Section 10AA of the *NSW Land Tax Management Act 1956* exempts land that is largely used for primary production, including cultivation and the maintenance of animals, so no offsetting land tax payments have been incorporated.

19.3.6 Valuing externalities

All direct impacts of a project that affect society must be taken into account in a proper CBA. However, a difficulty arises in that some of these impacts do not have a market or normal monetary value. These types of impacts are known as 'externalities' and are spillovers (positive or negative) from the production of a good or service, for example, air or noise pollution are negative spillovers. In addition, the 2015 Guidelines specify that external effects should be assessed cumulatively; that is, taking into account the effects of existing and already approved (but not yet operational) projects, and these have been considered in this analysis.

i Predicted externalities

The predicted environmental impacts of the project, including those from the associated Berrima Rail Project, are summarised in Table 19.1.

Table 19.1 Hume and Berrima Rail projects – predicted external effects

	Aspect	Issue	Predicted impacts
1	Surface water	Residual of licences (water demand minus existing licences)	5.5 ML is required as residual.
		Reduction in catchment area	Minimal reduction of approximately 94.2 ha in catchment areas: • 0.8% of the total catchment for Medway Rivulet to its confluence with Wingecarribee River (totaling approximately 12,264 ha); or • 0.01% of the total catchment for Lake Burragorang (905,100 ha).
2	Groundwater	Residual licensable groundwater take	Peak approximately 1GL/annum.
		Private bores within zone of greater than 2 m AIP minimal impact criteria	AIP 2012 minimal impact criteria exceeded at 93 landholder bores.
3	Visual amenity	Viewpoints close to the surface infrastructure area	Two viewpoints are predicted to experience a moderate visual impact (private residence along Medway Road and the Hume Highway at its intersection with Medway road). No further mitigation is recommended.
4	Noise	Properties predicted to exceed project-specific noise levels (voluntary acquisition zone)	Number of properties is 2.
		Properties predicted to exceed project specific noise levels (voluntary mitigation zone)	Number of properties is 9.
5	Ecology	Native vegetation to be removed	Clearing of 64 paddock trees (Brittle Gums and Scribble Gums) underlain by exotic pasture, resulting in an 'effective clearing area' requiring an offset of 8.3 ha for the mine infrastructure. Clearing of 2 ha of native vegetation (Broad-leaved Peppermint, Narrow-leaved Peppermint, grassy woodland and Snow Gum Woodland) for the Berrima Rail Project, requiring 0.2 ha to be offset.
		GDE to be impacted	No GDE to be removed. No impacts are expected to ecosystems on Belanglo Creek and south of Wells Creek if periods of prolonged drought are not experienced during mining.
		EEC vegetation to be removed	None
		Threatened species directly impacted	None
		Habitat of threatened species to be removed	Loss of 17 hollow bearing trees.
6	Air quality	Number of properties predicted to exceed dust criteria (acquisition zone)	Nil
		Number of properties predicted to exceed dust criteria (management zone)	Nil
7	Greenhouse gas	Scope 1 and 2 emissions over the life of the project	1.7 Mt $CO_{2\text{-}e}$
8	Traffic	Level of service at assessed intersections (construction)	No or only marginal increases in wait times with no change to levels of service.
		Level of service at assessed intersections (operations)	No or only marginal increases in wait times with no change to levels of service.
		Predicted safety implications	No perceptible change predicted.

Table 19.1 Hume and Berrima Rail projects – predicted external effects

	Aspect	Issue	Predicted impacts
9	Aboriginal heritage	Aboriginal sites identified in the project area	No sites of high significance will be disturbed. 11 sites will be avoided and fenced. 20 sites will be impacted to some degree by the surface infrastructure area: • 4 sites partially collected/fenced and avoided; • 10 sites will be collected; • 4 sites will be partially excavated with the remainder avoided; and • 2 sites will be subject to unmitigated impacts (subsurface sites of low significance which do not warrant further investigation or salvage).
			An additional 8 sites will be directly impacted by the Berrima Rail Project: • no sites of high significance; • 2 sites of moderate significance; and • 6 sites of low significance.

Notes: EECs refers to 'endangered ecological communities'. GDEs refers to 'groundwater dependent ecosystems'. AIP refers to 'Aquifer Interference Policy'.

ii Costing externalities

As noted earlier, calculating external effects needs to take into account 'cumulative' impacts. The impacts listed in Table 19.1 take account of other existing developments that contribute to baseline environmental conditions. Proposed developments that could occur concurrently with this project have been identified and assessed (Appendix R, Section 3.5). None of the proposed projects will have a material effect on externalities associated with this project.

The monetary value of externalities can be estimated by substituting either financial instruments or direct offsets.

External effects give rise to non-market impacts that are difficult to value. A variety of techniques have been developed to quantify these effects, which are discussed in Appendix Q. This analysis has used market-based and revealed preference techniques for valuing the external effects associated with the project. The unifying characteristic of both techniques is they aim to value non-market impacts by observing actual behaviour, and so are considered to be a reliable indicator of peoples' preferences.

a. Financial instruments

Financial instruments are generally compensation payments to affected individuals or payments for mitigation measures designed to address an external effect. This method relies on the observed behaviour of households or individuals of incurring financial outlays to insulate themselves against a non-market 'bad', for instance, by moving house or by installing double-glazing in noise-affected homes (Pearce et al. 2006).

External effects that have been valued in this manner (that is on the basis of costs that Hume Coal will incur if the project is approved) are:

- Noise impacts: noise will affect 10 properties (or 11 residential dwellings) owned by external parties, of which two are in the voluntary acquisition zone and nine in the voluntary mitigation zone. The expenditure on mitigation measures to address these impacts has been included as a cost in the CBA.

- Visual amenity impacts: visual amenity will be affected from two viewpoints. Hume Coal is undertaking mitigation works and the costs of screen planting, associated fencing, labour and ongoing maintenance have been used in the CBA.

- Aboriginal heritage impacts: a range of active (eg fencing) and passive (eg avoidance) measures will be used and the amount has been incorporated as a cost in the CBA.

- More detailed discussion of the methods used to estimate the costs of externalities using financial instruments is given in Appendix Q.

b. Offsets

Offsets refer to initiatives that deliver an outcome that is equivalent or preferable to the case in which a project does not proceed. The most common example is offsets to compensate for ecological impacts.

The ecological impacts resulting from the project would be mitigated by establishing an offset that would be approved under the NSW Biodiversity Certification Assessment Methodology. The resulting Total Fund Deposit is a useful substitute for the cost of the ecological impacts. It covers the costs of various management actions, including for bush regeneration, fencing, maintenance and signage installation, as well as recurring costs, such as for monitoring and reporting, council rates and targeted surveys. The value of the offset land also needs to be taken into account.

Given that the identified ecological impacts will be offset to achieve an outcome deemed to be as good or better than the status quo by the relevant NSW authorities, and under legislation, the ecological impacts associated with the project have been valued at the cost of implementing the offsets and associated initiatives.

c. Public values

Some external effects cannot be valued by estimating the costs of direct compensation or offsets but can be valued by considering the public expense or taxes that are used to achieve an acceptable environmental outcome. From this perspective, the consequences or outcomes of government decisions reflect implicit choices and value judgements. In this analysis the costs of complying with relevant government policies have been used to value impacts on surface water and groundwater.

- Where groundwater impacts are concerned, the modelling indicates that the AIP (NOW 2012b) minimal impact criteria will be exceeded at 93 privately owned bores. Hume Coal proposes to apply a range of 'make-good' measures so that landholders will continue to have access to a reasonable quantity and quality of water that fits with the bores' authorised use. The cost of estimated make-good measures has been accounted for in the costings for the project.

- Where surface water requirements are concerned, 5.5 ML of additional surface licence volume would be required over the life of the mine. The cost of acquiring this licence volume has been internalised by Hume Coal.

d. Greenhouse gas emissions

The project will give rise to GHG emissions. The additional Scope 1 and 2 GHG emissions have been valued in accordance with the NSW Government's 'Greenhouse Gas Emissions Valuation Workbook' using the social cost of carbon determined by the US EPA. Alternative valuations using the forecast European Union Emission Allowance Units price and the carbon price applied in the Australian Treasury Clean Energy Future Policy Scenario were also applied as part of the sensitivity testing; the results are given in Appendix Q.

e. Lost agricultural production

The sub-region in which the project is located makes up only about 20% of Wingecarribee LGA's total agricultural output (see Table 3.2 Appendix Q). Nevertheless, the project will displace some existing agricultural activities during its construction and operations over about 23 years. The land that will be disturbed is currently used for livestock production. Cropping in the project area is usually for fodder production. Current stocking rates (shown in Table 19.2) are considerably higher than when the land was initially purchased by Hume Coal owing to various pasture activities that have taken place since the purchase.

Table 19.2 Current livestock enterprises on the properties in the project area

Property	Land (ha)	Cattle[1]	Sheep[1]	DSE[2]	DSE/ha
Mereworth	500	1,500	N/a	11,250	22.5
Evandale	580	1,000	8,000	15,500	26.7
Stonnington	120	400	N/a	3,000	25.0
Eastern properties	80	250	N/a	1,875	23.4
Other freehold[3]	26	26	N/a	195	7.5

Notes: 1. Estimates as per Princess Pastoral Farm Management Plan (2015). 2) Calculated using the assumption that cattle correspond to 7.5 Dry Sheep Equivalents (DSE). 3) Land that will be disturbed by the project on other properties.

Source: Hume Coal.

To estimate the foregone or lost value of agricultural production from these properties gross margins per hectare for typical livestock enterprises were taken from budgets compiled by the NSW Department of Primary Industries (2016). Gross margins are calculated as sales revenues less operating costs for representative livestock production systems. The systems selected are conservative, being among the highest returning per Dry Sheep Equivalent (DSE), that is:

- fattening weaner calves at $48 per DSE; and
- merino ewes (20 micron wool) at $36 per DSE.

The gross margins (or value per hectare, per year) for the relevant properties and for farm properties applying 'typical' farm management practices are shown in Table 19.3. Gross margins on Hume Coal managed properties are much higher than would be the case for typical properties in the region because of the higher stocking rates being achieved. As a result, the foregone agricultural value added is also higher. This assumes that current practices would continue should the project not proceed, which may not be the case, adding to the conservatism of the assessment.

Table 19.3 Agricultural gross margins, $ per hectare (A$ 2016)

Property	Hume Coal owned land			Typical farm management		
	DSE/ha	$/DSE	$/ha/year	DSE/ha	$/DSE[1]	$/ha/year
Mereworth	19.6	46	900	9	46	414
Evandale	17.8	43	774	9	43	391
Stonington	16.9	48	810	9	48	432
Eastern properties	14.8	48	711	9	48	432
Other freehold[2]	9	48	432	9	48	432

Notes: 1. $/DSE is influenced by the percentage of sheep and cattle on the property. 2) Land that will be disturbed by the project on other properties.

Source: BAEconomics 2017.

The estimated foregone agricultural value added – the land removed from production multiplied by the corresponding gross margins – is shown in Table 19.4 for both the Hume Coal Project and the Berrima Rail Project. The foregone value added of agriculture is estimated at around $1.7 million in NPV. For the purposes of this assessment, a rounding to the nearest million dollars has been applied when calculating net benefits.

Table 19.4 Foregone agricultural value added (NPV A$ 2016, '000s)

Project phase	Hectares	Foregone value added
Construction phase	279	$529,000
Operational phase	135	$1,178,000
In perpetuity (post-operational phase)	3	$15,000
Total		$1,722,000

Notes: *NPVs calculated using an annual discount rate of 7%.*

Source: *BAEconomics 2017.*

f. Foregone income and employment

Income in the form of wages and salaries derived from agriculture is a component of agricultural value added; so it can be expected there may be some limited local impacts on income and employment due to agricultural land being removed from production. According to the ABS 2013–14 input-output requirements table (ABS 2016), employee compensation makes up about 15% of the value added by agriculture. The foregone income for both NSW and Wingecarribee LGA, assuming farm labour is sourced locally, would then be around $260,000 in NPV. Converting this estimate of foregone agricultural income to an annual amortised value[2] over the life of the project corresponds to about $22,000 a year. At an average regional wage of about $46,000, this represents a loss of full-time equivalent (FTE) jobs of less than 0.5 a year.

19.3.7 Change in economic surplus in other NSW industries

The 2015 Guidelines specify that the CBA should incorporate changes in economic surplus arising in other NSW industries. For example, local suppliers may achieve higher surpluses as a result of a mining project, while there may be a loss of economic surplus in other industries.

Various data limitations and other practical considerations detailed in Appendix Q mean the change in economic surplus in particular NSW industries arising from the project cannot be measured with any precision, and no attempt has been made to do this in the current analysis. However, overall, the impacts of the project on other NSW industries are likely to be positive, namely:

- Hume Coal will have operating costs (after deducting labour costs) of about $643 million in NPV. If it is assumed, for example, that 10% of these costs represents additional margins to NSW suppliers, these suppliers would gain an additional surplus of $64 million in NPV; and
- flow-on impacts for NSW will generate an additional value added in other industries of $73 million in NPV (see Section 19.5).

[2] Reducing the value of assets to reflect their declining worth over time. Amortising tends to be used for writing off intangible assets, such as goodwill.

19.3.8 Economic benefit to existing landholders

The 2015 Guidelines note that project proponents may purchase or lease land from an existing landholder(s) at a price that may exceed the opportunity cost of the land. This is more likely to occur when a proponent pays a premium above market prices for land acquisitions or leases. The corresponding surplus is an economic benefit gained by existing landholders and should be attributed to NSW.

Any future acquisitions, such as properties provided with voluntary acquisition rights as a result of the planning approval process, may include a slight premium to market value. However, the resulting net benefit accruing to landholders is insignificant relative to the overall net benefit to NSW generated by the project, and these premia often include a component of compensation to account for the costs of relocation. Therefore, the economic benefits accruing to local landholders have not been estimated. The approach adopted in the economic assessment is therefore conservative.

19.3.9 Net public infrastructure costs

Any net public infrastructure costs (the difference between the cost of the infrastructure to the public and any contributions made by the proponent) need to be included in the CBA. However, no public infrastructure costs are expected to be incurred for the project.

19.3.10 Net direct benefits of the project for NSW

The net direct economic benefit of the project for NSW is estimated at $295 million in NPV. The main components are:

- royalty payments, which are estimated at $114 million in NPV (38% of net benefits);
- net employment benefits in the additional disposable income gained by NSW residents and the NSW shares of personal and company income taxes, corresponding to:
    - $134 million in net disposable income benefits;
    - $21 million in the NSW share of personal income taxes;
    - $27 million in the NSW share of company income taxes; and
- incremental payroll taxes, council rates and various levies, amounting to around $20 million in NPV; and
- around $21 million of externality costs, including greenhouse gases and loss in agricultural production.

Specific costs and benefits are itemised in Table 19.5.

Table 19.5 Direct economic benefits of the project for NSW (NPV A$ 2016)

Costs	NPV (A$ m real 2016)	Benefits	NPV (A$ m real 2016)
Production related		**Production related**	
		Employment benefits:	
		Disposable income	$134
		NSW share of personal income taxes	$21
		NSW share of Medicare payments	$1
		Share of Hume Coal gross operating surplus accruing to NSW:	
		Royalties	$114
		NSW share of company income taxes	$27
		Taxes on production and imports:	
		Payroll taxes	$12
		Council rates	$1
		Land taxes	$1
		Levies	$5
Total production related		**Total production related**	$316
Externalities (costs)		**Externalities (offsets)**	
Loss of agricultural value added	$2	Loss of agricultural value added	$0
GHG emissions	$19	GHG emissions	$0
Total externalities	**$21**	**Total externalities**	**$0**
Net economic benefits			**$295**

Notes: *NPVs have been derived using an annual discount rate of 7%.*

Detailed calculations to derive production-related benefits that can be attributed to NSW are set out in Appendix Q.

Source: *BAEconomics analysis 2017.*

19.4 The project's local economic effects

In accordance with the 2015 Guidelines, this section describes the project's local direct economic effects on the Wingecarribee LGA. Flow-on benefits as a result of the project are discussed in Section 19.5.

19.4.1 Local income benefits

Taking into account both the share of the likely future operational workforce that already lives locally and the share that is expected to relocate to Wingecarribee LGA, it is expected that at least 65% of the operational workforce will live in the LGA. Local income benefits have been derived on this basis.

As is the case for the CBA, it has been further assumed that, in the absence of the project, a share of the workforce would find alternative local employment. The estimated local disposable income benefits have therefore been reduced by the proportion of the workforce assumed to find alternative local employment at an alternative wage. As noted in Section 19.3.3, for the purposes of the CBA it has been assumed that 80% of the workforce would find alternative employment in NSW without the project. This percentage has also been applied to the respective shares of the workforce that are assumed to live locally; that is, 52% (65% × 80%) of the project workforce is assumed to find alternative local employment if there were no project.

The 2015 Guidelines set out that, for the LEA, the alterative wage should be determined as the average level of income in the local area. The alternative wage has been assumed to be the median employee income in the Wingecarribee LGA, determined to be $46,296 in 2016 dollars.

19.4.2 Other net local benefits

In addition to the incremental income benefits discussed above, net rate payments to Wingecarribee Council also represent a direct local benefit. As discussed in Section 19.3.5, it has been assumed that Hume Coal would pay council rates of around $150,000 a year over the operating life of the mine. To estimate the project's local benefits these rate payments have been reduced by the rates that Hume Coal would pay in the no project case in which current agricultural production would continue.

19.4.3 Other matters raised in the 2015 guidelines

Other requirements of the 2015 Guidelines are discussed in the following sections.

i Non-labour project expenditure

The 2015 Guidelines require a proponent to quantify (non-labour) construction and operating spending and to attribute that spending to the relevant local area. As discussed earlier, data and other limitations make it impossible to provide a reliable estimate of the extent to which the projected operating spending would benefit the Wingecarribee LGA, and these benefits have not been quantified in this analysis. However, as noted in Section 19.1, Hume Coal will pay operating expenditures of around $640 million in NPV for the project. A share of what would be spent on, for instance, transport, repair and maintenance services, various consumables, and food and accommodation services, would be expected to benefit the local area.

ii Effects on other local sectors

The 2015 Guidelines require a qualitative discussion of the effects of a project on other local industries, including whether a project would displace specific land uses, affect tourism, or whether short-run market adjustments, for instance in housing markets, might be expected.

iii Local housing market

The project is not expected to have an adverse effect on the local housing market in either the construction or operations phases. During construction nearly all workers will be housed in a purpose-built temporary village. Over the much longer operations phase the current availability and forecast supply of new housing suggest that a more than adequate supply will be available to accommodate workers moving to the area. A detailed analysis of the project's effects on the housing market is given in the Social Impact Assessment (Appendix R).

iv Local tourism

In the year ending September 2014, Wingecarribee LGA recorded 1,407,000 visitors (including overnight and day-trip visitors), or 1.8% of the NSW total visitors (Destination NSW 2015b). According to the ABS 2011 Census, employment in accommodation and food services in Wingecarribee LGA amounted to 1,263 people or 8% of total employment.

More locally, in the sub-region where the project is located, only three tourism establishments making up 2% of total annual revenues for the whole Southern Highlands SA3 area are present. These figures suggest the project has only limited potential to affect local tourism. Other aspects of the project that would support this conclusion are that:

- While the temporary construction workforce will be housed in the accommodation village, there would be some demand for short-term accommodation while the village is being constructed and later by visitors to the project site. As set out in the SIA (Appendix R), the additional demand for short-term accommodation could be met relatively easily and would benefit local accommodation providers.

- The project is an underground mine, so any visual impacts will be limited. While some surface infrastructure will be developed, the visual impact assessment of the project (Appendix N) found there are unlikely to be significant impacts on the character and amenity of the area.

v Local agricultural impacts

The NSW Guidelines for Agricultural Impact Statements (NSW Government 2015a) specify a 'critical mass threshold' must be analysed if a project reduces the proportion of agricultural enterprises within a locality or region by more than 5%. The potential reduction in livestock production as a result of the project will be less than 5% of total cattle production in the SA3 Area and hence a critical mass analysis is not needed.

19.4.4 Local direct benefits of the project

The 2015 Guidelines specify that the LEA should translate the effects estimated at the state level to the local level. For the Wingecarribee LGA, the net benefits of the project are expected to amount to about $84 million in NPV, corresponding to:

- additional disposable income of $85 million by residents; and
- $1 million in NPV in additional council rate payments.

These benefits total $86 million but costs of about $2 million need to be deducted (see Table 19.6). Consequently, the net benefit would be $84 million taking account of the expected forgone value in agricultural production, foregone income from reduced agricultural activities and the council rate payments already made for agricultural activities. Importantly, this does not take into account the positive impacts from any potential procurement from local suppliers of capital items, or goods and services during operations, and is therefore conservative.

Table 19.6 Net direct benefits of the project in Wingecarribee LGA (NPV A$ 2016)

Costs	NPV (A$ m real 2016)	Benefits	NPV (A$ m real 2016)
Production related		Production related	
		Employment benefits:	
		Disposable income	$85
		Taxes on production and imports:	
		Shire rates	$1
Total production related		**Total production related**	**$86**
Externalities (costs)		**Externalities (offsets)**	
Loss of agricultural value added	$2	Loss of agricultural value added	$0
Total externalities	**$2**	**Total externalities**	**$0**
Net economic benefits			**$84**

Notes: *NPVs have been calculated using an annual discount rate of 7%.*

Source: *BAE conomics 2017.*

19.5 Flow-on benefits of the project

The project will have secondary or flow-on benefits for NSW of $73 million and 62 FTE jobs and locally for the Wingecarribee LGA of $44 million and 34 FTE jobs. These benefits have been determined using input-output multipliers. The method by which these multipliers have been derived and limitations on their use are discussed in detail in Appendix Q with a summary provided below.

19.5.1 Advantages and limitations of input-output analysis

Flow-on effects refer to the adjustments in the economy that follow from initial changes in the level of demand for goods, services and labour arising from a significant development (such as the project). Such effects occur at both the NSW and local levels but caution must be used in interpreting the results at a more fine grained or local level.

The principal advantage of the impact multiplier method is the simplicity with which levels of project investment, employment and output can be translated into measures of changes in regional income and employment. However, the accounting conventions that form the basis of input-output models and hence how multipliers are derived impose a number of restrictive assumptions. Some of these assumptions are about input-output analysis generally while others relate to the use and interpretation of input-output analysis at a local or state, as opposed to a national level. Four specific assumptions and/or limitations apply and they are discussed below.

i Fixed capital stocks

Input-output analysis is static in that it takes no account of the time required for the composition of inputs and outputs of production to shift to a changed level of output. Industries that require large amounts of fixed capital and labour adjust slowly, particularly when they are operating in or near full employment conditions or when the supply of skilled labour is tight. These dynamics are hard to predict, but the implication over the short- to medium-term is that input-output effects will be overstated to varying degrees across industries.

The fixed nature of the capital stock is a critical issue in local impact assessments. In moving from the national to state or local level, the location of fixed assets becomes increasingly important in establishing the goods and services that are supplied locally and those which are imported. Moreover, there is generally no information about whether fixed assets are owned locally or whether the owners are located outside the host region or state. As a consequence, determining the value added by local industries becomes increasingly difficult.

ii Supply constraints

Relatedly, when the initial impact considered is an increase in production, the assumption of fixed production patterns requires that there are sufficient resources available in (or able to migrate to) a local area to meet the increase in demand for inputs whose supply is fixed. These inputs include resources such as land and water, and labour with adequate skills. These required resources may not always be available to the growing industry.

iii Homogenous and fixed production patterns

The input coefficients that measure inter-industry flows between sectors are ‘fixed’ in input-output models; at any level of output, an industry’s relative pattern of purchases from other sectors is unchanged. These assumptions are likely to be inconsistent with production patterns in the local economy, since the local economy may not have on offer the range of input required for a given industry. Therefore, the impact of the change in output on the local economy will differ from that implied by a national multiplier.

iv Fixed prices

Input-output analysis assumes prices in the economy in question are held constant, so that the additional material and labour inputs are available at existing prices and wage rates. In reality, prices of inputs may change with substantive changes in their demand. To the extent there is an impact on prices, the imputed output effects will be overstated. However, this is only a problem in input-output analysis for projects that are big enough to materially shift the demand for production inputs and the total supply of industry output.

19.5.2 Implications for the LEA

Partial multipliers have been used in this assessment, rather than full multipliers, to avoid an overstatement of the benefits of the project.

There are also specific issues that arise in deriving local value added multipliers. Value added includes profits that are distributed on the basis of ownership of capital assets, which becomes increasingly uncertain as the analysis becomes more detailed.[3] The calculation of value added multipliers at a local level is therefore not valid and have not been calculated for the project.

19.5.3 Flow-on effects of the project for NSW

i Agricultural flow-on effects for NSW

The CBA's results show the project will increase NSW GSP by $295 million in NPV (including accounting for a small change in value added in offsetting agricultural impacts). The increase in NSW GSP would give rise to corresponding flow-on effects but with a small offset of foregone agricultural value due to part of the project area being taken out of farm production.

The opportunity costs of foregone agricultural production on downstream and upstream industries are related to the level of agricultural output, as measured by the gross value of agricultural production. Using a value added multiplier for NSW agriculture of 1.41, the flow-on effects corresponding to the foregone value of agricultural production would be of the order of $0.7 million in NPV. The estimated flow-on effects from the change in income and employment are estimated at:

- $0.2 million in NPV for foregone agricultural income; and
- 0.2 FTE jobs a year for foregone agricultural employment.

ii Combined flow-on effects for NSW

Table 19.7 shows the estimated flow-on effects of the project for NSW, taking into account the offsetting agricultural (value added, income and employment) impacts. The assumptions made for the input-output analysis are consistent with those made in the CBA. The calculation of flow-on benefits focuses on changes in disposable income, which were adjusted to account for the expectation that a share of workers would be employed elsewhere in the absence of the project.

Table 19.7 Initial flow-on effects for the project – NSW (NPV[2] A$ 2016)

	Total	Annual
Employment (Annual average FTE jobs)	N/a	62
Value added ($ millions)	$73	$6

Notes: *1. NPVs have been derived using an annual discount rate of 7%.*

Source: *BAEconomics 2017.*

[3] For instance, there is no way of knowing from generally available public information whether a productive asset (say, a factory) that is located in Wingecarribee LGA is owned by people living in that region, or in NSW, or elsewhere. It then becomes very difficult to attribute the value added generated by the factory on a regional and even state basis.

19.5.4 Flow-on effects for Wingecarribee LGA

The project's local flow-on effects will mostly be positive but also include a small negative impact from a reduction in agricultural activities. As noted above, because the calculation of value added multipliers for a small local area is not valid the analysis has focused on income and employment effects.

i Agricultural flow-on impacts

It is probable all agricultural labour will be sourced locally, so that the absolute impacts in terms of income and employment are the same as those estimated for NSW. Thus for Wingecarribee LGA the flow-on effects arising from land removed from agricultural production are about:

- $0.2 million for the flow-on arising from foregone agricultural income; and
- 0.2 FTE jobs for the flow-on effects corresponding to foregone agricultural employment.

ii Combined local flow-on benefits

The estimated flow-on effects for Wingecarribee LGA take into account the small reduction in impacts because of the displacement of agriculture by the project and they are as follows:

- the flow-on benefits in additional disposable income generated by the project are estimated at $44 million ($4 million annually) in NPV; and
- the employment flow-on effects are estimated at an annual average of 34 FTE jobs.

19.6 Significance of the resource

The repealed clause 12AA of State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007 (the Mining SEPP) indicates the matters that may be relevant in assessing the 'significance of the resource'. Clause 12AA of the Mining SEPP required the significance of the resource to be assessed for the economic benefits, both to the state and the region, of developing the resource. The matters taken to be relevant were:

- employment generation;
- expenditure, including capital investment; and
- payment of royalties to the state government.

The broader economic benefits to NSW and Wingecarribee LGA are considered in the CBA and given in sections 19.3.9 and 19.4.4 respectively. The net economic benefits of the project for NSW were estimated at $368 million and for Wingecarribee LGA $128 million, both in NPV.

Estimates of peak project employment are provided in Section 19.1. Over its life, the project will generate an average of 275 operational jobs, as well as an annualised average of 405 construction jobs at its peak.

The project is expected to require around $860 million in total capital expenditures, including for sustaining capital expenditures and rehabilitation, and around $1.4 billion in operating expenditures, including for materials and services. Estimates of royalties gained by the State of NSW were derived as part of the results for the CBA (Section 19.3.10) and are expected to generate around $266 million in royalty payments, or $114 million in NPV.

19.7 Conclusion

The project is expected to generate $295 million of direct net economic benefits for NSW. For the Wingecarribee LGA, the net direct benefits of the project are expected to amount to approximately $84 million in NPV terms. A number of indirect (or flow-on) effects will occur as a result of the project's capital and operating expenditure, and job creation. At the NSW level an additional $73 million in value added, discounted at 7%, will occur as an indirect benefit. There will also be an average indirect benefit of 62 full-time jobs added for each year of the life of the project.

Locally, at the Wingecarribee LGA level, indirect benefits of an additional $44 million in disposal income and an average 34 FTE jobs each year will be added, bringing the total direct and indirect benefits of $128 million for the local area.

20 Social assessment

20.1 Introduction

A Social Impact Assessment (SIA) was conducted to assess social impacts of the project during all of its four phases, including planning, feasibility and approvals, construction, operations and closure and decommissioning. The SIA describes initiatives incorporated into the project design to avoid and minimise negative impacts and maximise benefits and indentifies additional mitigation and management measures to be implemented to reduce impacts.

A full description of the project is provided in Chapter 2 of the EIS. From a social perspective, its principal aspects are that there will be:

- a total workforce, on average, of about 17 full-time equivalent employees during the planning, feasibility and approvals phase;
- a peak workforce of about 414 full-time equivalent employees during the construction phase, which will extend for about 2 years;
- a peak workforce of about 300 full-time equivalent employees during the operations phase, which will extend for 19 years;
- a total workforce of about 30 full-time equivalent employees during the initial two years of the decommissioning and closure, followed by the employment of up to three part time workers for the management of the mine until relinquishment occurs; and
- an emphasis on local participation and procurement of goods and services throughout the project's lifespan.

20.1.1 Assessment guidelines and requirements

This chapter summarises the comprehensive SIA EMM prepared to address specific requirements related to social impacts given in the Secretary's environmental assessment requirements (SEARs), as listed in Table 20.1 below. The full SIA is given in Appendix R.

Table 20.1 Relevant SEARs for this assessment

Requirement	Section addressed
An assessment of the likely social impacts of the development	Chapter 20 and Appendix R
Consultation with relevant local, State or Commonwealth Government authorities, service providers, community groups and affected landowners.	Chapter 4, Section 20.4 and Appendix R
The demand for the provision of local infrastructure and services, having regard to Wingecarribee Shire Council's requirements.[1]	Section 20.6 and Appendix R

Note: 1. WSC did not specify any requirements.

20.1.2 Adoption of leading practices

The SIA follows leading practice guidelines in its assessment of the social changes that are likely to occur as a result of the project. Both international and national guidelines were referred to during the preparation of the SIA as follows:

- Community Development Toolkit (Energy Sector Management Assistance Program, the World Bank and the International Council on Mining and Metals 2012);

- Leading Practice Strategies for Addressing the Social Impacts of Resource Development (Centre for Social Responsibility in Mining, Sustainable Minerals Institute, University of Queensland 2009);
- Cumulative Impacts – A Good Practice Guide for the Australian Coal Mining Industry (Centre for Social Responsibility in Mining, Sustainable Minerals Institute, University of Queensland 2010);
- Social Impact Assessment of Resource Projects (International Mining for Development Centre 2012); and
- Approaches to Understanding Development Outcomes from Mining (International Council on Mining and Metals 2013).

In the assessment of social changes, the SIA identifies and assesses both positive and negative impacts. In doing so, the SIA considers measures to enhance social opportunities from the project as well as measures to mitigate negative impacts during all phases of the project. This approach goes beyond regulatory compliance and is consistent with Hume Coal's commitment to adopting leading practices.

20.1.3 Local partnerships and procurement

Hume Coal has engaged with local people and businesses since commencement of the project in 2011, and aims to form partnerships within the community to enhance the local benefits of the project. Hume Coal procures local goods and services, and will continue to do so during all phases of the project, where they can be reliably and competitively supplied, and can meet applicable quality standards. So that this occurs to the greatest extent possible, Hume Coal has sponsored various capability building programs for selected local businesses, including helping to train employees through apprenticeships, and providing specialised training for potential recruits.

20.2 Assessment method

Conducting the SIA involved completion of eleven steps commencing with the identification of the social aspects of the project, followed by a description of current (or pre-mining) social conditions and concluding with a 'social balance sheet' which lists and compares all impacts – both positive and negative. All of the steps are described below and summarised in Figure 20.1.

Step 1: Document the social aspects of the project, particularly the required workforce and its likely origins, that is whether workers will be sourced locally or from elsewhere and thus be 'in-migrants'. This step takes into account the effects of Hume Coal's approach to local procurement and participation.

Step 2: Define the project's 'workforce catchment area'. This covers both the area from which local workers will be recruited and to where workers who are recruited from elsewhere in Australia will relocate. It is where most social impacts will occur.

Step 3: Estimate the residential distribution and population change from recruitment of the project's workforce.

Step 4: Describe relevant characteristics of the local community that is within the workforce catchment area, including the size and skills of its workforce, housing, services and other infrastructure available as well as the local and regional planning policies that apply. Consult key stakeholders, including landowners, community groups, councils, government agencies and service providers.

Step 5: Determine the project's likely social impacts and opportunities alone and cumulatively, that is with other major projects scheduled for development over the same time period as the project. Identify opportunities to enhance the project's local effects and add value to the broader community.

Step 6: Identify land use changes and other outcomes that will arise from the project, followed by a determination of the associated impacts and measures to mitigate adverse effects.

Step 7: Devise measures to effectively mitigate adverse impacts.

Step 8: Describe project activities that add value and stimulate local businesses, and other investments that will be made in community enhancement.

Step 9: Identify monitoring and reporting processes that will manage social impacts responsively over time, and keep the community well informed and engaged.

Step 10: List and compare all the project's positive and negative social impacts to show its overall or net effects.

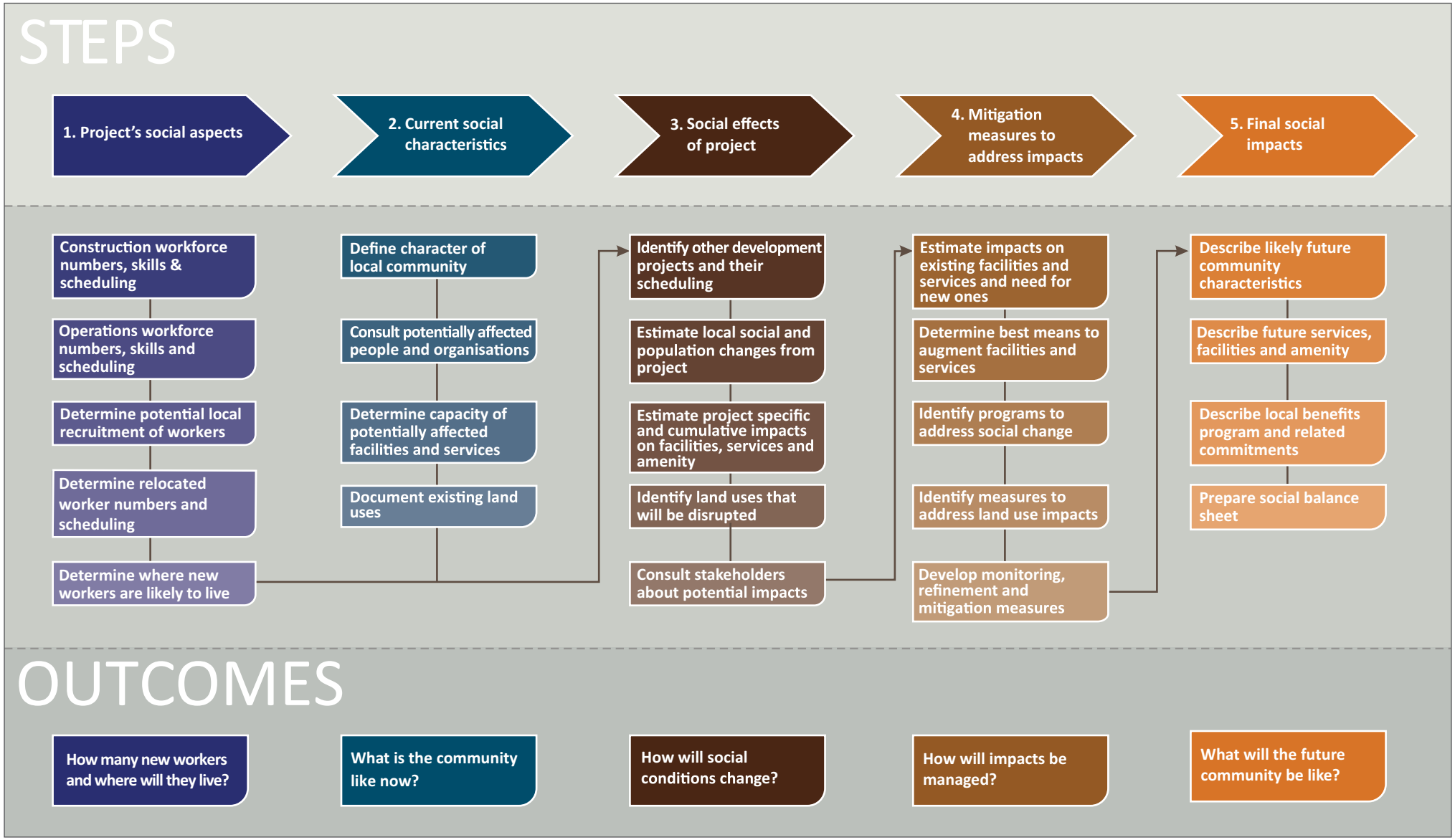
Step 11: Inform interested parties by documenting social impacts factually and clearly so the community can properly understand how the project might affect them.

20.3 Existing social environment

No social data is available that corresponds exactly with the project's workforce catchment area because it does not coincide with ABS Census Collection Districts (CCDs). For this reason and because up to 90% of the project's operational workforce will live in towns within the Wingecarribee LGA, the SIA considered only the towns and villages within the Wingecarribee LGA. This will still provide an accurate guide to the project's impacts as population growth from the project in the adjoining LGAs will be negligible.

To determine the existing social character of the assessment area, the following factors were considered:

- history and settlement pattern;
- population size and composition;
- employment and training;
- regional economy;
- social infrastructure (including housing, education and childcare services);
- health infrastructure (including primary health and emergency services); and
- transport infrastructure.



Summary of SIA method
Hume Coal Project
Environmental Impact Statement
Figure 20.1

20.3.1 Existing socio-economic character

i History, geography and settlement pattern

According to Tindale (1974), the project area falls within the Aboriginal language group boundary of the Gundungarra people whose territory extended between Camden and Goulburn and the Blue Mountains to the north. However, a number of neighbouring groups may have used the greater Southern Highlands region for travelling routes and other purposes such as ceremonies and gatherings. This includes the Ngunawal people to the south, the Dharawal-speaking Wodi Wodi people to the west and the Dharawal people to the north-west (Tindale 1974).

Settlers first explored the area in 1798 (WSC 2015). In 1821, a government settlement was established at Bong Bong, between Moss Vale and Burradoo (Profile.id 2015), and another settlement at Berrima followed in the 1830s. The area's cool climate, reliable rainfall and undulating terrain led to the establishment of a viable agricultural industry mainly based on sheep and cattle grazing (WSC 2015). In the 1860s, when the Main Southern Railway Line was opened, the population grew rapidly, particularly in the townships of Bowral, Mittagong and Moss Vale, and with some growth in the smaller settlements of Bundanoon, Exeter and Burrawang (Profile.id 2015).

The region continues to support a viable agricultural industry, including sheep and cattle grazing, fruit and vegetable growing and viticulture. Other important primary industries are timber production, mining and quarrying (WSC 2015a). In more recent years, the region has experienced strong growth in the services sector and it is now a major employer.

ii Population size, growth and future change

Wingecarribee LGA has experienced lower than average population growth over the last decade, with a 9.8% increase to an estimated 47,584 people in 2014. In comparison NSW's population grew by 13% over the same time (DP&E 2014).

Based on DP&E forecasts made in 2014, the Wingecarribee LGA's population is likely to continue to grow through to 2031, with an estimated 5,000 more people by 2031. While Wingecarribee's population will increase by 10.9%, this is a much slower rate than the 27.8% expected for NSW generally over the same period (DP&E 2014).

iii Population structure

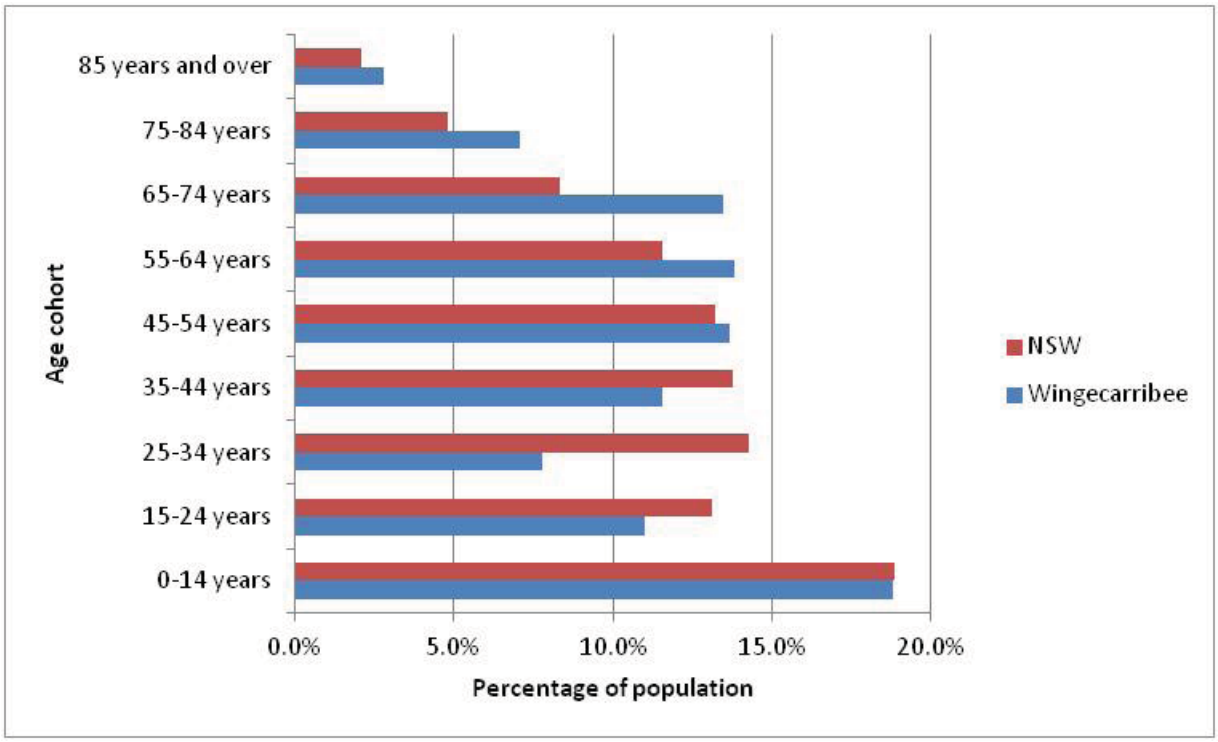
In 2011, the population distribution between males and females in Wingecarribee was 47.9% and 52.1% respectively. This compares with 49.3% males and 50.7% females across NSW (ABS 2011a).

The largest age cohort in the LGA in 2013 was 0–14 year olds, representing 18.8% of the population, followed by 55–64 year olds (13.9%) and 45–54 year olds (13.7%). The 85 years and over age cohort grew the most (91%) between 2001 and 2013, followed by the 65–74 year age cohort (83%) and 75–84 years (58%). There was a significant decline in the proportion of the population aged 25–34 years (-17%), 35-44 years (-10%) and 0–14 years (-7%) (ABS 2011a).

Wingecarribee's population is older than the NSW average. The LGA's median age increased from 38 to 44 between 2001 and 2011, compared with 35 to 38 across NSW. Wingecarribee also has fewer people of a young working age (25–34 years) compared with NSW (7.6% and 13.7% respectively) (ABS 2011a).

These figures indicate two key trends – an ageing population and migration of working age people to larger centres because of limited local employment opportunities.

About 20% of the population in the LGA were born overseas in 2011 compared with 31.4% across NSW. About 2% of the LGA's population identified as Aboriginal or Torres Strait Islander which is similar to the Indigenous population in NSW generally -2.5% (ABS 2011a).



Source: ABS 2015.

Figure 20.2 Population distribution of the Wingecarribee LGA and NSW, 2013

iv Households and income

The average household size in the Wingecarribee LGA in 2011 was 2.5 people, which is similar to the NSW average of 2.6 (ABS 2011a).

In 2011, Wingecarribee had a higher percentage of households containing couples with no children (31.5%) than NSW overall (24.6%). Conversely, the LGA had a lower percentage of households with couple families (54.1%) than NSW (59.7%). There was a relatively similar rate of one parent families between Wingecarribee (13.6%) and NSW (14.5%) (ABS 2011a).

Household and dwelling projection data predict significant increases in lone person households between 2011 and 2031 – a 37% increase – and couple only households (32%). Conversely, there will be a decrease in the number of households containing couples with children (-5%) (DP&E 2014).

Household incomes in Wingecarribee increased by 42% between 2001 and 2011. This was lower than NSW generally where average incomes grew by 49%. In 2011, median weekly household income in Wingecarribee ($1,094) was below the NSW median ($1,237) (ABS 2011a). But fewer families (7.2%) in the Wingecarribee LGA are low-income and welfare-dependent compared with 10.1% of families across NSW (PHIDU 2015).

Housing in Wingecarribee is relatively affordable: its median weekly rent ($365) was lower than NSW ($430) and surrounding LGAs, including Wollondilly ($390), and Kiama ($430) (RP Data 2015). Fewer households (30.2%) in Wingecarribee are under financial stress from mortgage and/or rent repayments and 2.3% live in homes they rent from housing authorities compared with 32.9% and 4.4% of households in NSW respectively (PHIDU 2015).

v Industry and employment

In 2013, there were 5,086 businesses in the Wingecarribee LGA, with 484 business entries and 706 business exits. Between 2009 and 2013, the number of businesses in the LGA declined by 3%. Conversely, there was a 1% increase in the total number of businesses in NSW over the same period (ABS 2015).

Of the total businesses in the Wingecarribee LGA, 17.6% were in construction, 13.3% in professional, scientific and technical services, 11.9% in agriculture, forestry and fishing, 10.7% in rental, hiring and real estate services, 7.1% financial and insurance services, 8.3% in retail trade and 5.0% health care and social assistance (ABS 2015). Each of the remaining service sectors accounted for less than 5% of the total businesses.

The main sources of employment in the Wingecarribee LGA are health care and social assistance (11.9%), retail trade (11.7%) and manufacturing (10.1%). Employment in the mining sector increased by 73.6% between 2001 and 2011, although it is likely to have declined significantly since 2011. Employment grew significantly in public administration and safety (34.0%), administrative and support services (33.1%) and health care and social assistance (33.0%). Employment in information media and telecommunications (-31.2%) and agriculture, forestry and fishing (-21.5%) declined over the same period (ABS 2011a). Among those employed, 59% worked full-time, 35% worked part-time and the balance – 6% – were unreported (ABS 2011a).

The most common occupations in the Wingecarribee LGA are professionals (20.1%), technicians and trade workers (15.7%) and managers (14.7%). There was a large increase in community and personal service workers (37.3% increase), professionals (23.1%) and sales workers (13.5%) in the Wingecarribee LGA between 2001 and 2011 (ABS 2011a).

In 2011, 22% of the Wingecarribee LGA's population indicated they participated in voluntary work for an organisation or group a much higher proportion than that for NSW overall- 17% (ABS 2011a).

vi Unemployment

In December 2015, the unemployment rate in Wingecarribee was 3.3% or about 760 people compared to 5.8% for NSW (Department of Employment 2016); 3.0% are long-term unemployment beneficiaries compared with 4.3% for NSW (PHIDU 2015). The unemployment rate in Wingecarribee has been increasing while the NSW unemployment rate has remained relatively stable (Department of Employment 2016).

vii Education and training

Within the Wingecarribee LGA, 20.6% of adults have completed a bachelor level degree. This is lower than the NSW level of 24.6% possibly suggesting that local people with higher educational qualifications have to move to cities to find suitable employment. However, certificate level qualifications are higher in Wingecarribee (35.3%) than NSW generally (30.9%) (ABS 2011a).

viii Relative disadvantage

The Wingecarribee LGA is ranked the 117th most disadvantaged of 153 LGAs in NSW for education (ABS 2013a), with a marginally lower rate of the population achieving year 12 or equivalent (44.0%) compared to NSW (49.2%). However, the proportion of the Wingecarribee population completing year 12 increased by 7% between 2006 and 2011. The percentage of the population that achieved year 10 or higher within the Wingecarribee LGA was higher (29.8%) than NSW (23.9%) (ABS 2011a).

20.3.2 Community services and facilities

i Education

Aside from childcare, the LGA contains 20 primary schools, seven secondary schools, two special schools and two tertiary education centres.

a. Childcare/pre-schools

There are 17 day care centres in the Wingecarribee LGA; most of them have vacancies (Australian Government 2015).

There are also five pre-schools in the Wingecarribee LGA. A pre-school or kindergarten program is different from day care in that it is a structured, learning-based program run by a qualified teacher.

b. Schools

Wingecarribee's 29 schools comprise: 15 public and six private primary schools; two public and five private secondary schools; and two special schools. There are approximately 7600 students enrolled with approximately 570 full-time equivalent teaching staff (Australian Curriculum, Assessment and Reporting Authority 2015).

Table 20.2 below compares the student to teacher ratio for each school type in the Wingecarribee LGA with that of NSW and Australia to indicate the existing capacity of Wingecarribee schools.

Table 20.2 Student to teacher ratios in the Wingecarribee LGA

School type	School level	Wingecarribee ratio	NSW ratio	Australian ratio
Government	Primary	15.8	15.8	15.3
	Secondary	12.9	12.5	12.7
Non-government	Primary	15.6	16.3	15.7
	Secondary	9.8	11.7	11.7
All school types	Primary	15.7	15.9	15.4
	Secondary	11.5	12.1	12.3

Sources: ACARA 2015, ABS 2011b.

In general, the student to teacher ratios in Wingecarribee schools are consistent with, or better than, student to teacher ratios across NSW and Australia, suggesting they have some but varying capacity to accommodate growth in student numbers. This assumes that there is adequate physical infrastructure available, particularly classrooms.

c. Tertiary education

TAFE Illawarra has a campus in Moss Vale that provides vocational education and training leading to certificates and diplomas. The Southern Highlands Campus of the University of Wollongong is also in Moss Vale and offers degrees in humanities and business.

ii Health

a. Hospitals and health centres

The Wingecarribee LGA is in the South Western Sydney local health district and has two hospitals that service the population. Bowral and District Hospital is a public hospital with 94 beds that provides a range of general medical, obstetrics, paediatric, surgical, orthopaedics, ophthalmology, geriatric and emergency services. The Tharawal Aboriginal Corporation provides a visiting Aboriginal GP service every Tuesday at the Tharawal clinic within Bowral and District Hospital.

Southern Highlands Private Hospital, with 73 beds, is co-located with Bowral and District Hospital and provides day surgery, oncology treatments, rehabilitation, palliative, physiotherapy, hydrotherapy, occupational therapy, dietetics, speech therapy and clinical psychology services.

Wingecarribee community health centre – a NSW government funded service in Bowral – provides a range of community health services, including women's health services, sexual assault counselling and family health services.

b. General and specialist practitioners

There are 78 practicing doctors in the LGA (PHIDU 2015), giving a service ratio of 169.1 doctors per 100,000 people compared with a GP service rate of 113 doctors per 100, 000 people compared to that in NSW (PHIDU 2015)[4]. The Australian Medical Workforce Advisory Committee recommends one GP per 950 people and Wingecarribee compares favourably to this with 1.6 GPs per 950 people.

In 2011, there were 40 specialist medical practitioners in Wingecarribee (PHIDU 2015), which provides a service ratio of 86.4 specialist practitioners per 100,000 people. This is a lower ratio than that for NSW which had 123.1 specialist medical practitioners per 100,000 people (PHIDU 2015). Specialist services include 19 dental practices, eight physiotherapy practices and six optometry practices.

iii Sporting and recreational facilities

As shown in Table 20.3, Wingecarribee LGA is well served by sporting, recreational and cultural facilities. These include 119 for sport and recreation and 40 cultural and community owned by the council (Parsons Brinckerhoff 2009), plus 28 sporting and recreational facilities and 52 cultural and community facilities that are privately owned.

[4] Note: there appears to be a mathematical discrepancy between the services ratio presented by PHIDU and the population of Wingecarribee. Based on a population of 47,584 the service ratio would be 163.9 doctors per 100,000 people.

Table 20.3 Wingecarribee sporting, recreational and cultural facilities

Sporting	Recreational	Cultural and community
Council owned		
22 sports fields	6 reserves and camping grounds	4 libraries (including a library roads vehicle)
2 golf courses	54 parks	3 guide/scout halls
2 cricket facilities	2 recreational centres	6 community centres
4 swimming centres/pools	2 cycle ways	1 tourist centre
11 tennis courts	4 pony clubs	16 memorial and community halls
3 bowling clubs		2 youth centres
2 skate ramps		2 war memorials
2 basketball courts		2 CWA halls
1 BMX track		2 museums
1 croquet club		1 theatrette
1 velodrome		1 Aboriginal community and cultural centre.
Privately owned		
8 golf courses	2 showgrounds	4 scout halls
1 gymnastics centre		13 community halls and spaces
1 tennis court		2 returned service leagues
1 race course		12 galleries and arts centres
2 bowling clubs		3 community centres and gardens
1 sailing club		5 rooms for hire
6 equestrian courses		1 cinema
1 basketball stadium		2 conference centres
2 sportsgrounds		1 school of performing arts
1 squash court		2 youth centres
2 swimming pools		3 CWA facilities
		3 historic monuments and museums
		1 bowling club

Source: Parsons Brinckerhoff 2009.

iv Women's services and programs

Services and programs for women in the Wingecarribee LGA respond to domestic violence as well as single women and women with children who are homeless or at risk of being homeless; and provide crisis and emergency relief, legal aid and advocacy.

v Aboriginal services

Services and programs available for Aboriginal people in Wingecarribee include a playgroup, an indigenous cultural and education program, and a walking group. Many of these programs are run with collaboratively with WSC.

vi Youth services

Government and non-government facilities available include youth and recreation centres, youth radio, the Southern Highlands Youth Arts Council, community housing, a youth refuge, and prenatal classes for young parents under the age of 23.

vii Emergency services

a. State Emergency Service

The Wingecarribee State Emergency Service (SES) unit in Mittagong falls within the Illawarra-South Coast State Emergency Services region. Regional headquarters in Wollongong coordinate all local SES units.

b. NSW Police

The Wingecarribee LGA has three police stations located in Bowral, Moss Vale and Robertson, they fall within the Hume Local Area Command.

c. Fire and Rescue NSW

The Wingecarribee LGA has Fire and Rescue stations in Bundanoon, Bowral, Mittagong and Moss Vale. The stations at Bundanoon, Bowral and Mittagong have retained staff that are fire fighters who are not rostered on duty at the station but are on call to respond to emergency incidents. The Bowral station is staffed by both permanent and retained employees.

d. NSW Rural Fire Service

There are 21 fire brigades staffed by NSW Rural Fire Service (RFS) volunteers in the Wingecarribee LGA.

e. NSW Ambulance Service

The Wingecarribee LGA has three ambulance stations located at Bowral, Canyonleigh and Bundanoon that are within the Southern Western Sydney Zone 1 (Metropolitan Division). Bowral ambulance station has full-time staff, while the Canyonleigh and Bundanoon stations are staffed by volunteers.

viii Transport services

a. Private vehicles

People in Wingecarribee rely heavily on private road transport. For example, 68.6% of the LGA's population travel to work by car, either as the driver or passenger, compared with the NSW figure of 62.6% (ABS 2011a). In addition vehicle ownership rates in the Wingecarribee LGA are relatively high with just 5.0% of dwellings in the LGA being occupied by people who do not own a motor vehicle, 36.3% own one vehicle and 55.7% own two or more vehicles. In comparison, 10.4% of dwellings in NSW do not own a motor vehicle, 37.8% own one motor vehicle and 48.6% own two or more vehicles (ABS 2011a).

b. Buses, coaches and taxis

Coach services run daily between Sydney and Canberra via the Southern Highlands. NSW Train Link also provides a regional coach service between Wollongong and Robertson, Burrawang, Bowral, Moss Vale, Exeter and Bundanoon.

Berrima Buslines provides a daily town bus service and a rural village service within and between towns in the Wingecarribee LGA, and a school bus service during school terms.

Southern Highlands Community transport provides transport services for the elderly, disabled and disadvantaged. The service runs Monday to Friday and transports passengers to medical appointments, social outings and local shopping centres.

The Southern Highlands taxi service provides coach and taxi services within the Wingecarribee LGA and beyond.

c. Bicycles

There are dedicated on-road bicycle lanes in the main centres within the Wingecarribee LGA. WSC has also received funds from RMS to develop a bicycle strategy so that rural towns and villages across the LGA can be better linked.

d. Trains

NSW TrainLink provides daily rail services between Sydney and Mittagong, Bowral, Moss Vale and Bundanoon. Sydney Trains provides daily services between Sydney and Yerrinbool, Mittagong, Bowral, Burradoo, Moss Vale, Exeter, Bundanoon, Penrose and Wingello.

20.3.3 Housing and short-stay accommodation

i Housing supply

In 2011, there were around 19,650 dwellings in the Wingecarribee LGA (ABS 2011a). Just 1.5% of the total housing stock comprised flats, units or apartments compared with 17.0% in NSW. A high proportion of the total private housing stock in the Wingecarribee LGA is unoccupied (15.1%) compared with NSW (9.7%), suggesting the LGA contains many holiday homes (ABS 2011a).

Housing forecasts for the Wingecarribee LGA predict an increase of 4,050 dwellings between 2011 and 2031 in response to population growth and shifting patterns in household structure and number (see Table 20.4) (DP&E 2014).

Table 20.4 Household growth forecasts for the Wingecarribee LGA.

	2011	2016	2021	2026	2031
Total Population	46,150	47,750	49,150	50,300	51,150
Total households	18,300	19,400	20,350	21,150	21,750
Average household size	2.46	2.40	2.34	2.30	2.27
Implied dwellings	21,400	22,700	23,850	24,750	25,450
Total dwelling change	-	1,300	1,150	900	700

Source: *DP&E 2014.*

Note: *Average household size is taken from DP&E 2014 but there is a mathematical discrepancy – average house size is not equal to the total population divided by the total number of households.*

Recent growth in housing supply can be estimated from residential building approval figures for the LGA. In the year ending June 2015, 432 new houses and 87 other residential buildings were approved, making a total of 519 new residential building approvals for the year, an increase of 293 from the previous year.

The estimated number of building approvals between 2011-2016 is more than 1,540 dwellings, of which approximately 1,300 have been constructed. This is more than enough to meet the expected demand for new dwellings in 2016 and beyond.

The Wingecarribee demographic and housing study (SGS Economics and Planning 2012) identifies a number of areas of residential zoned land in the LGA that will be able to accommodate future dwelling growth. The study suggests that the Wingecarribee LGA has the area and capacity to accommodate the predicted growth in dwellings to 2031.

ii b. Short-stay accommodation

In June 2015, there were 649 rooms within hotels, motels and serviced apartments available as short-term accommodation in Wingecarribee LGA (Destination NSW 2015a). This represented a reported 54% increase in the number of rooms available since June 2014, a very substantial increase that can only be explained by either or both a significant jump in development or reported discrepancies. Occupancy rates for the year ending June 2015 were approximately 51% (Destination NSW 2015a). Given the LGA's close proximity to nearby major population centres it is likely that these average figures conceal a more polarised usage pattern with occupancy rates on weekends being much higher than 50% and lower than 50% on weekdays.

20.4 Community issues and values

20.4.1 Stakeholder engagement and community consultation

A range of consultation tools have been employed by Hume Coal to continually inform stakeholders about the project. These include a project website, community shop fronts, information sessions, media communications and focus and advisory groups.

Since October 2011, Hume Coal has had a dedicated community liaison team to brief stakeholders and respond to requests for information and meetings. These consultation specialists remain part of the wider project team.

Hume Coal undertook extensive stakeholder engagement and consultation during the project planning phase and will continue this throughout the response to submissions and implementation phases.

20.4.2 Community surveys

Hume Coal has extensively researched community opinion across the Wingecarribee LGA, focusing on Moss Vale, Bowral, Burradoo and Berrima, including use of telephone surveys and focus groups to identify issues of concern to the local community.

Generally, the residents surveyed are optimistic about their lives and are positive about their choice to live in the Wingecarribee LGA. There is a strong sense of community connection with residents citing the relaxed lifestyle, friendly people, open space and general sense of safety and security as key reasons for living in the Wingecarribee LGA.

This echoes the 2009 NSW Adult Population Health Survey, which assessed social capital in Wingecarribee. Social capital is the positive inter-personal relationships within a group or community, and includes such things as the extent of trust between people and how they care for others (Ministry of Health 2014). Compared with NSW, the Wingecarribee LGA has strong social capital, indicating that the local community feels relatively secure within their environment (Ministry of Health 2014).

When asked what issues concerned people, the most important issues cited were the availability of hospitals and high quality health care (23.9% of respondents). There was also a strong focus on traffic, road maintenance and infrastructure (19.9%) and coal seam gas (14.8%), while mining, and crime and anti-social behaviour, were both seen as issues of less concern (4%). Figure 20.3 below shows a summary of current community issues.

In 2013, EMM consulted various community groups located near the project area. Relevant issues cited were concerns about the decline of Moss Vale commercial centre where it was noted that a number of shops had become vacant and the lack of job opportunities for young people even in affluent areas like Bowral.

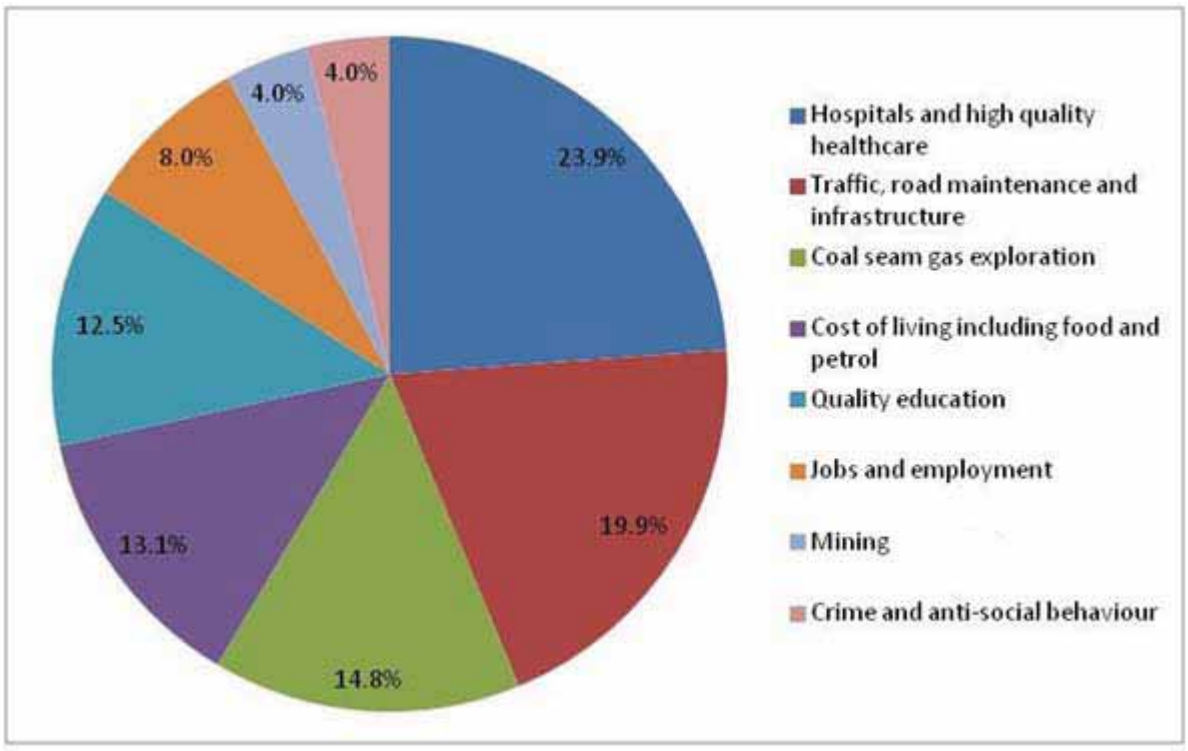


Figure 20.3 Summary of current community issues

20.5 Social aspects of the project

Population and social change will occur throughout the project's planning, construction, operations and closure phases. The social changes during each phase will be different and are described below.

20.5.1 Planning, feasibility and approvals phase

The project's planning phase began in December 2010 when Hume Coal acquired A349 from Anglo Coal. In March 2011, Hume Coal began exploration drilling which was followed by the opening of its project planning office in Moss Vale in August 2011. Since then, Hume Coal has conducted extensive geological, engineering, environmental, financial and other technical investigations to inform the mine plan and address environmental and other constraints. This included two stages of environmental and engineering investigations and three stages of opportunities and constraints analysis.

To undertake these activities, Hume Coal has retained the services of a large technical team including a number of consultants and contractors. In November 2015, Hume Coal had 17 direct employees who were involved in activities including environmental planning, mine planning, exploration, health and safety and administrative and executive roles. In addition to this, Hume has retained the services of over 40 consulting and contracting companies.

Hume Coal has also retained the services of a pastoral company, Princess Pastoral Pty Ltd, to manage agricultural land owned by Hume Coal.

Since February 2015, Hume Coal has invested around $250,000 per annum in the Hume Coal Apprenticeship program. This provides funding to trainees and apprentices in a number of local businesses.

In May 2015, Hume Coal also launched the Hume Coal Charitable Foundation. As part of the foundation, Hume Coal provided two rounds of funding per year to local organisations. The foundation invested approximately $200,000 per annum in the local community with a focus on educational, indigenous and not-for-profit childcare organisations within Wingecarribee LGA.

20.5.2 Construction phase

i Construction workforce

It will take about 2 years to construct the project, with about 105 workers required during early works, building up to a peak of around 414 after 11 months.

The main skills construction workers must have during the construction phase are as follows:

- project management and administration;
- engineering design and supervision;
- various construction trades;
- plant and equipment operators;
- labourers; and
- accommodation provision and servicing.

Some of these skills will be well suited to local contractors and local firms will be recruited where feasible. Examples include plant and equipment operators, trades, engineering and administration tasks, and providing food and accommodation for workers. However, most of the skills required during the construction phase are highly specialised, meaning specialist firms will need to be contracted for these tasks. As most of these specialist firms and their employees are located outside of the local area, these workers will relocate to the area during construction. For the purposes of this EIS, Hume Coal has conservatively estimated that around 90% of construction workers will be employees of specialist firms who will temporarily relocate to the area. The balance (10%) will be recruited locally. There are no practical means of increasing local recruitment for many key aspects of the project due to the specialised nature of the work.

The project's construction phase will take place concurrently with building a new rail spur and upgrading the existing Berrima Branch line (the Berrima Rail Project). Details of this related project are given in Appendix D.

ii Construction accommodation village

A construction accommodation village (CAV) to accommodate nominally 400 workers will be built before the major construction activities begin. It will accommodate Hume Coal's non-local construction workers and therefore the related Berrima Rail Project. The CAV will take approximately eight months to construct. During this time, workers building the village will live in temporary accommodation such as short-term rental houses. The CAV will be located within the mine surface infrastructure area and will be accessed via Mereworth Road and an internal mine road, as shown in Figure 2.2 Following its construction, nearly all non-local workers will be required to live in the CAV while they are rostered on. The CAV will be 'dry' (ie no alcohol permitted) and will contain a dining hall, gym, and recreation room. The on-site facilities mean there will be limited interaction between construction workers and the local community, meaning there will be little prospect of any unruly behaviour in nearby towns.

The CAV will be temporary and operate for a maximum of 36 months. It will be dismantled once construction works are complete and the project moves into its operational phase.

20.5.3 Operations phase

i Operations workforce

After the construction phase, operations will progressively build-up to a peak in year nine of the project and extend for 19 years. The operations workforce will consist of both semi-skilled and skilled mine operators and maintenance staff, engineers and managers requiring varying levels of experience and will total 300 workers after five years of operations. In the early commissioning and build-up phases, a core of experienced workers will be needed. However, over time there will be more opportunity to introduce effective training programs for workers without the necessary experience and to recruit less experienced workers. It will take around six to nine months to train an inexperienced person to work competently in an underground mine. Thus, as training programs become established the potential to recruit local workers will increase and, given the reasonably large pool of suitable local workers, it is estimated that about 70% of all workers will be sourced locally over the life of the project.

When recruiting, Hume Coal will apply the following criteria:

- completion of Year 12 schooling;
- a responsible character;
- be fit and medically suited to working in an underground mine;
- have a stable employment record (apart from apprentices and/or those leaving school); and
- ideally have a trade qualification or working towards one.

Hume Coal will give priority to local recruits who meet the above criteria.

ii Workforce catchment area

For work health and safety reasons Hume Coal will require all workers to live within 45 minutes travel time from the project area. This policy will minimise the risk of fatigue-related travel accidents, given that some of the operations workers will be required to work two 12-hour shifts and three nine-hour shifts each week. Figure 20.4 shows the 45-minute travel catchment, called the 'workforce catchment area' or 'local area'. It includes most of Wingecarribee LGA plus the following localities in adjoining LGAs:

- Wollondilly (Douglas Park, Picton, Thirlmere, Tahmoor and Wilton);
- Kiama (Carrington Falls);
- Shoalhaven (Kangaroo Valley); and
- Goulburn Mulwaree (Goulburn and Marulan).

Since all workers will be required to live in this workforce catchment area, most population and social change arising during post-construction phases of the project will occur there. These changes will take place in three ways:

- workers renting for an initial period before buying a home;
- relocating workers moving to the area; and
- 'local' workers who live in the outer parts of the workforce catchment area relocating closer to the project site.

Population growth from the project workforce recruited outside the local area (in-migration) will be the key source of population and social change, and the demand for new infrastructure and services.

iii Estimated population growth from workforce in-migration

On Census night in 2011, there were 187 people working in the mining sector residing in the Wingecarribee LGA with a further 876 mining workers residing in the adjoining LGAs as listed below (ABS 2011a):

- Wollondilly – 459;
- Kiama – 178;
- Shoalhaven – 135; and
- Goulburn Mulwaree – 104.

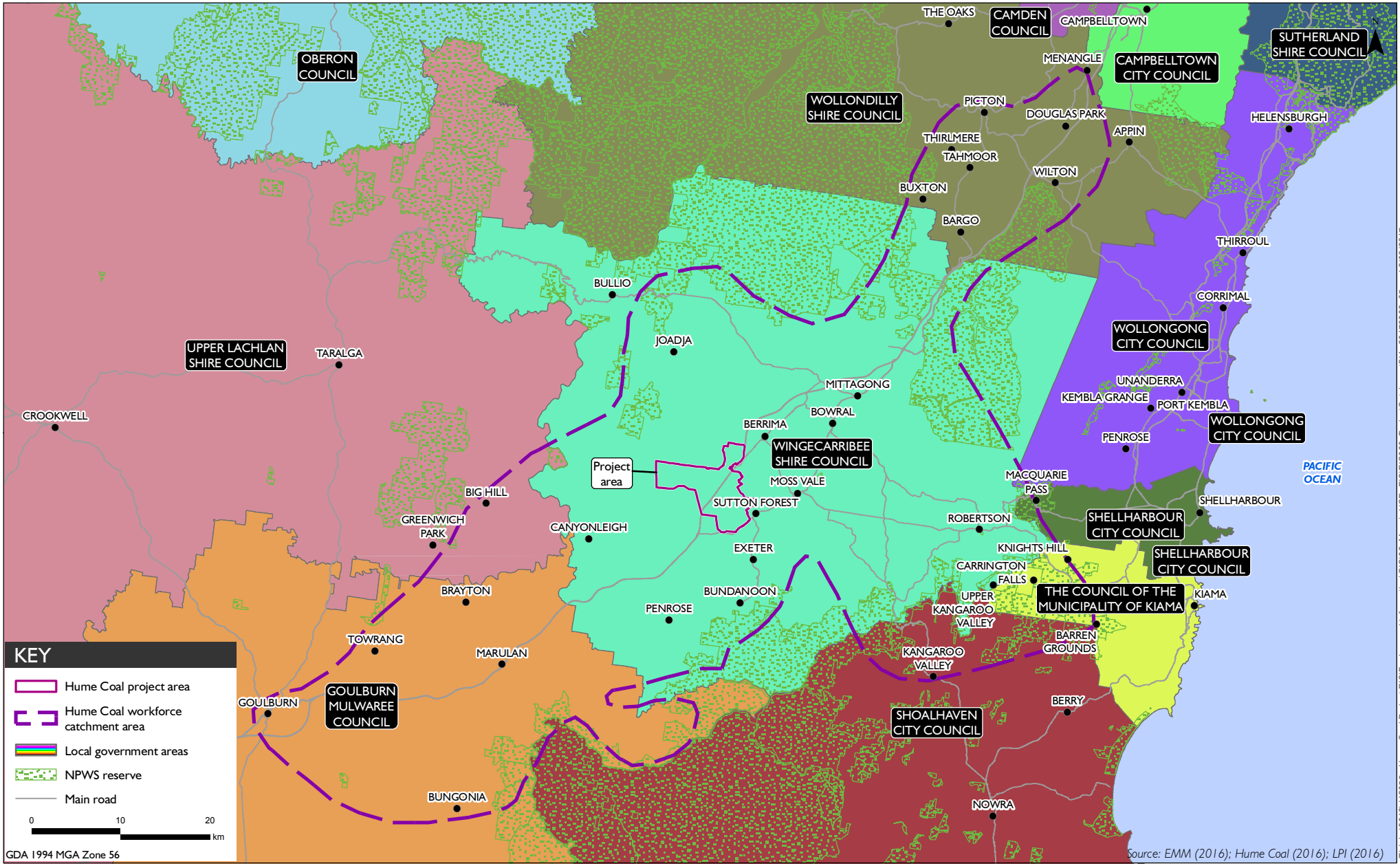
This ignores people who live in the local area and were working outside of the district on census night, people who work in related industries with highly transferable skills and people who have been forced to change industries due to a lack of local opportunities in mining, but who have skills in the industry. Thus, the pool of suitable local workers from which Hume Coal can recruit is expected to be substantially greater than the 300 workers needed for the project. Consequently, it is estimated that approximately 70% of all workers will be sourced locally over the life of the project being nearly all of those who are not needed for the early commissioning and build up activities. However, given the inexact nature of these estimates, this SIA has used two scenarios based on 70% (best estimate) and 50% (conservative case) local recruitment over the life of the project.

In the higher scenario, it is assumed the following would occur:

- initially 70 experienced workers would be recruited from outside the area and the remaining 30 would be locally recruited; and
- at peak production, a further 180 local people would be recruited after completing training programs, with 20 more people recruited from outside the local area.

In the second (or 50%) scenario it is assumed the following would occur:

- initially as above for the 70% scenario; and
- at peak production, a further 120 locals would be recruited after completing training programs as required, with 80 more people recruited from outside the local area.



Workforce catchment area

Hume Coal Project

Environmental Impact Statement

Figure 20.4

iv Residential location of workers

As long-term residents, workers on the operations phase of the project will exercise care in choosing the locations of their new homes. The Department of Infrastructure and Transport's Major Cities Unit (2013) and Brooker and Mitchell (2014) suggest a range of factors – categorised as availability, affordability, accessibility and amenity – will influence their choices. These factors are defined as follows:

- availability – enough zoned and subdivided residential land is available to meet the project's housing needs. The mining industry employs a relatively high proportion of workers aged between 25 and 44 years, with 56.7% falling into this age group (Australian Government 2011). Consequently, most relocating workers will be accompanied by young families, suggesting a strong preference for houses with three or more bedrooms;
- affordability – houses or units are available for purchase or rent at prices that are affordable by mine workers;
- accessibility – a town or village lies within an acceptable travel time to the project site (ie within 45 minutes) with closer locations being preferred; and
- amenity – a town or village has essential services, including general medical, a primary school and convenience retail facilities, with preference given to towns containing a broader range of facilities and services. The environmental amenity of each town and village is also relevant.

The above factors are not of equal weight. Availability and affordability are essential whereas accessibility and amenity are discretionary. In determining the residential distribution of the project's workforce, much greater weight has been given to those towns or villages that satisfy the availability and affordability criteria. The housing preferences of mine workers also need to be taken into account.

Table 20.5 rates the towns and villages within the workforce catchment area against all preference factors.

Table 20.5 Ratings of towns against all location preference factors

Rating Level	Availability	Affordability	Accessibility	Amenity
Level 1	**Wide choice:**	**Good:**	**Closest:**	**Very good:**
	Bowral, Mittagong and Moss Vale	New Berrima, Kangaroo Valley and Goulburn Mulwaree towns	Berrima, Moss Vale, New Berrima and Sutton Forest	Bowral, Mittagong, Moss Vale, Wollondilly and Goulburn Mulwaree towns
Level 2	**Some choice:**	**Average:**	**Close:**	**Good:**
	Exeter, New Berrima, rest of Wingecarribee, Wollondilly and Goulburn Mulwaree towns	Moss Vale, Mittagong, rest of Wingecarribee and Wollondilly towns	Bowral, Exeter, Mittagong Rest of Wingecarribee	Berrima, Exeter, Sutton Forest, rest of Wingecarribee, Carrington Falls and Kangaroo Valley
Level 3	**Little choice:**	**Low:**	**More distant:**	**Acceptable:**
	Berrima, Sutton Forest, Carrington Falls and Kangaroo Valley	Berrima, Bowral, Exeter, Sutton Forest and Carrington Falls	Carrington Falls, Kangaroo Valley, Wollondilly and Goulburn Mulwaree towns	New Berrima

These ratings suggest workers who are relocating will mostly move to Moss Vale and Mittagong. The next most attractive town is Bowral, where more highly paid workers are likely to live. All remaining towns and villages have various positive and negative characteristics that, in effect, make them indistinguishable from each other.

Table 20.6 summarises the forecast residential distribution of relocating workers and estimates the total number of relocating workers in each town for both in-migration scenarios.

Table 20.6 Residential distribution of re-locating operations workers

Locality	Residential distribution	Scenario 1 (30% in-migration)	Scenario 2 (50% in-migration)
Moss Vale	25%	23	37
Mittagong	25%	23	37
Bowral	20%	18	30
Rest of Wingecarribee LGA	6%	5	9
Wollondilly LGA	6%	5	9
Goulburn Mulwaree LGA	6%	5	9
New Berrima	4%	3	6
Sutton Forest	2%	2	3
Berrima	2%	2	3
Exeter	2%	2	3
Kiama LGA (Carrington Falls)	1%	1	2
Shoalhaven LGA (Kangaroo Valley)	1%	1	2
Total	100%	90	150

Note: Numbers are rounded to represent best estimates for population increases.

Table 20.7 shows the total population increase for all towns.

The weighted average household size in Wingecarribee, Wollondilly, Kiama, Shoalhaven and Goulburn Mulwaree LGAs is 2.59 people (ABS 2011a). This is marginally less than in Singleton LGA (2.7 people per household), which has a relatively high proportion of mining sector workers (ABS 2011a). The SIA considered 2.7 people a more accurate indicator of the typical household size for project workers and this has been used to determine the population growth associated with the projects workforce.

Table 20.7 Distribution of total population change associated with the project

Locality	Residential distribution	Scenario 1 (30% in-migration)	Scenario 2 (50% in-migration)
Moss Vale	25%	60	102
Mittagong	25%	60	102
Bowral	20%	49	81
Rest of Wingecarribee LGA	6%	15	24
Wollondilly LGA	6%	15	24
Goulburn Mulwaree LGA	6%	15	24
New Berrima	4%	10	16
Sutton Forest	2%	5	8
Berrima	2%	5	8
Exeter	2%	5	8
Kiama LGA (Carrington Falls)	1%	2	4
Shoalhaven LGA (Kangaroo Valley)	1%	2	4
Total	100%	243	405

Note: Numbers are rounded to represent best estimates for population increases.

20.5.4 Closure and decommissioning phase

The closure and decommissioning phase will involve works associated with decommissioning the mine and rehabilitating disturbed areas. This will extend for two years and require up to 30 workers. Following this, three part time workers will be employed for the management of the mine up until lease relinquishment occurs.

20.5.5 Concurrent development projects

There are a number of projects within the Wingecarribee LGA and surrounding LGAs that could be developed concurrently with the Hume Coal project. A summary of these projects, including workforce forecasts in operational and construction phases, is given in Table 20.8.

Table 20.8 Concurrent development projects

LGA	Project name	Project life	Year of Commencement	Construction workforce	Operational workforce
Wingecarribee	Green Valley Sand Quarry	30 years	Not stated	20 full-time equivalent employees	22 quarry employees 40 truck drivers
Wingecarribee	Berrima Rail Project	19 years	2020	38 full-time equivalent employees	16 additional full-time employees
Wingecarribee	New Berrima Quarry Project	30 years	Not stated	Not stated	4 full-time equivalent employees
Wingecarribee	Proposed Coomungie and Chelsea Gardens, Moss Vale planning proposal	Not stated	Not stated	Not stated	Nil

The cumulative impact of population change associated with the Hume Coal Project and concurrent developments for both the construction and operations phases represents a very small portion of the total population of the Wingecarribee LGA.

The cumulative population increase of the Hume Coal Project and other concurrent developments during construction is 472 people. The population of the Wingecarribee LGA is forecast to increase by 1,400 people between 2016 and 2021 (DP&E 2014). The cumulative population growth of the Hume Coal Project and other concurrent developments makes up around a third of this forecast population increase. During operations, the cumulative population increase of the Hume Coal Project and concurrent developments is 437 people. This is a relatively small portion of the population growth forecast for the Wingecarribee LGA over a similar timeframe, with the population forecast to increase by around 3,400 people between 2016 and 2031 (DP&E 2014). The cumulative impacts of the Hume Coal Project and concurrent developments should not create any unforseen pressure on community services and facilities as population growth caused by all know concurrent development projects is well within already forecast population growth.

20.6 Impact assessment

This section describes the project's social impacts. The comparative benchmark for the assessment is the area's existing social and economic conditions, as described in Section 20.2. The potential impacts considered are those typically experienced by mining projects in Australia and the issues identified by stakeholders.

A social impact is something that is experienced or felt (either real or perceived) by an individual, social group or economic unit (Franks 2012). Social impacts can be positive or negative and are the result of an action (or lack of action) undertaken by a person, company or group. In addition, social impacts can be direct or indirect and have the potential to accumulate over time as an activity progresses. Therefore, this assessment considers the direct, indirect and cumulative social impacts related to the project. There are a number of typical social impacts associated with mining projects and they are well documented in the literature (for instance, Franks 2012 and Franks et al. 2010). These typical or 'generic' impacts of mining have been used in this SIA to provide a comprehensive and objectively derived basis for the assessment; the generic impacts are listed in Table 20.9.

Table 20.9 Typical social consequences of mining projects and associated impacts

Area of change	Potential impacts
Population and demographics	In-migration, out-migration, workers camps, growth or decline of towns, changed demographic profile
Labour market	Changes in unemployment rate, workforce participation, training, health and safety, working conditions, remuneration, skills shortages, changing employment base
Economic change	Royalties, taxes, economic growth or decline, flow-on benefits, local business spending, economic narrowing and instability
Community services and facilities	Changes in demands on, or investment in, roads, rail, power and water supplies, childcare, health, education and emergency services
Housing and accommodation	Demand for and availability of housing, housing ownership, temporary accommodation, property values
Community liveability	Increased traffic, alcohol and substance abuse, pollution, amenity, disruption to social activities and norms, community engagement, community development and investment, land use change, land acquisition, reduced community participation, reduced community cohesion, sense of place, marginalisation of vulnerable groups

Note: Adapted from Franks 2012.

Mining projects pass through various phases as they develop, that is planning, construction, operations and closure. Each has its own distinctive social impacts and in this assessment potential impacts that could occur in all four phases have been considered individually.

The social impacts that could occur in each phase have been categorised according to the key parameters – duration, extent and magnitude and based on this information a level of significance has been assigned to each impact. Thus, impacts have been classed as having a low, medium or high impact on those affected, and being positive or negative; the criteria are defined in Table 20.10.

Table 20.10 Assessment criteria for determining significance of potential impacts

Criteria	Category	Description
Duration of impact	Short-term	Limited to a specific phase of the project
	Medium-term	Will occur for the duration of the project
	Long-term	Including and beyond the project life
Extent of impact	Site specific	Confined to the project area
	Local	Project area and neighbours
	Regional	Across the Southern Highlands, including the 45 minute travel zone
Magnitude of impact	Minor	Impact is barely noticeable, small number of people directly impacted
	Moderate	Impact has a noticeable impact, medium number of people directly impacted
	Major	Substantial change or effect, large number of people directly impacted

The social impacts and opportunities arising from each phase of the project have been assessed against the above criteria and are summarised in the following sections with detailed explanations of the methodology and results being provided in Appendix A of the SIA (refer to Appendix R).

20.6.1 Planning, feasibility and approvals phase

i Context

Exploration and other investigations within the land subject to A349 have been occurring since the 1950s. However, since Hume Coal acquired A349 in December 2010, there has been a heightened level of activity in and around the lease area as geological, engineering, environmental, financial and other technical investigations have been conducted. Further activities include Hume Coal's community consultation program about mining options and the responses by various individuals and groups to this. These investigations and activities have created greater awareness of the project in the local community.

ii Impact assessment

Table 20.11 outlines the social impacts and opportunities that could occur during the project's planning phase.

Table 20.11 Planning, feasibility and approvals phase impacts

Potential social impact or opportunity	Potential outcome	Duration	Extent	Magnitude	Overall significance	Potential to mitigate or enhance?
1. Population and demographics						
Change in the number of residents within the project area due to project-related property acquisitions and subsequent tenancy agreements.	Direct, positive	Medium	Site specific	Minor	Low	Yes
2. Labour market						
Create 17 direct employment opportunities.	Direct, positive	Short	Regional	Minor	Medium	Yes
Improve workforce skills by sponsoring around two trainees and four apprentices.	Direct, positive	Long	Regional	Minor	Medium	Yes
3. Economic change						
Provide economic stimulus to local economy through engaging local consultants and contracting companies for preliminary works and to provide services.	Indirect, positive	Short	Regional	Minor	Medium	Yes
4. Community services and facilities						
Improve community facilities and services through sponsoring local organisations through the Hume Coal Charitable Foundation.	Direct, positive	Short	Regional	Moderate	Medium	Yes
5. Housing and accommodation						
Small increase in demand for housing by direct employees.	Direct, positive	Short	Regional	Minor	Medium	Yes

Table 20.11 Planning, feasibility and approvals phase impacts

Potential social impact or opportunity	Potential outcome	Duration	Extent	Magnitude	Overall significance	Potential to mitigate or enhance?
6. Community liveability						
Create uncertainty about the type, location, timing and potential impacts of future coal mining on the local area.	Direct, negative	Short/Medium	Local	Minor	Medium	Yes
Improve amenity and rural character of project area by improving agricultural practices and output.	Direct, positive	Long	Local	Minor	Medium	Yes

iii Summary of impacts during the planning, feasibility and approvals phase

During the planning, phase, the project will generate a number of benefits, namely:

- a modest number (17) of new job opportunities (excluding contractors and consultants), as well as, further indirect and induced jobs from spending by Hume Coal and its employees, consultants and contractors;
- a small improvement in the skills base of the local workforce through Hume's apprenticeship and training program;
- improved community facilities and services from investments by the Hume Coal Charitable Foundation; and
- increasing agricultural output from the project area which will also benefit local rural services businesses.

There will also be a negative impact during the planning phase being stress and anxiety caused by uncertainty about aspects of the project and its potential impacts on the local area.

On balance, positive impacts will clearly outweigh negative ones during the planning phase meaning there will be a net benefit to the local community during this phase.

20.6.2 Construction phase

i Context

The construction phase includes three stages – early works, construction of surface infrastructure and construction of drifts and associated infrastructure. These works will be completed over about two years and will require a peak workforce of 414 people. It is proposed to construct a temporary CAV to accommodate most non-local workers during the construction phase.

ii Impact assessment

The social impacts and opportunities resulting from the construction phase are outlined in Table 20.12.

Table 20.12 Construction phase impacts

Potential social impact or opportunity	Potential outcome	Duration	Extent	Magnitude	Overall significance	Potential to avoid, mitigate or enhance?
1. Population and demographics						
Temporarily increase population of the Wingecarribee LGA through in-migration of non-local workers.	Direct, mostly positive	Short	Local	Minor	Low	Yes
2. Labour market						
Create 414 direct employment opportunities.	Direct and indirect, positive	Short	Regional	Minor	Medium	Yes
Employment opportunities for local residents.	Direct, positive	Short	Regional	Minor	Medium	Yes
Create skills shortages in the local economy.	Indirect, negative	Short	Regional	Minor	Low[5]	Yes
3. Economic change						
Provide economic stimulus to local businesses particularly contractors engaged for construction works.	Direct, positive	Short	Regional	Moderate	Low[6]	Yes
Limited direct spending by the workforce in the local economy due to provision of services at CAV and temporary nature of workforce.	Direct, positive	Short	Local	Minor	Low	Yes
4. Community services and facilities						
Temporarily increase demand for medical services.	Direct, negative	Short	Local	Minor	Low	Yes
Improve community services and facilities through continued investment by Hume Coal through a voluntary planning agreement (VPA).	Direct, positive	Long	Regional	Major	High	Yes
5. Housing and accommodation						
Help avoid inflationary and availability pressures on housing due to availability of the CAV.	Indirect, positive	Short	Regional	Minor	Medium	Yes
Increase demand for short-term accommodation during initial construction of the CAV.	Direct, positive	Short	Local	Moderate	Medium	Yes

[5] The significance of potential skills shortages in the local economy is expected to be low due to the very minor number of local workers required during this phase.

[6] While it is possible that the affects of economic stimulus to local businesses could be observed regionally, due to the overall potential impacts being very minor, significance is low.

Table 20.12 Construction phase impacts

Potential social impact or opportunity	Potential outcome	Duration	Extent	Magnitude	Overall significance	Potential to avoid, mitigate or enhance?
6. Community liveability						
Improve visual amenity due to tree planting and better agricultural land use.	Direct, positive	Long	Local	Minor	Medium	Yes
Reduced social cohesion due to influx of construction workers.	Indirect, negative	Short	Local	Minor	Low	Yes
Environmental impacts from construction activities.	Direct, negative	Short	Local	Moderate	Medium	Yes

iii Summary of impacts during construction phase

The main impacts expected during the project's construction phase are small benefits from increased direct and indirect local job opportunities. The construction phase has the potential to negatively affect the local housing market and increase the demand for community services. However, these impacts will be largely avoided by mitigation measures, particularly the availability of a CAV. This will avoid negative impacts, such as, the crowding out of tourist accommodation and unruly behaviour by non-local workers. The net impact on housing and access to community services during construction will therefore be minor. There could be some loss of social cohesion due to the influx of construction workers, some noticeable environmental impacts from construction activities and possible increases in demand and pressures on emergency medical services and some specialised trade services.

Table 20.12 shows that on balance benefits will outweigh negative impacts during construction, meaning there will be a net positive social outcome for the community.

20.6.3 Operations phase

i Context

The operations phase will extend for 19 years and will require a peak workforce of 300 people. There are two local recruitment scenarios:

- Scenario 1: 70% local recruitment (ie 210 local recruits and 90 external recruits); and
- Scenario 2: 50% local recruitment (ie 150 local recruits and 150 external recruits).

Assuming there is an average household size of 2.7 people associated with each operations worker, there will be a total population increase of 243 people under scenario 1 and 405 people under Scenario 2. This population increase will be distributed throughout the workforce catchment area which is mostly located in Wingecarribee LGA and also extends into parts of Wollondilly, Kiama, Shoalhaven and Goulburn Mulwaree LGAs.

ii Impact assessment

The operations phase will generate a number of social impacts and opportunities. These are outlined in Table 20.13.

Table 20.13 Operations phase impacts

Potential social impact or opportunity	Potential outcome	Duration	Extent	Magnitude	Overall significance	Potential to avoid, mitigate or enhance?
1. Population and demographics						
Population increase across the workforce catchment area.	Direct, positive	Medium	Regional	Minor	Medium	Yes
More normal age structure due to an increase in the number of family aged people.	Indirect, positive	Medium	Regional	Minor	Medium	No
2. Labour market						
Creation of approximately 300 direct and 62 indirect employment opportunities, 34 of which would be in Wingecarribee LGA.	Direct and indirect, positive	Medium	Regional	Major	High	No
Reduction in unemployment rates across the workforce catchment area.	Direct, positive	Medium	Regional	Moderate	Medium	Yes
Improved mental wellbeing of workers and their families due to improved economic prospects and reduced financial stress.	Direct, positive	Medium	Regional	Major	High	Yes
Changed labour force structure if local mining industry grows significantly.	Direct negative	Medium	Regional	Minor	Low[7]	Yes
Increase in demand for workers with relevant skills may result in labour shortages.	Indirect, negative	Short	Local	Minor	Low	Yes
Adverse health impacts from shift work.	Indirect, negative	Short	Local	Minor	Low	Yes
Provision of training for workers, focusing on improving their skills and future employment prospects.	Direct, positive	Long	Regional	Minor	Medium	Yes
3. Economic change						
Increased economic activity through direct business and employee expenditure.	Direct and indirect, positive	Medium	Regional	Minor	Medium	Yes
Increased revenue for WSC through project-induced growth in population and household numbers.	Direct and indirect, positive	Medium	Regional	Minor	Medium	Yes
Squeezing out established industries if there is excessive demand for labour.	Indirect negative	Long	Regional	Minor	Low[8]	Yes
Some economic instability due to commodities cycles and mine closure.	Indirect, negative	Medium	Regional	Moderate	Medium	Yes
Perceived impact on tourism industry due to amenity impacts from the mine.	Indirect, negative	Short	Local	Minor	Low	Yes

[7] Hume Coal's direct contribution to changes in the labour force would be minor.

[8] Hume Coal's demand for local labour is minor on a regional scale and the project is not expected to squeeze out other industries through demand for labour.

Table 20.13 Operations phase impacts

Potential social impact or opportunity	Potential outcome	Duration	Extent	Magnitude	Overall significance	Potential to avoid, mitigate or enhance?
4. Community services and facilities						
Minor increase in demand for community services, such as health, education and childcare.	Direct, negative	Short	Regional	Minor	Low[9]	Yes
Minor increase in demand for emergency services.	Direct, negative	Short	Regional	Minor	Low[10]	Yes
Increased use of road infrastructure resulting in increased congestion and reduced road condition.	Direct, negative	Short	Local	Minor	Low	Yes
Improved services and infrastructure due to continued investment in potential VPA.	Direct, positive	Medium	Regional	Moderate	Medium	Yes
Possible increase in demand for utilities, including electricity and water supplies.	Indirect, negative	Short	Local	Minor	Low	No
5. Housing and accommodation						
Increased demand for housing during operations – up to 150 dwellings over the life of the project.	Direct positive and negative	Short	Regional	Minor	Low[11]	Yes
Increased demand for short-term accommodation.	Direct, negative	Short	Local	Minor	Low	No
6. Community liveability						
Potential impacts on the character and amenity of the area due to land use changes and environmental impacts.	Indirect, Negative	Medium	Local	Minor	Medium	Yes
Loss of connection to rural environment as a result of changing landscape character.	Indirect negative	Medium	Site Specific	Minor	Low	Yes
Reduced social cohesion and loss of local customs due to rapid population growth and change.	Indirect negative	Short	Local	Minor	Low	Yes
Improved amenity of locality due to improved land management, such as more productive agricultural practices and revegetation works.	Indirect, positive	Long	Local	Minor	Medium	Yes
Improved quality of life resulting from better services and infrastructure.	Indirect, positive	Long	Regional	Minor	Medium	Yes

[9] Hume Coal's contribution to increased demand for community services will be minor and the implementation of the VPA is likely to assist in providing services to cater for this demand.

[10] Hume Coal's contribution to increased demand for emergency services would be very minor.

[11] The contribution of the Hume Coal Project to increased dwelling demand will be minor in comparison to expected natural population growth.

iii Summary of impacts during operations phase

The operations phase will have both positive and negative impacts and these can be summarised as follows.

Population and demographic impacts will be mostly positive. There will be a small increase in population that will help normalise Wingecarribee's age structure by increasing the number of family aged people.

Labour market impacts will be mostly positive. A moderate number of jobs will be created and the skills of those employed in the mine will improve which, in combination, will enhance the well-being of the workers and their families. Conversely, some local businesses may lose employees due to competition from the mine and workers may face adverse health impacts from the pressures of varying shifts.

The dominant economic effect of the operations phase will be increased economic activity. This is expected to have a positive effect overall and benefit the entire workforce catchment area although some local businesses may suffer due to increased competition for labour. Significant economic fluctuations associated with changing coal prices are not likely as mining is only a small part of the local economy.

The demand for community services will increase in-line with project-related population growth but the magnitude of growth should not be noticeable as it will be only a small portion of total forecast population growth. A noticeable positive outcome will be continued improvements to community facilities from funding provided by Hume Coal through a VPA or similar mechanism.

Impacts on housing and accommodation will be variable. There will be some stimulus within the housing market as a result of small increased demand, although it is expected this will be offset by new land releases.

Community liveability impacts will also be variable. Positive impacts will arise from improved local services and facilities from an increased population and improved land management in the project area. The slight increase in the number of miners should improve social cohesion in the area. At the same time, the project area's character will become more industrial.

During the operations phase, positive impacts should outweigh negative ones principally because the project's main effects will be economic stimulus through worker recruitments and local expenditure, and improved community facilities through Hume's VPA. There is potential for a wide range of negative impacts but mostly they are not significant and can be mitigated by implementing appropriate measures.

20.6.4 Closure and decommissioning

i Context

The closure and decommissioning phase will extend for two years. Following this, the project will enter a longer term period of agricultural land management leading to probable relinquishment of the land. The initial active works will involve decommissioning and removing mine infrastructure followed by the rehabilitation of disturbed areas with most of these being returned to agricultural uses and some smaller areas being restored for ecological, landscape or heritage reasons. Approximately 30 people will be employed during the peak of active closure works.

ii Impact Assessment

The social impacts and opportunities associated with the closure and decommissioning phase are outlined in Table 20.14.

Table 20.14 Closure and decommissioning phase impacts

Potential social impact or opportunity	Potential outcome	Duration	Extent	Magnitude	Overall significance	Potential to avoid, mitigate or enhance?
1. Population and demographics						
Potential minor drop in resident population within workforce catchment area.	Direct, negative	Short	Local	Minor	Low	Yes
2. Labour market						
Loss of jobs due to mine closure potentially resulting in higher unemployment rates.	Direct, negative	Long	Regional	Minor	Medium	Yes
Increased financial stress.	Indirect, negative	Medium	Regional	Minor	Medium	No
3. Economic change						
Reduction in economic activity as a result of mine closure.	Direct, negative	Short	Local	Major	Medium	Yes
Opportunities for new businesses, such as environmental rehabilitation.	Direct, positive	Short	Local	Minor	Low	Yes
4. Community services and facilities						
Potential minor reduction in demand for community services and facilities.	Direct, positive and negative	Short	Local	Minor	Low	No
Loss of funding for community services and facilities.	Direct negative	Long	Regional	Moderate	High	Yes
Ongoing legacy of improved services and facilities established during operations.	Indirect positive	Long	Regional	Moderate	High	Yes
5. Housing and accommodation						
Minor increase in housing supply resulting in reduced housing costs.	Direct, Positive and negative	Short	Regional	Moderate	Medium	No
6. Community liveability						
Stress and fear due to uncertainty about mine closure impacts.	Direct, negative	Short	Local	Moderate	Medium	Yes
Improved environmental amenity due to rehabilitation of surface infrastructure areas and return to agricultural land uses.	Direct, positive	Long	Local	Moderate	Medium	Yes

iii Summary of impacts during closure and decommissioning phase

Closure and decommissioning will result in overall net social costs primarily because of job losses and reduced local expenditure. However, the duration and significance of these impacts will depend on economic activity in the local economy at the time of closure, the number of displaced workers who remain in the region and the presence of future not-as-yet constructed mining or similar projects. Therefore, it is difficult to accurately predict the social impacts and opportunities associated with this most distant phase. The significance of impacts will also be influenced by the implementation of proposed mitigation measures throughout the operations phase to assist in preparing the workforce and local economy for mine closure. Therefore, while there is potential for negative social outcomes during closure and decommissioning, careful strategic planning will ease these impacts by laying the foundation for post-mine opportunities.

20.6.5 Overall social impacts

The overall social impacts of the project are illustrated in Figure 20.5. In the figure, each impact identified in Table 20.11 – 20.14 has been given a value based on its significance. A 'high' impact has a score of three, a 'medium' one two, a 'low' rating one and 'neutral' zero. Negative impacts receive the same scores but positioned below the axis. This implies that a 'high' impact is three times as significant as a low one which is obviously a simplification for illustrative purposes only. The actual significance of impacts will be judged by each individual or group who experiences the impact.

Figure 20.5 shows that the project's net social impacts will be positive in each phase except for closure and decommissioning. Most importantly a positive outcome will occur during operations, the longest phase. It follows then that the net social outcome for the project overall will be positive. This does not mean that negative social impacts will not occur, clearly there will be some and they are discussed individually in the preceding sections but negative impacts will be more localised or of shorter duration and lower magnitude.

The key finding of this SIA is that the project's overall social impacts will be positive - there will be more positive impacts than negative ones, and the duration and magnitude of positive impacts will be greater.

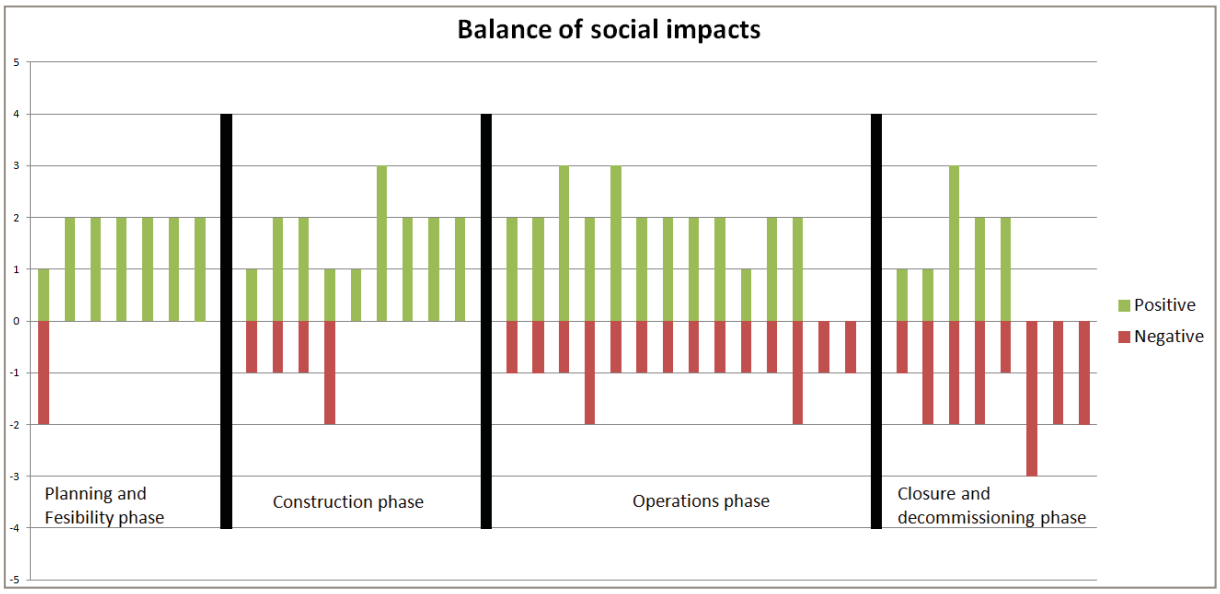


Figure 20.5 Balance of social impacts

20.7 Management and mitigation measures

A number of mitigation and management measures are proposed for the project. These measures will act to maximise community benefits and minimise negative impacts. The development of these measures has been guided by the outcomes of stakeholder engagement activities and the assessments of significance undertaken for each identified impact.

20.7.1 Population and demographics

One recurring issue raised during consultation has been concern about the population increase that would result from the project.

The establishment of a CAV will avoid or mitigate most potentially negative impacts from population increases during construction of the mine. The CAV will be constructed within the mine surface infrastructure area and is to accommodate nearly all of the non-local construction workers except for the small number of workers required to construct the CAV itself and CAV operational and maintenance workers. Any non-local construction workers will be obliged to reside in the CAV while rostered on. The CAV is a temporary facility and will be dismantled once construction works are complete. On-site facilities will be provided to ensure that there is limited interaction between construction workers and the local community. Throughout its operation the CAV will be managed by a specialist third party contractor.

The population increase associated with the mine is expected to result in a number of indirect impacts. These will be mostly positive but actions to address specific concerns with increased demand for services are discussed below.

20.7.2 Labour Market

Another key issue raised during stakeholder consultation has been providing employment opportunities for local residents. Hume Coal will endeavour to source most of its operations workers from the local area, defined as the 45 minute travel zone. This will include providing opportunities for training to local workers with the skills required to fulfil the type of positions needed by the operation.

Hume Coal will maximise local employment and provide training and education opportunities by:

- ensuring that all workers reside within the 45 minute workforce catchment of the mine;
- giving preference to employing locals wherever possible;
- encouraging local contractors to tender for work, during the construction, operations and closure phases;
- continuing to invest in apprenticeships and traineeships through partnerships with local businesses and 1300 apprentice;
- working with local recruitment, education and training providers to ensure the range of skills needed for the project are available; and
- providing in-house training and professional development opportunities for employees.

20.7.3 Economic change

Enhancing local economic opportunities is a key issue for stakeholders.

Hume Coal will maximise local business opportunities by giving preference to local suppliers where reliability, quality and financial competitiveness criteria can be satisfied.

20.7.4 Community services and facilities

The potential increased demand for community services is low and, consequently, it is not expected that the capacity of services or facilities will be stretched.

Hume Coal has played an active role in the local community through financial contributions through its charitable foundation. Hume will continue to actively support and align its future investment towards community needs by:

- continuing to provide contributions to community-based organisations through a VPA or similar mechanism with WSC or NSW State Government; and
- focusing contributions on community services and facilities which have been identified by the community as insufficient or where potential shortfalls have been identified.

The VPA will be designed to maintain current levels of service in all community facilities affected by the project. In addition, the improvements to services and facilities enabled by the charitable foundation will provide a lasting legacy following the closure of the mine.

20.7.5 Housing and accommodation

Hume Coal will develop a village to provide worker accommodation during the construction phase. The CAV will have capacity for 400 workers which is sufficient to house almost all construction workers from the Hume Coal project and the associated Berrima Rail Project. This will ensure inflationary and availability pressures are not generated by housing demand induced by the construction workforce.

Based on the current availability and forecast future supply of new housing in the region, the operations and closure workforce will not significantly impact the local housing market. It is probable that there will be adequate capacity to cater for the relocated workers and their families meaning mitigation measures will almost certainly not be needed.

20.7.6 Community liveability

The project will last for a little over two decades and Hume Coal is committed to making a significant and lasting contribution to the region's prosperity. Hume Coal is therefore actively promoting and supporting local businesses, industries and education facilities.

A charitable foundation was put in place which focuses on initiatives that directly benefit the local community. Since its initiation, the foundation has supported more than 40 local organisations, including KU Donkin Pre-school, Wingecarribee Family Support Service, Youth Radio MVH-FM, Kollege of Knowledge Kommittee for Kids, BDCU Children's Foundation, Challenge Southern Highlands, Moss Vale Dragons Junior Rugby League Club, Moss Vale Cricket Club, Bundanoon Highlanders Rugby League Football Club and Bowral Rugby Club.

The board of the Hume Coal Charitable Foundation contained a number of community representatives and these directors provide local advice to guide the foundation's investment decisions. The foundation makes available about $200,000 per annum to the local community, with priority being given to education, Indigenous programs and not-for-profit pre-schools.

The company's community support program includes the Hume Coal Apprenticeship Program, established in 2015 to support training and development within the local community. The apprenticeship and traineeship programs provided opportunities for local people to up-skill and gain employment by placing funded apprentices and trainees in local businesses. About $250,000 a year was spent on these programs and it is expected that during the construction and operations they will be replaced with a VPA and normal workplace training.

20.7.7 Closure and decommissioning

At the completion of mining activities, the project's infrastructure will be decommissioned and the mine site progressively closed and rehabilitated. While there will be a permanent loss of jobs, the timing of the wind-down and ultimate site decommissioning will be planned well in advance. Hume Coal will work with relevant stakeholders to provide information about the timing of these final stages and provide appropriate support to employees, suppliers and other directly affected members of the community. Specific measures to alleviate negative impacts associated with the mine's closure will be:

- training and staff development conducted throughout the mine life will give workers transferrable skills, opening up opportunities for these workers in other industries;
- communication and proactive engagement with employees and other directly affected stakeholders; and
- consultation with relevant authorities.

The above actions and others will be detailed in a formal mine closure plan which will be prepared towards the end of the project's operational life. The plan will build on the commitments made in this EIS and will detail all decommissioning, rehabilitation, redeployment and consultation activities required to ensure the mine is closed in a responsible manner.

The project will leave an important legacy of community facilities established by the Hume Coal Charitable Foundation. Hume Coal will set in place measures to ensure the long-term independence of community facilities created by the charitable foundation by:

- committing to long-term community partnerships; and
- tailoring its projects to achieve post-development independence.

20.7.8 Social impacts management plan

A social impact management plan (SIMP) will be developed for the project. It will detail all actions to be undertaken during the construction, operation, and closure phases of the project to monitor, report, evaluate, review and proactively respond to social change. The SIMP will summarise the findings of the social impact assessment, outline management and mitigation measures proposed, including estimates of their timing, frequency, duration and cost, and establish ongoing monitoring and reporting procedures. It will also outline the responsibilities of various parties in relation to the management of social impacts.

The SIMP will be prepared following project approval in consultation with relevant government agencies and the local community using the multi-stakeholder approach described below. It will be periodically reviewed and updated as the project progresses through different phases and will also contain provisions for ongoing stakeholder consultation.

20.7.9 Multi-stakeholder approach

For all proposed mitigation and management measures a multi-stakeholder approach will be adopted. This approach is used successfully to manage social impacts from mining operations in a number of other mining areas around the world. The approach includes forming multi-stakeholder groups for ongoing monitoring and management of social impacts associated with a project. The groups typically include diverse representatives from the community, such as youth and aged organisations, local businesses, tourism representatives, welfare agencies, emergency and community services, government agencies and environment and community groups. This ensures a broad range of social issues is considered and helps to align the activities of multiple groups.

20.7.10 Monitoring

Hume Coal will continue to monitor and respond to potential impacts that affect the local community over time. A key component of this will be continuation of the comprehensive stakeholder engagement plan. Monitoring will include:

- periodic review and updating (approximately every five years) of the social baseline study to address spatial and temporal changes during different project phases. This will enable management and mitigation measures to be reviewed and updated to reflect any significant changes in baseline conditions on which this impact assessment has been based;
- regular liaison and consultation with the community, government agencies and service providers;
- further meetings of the Hume Coal Social Reference Group or Community Consultative Committee;
- production of a public annual Environmental Management Report that will inform interested parties about the project's social and environmental performance each year;
- ongoing employment of a person whose role includes community liaison responsibilities;
- regular project updates through factsheets, bulletins and conducting community events; and
- implementation of a grievance and complaint handling system, including complaints communications channels such as a dedicated telephone line.

Hume Coal will maintain open and constructive communication channels with affected landholders and groups. Ongoing consultation and monitoring of impacts will ensure continuous improvements can be made to the project in response to changing circumstances and greater awareness of impacts over time.

20.8 Conclusion

This assessment has followed leading practice to clearly and objectively identify social impacts arising from the Hume Coal project. Impacts have been assessed separately for the four phases of the project and can be summarised as follows.

During the planning phase, the project creates a modest increase in job opportunities and contributes to strengthening the skills base of the local workforce as a result of Hume Coal's apprenticeship and traineeship program. Investment generated from Hume Coal's Charitable Foundation will result in improvements to community facilities and services. At the same time, sections of the community may experience stress and concern about the project. Overall during the initial planning phase, positive impacts will outweigh negative ones.

The project's construction phase will provide numerous job opportunities. There will be potential for some negative impacts, such as pressure on tourist accommodation but it will be largely eliminated by the provision of a well-managed CAV, which will accommodate non-local construction workers. Some negative environmental impacts will occur as a result of construction works but again these impacts will be mitigated by using well-proven environmental management measures. Consequently, during this second phase positive impacts again outweigh negative ones, meaning there will be a net positive social outcome for the community.

Operations will be the project's longest phase meaning impacts that occur then will be of the greatest consequence. The principal impacts will be creation of long-term employment positions, most of which will be filled by locals, and a substantial economic stimulus to the area from greater local expenditure. Other benefits will be skills improvements through training and continued investments in community facilities through a VPA. Conversely, there will be negative impacts. Some change in the character of the project area and environmental impacts from coal extraction and other mine operations will occur. The project has been designed to avoid or minimise its environmental impacts but, where impacts are unavoidable, conditions will be imposed to ensure the impacts are acceptable. In summary, during operations the project area will experience noticeable change but no impacts will be of a level that would be unacceptable, and substantial social benefits will occur. The net outcome will be positive for the local and broader communities.

The final closure and decommissioning phase will have net social costs. It will result in a loss of jobs and a consequent decline in economic activity. Benefits will occur because of rehabilitation of disturbed land and the ongoing legacy of the mine's contribution to the community through the VPA.

A set of mitigation and management measures will be put in place that have been designed to address specific impacts that will coincide with each phase of the project. All of the measures will be developed and detailed in a SIMP. The SIMP will include periodic monitoring of the effectiveness of measures and will be revised as necessary throughout the life of the project. Social impacts will be managed using a multi-stakeholder approach that has proven to be effective in other resource development jurisdictions.

The key conclusion of this social assessment is that the project will be socially beneficial. This will be the case for three of the four phases of the project's lifecycle that is from planning through to the end of operations. Negative effects will outweigh positive effects only during the final closure phase which has a short duration. The greatest benefit will occur during the operations phase and most of these benefits are of long duration and benefit the whole region.

21 Aboriginal heritage

21.1 Introduction

This chapter provides a summary of the Aboriginal cultural heritage assessment (ACHA) prepared for the project, which is provided in full in Appendix S. It discusses the historical context in and surrounding the project area, describes the consultation undertaken with the Aboriginal community, outlines study methods and items identified in the project area, and assesses the potential impacts of the project on Aboriginal cultural heritage values in the project area and, where impacts are unavoidable, the measures proposed to mitigate impacts.

The impact of the project at a landscape level on Aboriginal cultural heritage values will be relatively small in comparison to the extensive traces of archaeological evidence identified throughout the project area and its surrounds. The surface infrastructure facilities have been specifically designed to avoid the areas of highest archaeological sensitivity and will only partially impact the more significant deposits by linear project elements. The archaeological deposits identified are generally disturbed to some degree from historic land use and bioturbation. However, they still have value to the Aboriginal community as tangible links to their culture, and scientifically by providing information about stone artefact types, materials and their broader landscape associations. Notwithstanding, these deposits do not have the artefact frequency or contextual integrity to warrant outright conservation that would constrain the project further than the measures already undertaken to minimise impacts on Aboriginal cultural heritage values.

The project will not directly impact grinding groove sites, rock pools, rock shelters or scar trees. No subsidence impacts are predicted to occur for any known site or unknown sites. The underground mining method has been designed to result in imperceptible to negligible surface subsidence. This will significantly reduce the risk of cracking rock shelters or expanses of sandstone where sites are present. Despite the very low risk of impacting these sites, subsidence monitoring will be used as a precautionary measure. Furthermore, no statutory or non-statutory Aboriginal places of socio-cultural or historic significance have been identified in the project area.

21.1.1 Assessment guidelines and requirements

The SEARs require an assessment of the likely Aboriginal cultural heritage impacts of the project; relevant specific requirements are given in Table 21.1.

Table 21.1 Aboriginal heritage related SEARs

Requirement	Section addressed in this chapter and Appendix S
Heritage — including an assessment of the likely Aboriginal and historic heritage (cultural and archaeological) impacts of the development, having regard to OEH's requirements (see Attachment 2).	Chapter 21 and Appendix S This chapter addresses Aboriginal cultural heritage; Historical heritage is addressed in Chapter 22 and Appendix T.

DP&E also invited other government agencies to recommend matters to address in the EIS, which the Secretary for DP&E took into account when preparing the SEARs. OEH raised matters relevant to the Aboriginal heritage assessment, including standard requirements for projects of this nature, as well as some project-specific requirements. The matters raised are listed in Table 21.2 with reference to where they are addressed in this chapter. These matters are addressed in full in Appendix S.

Table 21.2 OEH's comments: standard and project-specific assessment recommendations

Recommendation	Sections addressed in this chapter and Appendix S
2. The EIS must identify and describe the tangible and intangible Aboriginal cultural heritage values that exist across the whole area that will be affected by the project and document these in the EIS. This may include the need for surface survey and test excavation. The identification of cultural heritage values should be guided by *Guide to investigating, assessing and reporting on Aboriginal Cultural Heritage in NSW* (DECCW 2011a) and consultation with OEH regional officers.	Sections 21.2 to 21.6 of the EIS. Chapters 3–9 of Appendix S. Key correspondence with OEH is provided in Appendix G of Appendix S.
3. Where Aboriginal cultural heritage values are identified, consultation with Aboriginal people must be undertaken and documented in accordance with the *Aboriginal Cultural Heritage consultation requirements for proponents 2010* (DECCW 2010a). The significance of cultural heritage values for Aboriginal people who have a cultural association with the land must be documented in the EIS.	Section 21.2. Chapters 2, 9 and Appendix A of Appendix S.
4. Impacts on Aboriginal cultural heritage values are to be assessed and documented in the EIS. This EIS must demonstrate attempts to avoid impact upon cultural heritage values and identify any conservation outcomes. Where impacts are unavoidable, the EIS must outline measures proposed to mitigate impacts. Any objects recorded as part of the assessment must be documented and notified to OEH.	Sections 21.6, 21.7 and 21.8. Chapters 10 and 11 of Appendix S.
Project specific requirements	
B. The assessment of cultural heritage values must include a surface survey undertaken by a qualified archaeologist in areas with potential for subsurface Aboriginal deposits. The result of the surface survey is to inform the need for targeted test excavation to better assess the integrity, extent, distribution, nature and overall significance of the archaeological record. The results of surface surveys and test excavations are to be documented in the EIS.	Sections 21.4 and 21.5 Chapter 6 (survey) and Chapter 7 (test excavation) of Appendix S.
C. The EIS must outline procedures to be followed if Aboriginal objects are found at any stage of the life of the development to formulate appropriate measures to manage unforseen impacts.	Section 21.8.1 and 21.8.7 Chapter 11 of Appendix S.
D. The EIS must outline procedures to be followed in the event Aboriginal burials or skeletal material is uncovered during construction to formulate appropriate measures to manage the impacts to this material.	Section 21.8.7 Chapter 11 of Appendix S.

21.1.2 Overview of assessment methods

The ACHA was guided by the following documents to fulfil the requirements of the SEARs:

- *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (DECCW 2011a).
- *Code of Practice for Archaeological Investigation of Aboriginal Objects in NSW* (the Code) (DECCW 2010b); and
- Aboriginal consultation undertaken as part of the assessment was conducted in accordance with the Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010 (DECCW 2010a).

EMM also consulted with the OEH Illawarra Region archaeologist during the ACHA process for their advice on the methods used for survey, consultation and test excavation. Relevant consultation documentation with OEH is provided in Appendix G of Appendix S.

The results of the survey and test excavation in the adjacent Berrima Rail Project area are also summarised in this chapter. This is because the ACHAs for the Hume Coal Project and the Berrima Rail Project were undertaken as one unified process and their combined results have been used to characterise the archaeological resource across a broader landscape using information collected in the same manner.

The Berrima Rail Project ACHA specifically addresses the potential impacts and management recommendations for the Aboriginal cultural heritage values identified in the Berrima Rail Project area, which are not addressed in this chapter. Notwithstanding, the cumulative impacts from both projects are addressed in Section 21.7.7.

21.2 Aboriginal consultation

21.2.1 Stage 1 – notification and registration of Aboriginal parties

Aboriginal consultation followed two separate rounds of notification and Aboriginal party registration in 2012 and 2013. In the first round only three Aboriginal groups registered and thus a second round of notification and registration was considered appropriate to encourage all interested parties to register. Ultimately, eight Aboriginal parties registered their interest in the project and are listed below in Table 21.3.

Table 21.3 List of registered Aboriginal parties (RAPs) for the project

Organisation	Date of registration
Gundungurra Aboriginal Heritage Association Inc.(GAHA)	07-Sep-12
Cubbitch Barta Native Title Claimants Aboriginal Corporation (Cubbitch Barta)	18-Sep-12
Illawarra Local Aboriginal Land Council (ILALC)	11-Dec-12
Peter Falk Consultancy	01-Aug-13
Northern Illawarra Aboriginal Collective Inc. (NIAC)	08-Aug-13
Koomurri Ngunawal Aboriginal Corporation (KNAC)	20-Aug-13
Buru Ngunawal Aboriginal Corporation (BNAC)	26-Aug-13
Yamanda Aboriginal Association (Yamanda)	11-Sep-13

Three Aboriginal groups that contacted EMM after the two rounds of registration also expressed their interest in being kept updated about the Hume Coal Project. They are:

- Joanne Goulding (contacted EMM on 16 May 2014);
- Moyengully Natural Resource Management Group (contacted EMM on 23 May 2014); and
- Koori Kulcha Experience (Marie Barbaric – also a member of the Illawarra LALC) (first contacted Hume Coal on 3 November 2014 with a request to visit parts of the project area).

21.2.2 Stages 2 and 3 – presentation of information and gathering cultural information

i Presentation of project and assessment information

RAPs were initially issued a letter on 17 April 2014 presenting an overview of the Hume Coal Project, outlining the proposed assessment methods and requesting cultural information associated with the project area. RAPs were given 28 days to respond to the proposed assessment method, but were told that cultural information could be provided throughout the duration of the assessment.

RAPs were also kept updated about the project and assessment methods through letters issued before each stage of the field survey and prior to the commencement of the test excavation program.

Hume Coal and EMM held a consultation meeting on 26 August 2015 at the Blue Circle Sport and Recreation Centre in New Berrima. EMM issued an open invitation to RAPs and representatives from KNAC, Cubbitch Barta, BNAC and NIAC attended the meeting. At the meeting updates on the project were presented along with a summary of the progress on the ACHA, the next steps in the ACHA process and a reminder for RAPs to provide any relevant cultural information about the area. The proposed test excavation method was also presented to RAPs for their response and feedback. Additionally, a letter detailing the draft test excavation method was issued on 27 August 2015 followed by the meeting minutes on 3 September 2015. As per the relevant guideline, RAPs were given with the required 28 day review period to provide commentary.

A number of minor changes were made to the test excavation method prior to its commencement. These changes were based on the RAPs' review and also in consultation with OEH.

ii Gathering cultural information

EMM consulted with RAPs to determine whether any socio-cultural heritage value related specifically to the project area regardless of archaeological evidence. RAPs were offered the opportunity to provide cultural information about the project area and its surrounds starting from 17 April 2014 until the ACHA was finalised in November 2016.

An additional meeting was held with Yamanda on 18 July 2016, upon their request for the project and ACHA to be explained in more detail. The elders from Yamanda (Auntie Val Mulcahy and Auntie Annie Warren) were subsequently invited to visit the project area however, were unable to attend. EMM offered to reorganise the meeting; however, Yamanda declined because of other commitments. To date, no information has been received that identifies specific socio-cultural or historic heritage values unrelated to the Aboriginal sites and objects found in the project area.

NIAC suggested that an Aboriginal burial site exists near Oldbury Farm approximately 200 m east of the project area boundary. It is approximately 2.5 km east of the nearest area of direct ground disturbance. If identified, the site would have high cultural and historical importance. However, the suggested location is outside the project area and on private property, which could not be accessed to verify the site during the course of the ACHA.

Other RAPs, including Yamanda and those present at the meeting on 25 October 2016 expressed that the Southern Highlands in general may contain mass burial sites, but none were known to be in the project area.

Further commentaries on socio-cultural and historic values and their significance are provided in Section 21.6.2.

21.2.3 Stage 4 – review of draft Aboriginal Cultural Heritage Assessment

A draft version of the ACHA, which included all background, results, draft significance assessment and draft management recommendations, was issued to all RAPs on 30 September 2016. A 28 day review period was initially provided, but this was extended to 32 days to provide RAPs with additional time to consider and comment on the outcomes of a recent consultation meeting on 25 October 2016.

Hume Coal and EMM held a consultation meeting at the Moss Vale Services Club on 25 October 2016 during the draft ACHA review period. The primary aim of the meeting was to enable RAPs to discuss the draft assessment and draft management recommendations. The meeting focused on presenting the cumulative impacts and management recommendations for both the project and the Berrima Rail Project.

Responses were obtained verbally from RAPs which indicated general agreement with the draft assessment and draft recommendations. The RAPs emphasised that the intangible significance of the environment to the Aboriginal people should receive greater acknowledgement. The outcome was that RAPs agreed that an opening statement of cultural significance be provided in the ACHA to convey this message. Subsequently, this is provided at the start of Appendix S.

Written responses were received by NIAC, Cubbitch Barta, BNAC, KNAC and Yamanda. No written or verbal responses were received by RAPs other than those indicated above and provided in consultation documentation. No new Aboriginal cultural heritage values were raised by RAPs other than those identified in the draft ACHA and at the meeting on 25 October 2016.

The key issues relating to the assessment and management of the Aboriginal sites in the project area are outlined below:

- RAPs emphasised that the intangible significance of the environment to the Aboriginal people should receive greater acknowledgement. The outcome was that RAPs agreed that an opening statement of cultural significance was to be included in the ACHA to convey this message.

- RAPs expressed that the Aboriginal objects recovered from the project area should not to be held on-site in Hume Coal offices. Instead, Yamanda requested to be custodians of the recovered objects. This may be confirmed during the development of the ACHMP (refer to Section 21.8.7). This would require a care agreement between Yamanda and OEH to allow the transfer of the objects to Yamanda for safekeeping.

- Cubbitch Barta requested for 2.5 mm or 3 mm sieves to be used during salvage excavation measures. As such, the salvage excavation measures have been given flexibility for the use of sieve sizes smaller than 5 mm.

- Cubbitch Barta requested that the management of all rock shelters should include baseline recording of all shelters and future monitoring after mining. The response was that all rock shelters have been recorded and sketched and a selection of the most significant and largest rock shelters above the underground mine area will be monitored. It would be unfeasible to monitor all rock shelter sites. In any event, it is considered unjustifiable because there are no predicted subsidence impacts on any surface features.

Detailed responses to all RAP submissions are provided in Table 2.3 of Appendix S.

21.3 Existing environment

21.3.1 Landscape overview

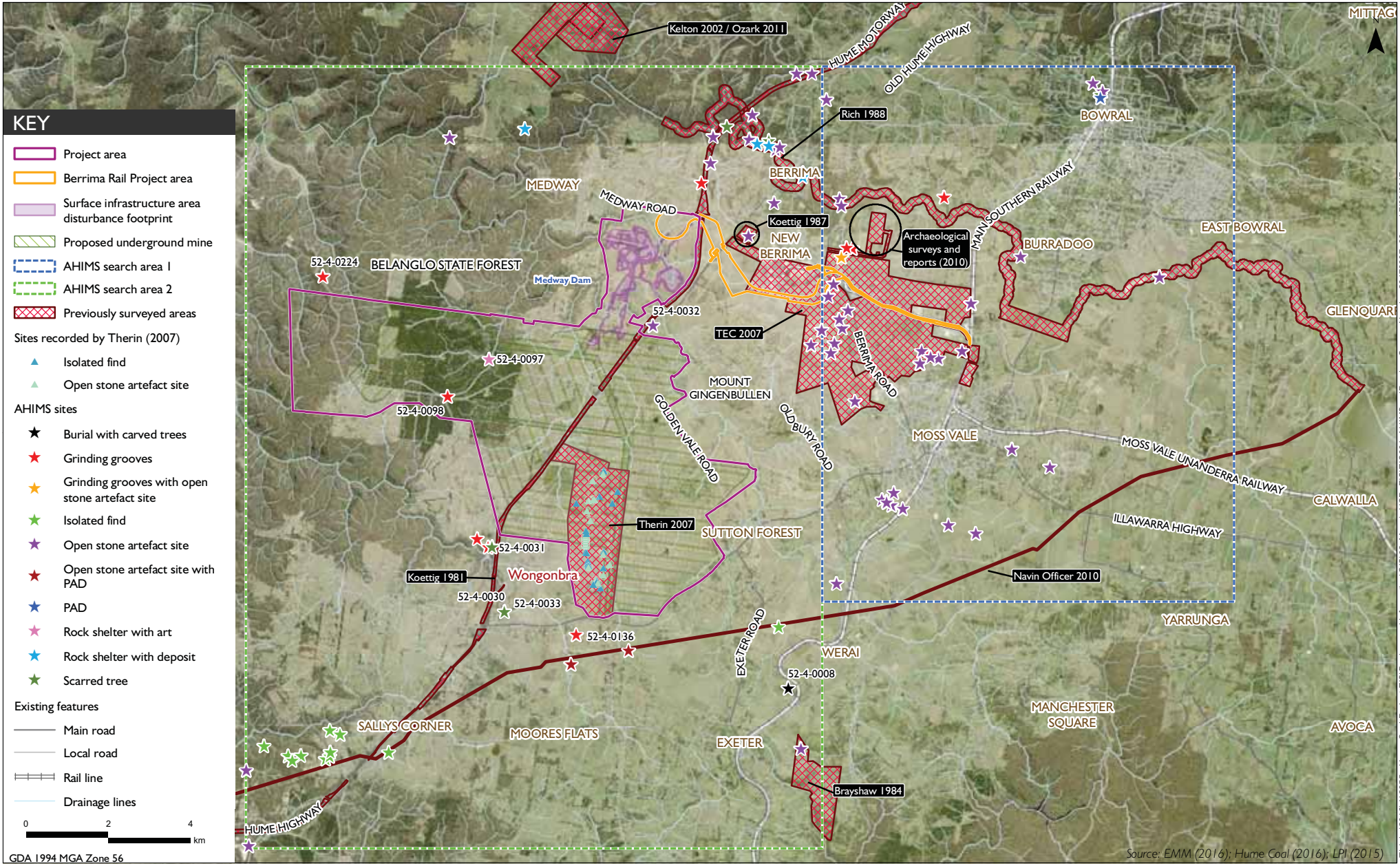
The landscape of the project area can be divided into two broad areas. The first is characterised by sandstone scarps, cliffs and stream channels underlain by Hawkesbury Sandstone. This landscape is on the western side of the project area in the Belanglo State Forest where the western portion of the underground mining area is proposed. This area is likely to contain rock shelters, grinding grooves and similar site types.

The second area to the east of the Belanglo State Forest is markedly different and characterised by low rolling hills, now mostly used as farmland. This landscape characterises the land on which the surface infrastructure area is proposed and also includes the eastern portion of the underground mining area. Notably, most of the agricultural land in the project area has been cleared of its native vegetation and subjected to repeated ploughing events in the past. These activities are likely to have displaced Aboriginal stone artefacts more than natural disturbances such as bioturbation, but without totally diminishing their cultural and archaeological value. The stratigraphic integrity of artefacts within the topsoil is unlikely to have been preserved, and the artefacts are likely to have moved both horizontally and vertically in the soil matrix, but generally within the landforms in which they were originally deposited.

21.3.2 Archaeological background

Searches of the Aboriginal Heritage Information Management System (AHIMS) register identified 89 sites in a 34 km^2 search area based on the centre of the project area. Only two sites were registered in the project area: a rock shelter with art (AHIMS #52-4-0097) and a grinding groove site (AHIMS #52-4-0098). Another 37 sites had been recorded in 2007 but were not submitted to AHIMS (Therin 2007) until January 2016 by EMM. The sites in the AHIMS search area and previously published survey locations are shown in Figure 21.1.

A review of previous investigations indicated that a number of Aboriginal site types were likely to exist in the project area. Notably, open stone artefact scatters and isolated finds have been recorded close to streams, rock shelters in areas along rocky scarps and cliff lines, and grinding grooves in or adjacent to stream beds on outcropping sandstone.



AHIMS results and locations of previous surveys

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Figure 21.1

21.4 Fieldwork methods

21.4.1 Predictive model of Aboriginal site location

A predictive model of Aboriginal site location was developed based on consideration of the environmental, archaeological and ethno-historic context, and relevant advice obtained from Aboriginal consultation. The predictive model was used to target specific areas during archaeological surveys and the subsequent test excavation, given that the project occupies a considerable area. A summary of the predictive model is as follows:

- **Open stone artefact sites (scatters of artefacts) and isolated finds** are the site types most likely to occur in the project area; these may be on all landforms as background scatter but are most likely concentrated on elevated landforms or raised portions in lower-lying landforms adjacent to ephemeral and perennial streams (typically within 200 m). These features are found throughout the project area but mainly to the east of the Belanglo State Forest in what is now open farmland.

- **Rock shelters (which may contain archaeological deposits, art or engravings)** are likely to be present in areas along rocky scarps and cliff lines. In the project area, these are only likely to occur adjacent to streams on the Nattai Tablelands and Hawkesbury soil landscapes which overlay sandstone geology. Areas with this potential are confined to the underground mining area in the western part of the project area.

- **Grinding groove and engraving sites** are most likely to be present on outcropping sandstone in stream beds or adjacent to streams. The project area has outcropping sandstone on the Nattai Tablelands soil landscape and the Hawkesbury soil landscapes and therefore it is possible that grinding grooves exist throughout the project area but are confined to nearby streams. Grinding grooves may also exist in areas mapped as shale geology where discrete sandstone outcropping occurs. This situation occurs rarely, but where it does exist it takes the form of isolated boulders rather than large expanses of sandstone.

- **Modified trees (scarred or carved)** may occur in areas where mature trees of a sufficient age to bear the marks of traditional Aboriginal scarring or carving. They are likely to be confined to areas that have not been cleared. They are most commonly located near streams where native vegetation remains, and may also occur on now-dead trees. These are unlikely to exist in the surface infrastructure area footprint because of extensive historic clearing but could occur elsewhere throughout the project area where native vegetation remains.

- **Other less common site types** such as ceremonial grounds, mythological sites, and burials can occur anywhere in the landscape and their identification is rare. Burial sites have been historically and orally noted by RAPs in association with hills or at the base of a hill in one instance (Mount Gingenbullen). Generally, they could be identified by mounds of earth, carved trees or stone markers arranged in a conspicuous layout.

21.4.2 Archaeological survey

EMM archaeologists, accompanied by Aboriginal site officers and Hume Coal representatives, surveyed the project area and its surrounds on foot in four stages between May 2014 and September 2015. The survey was undertaken over 16 days. Stages 1 and 2 covered the underground mine area and Stages 3 and 4 covered the surface infrastructure area and the Berrima Rail Project area. Additionally, EMM archaeologists inspected some small areas that had been added to the project area on 19 and 20 April 2016.

The survey was designed to address the type of impacts that could be caused by development of surface infrastructure or underground mining. The survey in the surface infrastructure area focused on the proposed ground disturbance footprint, while survey over the underground mine area focused on landforms predicted to have outcropping sandstone where sites such as rock shelters and grinding grooves could occur. The survey also covered areas outside the project area in the Berrima Rail Project area.

21.4.3 Test excavation

An archaeological test excavation program was conducted over three weeks from October to November 2015. The aims of the test excavation program were to:

- characterise the subsurface archaeological deposit in a selection of known open stone artefact sites (surface sites);
- verify the presence of subsurface Aboriginal objects in landforms that indicated PAD, but where surface sites were not visible;
- test the predictive model, primarily relating to sites and their relationship to streams; and
- determine the level of disturbance resulting from historic farming activities and bioturbation.

The program involved hand digging of 160 50 cm x 50 cm test pits across 16 linear transects in the project area (n=10) and in the Berrima Rail Project area (n=6). The locations of the transects are shown on Figure 21.2.

The locations of the test excavations and transects were chosen to gather baseline data for the landscapes present across the surface infrastructure area, particularly in the surface disturbance footprint (Figure 21.2 and). Given that the project area spans a large geographic extent, the test excavation strategy aimed to retrieve smaller data samples across many locations rather than concentrating efforts in only a few locations. This approach was designed to achieve as representative a sample as was practicably possible.

21.5 Results

21.5.1 Survey coverage results

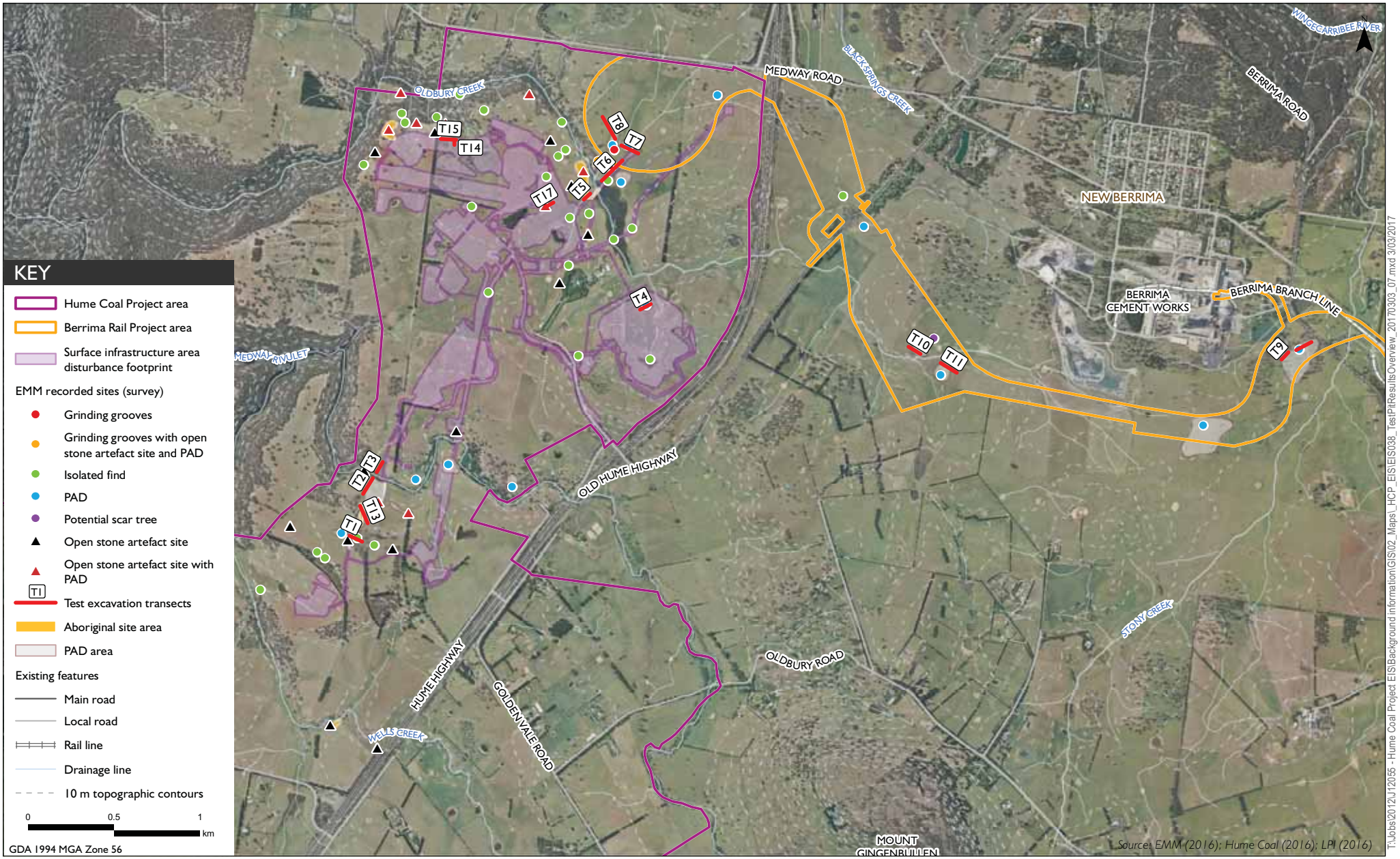
The survey comprised 142 pedestrian transects, adding up to a distance of approximately 124 km. A total of 118 transects were conducted in the project area. The remaining transects were either in the Berrima Rail Project area or slightly outside the project area. The survey team covered approximately 63 km of transects in the underground mine survey area and 54 km in the surface infrastructure area survey area. Figure 21.3 provides an overview of the survey effort and sites recorded during survey.

The effective coverage results (referring to ground surface visibility) indicate that the survey in the surface infrastructure area was generally effective for identifying open stone artefact sites, particularly on hill crests and stream banks. However, there were considerable areas of archaeologically sensitive landforms that remained heavily grassed and had very limited visibility. Notably, these included rises on undulating plains, foot slopes and some hill crests near perennial streams including Wells Creek, Medway Rivulet, Oldbury Creek and Stony Creek.

The coverage results were comprehensive for grinding grooves, rock pools and engravings in the surface disturbance footprint because sandstone outcrops were isolated and clearly exposed in cleared paddocks. The results were also comprehensive for mature trees as any suitable trees in the surface disturbance footprint were confined to isolated pockets and riparian corridors.

The statistics for effective coverage of the underground mine survey area is less relevant because the survey targeted obtrusive site types, such as rock shelters, whose identification is not dependent on ground surface visibility. Notwithstanding, the survey above the underground mine area indicated that:

- Survey coverage was comprehensive for rock shelters, and it is likely that all rock shelters present in the underground mine area were inspected.



Test excavation locations

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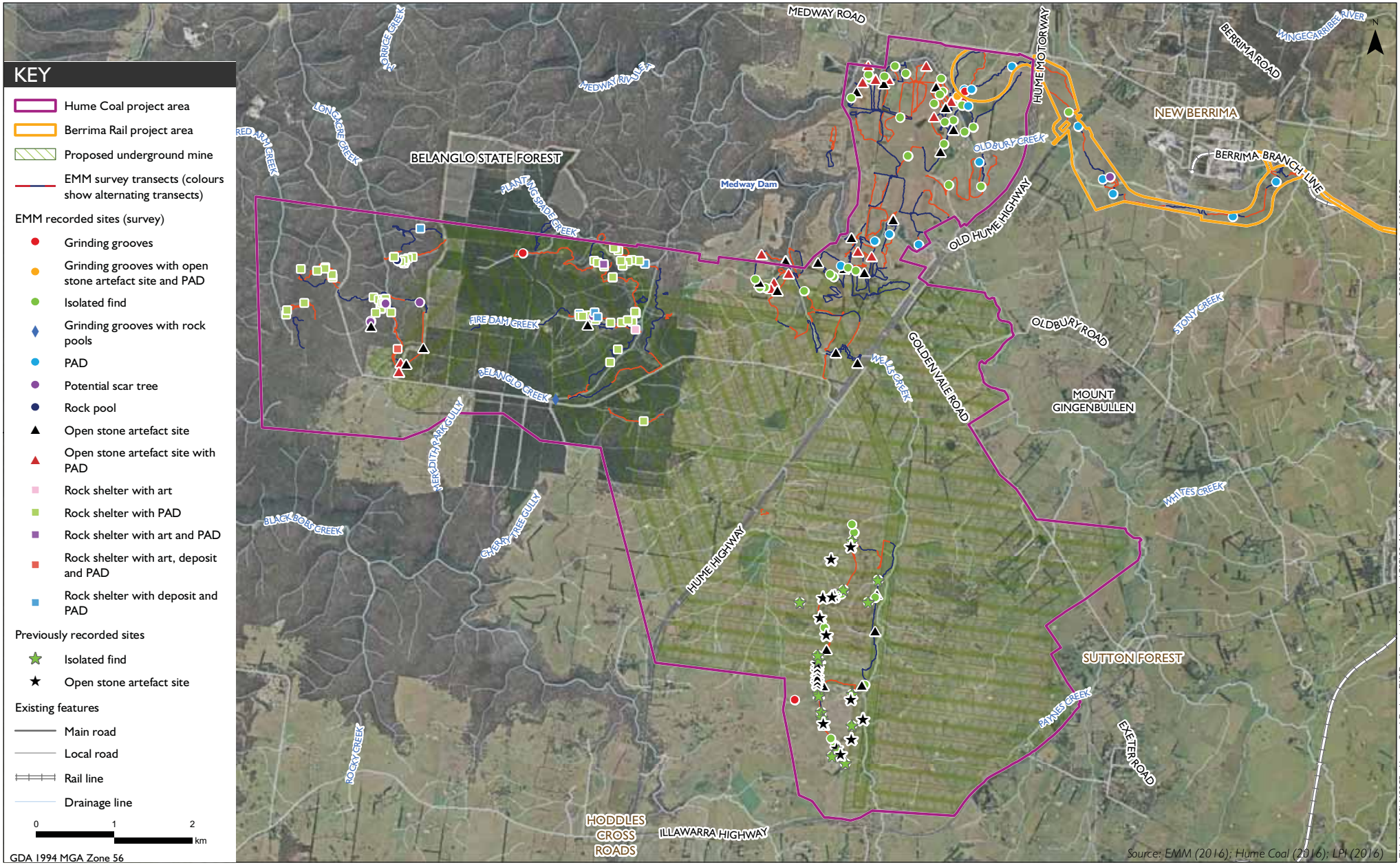
Figure 21.2



Aboriginal heritage survey coverage and results overview

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Figure 21.3

- There are likely to be a considerable number of unidentified rock shelters in the unsurveyed far western part of the project area (outside the areas proposed for development or mining).

- The coverage was less comprehensive for grinding grooves because, although all areas of visible sandstone were inspected, natural changes in vegetation cover over time may have obscured this site type.

Not all mature native trees in the underground mine area were inspected, particularly because the proposed mining method is not predicted to impact trees.

21.5.2 Survey site results

The survey team recorded 181 sites made up of:

- 166 newly recorded sites in the project area;

- 11 newly recorded sites in the Berrima Rail Project area;

- two newly recorded sites outside both project areas; and

- two sites previously recorded on the AHIMS register (grinding groove site 'International House' AHIMS# 52-4-0098 and rock shelter with art 'Compartment 157' AHIMS#52-4-0097) that were re-recorded by EMM.

A variety of Aboriginal sites were recorded including rock shelters (some with art, artefacts and potential archaeological deposit (PAD)), grinding grooves, rock pools, open stone artefact sites, areas of PAD and potential scar trees. The site types and their frequencies are listed in Table 21.4, and shown on Figure 21.4 to Figure 21.8. Aboriginal site results for surveys in the Berrima Rail Project area are shown on Figure 21.9 to display overall survey coverage.

Table 21.4 Aboriginal sites and their frequency

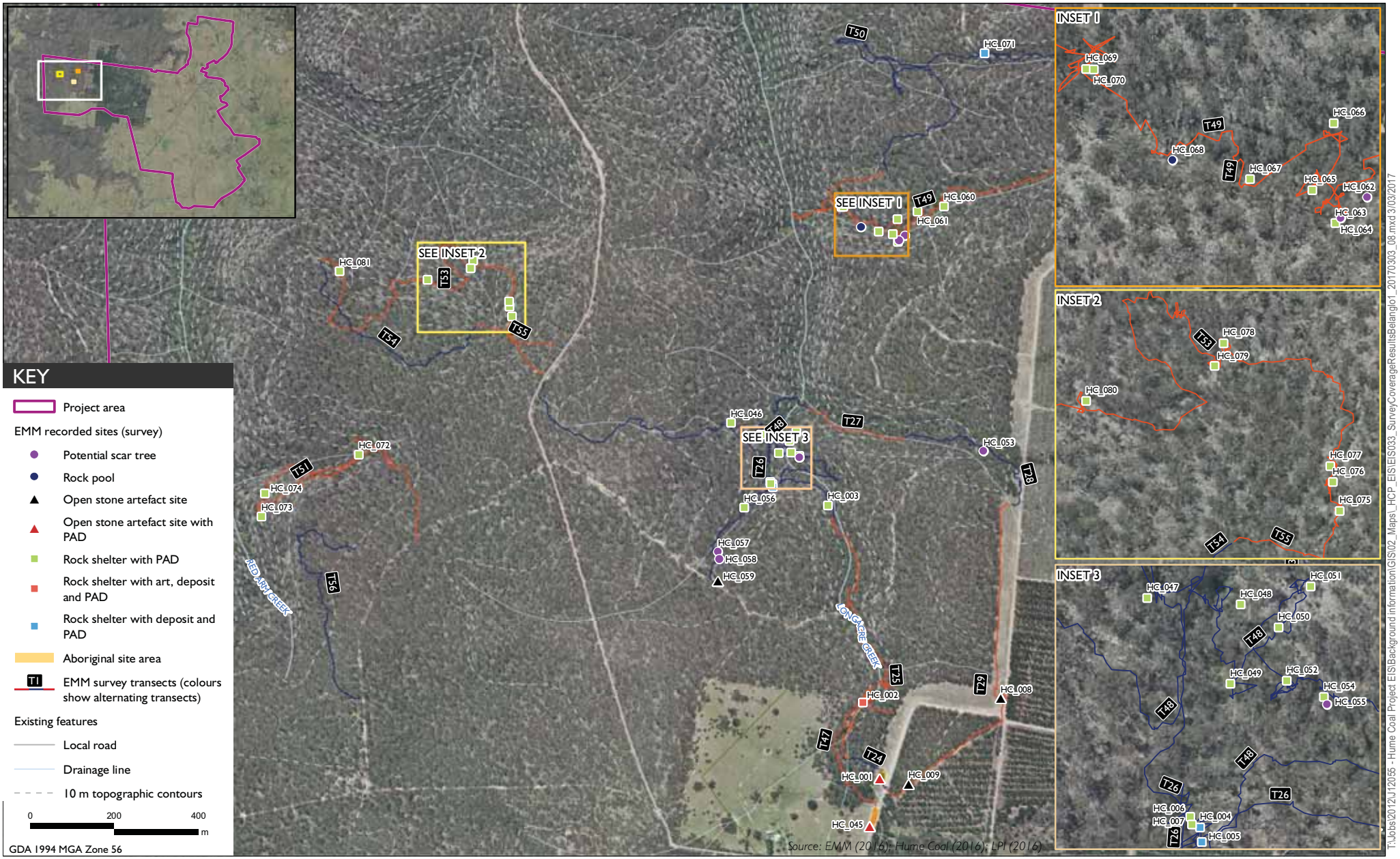
Aboriginal site type frequency	Site type	Percentage of sites (rounded to one decimal point)
Grinding grooves	3	1.7%
Grinding grooves with open stone artefact site and PAD	1	0.6%
Grinding grooves with rock pools	1	0.6%
Isolated find	39	21.5%
Open stone artefact site	30	16.6%
Open stone artefact site with PAD	16	8.8%
PAD	14	7.7%
Potential scar tree	8	4.4%
Rock pool	1	0.6%
Rock shelter with art	1	0.6%
Rock shelter with art and PAD	1	0.6%
Rock shelter with art, deposit and PAD	1	0.6%
Rock shelter with deposit and PAD	10	5.5%
Rock shelter with PAD	55	30.4%
Total	**181**	**100.0%**

The most widely distributed Aboriginal objects are stone artefacts. These are present in the following site types: open stone artefact sites (25.4 %, including those with PAD), isolated finds (21.5%), rock shelters with deposit and PAD (6%) and one grinding groove with open stone artefact site. Overall, surface stone artefacts are present in 96 of the 181 sites identified during the survey (53%).

Thirty-one sites were considered to have areas of PAD (not including rock shelters with PAD), 14 of which had no visible surface artefacts. Note: areas of PAD are not technically Aboriginal sites until the presence of Aboriginal objects is confirmed; this is typically achieved through test excavation.

A considerable number of rock shelters were recorded. Most of them did not have any visible deposit or art (n=55), but there was evidence of soils that may retain artefactual material (referred to as PAD). Ten rock shelters had stone artefacts at their floors (rock shelter with deposit and PAD), one rock shelter had deposit, art and PAD (HC_002), one has art and PAD (HC_037) one rock shelter had art only (Compartment 157).

Less common site types include grinding grooves and potential scar trees. Five grinding groove sites were recorded, two of which were near the surface infrastructure area (HC_136 and HC_138) and three in the underground mine survey area (International House, HC_175 and HC_034). Eight potential scar trees were identified, seven of which are in the Belanglo State Forest within the underground mine survey area, and one outside the project area.



Aboriginal site results - Belanglo State Forest (west)

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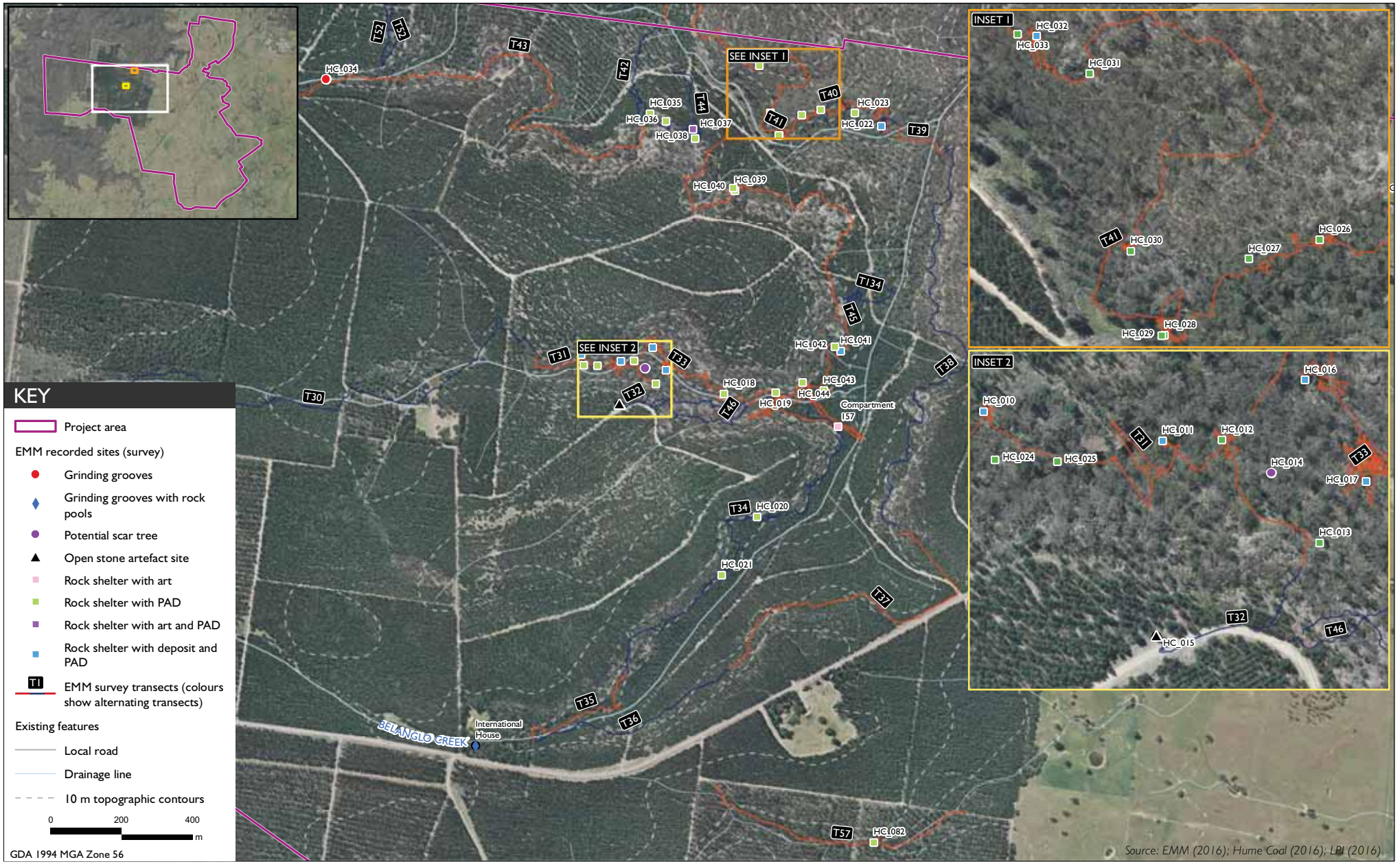
Figure 21.4



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Aboriginal site results - Belanglo State Forest (east)

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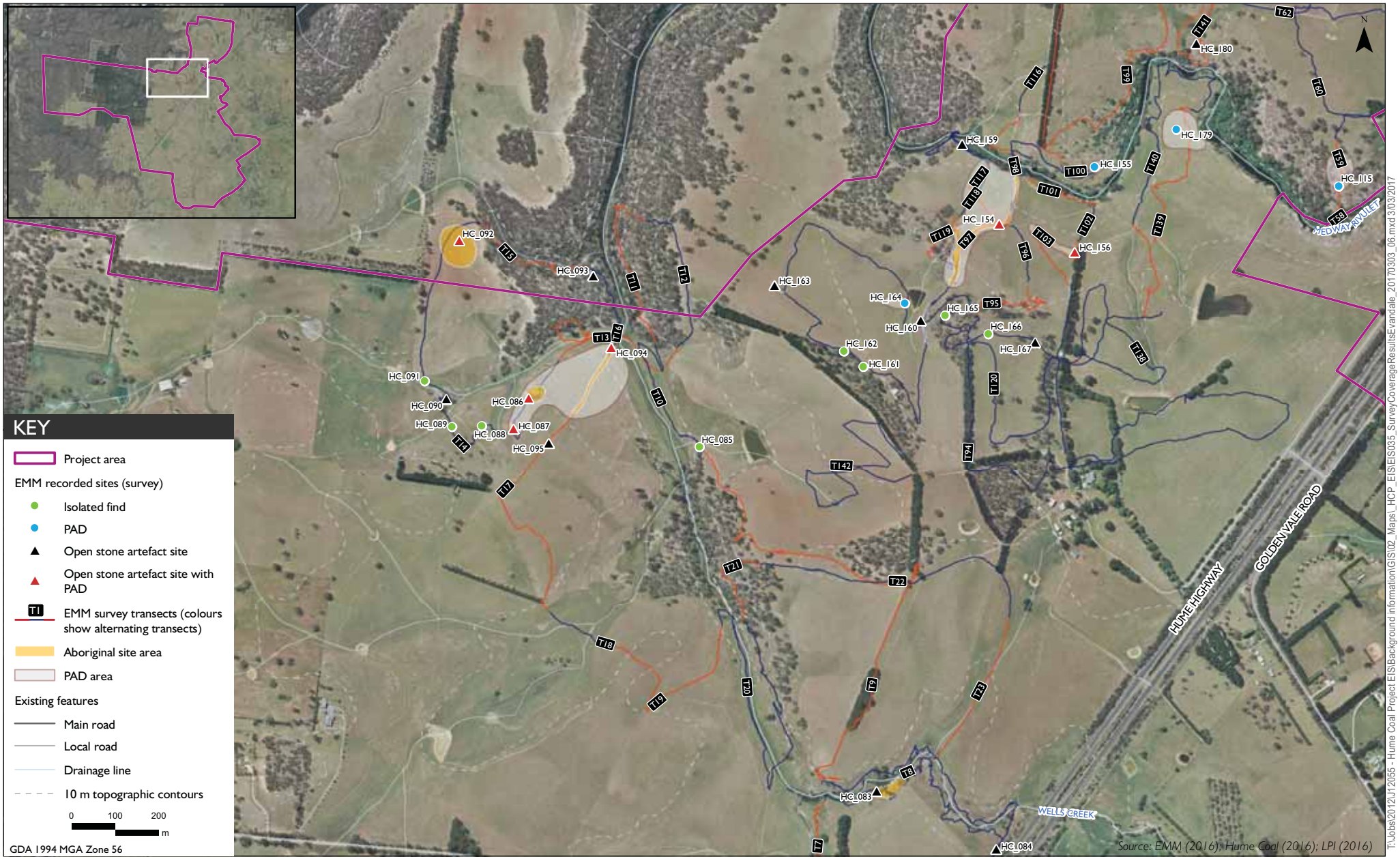
Figure 21.5



Aboriginal site results - Evandale

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Figure 21.6

Aboriginal site results - Mereworth

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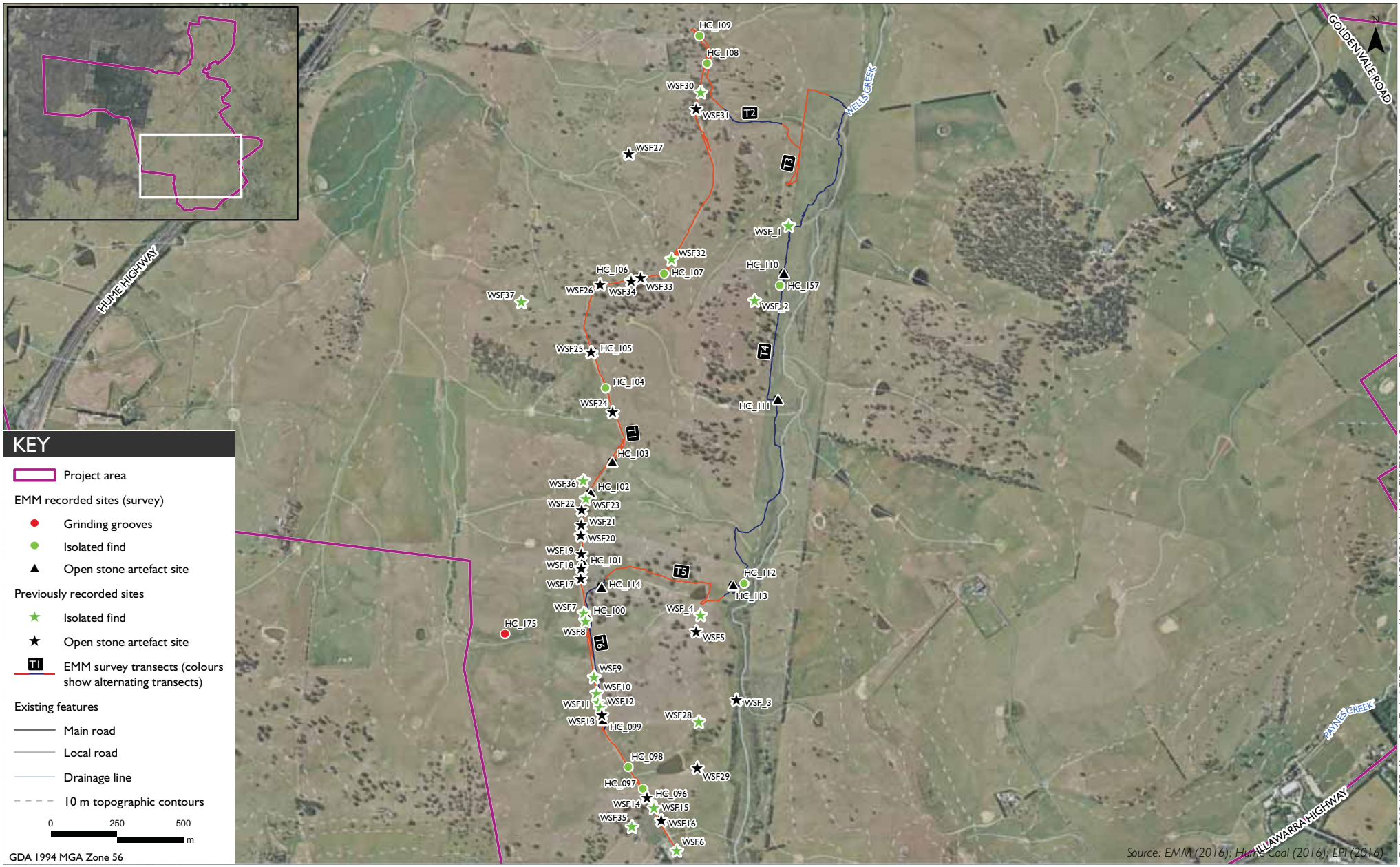
Figure 21.7



Aboriginal site results - Wongonbra

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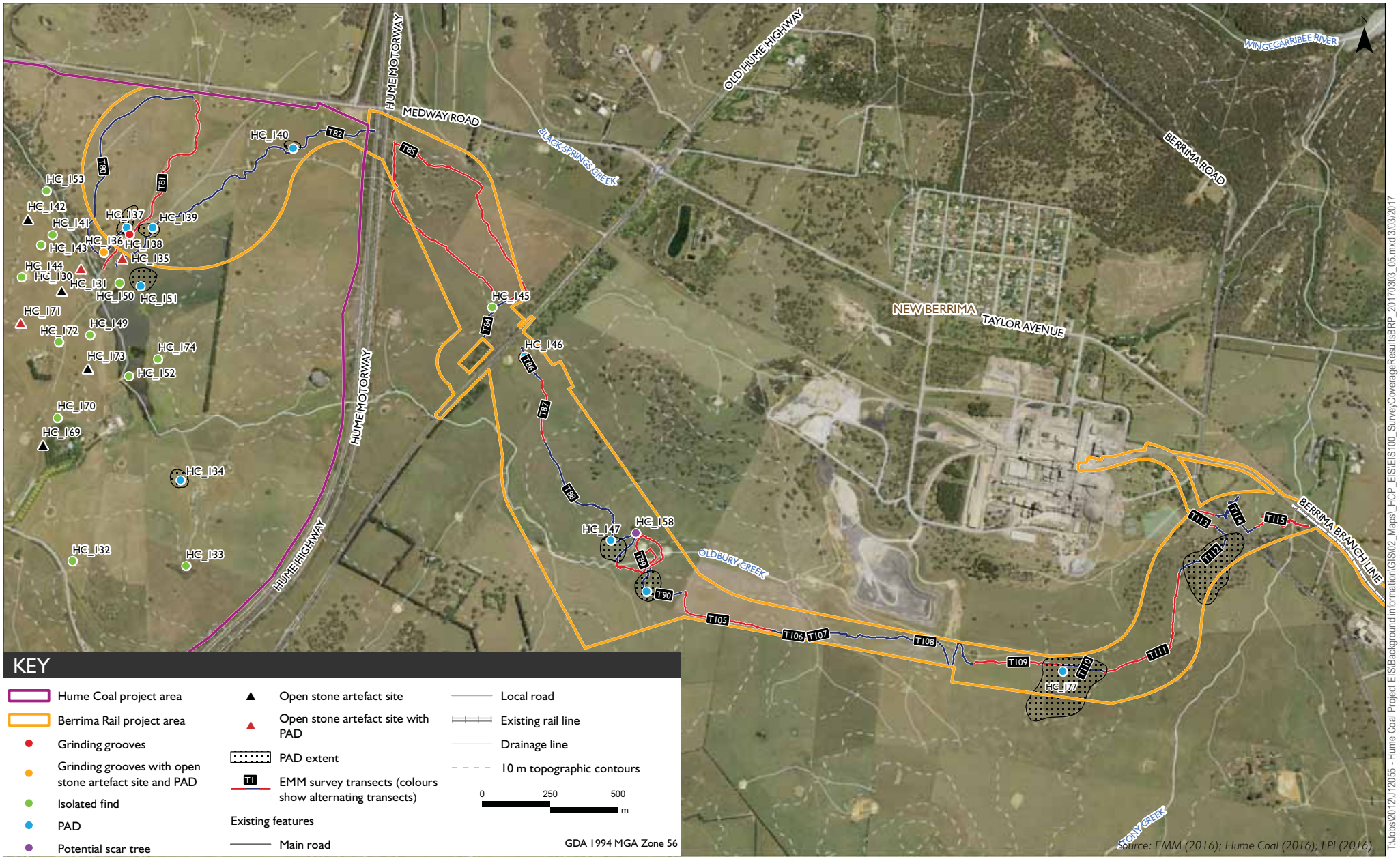
Figure 21.8



Aboriginal site results - outside project area in Berrima Rail Project area

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Figure 21.9

21.5.3 Test excavation results

A total of 281 artefacts were recovered from the test pits with an overall average artefact density of 7 artefacts/m^2. The distribution of artefacts was very uneven with almost half (45%) being found in one transect (Transect 6) next to Oldbury Creek. Soils vary throughout the landscape and the upper soil profile is generally mixed from historic ploughing and bioturbation. The upper soil profile is the artefact bearing layer and no stratigraphically intact deposits were identified. Artefacts were mostly confined to the upper 20 cm of soil (78%, n=219), 20% (n=55) were between 20–40 cm depth and 2% (n=7) were between 40–60 cm depth.

A total of 11 artefacts had evidence of retouch which placed them in the category of 'tools'. Most tools were identified as scrapers (40%) and backed artefacts (30%). The dominant materials in the assemblage were silcrete (44%) and quartz (37%), but quartzite (6%), indurated mudstone/tuff (IMT) (9%), volcanic material (1%) and petrified wood (1%) were also recovered.

The following changes were made to site type definitions based on the results of the test excavation:

- The PADs HC_134, HC_137, HC_139, HC_147, HC_148 and HC_176 were confirmed to have subsurface artefacts. These sites are hereafter re-classified as 'subsurface artefact deposit'.
- The open stone artefact sites HC_130, HC_135, HC_154, HC_160 and HC_171 were confirmed to have associated subsurface material. These sites are hereafter re-classified as 'open stone artefact sites with subsurface deposit'.
- One additional area, HC_178, not previously assigned PAD during survey was excavated and confirmed to have subsurface artefacts. Following the terminology for tested PADs, this site is hereafter re-classified as 'subsurface artefact deposit'.

The excavation results were grouped into two categories to identify if artefact concentrations were higher next to perennial streams rather than ephemeral streams. This approach was used in an attempt to gauge the distribution of subsurface artefacts throughout the landscape. The results suggest that:

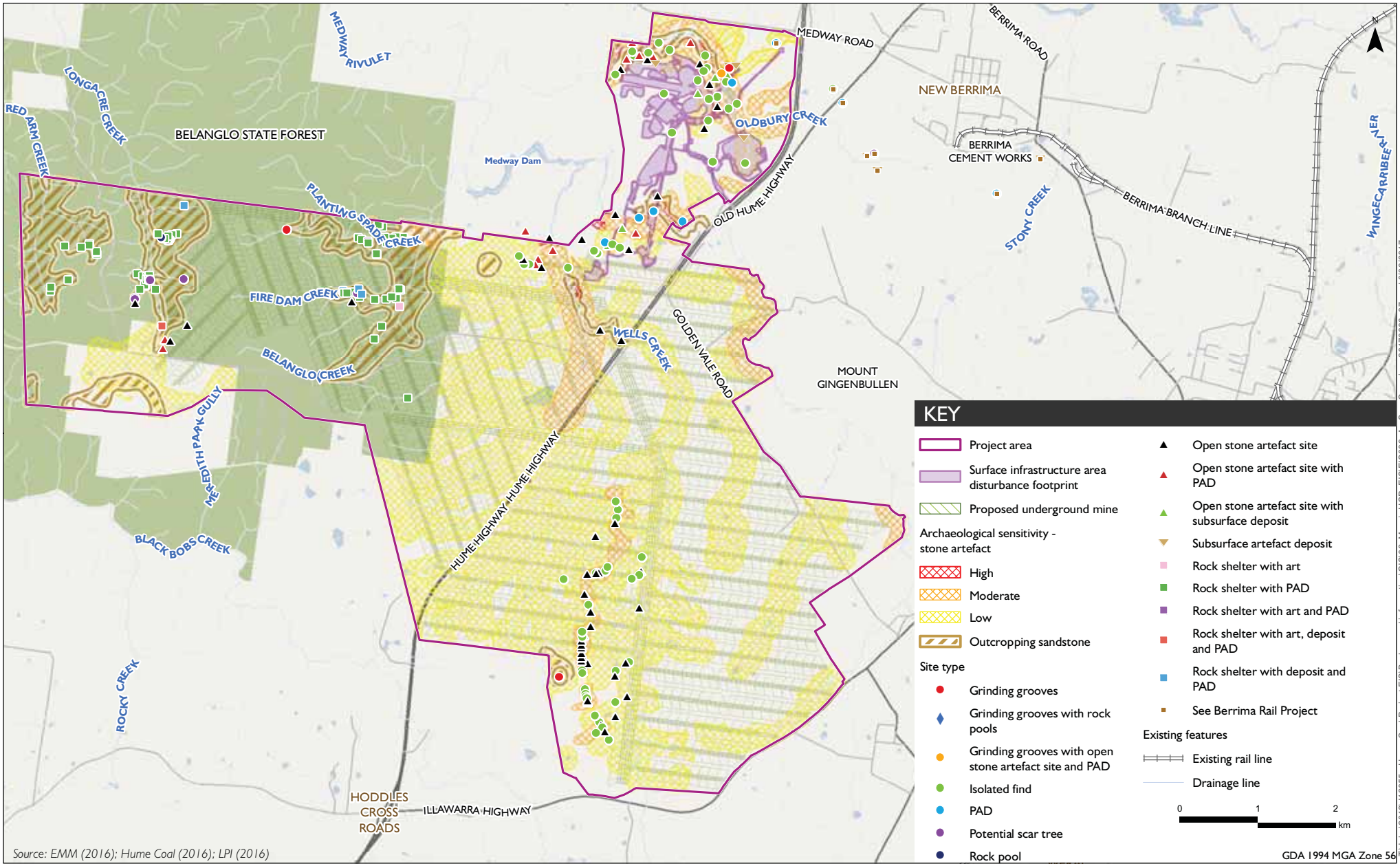
- suitably elevated, level to gently inclined land within 150 m of ephemeral streams is likely to contain a very low density subsurface deposit containing an average density of up to 2.7 artefacts/m^2; and
- suitably elevated, level to gently inclined land within 200 m of perennial streams and prominent hill crests are likely to contain moderate density subsurface deposits containing an average density of up to 14 artefacts/m^2.

21.5.4 Archaeological sensitivity model

The results of the survey and test excavation helped to develop a model for 'archaeological sensitivity'. The model is a visual guide for defining the predicted distribution of sites and artefact densities across the landscape. It also serves as a refinement of the predictive model for site location.

The areas of archaeological sensitivity, shown generally in Figure 21.10 and in detail for the surface infrastructure area in Figure 21.11, represent the inferred distributions and densities of archaeological material in the project area. Where the sensitivity modelling overlaps with areas already test-excavated and surveyed, its main use is for inferring subsurface artefact distributions, with the acknowledgement that surface sites such as open stone artefact sites and rock shelters are already accounted for during survey.

The sensitivity mapping has been divided into areas of low, moderate and high sensitivity for stone artefacts. These categories are based on predicted artefact densities and current disturbance levels across the landscape (refer to Section 8.4 of Appendix S). Furthermore, the predicted areas of outcropping sandstone are also mapped. This mapping aims to identify areas of outcropping sandstone that have potential for rock shelters or grinding groove sites. The areas that have not been mapped for sensitivity (blank areas) are likely to have very sparse archaeological traces that cannot be mapped in a predictable fashion.



Overview of areas of archaeological sensitivity

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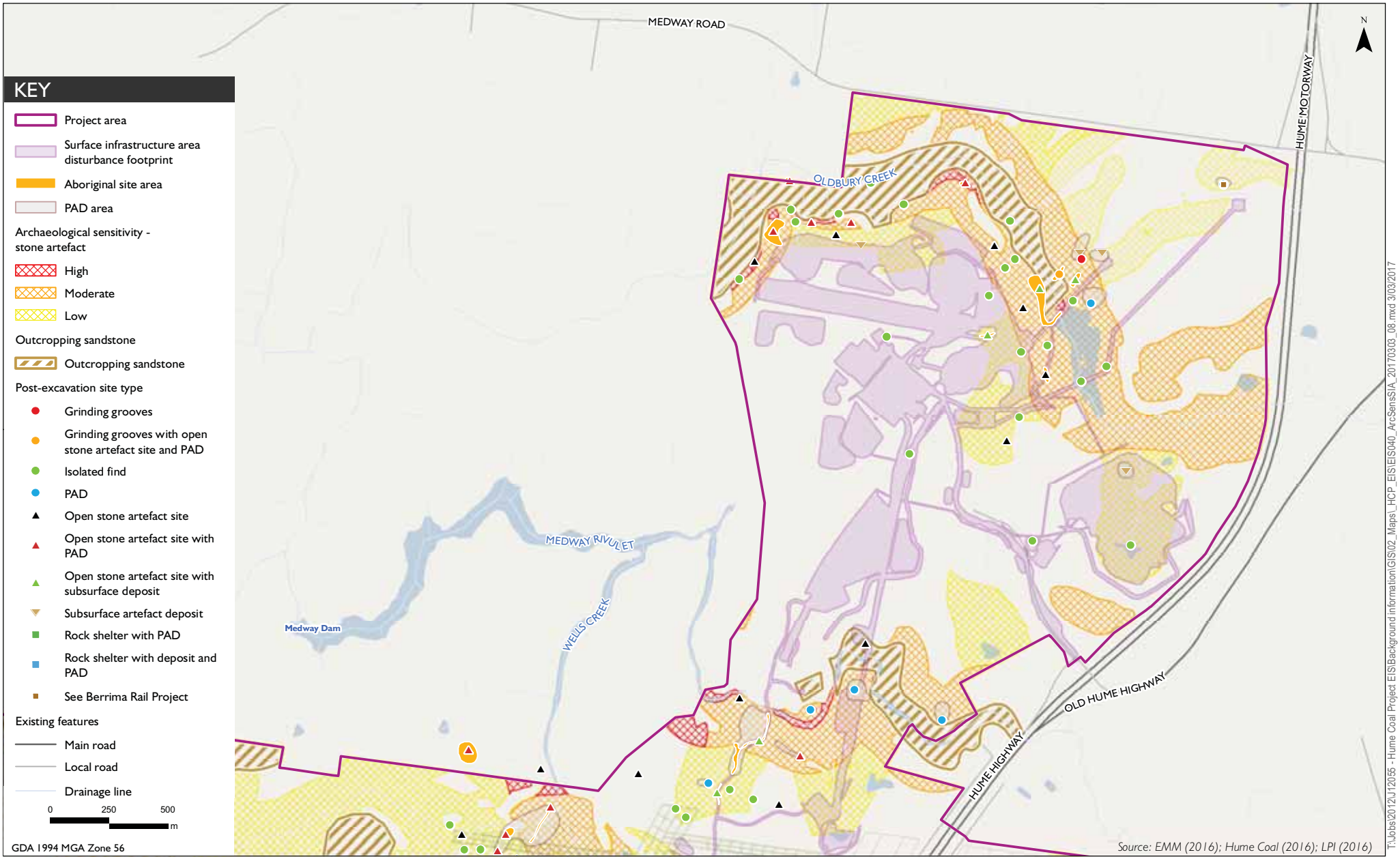
Figure 21.10



Areas of archaeological sensitivity - surface infrastructure area

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Figure 21.11

21.6 Significance assessment

21.6.1 Overview

Heritage sites, objects and places hold value for communities in many different ways. The nature of those heritage values is an important consideration when deciding on how to manage such sites, objects or places, and balance competing land-use options.

The main heritage values are summed up in an assessment of 'cultural significance'. This assessment considers two main aspects of significance being firstly socio-cultural and historic value (the significance for the Aboriginal community), and secondly scientific value.

21.6.2 Socio-cultural and historic value: significance for the Aboriginal community

Research and consultation with the Aboriginal community was conducted to determine whether any socio-cultural heritage value relates specifically to the project area regardless of archaeological evidence.

Aboriginal heritage sites with archaeological evidence are all of value to the Aboriginal community through the tangible connection that they represent with pre-colonial Aboriginal land use. It is acknowledged that the Aboriginal community consider Aboriginal objects as culturally significant items.

To date, no information has been received that identifies specific heritage values unrelated to the Aboriginal sites and objects in the project area. No historical connection has been identified specifically about the project area. Notwithstanding, cultural information that has been gathered from RAPs is considered in the overall significance assessment.

No sites were identified as having specific socio-cultural or historic value and therefore each site in this report has not been attributed with a socio-cultural or historic significance rating as has been completed for scientific and educational values.

21.6.3 Scientific values

Scientific values were determined according to a site's research potential, rarity and representativeness, integrity, research themes and educational value. Each identified Aboriginal site was rated as having 'low', 'moderate' or 'high' value based on its individual characteristics. The significance assessment covered 219 sites, comprising:

- the 166 newly recorded sites in the project area;
- 11 newly recorded sites in the Berrima Rail Project area;
- two newly recorded sites outside both project areas;
- two sites previously recorded on the AHIMS register (grinding groove site International House AHIMS# 52-4-0098 and rock shelter with art 'Compartment 157' AHIMS#52-4-0097) that were re-recorded by EMM;
- 37 sites recorded previously by Therin (2007); and
- one site identified through test excavation (HC_178).

The scientific significance of the sites is summarised as follows:

- 10 sites were assessed to be of high significance, all of which are in the Belanglo State Forest part of the project area and are rock shelter or grinding groove sites;
- 39 sites were assessed to be of moderate significance, four of which were attributed with higher moderate significance because of their comparatively greater subsurface artefact densities. All but two of the sites (HC_176 and HC_177) of moderate significance are in the project area; and
- 170 sites were assessed to be of low significance, 162 of which are in the project area.

21.7 Impact assessment

21.7.1 Measures to minimise harm and alternatives

How the project has evolved and the design alternatives considered are described in detail in Chapter 6 of the EIS. The most notable consideration from an Aboriginal cultural heritage perspective is the location and design of the surface infrastructure, and selection of a first workings mining method. The first seeks to avoid and minimise disturbance of sites, and the second also is predicted to cause no subsidence impacts.

During the project's planning phase, desktop constraints analysis and archaeological surveys were undertaken to identify the most archaeologically sensitive areas so that the surface infrastructure area could be designed to avoid substantial impacts to Aboriginal sites.

One example of a resulting design modification is the original design of the surface infrastructure area which extended much closer to Oldbury Creek. After areas of archaeological constraints were identified, it was set-back beyond 200 m of Oldbury Creek and Medway Rivulet where possible. Consequently, the surface infrastructure area has avoided most Aboriginal sites and areas of moderate archaeological sensitivity. Some unavoidable impacts will occur from the development of linear infrastructure, such as conveyors, which traverse Medway Rivulet and Oldbury Creek. However, any alternative options would have similar constraints as archaeological potential is at its highest within 200 m of these streams generally at any given point.

The proposed underground mining area and method is predicted to avoid impacts to rock shelters and grinding groove sites. The initially planned mining options would have enabled greater extraction of coal but the final mine plan significantly reduced both the area to be mined and the degree of subsidence.

21.7.2 Sources of impact

The impacts of the project on Aboriginal cultural heritage values can potentially occur in two distinct ways:

- Direct impacts from disturbance due to construction of surface infrastructure facilities as well as construction of the outlet or entry points to vents and drifts. The project elements that will directly impact sites are conveyors, stormwater earthworks, pipelines, internal roads and soil stockpiles.
- Indirect impacts from underground mining and associated subsidence.

Impacts will occur on a scale varying from disturbance, where artefacts are moved locally from their original setting, to a loss where artefacts are removed or destroyed. An example of this disturbance is pipeline construction where topsoil including artefacts is moved to one side during trench excavation but replaced following construction. Artefacts are retained generally in the same locality, but with a loss of context and spatial patterning. Total loss occurs when the entirety of a site will be lost as a result of development works.

21.7.3 Overview of impacts

The section addresses the 206 sites in the project area and the two sites that are outside both the project area and the Berrima Rail Project area (totalling 208 sites). The impacts to the 11 sites within the Berrima Rail Project area addressed in the Berrima Rail Project EIS (refer to Appendix D).

Impacts to Aboriginal sites (not including sites in the Berrima Rail Project area) are summarised according to their level of significance in Table 21.5.

Table 21.5 Site significance and levels of impact

Significance rating	Impact type					
	Surface infrastructure area				Underground mining	
	No impact	Total disturbance	Partial loss	Total loss	No predicted subsidence impact	Total
High	4				6	10
Moderate	15		6		15	36
Low	80	3	4	7	68	162
Total	**99**	**3**	**10**	**7**	**89**	**208**

21.7.4 Direct impacts from surface infrastructure development

Out of the 206 Aboriginal sites in the project area, 20 sites will be impacted to some degree by the surface infrastructure area. Of these, three sites will be totally disturbed, 10 partially lost and seven totally lost. Table 21.6 summarises the direct project impacts on Aboriginal sites.

Table 21.6 Direct impacts of surface infrastructure development

Site name	Site type	Significance rating	Impact type	Level of impact
HC_124	Open stone artefact site with PAD	Moderate	Stormwater management earthworks	Partial loss
HC_129	Isolated find	Low	Disturbed area for pipeline connection	Total disturbance
HC_130	Open stone artefact site with subsurface deposit	Moderate	Conveyor and all-weather track	Partial loss
HC_132	Isolated find	Low	Topsoil stockpile	Total loss
HC_133	Isolated find	Low	Primary Water Dam	Total loss
HC_134	Subsurface artefact deposit	Low	Primary Water Dam	Total loss
HC_135	Open stone artefact site with subsurface deposit	Higher moderate	Conveyor and all-weather track	Partial loss (impact to subsurface deposit only)
HC_144	Isolated find	Low	Stormwater management earthworks	Total loss
HC_151	PAD	Higher moderate	Conveyor and internal road	Partial loss (impact to subsurface deposit only)
HC_152	Isolated find	Low	Powerline and pipeline easement	Total disturbance
HC_154	Open stone artefact site with subsurface deposit	Moderate	Internal road	Partial loss
HC_160	Open stone artefact site with subsurface deposit	Low	Internal road	Partial loss

Table 21.6 Direct impacts of surface infrastructure development

Site name	Site type	Significance rating	Impact type	Level of impact
HC_168	Isolated find	Low	Conveyor and water pipeline	Total loss
HC_171	Open stone artefact site with subsurface deposit	Low	Conveyor and internal road	Partial loss
HC_172	Isolated find	Low	Stormwater management earthworks	Total loss
HC_173	Open stone artefact site	Low	Internal track	Partial loss
HC_174	Isolated find	Low	Powerline and pipeline easement	Total disturbance
HC_178	Subsurface artefact deposit	Low	Stormwater management earthworks	Partial loss
HC_179	PAD	Moderate	Conveyor and stormwater management earthworks	Partial loss
HC_180	Open stone artefact site	Low	Conveyor	Total loss

No sites of high significance will be impacted by the project.

A total of six sites of moderate significance will be partially lost. Two of these are of higher moderate significance (HC_135 and HC_151) and will be partially lost as a result of conveyor and internal road construction. HC_135 is an open stone artefact site with confirmed subsurface deposit. The disturbance footprint will not impact the surface contents of HC_135, but will impact its subsurface deposit directly to the east within approximately 200 m of Oldbury Creek. The other site of higher moderate significance, HC_151, is an area of PAD nearby HC_135. However, as indicated from the test excavation results, HC_151 and HC_135 are likely to be a continuation of the same moderate density deposit within 200 m of Oldbury Creek and should be seen as an extension of one site.

Four other sites of moderate significance (HC_124, HC_130, HC_154 and HC_179) will be partially lost. HC_124 will have a small portion of its surface scatter impacted. HC_130 will be partially impacted by a conveyor and internal road, but most of the surface artefact area will be avoided to the north. HC_179 will be partially impacted by a conveyor and stormwater management earthworks. The impacts to HC_154 will mainly be to the subsurface deposit within 200 m of Medway Rivulet where an internal road will be constructed from an existing track and will be widened to a 4 m width.

A total of 14 sites of low significance will be impacted to varying degrees, comprising eight isolated finds, two open stone artefact sites, two open stone artefact sites with subsurface deposit, and two subsurface deposits.

21.7.5 Impacts on archaeologically sensitive areas

The surface infrastructure area has been designed to avoid the most archaeologically sensitive areas which are broadly within 200 m of Medway Rivulet and Oldbury Creek. No areas of high archaeological sensitivity will be impacted by surface infrastructure development. The surface infrastructure area only overlaps with the periphery of areas of moderate archaeological sensitivity or in linear sections where the project footprint will unavoidably traverse Medway Rivulet and Oldbury Creek, such as the overland conveyor and internal roads.

The surface infrastructure area will also impact some areas of low archaeological sensitivity. This is unavoidable given that the infrastructure intersects with some ephemeral streams that drain into Oldbury Creek and Medway Rivulet. However, if compared to the broader project area landscape, the surface infrastructure area affects comparatively few areas of low sensitivity. This is because it is located on low rolling hills with only a small network of ephemeral streams. Considerable testing within these areas indicated that artefact densities would be very low, that is approximately 2.7 artefacts/m^2 or lower and in a less predictable pattern. Overall, the surface infrastructure area has low archaeological sensitivity, with deposits already disturbed by many years of ploughing and other farming activities.

21.7.6 Potential subsidence impacts

i Subsidence predictions

Predictions of impacts from subsidence have been made using the specialist assessment report (Appendix L) and guided by a prediction rating system for underground mining areas prepared by Ditton (2012).

Mine Advice Pty Ltd (2016a) has estimated future subsidence, tilt and horizontal strain arising from the proposed underground mining. The maximum predicted value of surface subsidence above mine panels will be less than 20 mm. The report concluded that "the predicted maximum subsidence parameters are sufficiently low such that any associated impacts fall into the 'imperceptible' or 'negligible' category for all of the surface features that can be evaluated according to pre-set or established numerical criteria" (Mine Advice 2016a). However, because there are no strictly established numerical criteria for subsidence of rock shelter and grinding groove sites, it was useful to compare the predicted subsidence levels to previous investigations that have used probability rating systems to predict impacts (Ditton 2012).

Using Ditton's parameters established for the Tasman Extension Project in the Hunter Valley of NSW, the predictions for impacts to rock shelters or grinding grooves in the project area from increases in tensile strain, compressive strain and tilt all substantially fall within the category of 'very unlikely' (<5% probability) (refer to Section 10.1.2 of Appendix S). The predicted maximum values of tilt, curvature and strain are sufficiently low for the project that there was no need to individually assess each site across the underground mine area.

Subsequently, all sites above the underground mine area are labelled as having 'no predicted subsidence impact'.

ii Potential impacts

No subsidence impacts such as cracking or toppling is predicted for rock shelters or grinding groove sites. No subsidence impacts are predicted for open stone artefact sites or isolated finds, as cracking soil and any associated acceleration of erosion is not predicted to occur. No subsidence impacts are predicted for trees (including any Aboriginal scarred or carved trees) that would cause damage.

Despite there being no predicted subsidence impacts to any sites, it is relevant to account for the sites that are above the underground mine area so that measures such as subsidence monitoring can be applied to certain sites with sandstone features. As such, the sandstone site types (rock shelters and grinding groove sites) are differentiated from other site types (such as open stone artefact sites, isolated finds and potential scarred trees) above the underground mine area.

There are 36 sandstone site types above the underground mine area:

- Six of these sites are of high significance: a rock shelter with art and PAD (HC_037), rock shelter with art, deposit and PAD (HC_002), rock shelter with deposit and PAD (HC_017), rock shelter with art (Compartment 157) and two grinding groove sites (International House and HC_034).
- Ten of these are of moderate significance: this comprises five rock shelters with deposit and PAD and five rock shelters with PAD.
- 20 of these sites are of low significance: all of these sites are poorer examples of rock shelters with PAD, with no art or artefacts recorded.

The remaining 53 sites above the underground mine area are made up of open stone artefact sites, isolated finds and potential scarred trees. None of these sites are of high significance, five sites of moderate significance and 48 sites of low significance.

21.7.7 Cumulative impacts

The cumulative impacts of the project and the Berrima Rail Project have been considered. Excluding subsidence related impacts the Hume Coal Project will directly impact 20 sites and the Berrima Rail Project will directly impact eight sites, totalling 28 sites. Twenty of the 28 sites are of low scientific significance, two of which may be of essentially no significance.

Eight sites of moderate significance will be partially lost, two of which are PADs that would need further testing to determine their actual significance (HC_177 and HC_179). Sites HC_135, HC_151, HC_176, and HC_177 are of a higher level of moderate significance and HC_179 may also fall into this category depending on the results of further testing.

Furthermore, with the use of sensitivity modelling, it is reasonable to assume that many undiscovered Aboriginal sites outside the surface disturbance footprint remain in the broader project area and the surrounding region.

Impacts to the most archaeologically sensitive areas are from the development of linear infrastructure along defined corridors, a significant amount of archaeologically sensitive land (additional to the identified sites) will remain untouched within 200 m of Oldbury Creek and Medway Rivulet.

In summary, the project and the Berrima Rail Project will have the following combined impacts:

- 20 sites will be directly impacted by the Hume Coal Project surface infrastructure area. This comprises:
  - no sites of high significance;
  - six sites of moderate significance, two of which are of higher moderate significance (HC_135 and HC_151); and
  - 14 sites of low significance.
- Eight sites will be directly impacted by the Berrima Rail Project. This comprises:
  - no sites of high significance;
  - two sites of higher moderate significance (HC_176 and HC_177); and
  - six sites of low significance.
- 89 sites are above the project underground mine area, but no subsidence impacts are predicted to occur.
- 102 sites are outside the Hume Coal Project surface infrastructure disturbance footprint and underground mine area and the Berrima Rail Project disturbance footprint. These sites will be avoided.
- Taking the very low risk of subsidence impacts into account, it is very likely that 191 of the 219 sites (87%) assessed as part of this ACHA will not be impacted from either project.

The cumulative impact on rock shelters and grinding groove sites in the locality and the wider region will remain low as subsidence impacts are predicted to be very unlikely. Subsidence impacts are rare throughout region, even above mining areas with much greater subsidence predictions than the project (see Sefton 2000). None of these site types in the project area will be directly impacted.

Consequently, the project and Berrima Rail Project when considered collectively will not cause a substantial impact on the archaeological resource mainly because most of the impacts will be limited to sites of low significance and only partial impacts will occur to sites of moderate significance, leaving some of their deposits preserved.

The conclusions given above also need to be considered in the context that most widespread impact in the region is probably from historic clearing and ploughing of farmland. These activities are likely to have removed modified trees and reduced the archaeological integrity of many open artefact sites, particularly on shallow soils where ploughing has disturbed the entire soil profile.

An Aboriginal heritage impact permit (AHIP) (#C0001763) was issued to allow continued farming activities (ploughing, sowing crops and harvesting) in the project area and its surrounds and the maintenance of an existing road on the Wongonbra property (EMM 2017c). The impact of continued ploughing was found to be low because the activity has taken place repeatedly since colonial settlement. Continued ploughing would only have a significant cumulative impact if the open paddocks in the project area had not already been extensively cleared and ploughed and intact archaeological deposits or features were present.

21.8 Management measures

21.8.1 Overview

A Hume Coal Project Aboriginal Cultural Heritage Management Plan (ACHMP) will be prepared in consultation with DP&E and RAPs. The ACHMP will detail the management measures and provide for:

- active protection of Aboriginal sites close to the surface infrastructure area;
- passive management by avoidance of Aboriginal sites that are within the project area but which will not be impacted by the proposed development;
- monitoring certain sites in the underground mine area;
- salvage of Aboriginal sites in the disturbance area; and
- new actions to be taken in the event of discovery of human skeletal remains, discovery of Aboriginal sites, and for the ongoing care of salvaged Aboriginal objects within a keeping place.

The ACHMP will be prepared after project approval and in addition to the above points, will address all relevant conditions of approval.

A summary of the proposed management measures is provided in Table 21.7 and illustrated on Figure 21.12 to Figure 21.16.

Table 21.7 Site management summary

Management measure	Count of sites
Passive management: avoidance	161
Active management: fence and avoid	11
Partial collection/fence and avoid	4
Collection	10
Unmitigated impacts	2
Subsidence monitoring	16
Partial salvage excavation/avoid remainder of deposit	4
Refer to the Berrima Rail Project EIS (Appendix D) for management	11
Total	**219**

21.8.2 Avoidance

i Active management

Active management will involve fencing whole sites or parts of sites for their protection. Active management will apply to sites close to the infrastructure area (within 25 m of the construction buffer zone) for the duration of the project. For added protection it will also apply to grinding groove site HC_136 even though it is beyond 25 m from the construction buffer zone (Figure 21.15). The Aboriginal sites subject to active management are listed in Table 11.2 in the ACHA (refer to Appendix S).

Eleven sites will be completely avoided and fenced, and the remaining four surface sites will be fenced after salvage collection.

After salvage excavation, the relevant sites will be assessed as to whether avoidance of the surrounding landscape (currently identified as PAD) is required. This may include fencing to prevent any inadvertent impacts to subsurface deposits that may extend beyond the disturbance footprint and into the construction buffer zone. These sites are listed for 'partial salvage excavation/avoid remainder of deposit' in Table 21.7.

ii Passive management

No active management measures will be taken for sites more than 25 m (except HC_136 which will be fenced) from the surface infrastructure area unless otherwise determined during the preparation of the ACHMP. A total of 159 sites in the project area will be passively avoided unless found at a later date to be at risk of project impacts.

21.8.3 Collection

All surface stone artefacts in the infrastructure area disturbance footprint will be collected. This will involve collecting the entire visible contents of 10 sites and partially collecting four sites.

21.8.4 Salvage excavation

Four sites will be archaeologically excavated in the project area. The four sites are two open artefact sites with subsurface deposit (HC_135 and HC_154) and two PADs (HC_151 and HC_179). The established subsurface sites have been confirmed to contain the highest artefact densities in the surface infrastructure area through test excavation and the PADs are anticipated to have similar contents. These sites are likely to provide good representative samples of stone artefacts, raw materials and implements used in the local area. However, these sites do not warrant outright conservation as they lack archaeological integrity due to the widespread disturbance from historic clearing and ploughing, leaving a mixed artefact deposit and low potential for other features such as hearths.

21.8.5 Unmitigated impacts

Unmitigated impacts will apply to two sites in the project area: HC_134 and HC_178. Unmitigated impacts to these two sites simply apply because they relate to subsurface sites of low significance which do not warrant further investigation or salvage.

21.8.6 Condition monitoring

Although subsidence impacts on rock shelter and grinding groove sites are very unlikely, a program of archaeological condition monitoring will be undertaken for a selection of the most significant sites above the underground mine area. The results of the monitoring will be consolidated into a report to contribute to a better understanding of subsidence impacts in the region. An initial version of this report will be prepared and then periodically updated as mining progresses under further rock shelters and grinding groove sites. The approximate timing of this will be set out in the ACHMP.

Eleven of the 16 sites selected for monitoring are those that retain visible evidence of Aboriginal occupation (art, or stone artefacts present on the shelter floor), and which are of moderate and high significance. All grinding groove sites (HC_034 and 'International House'), rock shelters with art (HC_002, HC_037 and Compartment 157) and rock shelters with deposit and PAD (HC_010, HC_011, HC_016, HC_017, HC_032) above the underground mine area will be subject to monitoring. Additionally, monitoring will occur in the only three rock shelters of moderate significance with shelter internal volume over 50 m^3 (HC_018, HC_033 and HC_042). This recommendation responds to the likelihood that larger shelters are generally more susceptible to subsidence (Sefton 2000).

21.8.7 Special procedures

i Aboriginal ancestral remains

In the event that known or suspected human skeletal remains are encountered during the activity, the following procedure will be followed as soon as the suspected remains are discovered:

- in the immediate-term all work in the vicinity will cease and the find will be reported to the work supervisor who will advise the site supervisor or other nominated senior staff member;
- the site supervisor or other nominated senior staff member will promptly notify the police and the state coroner (as required for all human remains discoveries);
- the site supervisor or other nominated senior staff member will contact OEH for advice on identification of the skeletal material as Aboriginal and management of the material; and
- if it is determined that the skeletal material presents Aboriginal ancestral remains, the RAPs will be contacted and consultative arrangements will be made to discuss ongoing care or reinterment of the remains.

ii Aboriginal keeping place

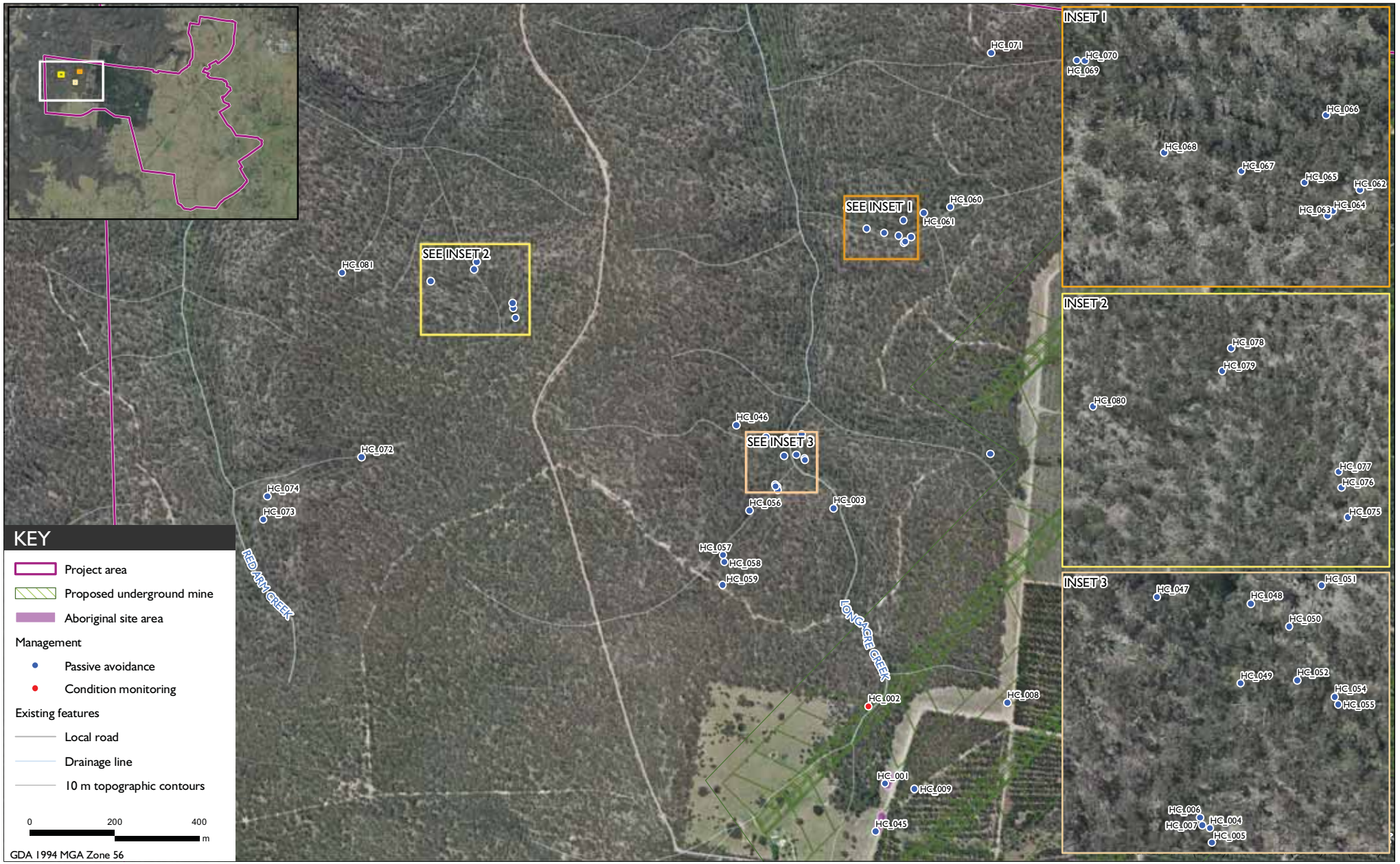
A keeping place is a designated secure area for the purpose of storing and curating Aboriginal cultural materials and their associated documentation.

RAPs have expressed that the objects recovered from the project area should be kept by an Aboriginal organisation. This would involve applying for a care agreement with OEH for transferring the objects to the organisation for safekeeping.

The facility for the recovered objects will be determined during the development of the ACHMP. All associated reports and records will be stored in close proximity to the artefacts, and kept in both hard copy and digital forms. The procedures to be adopted for access to the objects will be detailed in the ACHMP.

iii Discovery of new Aboriginal sites in the project area

In the event of discovery of new Aboriginal sites in the project area, all work in the potentially affected area will halt and an archaeologist and appropriate RAP representatives will be contacted to determine the significance of the object(s). Any new sites will also be registered in the AHIMS database. Objects will be managed in a manner consistent with the management measures outlined above and detailed in the ACHMP, including appropriate forms of salvage collection.



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Management measures - Belanglo State Forest (west)

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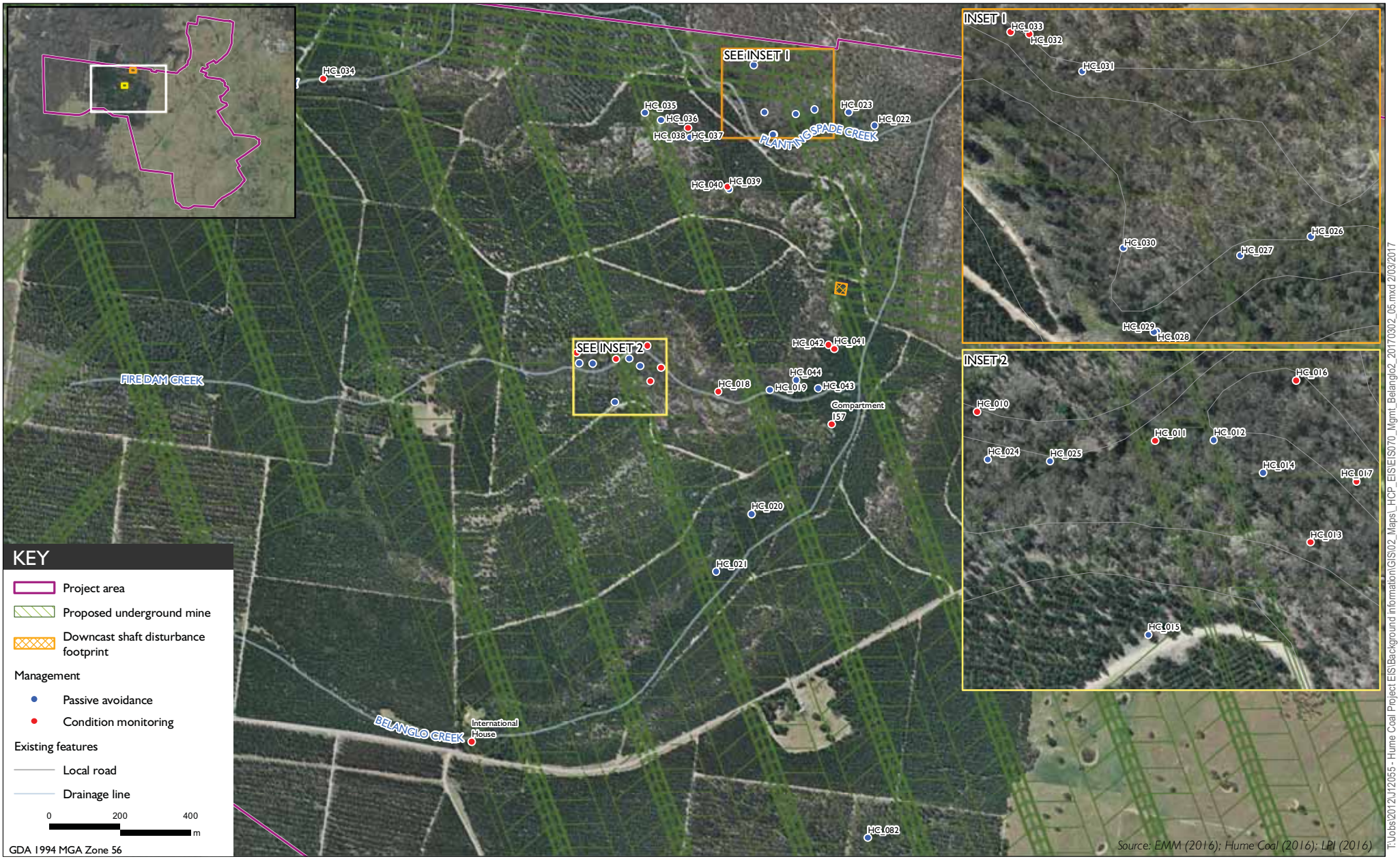
Figure 21.12



Management measures - Belanglo State Forest (east)

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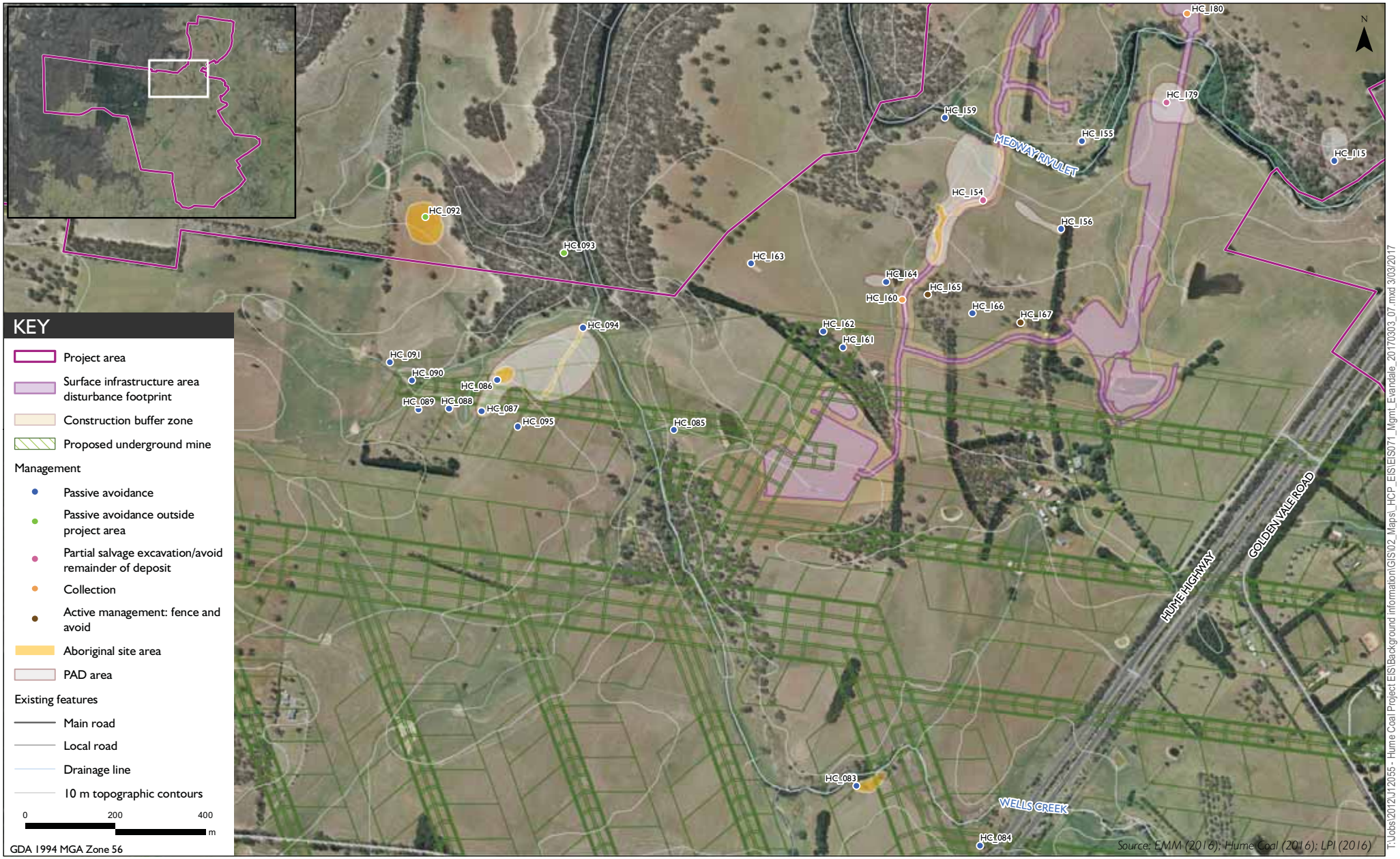
Figure 21.13



Management measures - Evandale

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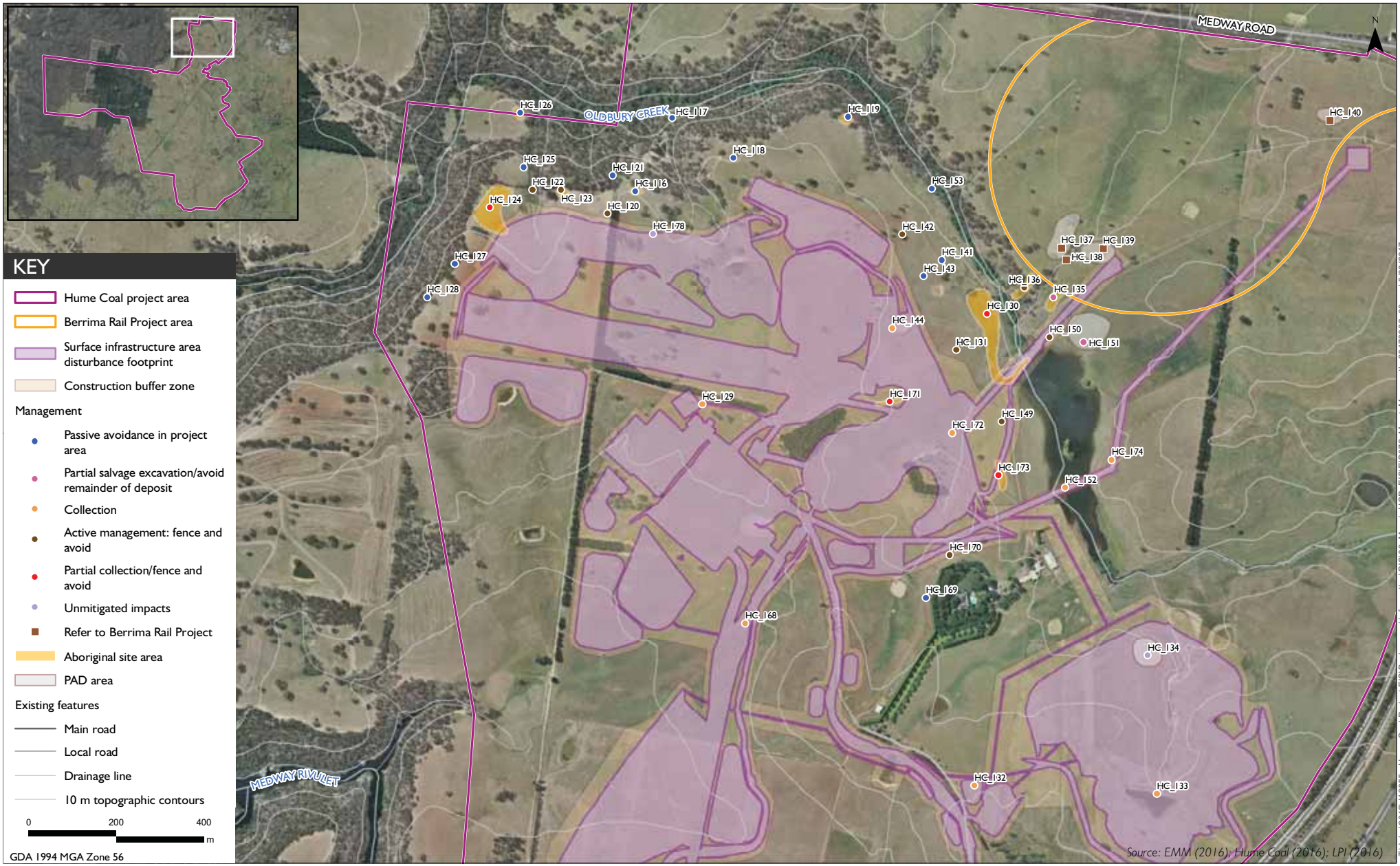
Figure 21.14



Management measures - Mereworth

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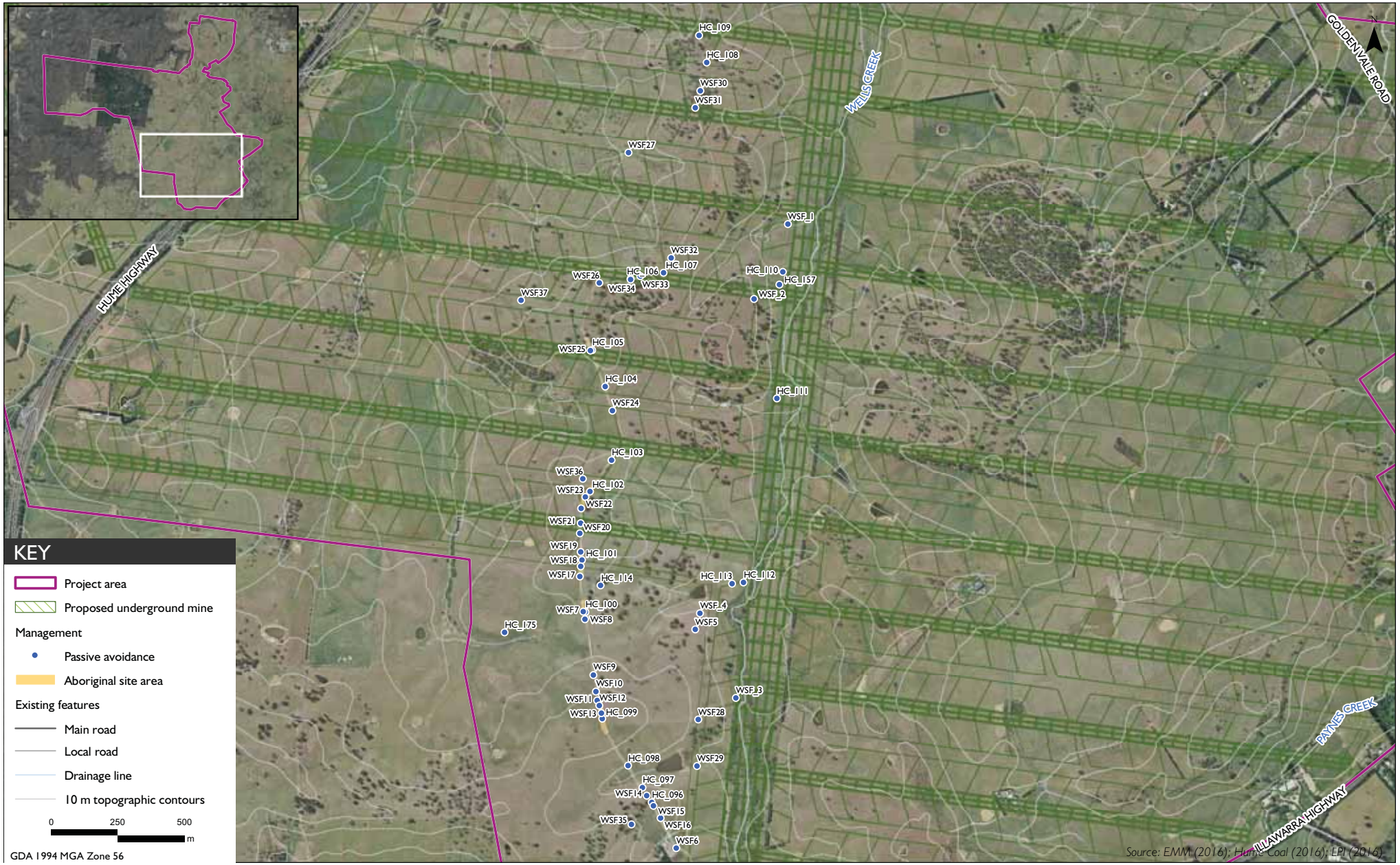
Figure 21.15



Management measures - Wongonbra

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Figure 21.16

21.9 Conclusion

The project's impact on Aboriginal cultural heritage values at a landscape level will be relatively small. 206 Aboriginal heritage sites were identified in the project area, of which 20 sites will be disturbed to some degree by the surface infrastructure area, comprising:

- six sites of moderate significance, two of which are of higher moderate significance (HC_135 and HC_151); and
- 14 sites of low significance.

No sites of high significance will be directly impacted by the project.

89 sites were identified within the underground mining footprint; however due to the negligible subsidence predicted, no subsidence related impacts on these sites are anticipated.

The surface infrastructure area has been specifically designed to avoid the areas of highest archaeological sensitivity, which are broadly within 200 m of Medway Rivulet and Oldbury Creek, and linear project elements will only partially impact the more significant deposits. The archaeological deposits present are generally disturbed to some degree from the historic agricultural land use.

Mitigation measures have been identified to mitigate impacts to the Aboriginal sites identified within the surface infrastructure footprint of the project, including test excavation and artefact collection. An Aboriginal Cultural Heritage Management Plan will be developed in consultation with the DP&E and registered Aboriginal parties. The plan will detail the management measures for the project, including provisions for the active and passive management of Aboriginal sites, ongoing monitoring requirements and site salvage procedures.

22 Historic heritage

22.1 Introduction

This chapter provides a summary of the historic heritage assessment and statement of heritage impact (SOHI) prepared for the project, which is provided in full in Appendix T. It describes the historical context in and surrounding the project area, outlines listed and other potential heritage items identified in the study area, and assesses the potential impact of the project on historic heritage.

Eight items of registered historic heritage significance have been identified in the project area. Of these, seven items will not be physically impacted by the project. The eighth item is *Mereworth House and Garden*, which is listed on the Wingecarribee LEP. A portion of the listed curtilage of the property will be impacted by the project; however, the actual house and garden will not be impacted. Impacts on substantial and intact relics are also not anticipated as a result of the project.

22.1.1 Assessment guidelines and requirements

The SEARs require an assessment of the project's potential impacts on historic heritage items. The specific requirements and sections of the EIS that address them are in Table 22.1.

Table 22.1 Historic heritage-related SEARs

Requirement	Section addressed
The EIS must address heritage including an assessment of the likely Aboriginal[1] and historic heritage (cultural and archaeological) impacts of the development, having regard to OEH's requirements.	This chapter, and Appendix T.

Note: 1. Aboriginal heritage is assessed in Chapter 21.

DP&E also invited other government agencies to recommend matters to address in the EIS, which the Secretary for DP&E took into account when preparing the SEARs. OEH raised matters relevant to the historic heritage assessment. Table 22.2 identifies OEH's requirements, including where they are addressed in the EIS.

Table 22.2 OEH's comments: Standard and project-specific assessment recommendations

OEH requirements	Section addressed
The EIS must provide a heritage assessment including but not limited to an assessment of impacts to State and local heritage including conservation areas, natural heritage areas, places of Aboriginal heritage value[1], buildings, works, relics, gardens, landscapes, views, trees should be assessed. Where impacts to State or locally significant heritage items are identified, the assessment shall:	All of these aspects related to heritage are addressed in this chapter except for Aboriginal values, which are assessed in Chapter 21.
a. outline the proposed mitigation and management measures (including measures to avoid significant impacts and an evaluation of the effectiveness of the mitigation measures) generally consistent with the NSW Heritage Manual (1996),	Section 22.5
b. be undertaken by a suitably qualified heritage consultant(s) (note: where archaeological excavations are proposed the relevant consultant must meet the NSW Heritage Council's Excavation Director criteria),	The historic heritage assessment was prepared by three suitably qualified heritage consultants. The EIS study team is provided in Appendix C. Archaeological excavation of relics is not proposed.
c. include a statement of heritage impact for all heritage items (including significance assessment),	Section 22.4. A detailed significance assessment is provided in Chapter 6 of the heritage report (refer to Appendix T).

Table 22.2 OEH's comments: Standard and project-specific assessment recommendations

OEH requirements	Section addressed
d. consider impacts including, but not limited to, vibration, demolition, archaeological disturbance, altered historical arrangements and access, landscape and vistas, and architectural noise treatment (as relevant), and	Potential impacts are described in Section 22.4. Vibration impacts are assessed in Chapter 11. No architectural noise treatments on heritage buildings are proposed or required.
e. where potential archaeological impacts have been identified develop an appropriate archaeological assessment methodology, including research design, to guide physical archaeological test excavations (terrestrial and maritime as relevant) and include the results of these test excavations.	Areas of historical archaeological sensitivity have been identified within the project area but one will not be subject to impacts, while the other is unlikely to be subject to impacts. Management measures addressing the possibility of inadvertent impacts are given in Section 22.5.

Note: 1. Aboriginal heritage is assessed separately in Chapter 21.

22.2 Methods

22.2.1 Study area

The SoHI study area comprises the project area as well as the surrounding area within approximately 5 km of the project area boundary. It includes the townships of Berrima, Moss Vale and Exeter to the north, east and south respectively, and large expanses of state forest to the west.

Within the project area, the assessment focussed on the surface infrastructure footprint, as this is the area where surface disturbance will occur. Areas of archaeological sensitivity for historical relics have not been identified in areas above the underground mine plan. If relics were to exist, they are unlikely to be affected by the project as there are no subsidence related impacts predicted above the underground mining area.

22.2.2 Assessment approach

The historic heritage assessment was conducted using the principles of *The Australian International Council on Monuments and Sites, Charter for Places of Cultural Significance* (also known as the *Burra Charter,* Australia ICOMOS 2013) and the NSW *Heritage Manual* (Heritage Office 1996 and updates and additions).

The *Burra Charter* defines the concept of cultural significance as "aesthetic, historic, scientific, social or spiritual value for past, present or future generations" (Australia ICOMOS 2013, Article 1.2). It identifies that conservation of an item of cultural significance should be guided by the item's level of significance.

The Heritage Manual provides guidelines for the assessment of heritage significance and the listing of heritage items in LEPs or on the State Heritage Register. The components of the Heritage Manual are informed by the values and definitions in the *Burra Charter* (Australia ICOMOS 2013). OEH provides other leading practice guides which informed the historic heritage assessment including:

- *Statements of Heritage Impact* (NSW Heritage Office and Department of Urban Affairs & Planning 2002);
- *Assessing Heritage* Significance (Heritage Office 2001);
- *Investigating Heritage Significance* (NSW Heritage Office 2004); and
- *Assessing Significance for Historical Archaeological Sites and 'Relics'* (Heritage Branch Department of Planning 2009).

The study area's historic context was documented following research of relevant literature and consultation with local stakeholders. The assessment included the following tasks:

- a search of relevant statutory heritage registers, namely:
    - The National Heritage List (NHL). This register is made under the EPBC Act.
    - The Commonwealth Heritage List (CHL). This register is made under the EPBC Act.
    - The State Heritage Register (SHR). This register is made under Part 3A of the Heritage Act.
    - The Heritage and Conservation Register (s170 register). This register is made under Section 170 of the Heritage Act.
    - Schedule 5 of the Wingecarribee LEP.
    - The State Heritage Inventory (SHI), which was cross-checked with Schedule 5 of the Wingecarribee LEP and the s170 register.
- a search of relevant non-statutory heritage registers, namely;
    - National Trust of Australia, NSW.
    - Register of the National Estate.
- a review of existing archives that may hold relevant original material, such as;
    - newspaper articles.
    - photographs.
    - land title information.
    - maps, plans and sketches.
    - current and historic aerial photography.
- secondary research of published material such as books, journals and interpretive material as well as unpublished sources;
- several field surveys of the study area between 2014 and 2016;
- an analysis of the study area to assess the potential for heritage items, including relics, and assist with the assessment of significance; and
- seeking information about the location of now-gone buildings and sites from local residents.

Field surveys were conducted on a number of occasions and were planned using the information gathered during background research. The surveys were conducted on foot and targeted areas that were predicted to hold tangible historical evidence, and the surface disturbance footprint of the project. The search for historical sites continued during the survey for the Aboriginal cultural heritage assessment. Items and places were recorded through digital photography, GPS coordinates and written descriptions. Heritage items on the Illawarra Highway (*The Pines, The Harp, Sutton Farm House* and *Newbury* – refer to Section 22.3.2) were viewed from the road. Survey tracks are shown in Figure 4.1 of the technical assessment report (Appendix T).

One listed heritage property, *Mereworth House and Garden,* was surveyed specifically for its historical heritage value because of its location within the proposed surface infrastructure area. The Evandale property, whilst not a listed heritage item, was also surveyed as a portion of the surface infrastructure area will be located on the property. The proposed locations of the two downcast ventilation shafts, one on *Carlisle Downs* and the other in the Belanglo State forest, were also inspected.

22.3 Existing environment

22.3.1 Historical context

i Exploration and early settlement

The earliest colonial presence in the Southern Highlands dates back to 1798 when several explorers visited the area near the Wingecarribee River (Jervis 1986). Several other expeditions were made to the area between 1798 and 1814 prior to settlement by pastoralists in 1819. Three large land grants, *Newbury, Oldbury* and *Mereworth*, were part of the initial settlement of Sutton Forest. Within twenty five years, convict gangs had built the South Road which later became the Great Southern Road, one of the three main roads in the colony. With the coming of the railway in the 1860s, European settlement in the area began in earnest.

The earliest pastoralist recorded in the area was John Oxley who was granted 2,400 acres in 1819 to legitimise the presence of his stock in the area. Following the settlement by early pastoralists, grazing and cattle rearing for dairy and beef became the primary occupation of settlers in the area. Sheep, pigs and other animals were also farmed and crops such as wheat, maize and barley were grown. After the turn of the century, orcharding also became an important industry.

James Atkinson, of 'Oldbury' in Sutton Forest, received a permit in 1822 to occupy an area of land on the right bank of Medway Rivulet as a grazing farm. James was followed by his brother John, who established 'Mereworth' on 2000 acres across the Southern Road from Oldbury. John built a 'plain cottage' (*Southern Highland News* 2 May 2011) as well as an inn.

ii Historical mining and industrial development

Coal resources in the area were first discovered near Berrima in 1845, commencing the start of the mining industry in the district. The history of coal mining in the Southern Highlands is tied to the history of other industries, notably collieries established to supply coal to iron works, such as the Fitzroy Iron Works, and cement plants. Rail lines were built to service these industries and transport coal, iron and cement to other destinations such as Sydney and Port Kembla.

In 1854, the first coal mine was opened at Black Bobs Creek to supply coal to the Fitzroy Iron Works at Mittagong. In 1867, the Cataract mine was opened on the banks of Medway Rivulet. It supplied the Fitzroy Iron Works until around the late 1860s upon the closure of the iron works (various dates are given for the closure of the iron works including 1869 (SHI ID 2681711) and the 1890s (Fitzroy Iron Works 2014).

James John Atkinson, the son of James, opened a mine at Medway in 1880, and the following year an act was passed to enable a company called 'The Berrima Coal-mining and Railway Company (Limited)' to construct a railway from the Berrima Coal mine to the Great Southern Railway near Moss Vale (http://www.legislation.nsw.gov.au/acts/1881-bcm.pdf). The mine mostly supplied coal to the NSW Railways for their steam locomotives.

During the 1920s, a number of new mines opened in the West Berrima area (now Medway); including the Loch Catherine Colliery and the Flying Fox Mine. In 1924, Arnold Stanley 'Stan' Taylor opened the Medway Colliery and Railway Company and took over the Loch Catherine mine.

Along with mining, sawmilling was an important industry and the first sawmill was established in Sutton Forest in 1881, and at nearby sites in the following decades. Boral Cement was built on an old lumber yard and fed by coal from Medway Colliery, delivered by rail. Other important industries in the region included kerosene shale production (at Joadja), timber-getting, sawmills and tourism. Many of these remain important industries in the region today. The region became popular as a tourist destination early in its history and was considered quite fashionable by the late nineteenth century.

One of the earliest towns to be established in the Southern Highlands was Bong Bong (where Bong Bong Common is now), built in 1821. Following the construction of the Great Southern Road, the government buildings moved to the area now known as Berrima.

Berrima was first laid out in 1829 by Surveyor General Sir Thomas Mitchell and quickly grew. The discovery of gold in the area enlivened the town; although when the rail line bypassed Berrima in 1851, the population declined to 192. Berrima grew again as tourism increased, resulting in the emergence of tourist accommodation and maintenance of the character that continues to invite day-trippers and longer stay visitors today.

Sutton Forest was likely to have been established after the dissatisfaction about the location of Bong Bong. A church and cemetery were built by 1830 and houses nearby began to be built. However, the town was not officially recognised until 1854 (Jervis 1986).

Exeter was established on land belonging to the Badgery family, who owned a large portion of land in the area of present day Exeter. The town was divided into lots and sold throughout 1891.

iii Road and rail

The earliest road through the region, the Argyle Road (now the Old Argyle), ran south from the County of Cumberland, through the County of Camden and County of Argyle from 1810 (Jack 1997). In 1858, the Great Southern Road was proclaimed one of the three main roads in the NSW Colony and by 1928 it was proclaimed a state highway and renamed the Hume Highway (RMS 2013).

Railways were also an essential part of the development of towns and industry in the region. Railways in the Southern Highlands followed the establishment of industry, and soon all industry in the area relied on rail (Jack 1997). Local rail lines joined the Main Southern Railway that connected Mittagong to Sydney from 1867, and which extended further to the south in later years.

22.3.2 Listed heritage items

There are eight heritage items that are listed on the Wingecarribee LEP in the project area. Of these, four are wholly within the project area; one occurs within the project's surface infrastructure area (*Mereworth House and Garden*) while the others are located above the underground mining area. All items have been assessed as being of *local* significance. The items are listed below with their relevant LEP item number in brackets:

- *The Harp* (I027);
- *Mereworth House and Garden* (I351);
- *The Pines* (I029); and
- *Sutton Farm House* (formerly the Red Cow Inn) (I035).

The remaining four listed items are partially contained within the project area; that is, some of the paddocks associated with the heritage listed items overlie the underground mining area. These listed items are:

- *Newbury* house, grounds and outbuildings (I202, I036);

- *Eling Forest Winery,* house, grounds and outbuildings (I004, I009, I010);
- *Bunya Hill* house, grounds and outbuildings (paddocks only) (I018); and
- *Comfort Hill* house, grounds and outbuildings (paddocks only) (I021, I356, I357).

These properties were not surveyed, given that only the surrounding paddocks associated with these heritage items are within the project area, and not any building or structures, combined with the anticipated negligible subsidence impacts (refer to Section 22.5).

A further 113 listed heritage properties occur within the study area; that is within approximately 5 km of the project area boundary.

The listed historic heritage items identified in the study area are shown in Figure 22.1. The items within the project area are summarised in Table 22.3.

22.3.3 Unlisted heritage values

i Cultural landscapes

Unlisted, but previously identified heritage landscape values by others, were also considered in the historic heritage assessment for the project. Despite their lack of statutory protection, they are part of, and contribute to, the character of the project area and surrounds.

Two separate landscape descriptions were identified during the research phase of the assessment, namely;

- The 'Sutton Forest key historical unit (Unit 6)' identified in the Wingecarribee Heritage Study 1991 (JRC) as a significant landscape. This unit is not listed in the Wingecarribee LEP.
- The 'Exeter/Sutton Forest Landscape Conservation Area' classified by the National Trust.

Both of these significant landscapes overlap to a large degree over Sutton Forest. The National Trust classification includes part of Exeter to the south and the Wingecarribee Heritage Study includes part of Berrima to the north.

The two landscapes are shown in Figure 22.1.

ii Relics

Archaeological sites are protected by Section 139 of the Heritage Act if they are assessed to be relics, that is, of local or State significance. A formal listing is not required for protection, and disturbance can only occur with approval, either under the Heritage Act or through the Minister's conditions of consent for State significant development.

Archival research, local community consultation and field survey was undertaken to identify potential archaeological sites and assess whether they qualify as relics. Two potential archaeological sites were identified within the project area (refer to Table 22.4):

- Mereworth 1 (the former homestead site) presumably underneath the current house and garden; and
- HC_127, which includes a scatter of glass, ceramic and metal amongst Aboriginal stone artefacts on the Evandale property (refer to Photograph 22.1).

The project area does not possess any items specifically listed for their archaeological value.

Identified heritage items and values in the study area

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Figure 22.1

Table 22.3 Listed historic heritage items in the project area

Item name	Register listing								Location
	National Heritage List	C'wealth Heritage List	State Heritage Register	S170 (Heritage Act)	LEP	National Trust of Australia (NSW)	Register of the National Estate	Other	
The Harp (former 'Bindagundra' house, grounds and outbuildings)	-	-	-	-	I027	-	1637*		Underground mining area
Mereworth House and Garden	-	-	-	-	I351	-	-		Surface infrastructure area
The Pines	-	-	-	-	I029	I029	-		Underground mining area
Sutton Farm house, grounds and outbuildings (former Red Cow Inn)	-	-	-	-	I035	I035	-		Underground mining area
Newbury house, grounds and outbuildings (part)**	-	-	-	-	I202 I036	-	-		Underground mining area
Bunya Hill house, grounds and outbuildings (part)**	-	-	-	-	I018	-	-		Underground mining area
Eling Forest Winery, house, ground and outbuildings (part)**	-	-	-	-	I004 I009 I010	-	-		Underground mining area
Comfort Hill house, grounds and outbuildings (part)**	-	-	-	-	I021 I356 I357	-	-		Underground mining area
Sutton Forest Unit 6 landscape area								Heritage study 1991	
Exeter/Sutton Forest Landscape Conservation Area						R2218			Partially in project area

Notes: ** Listed as Bindungurra on the RNE. ** only part of the property occurs in the underground mining area but no listed buildings.*

Table 22.4 Potential relics identified in the project area

Item name	Listing	Report ID	Location
Evandale scatter	None	HC_127	Adjacent to surface infrastructure area
Former house at Mereworth (Mereworth 1)	None	MH	Adjacent to surface infrastructure area

22.3.4 Site survey and analysis

The results of the pedestrian field survey are provided in this section. As noted in Section 22.2, survey was conducted on a number of occasions and focused on areas that were predicted to hold tangible evidence of the historical development of the Southern Highlands.

i Mereworth house and garden

The existing house at *Mereworth* was built in 1965 and designed by John Amory. It is a two-storey brick building with outbuildings. The house is shown in Photographs 22.1 and 22.2, and is a French Provencal style house, combining Georgian proportions and symmetry with late Victorian Gothic elements. The house is accessed by a long driveway lined with conifers and golden elms ending at a porte-cochere (Photograph 22.3).

The setting of *Mereworth* is a combination of the designed landscape that encompasses the house and the surrounding rural landscape. The garden creates an 'island' effect, heightened by the ha-ha, which creates a physical boundary from the surrounding paddocks while also creating a visual continuity with the greater landscape (Photograph 22.4). The landscape design incorporates a lawn, large hedges of tightly packed Bhutan cypresses, a rose garden and a mature cold-climate forest.

The garden was designed and planted by Paul Sorensen, who was a landscape architect best known for his mid-century work in the Southern Highlands, the Blue Mountains and the Illawarra. Sorenson designed residential and industrial sites, and his style included cold-climate species combined with natives.

The driveway that originally led from the former Hume Highway (now the Old Hume Highway) to the house was bisected by the highway duplication in 1985 and the property is now accessed from the remaining section of the original driveway to the south of the property.

Mereworth was surveyed on 25 and 26 March 2015 and again on 29 March 2016 by the EMM heritage team. The potential for relics was also investigated given the age of the property. Research indicates that the original homestead (1820s) was located within the area of the current house and gardens.

Views and vistas from *Mereworth* were assessed from the second floor of the house and from within the gardens. Views from the house are predominantly to the north, through a line of trees growing along the ha-ha. The trees along the ha-ha were intended to be pruned to keep the view to the north open (Ratcliffe 1990). Views to the north-west are obscured by large Bhutan cypresses.

Potential relics have been identified within the curtilage of the house and garden and extending to the north-east to where farm buildings and a farm track are now located. These features were captured on an aerial photograph in 1949 in what appears to be a homestead site. Research for the project indicates that this homestead may have been where John Atkinson and his family and some employees lived, which would date it to around 1823 at the earliest. Construction of the existing house and garden are very likely to have destroyed much of the archaeological site, but evidence of some features such as fence lines at the rear of the house (to the north-east) may have survived in the area that now supports modern farm sheds, yards and driveway.

Photograph 22.1 The rear of Mereworth House with the cold climate garden behind. View south

Photograph 22.2 The grounds of Mereworth on the southern side of the dwelling. View north-west.

Photograph 22.3 Rows of golden elms and flowering cherries lining the avenue to the house at *Mereworth*. View north-north-east.

Photograph 22.4 The ha-ha on the northern side of the *Mereworth* garden. This view is to the south, facing the house.

Photograph 22.5 The core residential and garden components of *Mereworth* (behind the trees). View north-west.

Photograph 22.6 The view from *Mereworth's* master bedroom balcony to the north across the ha-ha to the paddocks beyond

Photograph 22.7 **View north-west to the *Mereworth* driveway at the junction where it meets the avenue of trees**

ii Evandale

Whilst this property is not heritage listed, parts of the property, which are owned by Hume Coal, were surveyed as components of the project's surface infrastructure will be located on this property.

One site that may be a relic (under the Heritage Act) was recorded at the edge of a paddock and mixed with Aboriginal artefacts. This site (HC_127, refer to Photograph 22.8) comprises glass fragments, a metal buckle and ceramic sherds with Aboriginal artefacts made of indurated mudstone, quartz and silcrete (three Aboriginal artefacts recorded by survey). A mature yucca plant was recorded within 4 m of the scatter. Verification of the site as a relic has not been possible as records of structures in this area have not been located and no other suggestion of fabric was visible. However, as this paddock has been historically ploughed, the most likely scenario is that the yucca is self-seeded and has been avoided in subsequent ploughs as it is close to the edge of bushland. The glass, ceramic and metals are likely to be redeposited refuse or possibly evidence of Aboriginal-European contact. HC_127 is approximately 70 m from the surface disturbance footprint (refer to Figure 22.1) and will be fenced as an exclusion area.

The main locus of the *Evandale* farm complex is at the southern end of the surface infrastructure area. The landscape in the southern section of Evandale is consistent with the surrounding landscape. The area is largely cleared agricultural land used for cultivation and grazing. Some areas of native vegetation also remain. Since 1949, windbreaks have been planted around the property, which have now matured and become iconic features of the area. A mix of native, endemic and exotic tree species lines the main driveway and surrounds the primary dwelling. These lines of trees are visually pleasing and important to the aesthetic appeal of the Southern Highlands today.

Photograph 22.8 **HC_127 (also an Aboriginal site) with a ceramic tea cup handle, a plate fragment and a metal buckle.**

The cluster of buildings on *Evandale* includes the main residence, two smaller residences, a shearing shed and four ancillary sheds. None of these buildings are of heritage significance although the tree-lined garden contributes to the landscape values of the surrounding area.

No other areas where relics may exist were noted.

a. Downcast shafts

No evidence of historical heritage values was noted at the sites proposed for the two downcast ventilation shafts; one on *Carlisle Downs* and another in the Belanglo State Forest.

b. Upcast shaft

No evidence of historical heritage values was noted at the site proposed for the upcast shaft located on *Evandale.*

iii Heritage items over the underground mining area

Seven heritage listed properties occur over the underground mining area. These items were not surveyed as subsidence related impacts are not anticipated, as discussed further below in Section 22.4.

22.4 Statement of heritage impact

22.4.1 Overview

Extensive effort was given to avoiding potential impacts to heritage items in the design of the project. The principal avoidance measure was the adoption of an underground mining method, and then siting of the underground mining area to avoid extraction beneath heritage items listed on the State Heritage Register. Following this, detailed surveys of surface areas were undertaken and infrastructure areas were designed to have the smallest footprint possible, with individual facilities located to avoid any items of heritage value. The design also aims to avoid rows of mature trees, which contribute to the current pastoral landscape.

The resulting surface infrastructure area design avoids impacts to the significant elements on the *Mereworth* property, being the house and surrounding garden.

There are two activities associated with underground mining with the potential to impact on historic heritage items, namely:

- the construction and operation of the surface infrastructure area; and
- subsidence from the underground mining; however, this is predicted to be negligible as outlined in Chapter 14.

Potential impacts to the identified heritage items in the project area are described below.

22.4.2 Mereworth House and Garden

Mereworth House and Garden is listed on the Wingecarribee LEP as an item of local significance, and is the only listed heritage item in the project's surface infrastructure area, as shown in Figure 22.2. It is also in the Exeter/Sutton Forest Landscape Conservation Area, which is a classification by the National Trust. The house is vacant and the gardens are being maintained by a professional horticulturalist engaged by Hume Coal. The surrounding paddocks are licensed to a farm management company, which is raising cattle and sheep and will be producing fodder crops.

Mereworth is one of a number of Hume Coal-owned properties that have been licensed out for raising stock and growing of commercial crops, resulting in an increase in farming activity in the project area (as discussed in Chapter 9). Farming is one of the dominant historical activities that have produced the landscape in the Southern Highlands.

While most of the surface infrastructure is located within the broader *Mereworth* property boundary, no physical impacts to the house, gardens or the avenue of trees, that is, the significant elements identified in the heritage listing, will occur. The layout of the infrastructure area has been designed to avoid physical impacts to these items, and therefore the house and gardens are not within the direct disturbance footprint of the project. Underground mining will not occur beneath it.

The most significant impact on *Mereworth House and Garden* arising from the project is of a visual nature. Construction of the surface infrastructure area will change some aspects of the *Mereworth* landscape and immediate surrounds. The only place where views from the house and garden will be affected is to the north and north-east across the ha-ha to the surrounding paddocks and dam. However, views from the house to the surrounding landscape are generally constrained by the perimeter plantings of Bhutan cypress and the design of the garden is deliberately inward-looking.

Identified heritage items and values in the surface infrastructure area

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Figure 22.2

The broader setting of *Mereworth* will be modified for the life of mine operations, with built elements of the project within approximately 540 m of the house, including the stockpiles, temporary accommodation village, administration buildings, coal preparation plant, conveyor to the rail loop, train load-out, and the rail loop itself which is part of the Berrima Rail Project EIS (refer to Appendix D). These structures will be visible from within the property and affect only Hume Coal and farming personnel. The primary water dam that will be created between the house and the Hume Highway will have a minor temporary impact as it is standard farm infrastructure and will be absorbed into the landscape readily. The main mine substation will be directly north-west of the house and garden but will be largely obscured by the perimeter plantings of the garden.

Overall, it is anticipated that the impacts of the project to the setting of *Mereworth* and the character of the identified significant landscapes will be moderate. These impacts will be ameliorated through the continued farming at Mereworth and the introduction of new tree lines as screens, which will largely conceal industrial structures from public viewing. Also, impacts on the setting of *Mereworth* will not be permanent, occurring only for the 23 year life of the project.

Importantly, as described below in Section 22.5, a Conservation Management Plan (CMP) will be developed for the *Mereworth House and Garden* which will guide maintenance and management of the property leading to a positive transformation.

A positive impact of the project is that the project will provide a platform for additional archival investigation of *Mereworth* and its associations within the local area. Farming has been introduced and will continue for the life of the project, provided it is profitable, which is a positive outcome for the local region. Farming was once a significant economic activity in the Southern Highlands but has diminished with the subdivision of farmland.

As described in Section 22.3.4, the potential for relics associated with the old homestead to the south-west of the main existing dam on the property was also identified (Mereworth 1). Mereworth 1 represents the location of a former homestead, more than likely built by John Atkinson, which is thought to be located in the curtilage of the currently listed *Mereworth House and Garden*. However, the level of archaeological sensitivity is low, with little structure or integrity anticipated for the survival of relics associated with the homestead. If they exist they are likely to be ephemeral and truncated, due to more recent changes associated with the modern farm.

Pipelines from the primary water dam will be constructed past the perimeter of *Mereworth House and Garden*. The general location of the mine water pipeline is considered appropriate with respect to its proximity to these items, because of the flexibility Hume Coal has in determining its exact location within the construction corridor.

The CMP that will be prepared for Mereworth will identify the location of artefacts of potentially high significance, outline management practices for the potential significant items should they be found and detail ongoing management practices. This CMP will be implemented during construction of the mine water pipeline. Management practices which may be implemented include having a suitably qualified person accompany the ground disturbance works associated with the project and/or making minor changes to the pipeline route to avoid impacting on significant artefacts. The CMP will also outline the salvage protocol in the event that objects are found.

22.4.3 Evandale

Evandale is not a statutory listed heritage property. However, it is a component of the rural landscape and within the Sutton Forest key historic unit (Unit 6) and the Exeter/Sutton Forest Landscape Conservation Area, and as such it was considered in the historic heritage assessment. Whilst one of the drift portals will be located to the north-east and within 230 m of the main dwelling associated with the property, no physical impacts to the building will occur. The character of the overall property will change as some surface infrastructure components will be constructed on the property (which is owned by Hume Coal), although the magnitude of change is considered to be low.

A potential relic was also identified in the north-western area of the Evandale property (HC_127, refer to Figure 22.1). The project has been designed to avoid HC_127, and therefore this item will not be subject to surface or subsurface impacts as a result of the project. Further, this area has been historically ploughed over the last 150 years, which would have substantially compromised any relics there if they exist. The most likely scenario is that the scatter is the result of rubbish dumping.

22.4.4 Other heritage properties in the underground mine area

As discussed in Section 22.3.2, three other heritage listed items (*the Harp, the Pines and Sutton Farm House*) as well as parts of paddocks associated with four heritage listed properties (*Newbury, Eling Forest Winery, Bunya Hill and Comfort Hill*) are within the project area, and specifically above the underground mining footprint. All items and properties have been identified as having local heritage significance and are listed on the Wingecarribee LEP.

As the predicted level of subsidence is negligible due to the first workings mine method adopted (refer to Chapter 14 subsidence), subsidence related impacts on these properties are not predicted. Similarly, no impacts to built structures are anticipated.

Areas of archaeological sensitivity for historical relics have not been identified in areas above the underground mine plan. If relics were to exist; they are unlikely to be affected by the project. Further, the two downcast and one upcast ventilation shafts will be located in areas that are not considered to be archaeologically sensitive.

22.4.5 Summary

A summary of the potential impacts to the identified historic heritage items is summarised in Table 22.5.

Table 22.5 Summary table of impacts on heritage items

Place	Item ID	Significance	Project location	Physical impact	Impact to setting (visual)	Total area (ha)	Ha inside project area	% total project area	% total infrastructure area
Mereworth house and garden	I351	Local	Surface infrastructure area (over paddocks only)	Partial to non-significant curtilage	Moderate	500.70	425.76	85%	19%
The Pines	I029	Local	Underground mining area	None	None	0.64	0.64	100%	0%
The Harp	I027	Local	Underground mining area	None	None	1.97	1.97	100%	0%
Sutton Farm House, grounds and outbuildings	I035	Local	Underground mining area	None	None	19.35	19.35	100%	0%
Comfort Hill	I021 I356 I357	Local	Underground mining area	None	None	216.57	59.07	28%	0%
Newbury	I202 I036	Local	Underground mining area	None	None	161.85	72.02	45%	0%
Bunya Hill	I018	Local	Underground mining area	None	None	48.44	12.66	26%	0%
Eling Forest Winery	I004 I009 I010	Local	Underground mining area	None	None	64.46	5.79	9%	0%
Mereworth 1 (potential relics)	None	Local	Surface infrastructure area (will be avoided)	Possible (unlikely)	None	2.68	2.68	100%	100%
Evandale scatter HC_127 (potential relics)	None	Local/Nil	Surface infrastructure area (HC_127 will be avoided)	None	None	0.0002	0.0002	100%	100%
Key Historic Unit 6 (1991)	None	Local	Surface infrastructure area and underground mining area	Part	Low to moderate	3492.11	2770.35	79%	1%
Landscape Exeter/Sutton Forest (1992)	None	Local	Surface infrastructure area and underground mining area	Part	Low to moderate	10152.89	3492.11	34%	0.02%

i Cumulative impacts

Short-term cumulative impacts will occur as the project will be one of a number of operating industries in the area. However, in the long-term, the project's surface infrastructure area will be removed and the land rehabilitated to its current land use. The house and garden at *Mereworth* will have undergone a positive transformation due to the preparation and implementation of a CMP, which will guide maintenance and management and enhance the significant aspects of the place.

The most relevant project in relation to potential cumulative impacts on historic heritage items is the Berrima Rail Project, which may have an impact on a section of a surviving Sorensen garden at the Berrima Cement Works where a new rail connection will be built (if the preferred option presented in the EIS is constructed). The impacts will be contained to a section of this garden.

The potential cumulative impacts of the Hume Coal Project and the Berrima Rail Project will largely be restricted to visual impacts and the setting of the house and garden at *Mereworth*. Neither project will physically impact the house and garden. Changes to the landscape are considered to be moderate within the property and low when viewed from certain vantage points from outside the property; none of the visual impacts will be permanent. Rehabilitation upon mine closure will return the landscape to farmland with the removal of infrastructure (although some dams suitable to the future land use may remain). Moreover, the surface infrastructure area has been designed to create as minimal a visual impact as possible when viewed from the public domain, as discussed further in Chapter 16.

22.5 Mitigation, management and monitoring

22.5.1 Approach to heritage management

The overriding objective in managing heritage significance is the avoidance of impacts. Avoidance removes the need for mitigation or amelioration and is in keeping with the philosophy of the *Burra Charter 2013* (Article 2). As described above, impacts on heritage items have been avoided through the adoption of an underground mining method, and deliberate placement of the infrastructure area such that physical impacts to listed heritage items in the area will not occur.

In all cases where significant heritage values may be affected by a project, it is prudent to take a precautionary approach by excising the construction disturbance footprint where it intersects with heritage items or with areas that have been identified as having potential to contain relics. This has been the approach adopted in planning the project. Specific mitigation and management measures are outlined below.

22.5.2 Mitigation and management measures

The following overarching strategy to protect the significance of heritage items within the project area has been followed to date and will continue as required:

1. A precautionary approach will be followed to all activities that could impact on heritage items or potential heritage items. That is, the items will either be completely excluded from the disturbance footprint or its heritage values will be investigated and recorded prior to the works.

2. Impacts to heritage items including buildings, bridges, landscapes and landscape elements will be avoided through the project design.

3. Following project approval and prior to any work commencing, an historical heritage management plan (HHMP) will be prepared to guide the conservation of heritage items and unexpected finds for the duration of the project. The relevant measures in the HHMP will be incorporated into the project construction environmental management plan (CEMP) to avoid inadvertent impacts during the construction phase of the project.

4. The management measures outlined in this section will be specified in detail in the HHMP.

5. The Department of Planning and Environment as well as the Heritage Division (OEH) will be consulted on the content of the HHMP and the relevant sections of the CEMP.

6. Tree line windbreaks will be retained to the greatest extent practicable and/or replaced as soon as possible if their removal is unavoidable.

7. The window frame and wagon wheel fragment leaning against the shed on the north-west of the house and garden at *Mereworth,* to the main house within the garden for safekeeping.

Further detail on the HHMP and specific management measures is provided below.

22.5.3 Historic heritage management plan

The HHMP will include detail on the following:

- avoidance measures;
- archaeological monitoring of the mine water pipeline;
- archival recording;
- unexpected finds;
- preparation of a CMP for *Mereworth* House and Garden;
- tree windbreaks and screens; and
- fencing.

i Avoidance

Avoidance is the best way of protecting an item and its heritage values. Protection is through ensuring that construction and operation activities do not occur within the heritage curtilage of the item where those activities do not need to occur. Where there is potential for surface infrastructure to physically impact on the curtilage of a heritage item, modifications to the design will be made to avoid those impacts.

ii Archaeological monitoring of mine water pipeline

Prior to commencing construction of the mine water pipeline where it will be installed adjacent to the existing farm building, a CMP will be developed (refer to Section 22.5.3v), which will consider development of an archaeological research design to support an archaeological monitoring program, if deemed required. The archaeological monitoring program would focus on investigating the association of relics (if they exist) in the area. It is likely that relics in this area, should they survive, will be ephemeral.

iii Archival recording

Archival recording will be undertaken prior to construction commencing. In particular, as the setting of *Mereworth* will be affected for the life of the mining operations, and because the area will be rehabilitated at the cessation of mining operations, a good quality record of the existing environment needs to be made. The record will take the form of a report, which includes photographs, sketches and descriptions of the place. Additionally, a photographic archival record will be made of the house and gardens at Mereworth and used as a baseline for maintenance and repair.

Guidelines for preparing archival records are available on the OEH website at http://www.environment.nsw.gov.au/Heritage/publications/index.htm:

- *How to prepare archival records of heritage items* (Heritage Office 1998); and
- *Photographic recording of heritage items using film or digital capture* (Heritage Office 2006).

iv Unexpected finds

If unexpected finds are unearthed, assessment will be required to ascertain their significance and, if necessary, archaeological excavation undertaken. Salvage excavation is a last resort where an item of archaeological value will be destroyed by the project. A detailed archival record would be prepared and excavation used to obtain as much information as possible from a site before it is destroyed and will require research and a research design as a framework for the excavation. Should unexpected finds be discovered, consultation will be undertaken with the DP&E.

v Conservation management plan

A CMP for *Mereworth* will be prepared and include the house and significant outbuildings (to be determined), the garden and garden elements, the avenue of trees and the tree-lined drive. An investigation into the surviving tree line along the original drive from the Old Hume Highway should also form part of the investigation to determine if it requires maintenance. Attention to the rose garden, the cold-climate plantings and the sunken lawns will also be required. The garden is a significant aspect of the complex and should be maintained in a suitable manner with attention to ensuring that Sorensen's original plan is not overly modified. Suggested contents of the CMP are included in the historic heritage assessment report in Appendix T.

vi Tree line wind-breaks and screens

To reduce any potential impacts on tree line wind-breaks, the following measures are proposed:

- tree line wind-breaks will be conserved to the greatest extent practicable;
- new tree line wind-breaks will be planted to replace those that have to be removed;
- tree species in new tree lines will be consistent with the existing species; and
- new tree lines of suitable species will be planted to act as visual screens to infrastructure such as the screening used by Boral Cement in New Berrima.

vii Fencing

Fencing will be used to protect items from damage during construction or operational activities. Some fences may be temporary while others may be erected for the duration of the project.

22.6 Conclusion

A total of eight heritage items listed on the Wingecarribee LEP are located in the project area. One item occurs within the surface infrastructure area and the rest are over the underground mining area. In addition to the listed heritage items, there are two potential archaeological sites that (if present) may reach the threshold of 'relics' (HC_127 and Mereworth 1). Two significant cultural landscapes were previously identified in the project area, being the Sutton Forest Key Historic Unit 6 (JRC Planning 1991) and the Exeter/Sutton Forest Landscape classified by the National Trust of Australia (NSW 1998).

The design of the project avoids physical impacts to the majority of the listed heritage items, with the one exception being part of the listed LEP curtilage of *Mereworth.* However, the actual house and garden at *Mereworth* will not be subject to physical impacts, nor will any significant structures in the project area be affected.

Long-term residual impacts to the landscape and built environment will be low as when mining operations come to an end, a rehabilitation plan will be implemented. The project does not involve any demolition of heritage items, and with the use of archival photography the landscape will be rehabilitated to a similar state. Changes that may remain include dams, which are utilitarian items in rural landscapes, and the improvement of *Mereworth House and Garden*.

A HHMP will be prepared to guide the preservation of identified historic heritage items and to avoid inadvertent impacts. The HHMP will also outline the protocol for unanticipated finds such as relics and human skeletal material. Where impacts cannot be avoided, specifically those that will visually impact on the cultural landscape and views and vistas, the HHMP will provide guidance on how to record the current landscape to inform the rehabilitation plan.

A CMP will be prepared and implemented for *Mereworth House and Garden*. This document will record the significance of the house and garden in more detail than what is available at present and identify areas that require immediate repairs. The CMP will include a cyclical maintenance plan for the house and garden and provide guidance on suitable uses.

The historic heritage assessment conducted for the project, and any future assessments, will add and contribute to further archival investigations of both the *Mereworth House and Garden* and will add to the historic information for the local region. Farming on the property has been increased and will continue for the life of the project, provided it is profitable, which is positive outcome for the local region.

Part E

Outcomes and justification

Chapter 23: Summary of commitments
Chapter 24: Project justification and conclusion

23 Summary of commitments

23.1 Introduction

This chapter provides a consolidated summary of the measures that will be implemented during the construction and operation of the project to manage, mitigate and/or monitor potential impacts identified within this EIS. In addition, measures to monitor and report on the environmental performance of the project are provided.

23.2 Environmental management system

Environmental aspects of the project will be managed under an environmental management system (EMS), which will be designed in accordance with the principles of continuous improvement and will be generally based on the Plan, Do, Check, Review cycle, which forms the basis of common international EMS standards (including ISO14001), as follows:

- Plan – identify what is required;
- Do – implement the activities;
- Check – monitor performance through checking and corrective action; and
- Review – evaluate the suitability, adequacy and effectiveness of the system through management review.

Key components of the EMS will include the environmental policy, as described in Section 23.2, an environmental risk register, objectives and targets, and a series of management plans and procedures. The EMS will provide a framework and tools so that the project's development consent conditions, along with other relevant statutory obligations, are implemented and complied with.

The EMS will contain a construction environmental management plan (CEMP) and an operational environmental management plan (OEMP). Management plans described in the CEMP and OEMP will be prepared by suitably qualified persons and in consultation with relevant government agencies where deemed necessary. The CEMP and OEMP will be prepared to be consistent with the relevant conditions of development consent and statutory obligations.

23.2.1 Construction Environmental Management Plan

The CEMP will contain the site-specific management and mitigation measures to be implemented during construction, including timeframes and responsibilities. It will provide a framework for the management of potential material construction impacts identified in this EIS, including:

- water (including erosion and sedimentation);
- soils and land resources;
- terrestrial and aquatic biodiversity;
- noise and vibration;
- air quality;
- traffic;
- Aboriginal heritage; and
- historic heritage.

These individual management plans that support the overarching CEMP will describe the processes and procedures for the management of specific environmental aspects and mitigation of impacts, as well as any specific monitoring and construction rehabilitation measures to be undertaken.

The CEMP will also contain provisions for site-specific training and induction of construction personnel so that they are made aware of the requirements in the CEMP that are relevant to their respective work activities.

23.2.2 Operational Environmental Management Plan

The OEMP will contain the impact-specific management measures to be implemented during operations, including timeframes and responsibilities. The OEMP will contain a number of sub-plans, which are anticipated to include:

- water management plan (including a groundwater management subplan, an erosion and sediment control plan and various monitoring subplans);
- biodiversity management plan;
- noise management plan;
- air quality management plan;
- subsidence management plan;
- rehabilitation management plan;
- bushfire management plan;
- social impact management plan including a stakeholder engagement plan;
- Aboriginal cultural heritage management plan;
- historic heritage management plan; and
- waste management plan.

Similar to the CEMP, these individual management plans that support the overarching OEMP will describe the processes and procedures for the management of specific environmental aspects and mitigation of impacts, as well as any specific monitoring and construction rehabilitation measures to be undertaken.

The OEMP will also contain provisions for site-specific training and induction of employees and relevant contractors so that they are made aware of the applicable requirements to their respective work activities.

23.2.3 Annual review

Generally, new mines in NSW are required by DP&E to prepare annual reviews, which are a tool used by regulatory agencies to determine if mines are in compliance with approval conditions. Hume Coal will prepare annual reviews in accordance with NSW Government (2015c) *Post-approval requirements for State significant mining developments: annual review guideline*, which will contain the following for the reporting period:

- summary of operations;
- description of the project's environmental and rehabilitation performance; and
- summary of community engagement activities.

23.3 Summary

A summary of the key management and mitigation measures for addressing the potential residual environmental impacts of the project is provided in this section. The construction and operation of the project will be generally in accordance with the management and mitigation measures outlined in Table 23.1. A summary of the key commitments as outlined in the EIS are presented in Table 23.2.

Table 23.1 Summary of management and mitigation measures

Water resources

- Monitoring data will be collected from a surface water and groundwater monitoring network, as described in the water management plan. This network may be expanded or amended, pending outcomes of ongoing data review.
- If analysis of monitoring results shows that the potential impacts in Table 7.18 (refer to Chapter 7 of the EIS) occur, the corresponding management measures will be implemented.

Soil and land resources

Erosion and sediment control

- During construction, sediment dams will be constructed generally in accordance with *Managing Urban Stormwater: Soils and Construction – Volume 1 4th Edition* (Landcom 2004) and *Managing Urban Stormwater Volume 2E: Mines and Quarries* (DECC 2008).

Topsoil

- Disturbance areas will generally be stripped (refer to Table 7.3 of Appendix F of the EIS), except for soil stockpiling areas and areas of minimal disturbance.

Topsoil stripping procedures

- Topsoil will be stripped, stockpiled and stored in accordance with the procedures outlined in the CEMP.

Topsoil application

- During rehabilitation works, topsoil will be re-applied to achieve the land capability classes specified in Chapter 8 and illustrated in Figure 8.4 where feasible.

Agricultural resources

- Management plans relevant to agriculture will include the water management plan (including sub-plans), subsidence management plan, biodiversity management plan, bushfire management plan and rehabilitation management plan.
- Relevant management plans will include monitoring programs for assessing impacts of the project on agricultural resources and, where appropriate, establishment of triggers and their appropriate responses.

Biodiversity

- Vegetation clearing will be undertaken in accordance with a two-stage tree clearing procedure, as outlined in the CEMP.
- The required waterway crossings and culverts will be designed and constructed generally in accordance with the guidelines entitled *'Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings'* (Fairfull and Witheridge 2003), *Policy and Guidelines for fish habitat conservation and management* (DPI 2013b) and *Guidelines for watercourse crossings on waterfront land (NOW 2012c)*.
- Hume Coal will prepare a Biodiversity Offset Package in consultation with OEH and DP&E, and will submit the draft to the Secretary for approval within 12 months of development consent being granted.

Noise

- Noise and vibration will be managed during construction and operation in accordance with the relevant measures in the CEMP and OEMP respectively.
- A noise management plan will be developed as part of the OEMP, which will:
  - identify noise-affected properties consistent with the noise and vibration assessment and any subsequent assessments;
  - outline mitigation measures to achieve the noise limits established;
  - outline measures to reduce the impact of intermittent, low frequency and tonal noise where practicable;
  - specify measures to quantify, document and ameliorate impacts that are greater than predicted, if they occur;
  - specify protocols for routine, regular attended and unattended noise monitoring of the project, including provision for regular low-frequency noise monitoring;
  - outline the procedure to notify property owners and occupiers that could be unduly affected by noise from the mine;
  - establish a protocol to handle noise complaints that includes recording, reporting and acting on complaints; and
  - specify procedures for undertaking independent noise investigations.

Table 23.1 Summary of management and mitigation measures

Air quality monitoring
• Air quality will be managed during construction and operation in accordance with the relevant measures in the CEMP and OEMP respectively. • An air quality management plan will be developed as part of the OEMP, which will include a description of monitoring locations, monitoring methods and reporting responsibilities. • Real-time air quality and meteorological monitoring will be undertaken during construction and operations, at locations which are adjacent to the majority of the surface infrastructure, as described in the air quality management plan. • Ventilation shaft emissions will be measured once the project is at full operation to verify the assumptions used in modelling.
Subsidence
General surface monitoring for verification purposes will be undertaken, as outlined in Appendix L of the EIS.
Traffic and transport
A construction traffic management plan will be prepared and implemented if temporary construction stage access is required for any project worksite not on Mereworth Road.
Hazard and risk
Bushfire A bushfire management plan will be prepared in consultation with the RFS and will contain measures to manage and mitigate bushfire risks and prevent ignition and spread of fire during operation of the project. *Dangerous goods* Measures to manage and mitigate hazards and risks during construction and operation of the project will be outlined in the OEMP, including identification of the relevant Australian standards for the transport, handling and storage of dangerous goods used at the mine.
A social management plan will be prepared and implemented which will document actions to be undertaken during the construction, operation, and closure phases of the project to monitor, report, evaluate, review and proactively respond to social change. It will also contain responsibilities of various parties in relation to the management of social impacts.
Aboriginal heritage
An Aboriginal cultural heritage management plan will be prepared in consultation with the RAPs and OEH, which will detail management of Aboriginal heritage items during construction and operation of the project generally in accordance with the measures outlined in Chapter 21 and Appendix S of the EIS.
Historic heritage
A historic heritage management plan will be prepared in consultation with DP&E and the Heritage Division, and will describe the measures to manage and mitigate historic heritage impacts during construction and operation of the project. As part of the historic heritage management plan, a conservation management plan for Mereworth house and garden will be prepared and implemented.

The project will be undertaken in accordance with the key commitments summarised in Table 23.2.

Table 23.2 Summary of commitments

Commitment
Water resources
• Impacts greater than the minimal AIP impact criteria will be subject to make good provisions. The make good provisions proposed are described in Appendix O of the Water Assessment Report (refer to Appendix E of the EIS). Hume Coal will make reasonable endeavours to negotiate make good strategies, in accordance with the measures documented in the make good report, with each of the affected landowners prior to any project-related impact occurring which exceeds the AIP minimal impact criteria.
• The make good strategies will be determined on a case by case basis, and will be dependent on the existing infrastructure, usage patterns, water licence allocation and the degree of impact at each site, and the landowner's preferred method of mitigation or compensation, within reasonable limits.
Groundwater model validation
• The groundwater model will be validated regularly. Significant deviations from the predicted impacts will be investigated, and results reported in the Annual Review. Model recalibration will be considered every two years or as required, pending the outcomes of model validation over time as physical monitoring data is incorporated.
Biodiversity
Construction
• A ground disturbance permit system will be developed that will be implemented for all clearing activities.
• The boundaries of vegetation to be cleared will be clearly delineated.
• A pre-clearance survey will be completed by a suitably qualified and trained ecologist to identify and mark hollow-bearing trees, hollow logs, burrows and nests that require management during clearing.
• All Paddys River Box trees in the construction disturbance footprint will be identified and clearly marked or fenced.
• Hollow-bearing trees removed will be replaced with salvaged hollows or nest boxes, which will be placed in general proximity to the removed hollow-bearing tree where possible.
Operations
• The surface infrastructure area will be managed for weeds.
• Fencing will be maintained to separate the CPP from adjacent grazing areas and threatened species habitat along Oldbury Creek.
• Terrestrial vegetation along Belanglo Creek and south of Wells Creek will be monitored during extended periods of drought. An appropriate response will be determined if the condition of the EEC is observed to be in decline and the decline is attributable to Hume Coal operations.
Noise and vibration
Construction
• Construction noise levels will be monitored to validate the predicted construction noise levels, and subsequently re-evaluate the predicted construction noise levels at assessment locations if required.
• Where required, noise management and mitigation measures will be amended to reduce noise levels below the NMLs.
• Affected landholders will be consulted where possible before and during construction where exceedance of NMLs are predicted, and will be notified of proposed mitigation measures that will be used to manage construction noise levels to below ICNG NMLs.
• If the safe working distances in Section 11.4.8 of the EIS are encroached, vibration monitoring will be carried out at nearby structures.
Operations
The following noise mitigation measures will be implemented:
• Low-noise conveyor idlers will be used on open sided surface conveyors to minimise conveyor noise impacts.
• The CPP building, conveyor transfer stations, crushing plant, tertiary screens and the paste plant will be enclosed to minimise noise and dust impacts.
• Low noise conveyor drives or enclosures will be used for surface conveyors.
• The CPP design will include the use of VVVF drives to minimise the potential for low-frequency noise.
• Silencers will be used on the main ventilation fans to minimise noise impacts.
• Dozer operation will be limited to the day-time only.

Table 23.2 Summary of commitments

Commitment
Air quality and greenhouse gas
• The CPP building, conveyor transfer stations, crushing plant and tertiary screens will be enclosed to minimise noise and dust impacts. • Product stockpiles will be orientated parallel to the prevailing westerly wind as much as possible to minimise potential for dust generation. • Once sufficient room is available in the mined-out voids, rejects will be emplaced underground to remove the need for a permanent surface reject emplacement. • Coal stockpiles will be designed using stackers and reclaimers to avoid the need to use dozers. • Water sprays will be fitted to the ROM and product stockpiles and the temporary reject storage area to maintain surface moisture levels. Water spray intensity will be adjusted in real-time based on meteorological observations.
The following measures will be implemented to reduce GHG emissions from the project: • materials will be sourced locally where feasible to minimise emissions generated from upstream activities; • energy efficient lighting technologies and hot water and air conditioning systems will be used wherever practical; and • awareness on energy efficiency measures will be included in site induction training packages.
Traffic
Construction • The cross-section of Mereworth Road will be widened and upgraded to an appropriate standard for the anticipated peak hour and daily traffic volumes the project will generate, with marked road centre and edge lines and gravel road shoulders. • The non-local component of the construction workforce will be housed in the onsite accommodation village to mitigate project-related traffic impacts during the construction phase.
Operations • The current intersection priority at the Mereworth Road/Hume Highway northbound off-ramp intersection will be reconfigured to realign the future traffic priority to Mereworth Road. This will change the priority at this intersection to a standard 'T' intersection with through-traffic priority, rather than the current right turn priority. • Oversize vehicle routes will be determined in consultation with RMS on a case by case and in accordance with RMS policy for oversize vehicle movements.
Visual amenity
The tree screens already planted at relevant locations around the project area will be maintained throughout the construction and operational phases of the project as required.
Lighting The following measures in Australia Standard 4282 (AS4282) *Control of Obtrusive Effects of Outdoor Lighting* will be implemented: • Mobile lighting will generally be directed away from private receptors. • Lighting sources will generally be angled below the horizontal to minimise potential light spill. • Light systems will be designed to minimise wastage. • Lighting will be screened from viewers external to the project where possible. • Light coloured (highly reflective) surfaces will not be lit where possible.
Building colours • Suitable colours will be chosen for project infrastructure during detailed design to minimise visual impacts.
Closure and rehabilitation
The overarching rehabilitation objective of the project is to restore the land to its pre-mining land use; that is, an agricultural land use comprising grazing on improved pasture. Within five years prior to mine closure, Hume Coal will prepare a detailed mine closure plan with the aim of creating a land use capability compatible with the pre-mining agricultural land use (unless other beneficial uses are pre-determined and agreed).
Hazard and risk
Bushfire • Vehicle refuelling will be confined to designated refuelling bays (where practicable). • Fire extinguishers will be provided in buildings, vehicles and refuelling areas.

Table 23.2 Summary of commitments

Commitment
• Spill response kits will be available.
• Firefighting water reticulation with diesel pump backup will be provided to surface infrastructure facilities, including coal stockpiles.
Social
Population and demographics
• A construction accommodation village will be constructed and operated to accommodate non-local construction workers for the construction phase of the project.
Labour market
• Where possible, preference will be given to local workers and firms for employment opportunities.
• Local contractors will be encouraged to tender for work during the construction, operations and closure phases.
• Training and professional development opportunities will be provided for employees.
Economic change
• Hume Coal will maximise local business opportunities by giving preference to local suppliers where reliability, quality and financial competitiveness criteria can be satisfied.

24 Project justification and conclusion

24.1 Introduction

The SEARs specify the EIS must describe the "reasons why the development should be approved, having regard to environmental, economic and social considerations, including the principles of ecologically sustainable development". They also specify that "particular attention" must be given to the economic "significance of the resource". This chapter addresses all of these requirements.

24.2 Significance of the resource

The Southern Coalfield is the only significant source of quality hard metallurgical or coking coal in NSW. Within the project area, coal deposits have been extensively explored and analysed for well over 60 years and particularly since 2011 by Hume Coal. The results show the coal has all the necessary characteristics to meet export coking coal specifications.

The remaining unallocated prime coking coal resources in the Southern Coalfield are in the Bulli and Balgownie Seams underlying the Campbelltown-Camden-Picton region, and in the Wongawilli Seam in the southern part of the coalfield (DI 2016). Further mine development in much of the Campbelltown-Camden-Picton area is constrained by its closeness to existing and planned urban areas. Conversely, mining in the Wongawilli Seam in the project area is relatively unconstrained and has the substantial advantage of closeness to rail infrastructure that links directly to the Port Kembla coal terminal. The project seeks to draw on these positive features.

Other matters that can be used to determine the resource's importance for NSW are: employment generation, expenditure, including capital investment, and royalty payments to the state government. The resource's importance in light of these factors is described in Section 19.6 and can be summarised as follows:

- Employment generation: at its peak the mine will create 300 jobs. Although not all of these will be additional because some will replace employment in other industries, the project's job creation effects will still be notable, especially as local residents will fill most operations jobs.
- Expenditure: capital expenditure will be around $860 million and operating expenditure will be around $1.4 billion over the life of the mine.
- Royalties: payments to the NSW government will total around $266 million over the life of the project or $114 million at today's value.

It is evident the project, which will develop a dormant publically owned resource – Wongawilli Seam coal – will be of significant benefit to the local and broader NSW communities.

24.3 Economic justification

The project is justified economically due to the net economic benefits and the economic stimulus it will provide locally and to NSW, as discussed below.

24.3.1 Benefits and costs

A project is economically beneficial if its benefits exceed its costs measured in today's values (known as net present value or NPV).

The total direct economic benefit of the project for NSW is estimated at $316 million in NPV terms, comprised as follows:

- royalty payments, which are estimated at $114 million in NPV terms;
- net employment benefits being the additional disposable income that NSW residents will receive, as well as the shares of personal and company income taxes that will go to NSW, that is:
  - $134 million of net disposable income benefits;
  - $21 million of the NSW share of personal income taxes;
  - $27 million of the NSW share of company income taxes; and
- incremental payroll taxes, council rates and various levies, amounting to around $20 million.

To determine the net or after cost benefit, costs associated with GHG emissions, and the foregone agricultural value added due to land being removed from agricultural production, estimated at $21 million, need to be deducted, giving a net figure of $295 million.

For the Wingecarribee LGA, the net benefits of the project are expected to amount to approximately $84 million in NPV terms.

24.3.2 Economic stimulus

A number of flow-on effects will occur as a result of the project's capital and operating expenditure, and job creation. At the NSW level an additional $73 million in value added, in today's values, will occur. There will also be an average of 62 full-time jobs added in each year of the life of the project. Locally, at the Wingecarribee LGA level, an additional $44 million in disposal income and an average 34 FTE jobs each year will be added.

24.4 Social justification

The project's social impacts have been addressed for all four phases of its development and operations.

The first phase covers planning, feasibility and approvals. During this phase positive social impacts outweigh negative ones. There will be a modest increase in local job opportunities of about 17 positions, and some strengthening of the skills base of the local workforce from Hume's apprenticeship and traineeship programs in which Hume Coal will have invested $250,000 a year. In May 2015, Hume Coal also launched the Hume Coal Charitable Foundation, providing two rounds of funding each year to local organisations. The foundation has already invested around $200,000 each year in the local community, with a focus on educational, Indigenous and not-for-profit childcare organisations within Wingecarribee LGA. On the negative side, some sections of the community will experience stress and anxiety about the project's potential impacts. These concerns will be addressed by regularly providing information to concerned individuals and groups.

During the construction phase positive impacts will also outweigh negative ones. About 414 FTE positions will be created when the construction workforce is at its peak (in just under a year from the start). Although this will be generally beneficial, the specialised nature of the jobs means that most will not be filled by locals. Potential adverse impacts associated with the influx of construction workers are crowding out of tourist and other short-term accommodation, as well as potential unruly behaviour by non-local workers during recreation time. These potential problems will be overcome by building an on-site accommodation village for all construction workers.

The operations phase will be the longest and of greatest consequence. The main impacts will be to create about 300 FTE long-term jobs, most of which will be filled by locals, and the economic stimulus which will be injected into the area from greater local expenditure on goods and services. Other benefits will be skills improvements through training and continued investments in community facilities from funding provided by Hume Coal through a VPA or similar mechanism. Environmental impacts and some change in the character of the project area will occur during operations. However, residual impacts will be managed to achieve the standards specified by regulators and, as such, none will be unacceptable.

The final closure and relinquishment phase is the only one where there will be net social costs overall. This outcome will be caused by the loss of jobs and reduced economic activity in the area, although the project will leave a legacy of a more skilled workforce and substantially upgraded community facilities as a result of funding via the VPA or similar mechanism.

In summary, the project has social merit. For three of its four phases, there will be significant net positive social outcomes largely due to four management measures: local procurement and workforce recruitment; a social impact management plan to ensure effective implementation; a VPA or similar mechanism; and a construction accommodation village for non-local all workers during construction.

24.5 Environmental justification

Great care has gone into planning the project so that its design achieves leading practice in most respects. From an environmental perspective, the design avoids most potential environmental impacts. The project's design has features that exceed the normal practices used in Australian coal mines and go beyond minimum regulatory standards, particularly:

- A low impact underground coal mine that employs a first workings mining method, resulting in negligible subsidence. This has the dual benefits of avoiding both surface disturbance and cracking in the aquifer overlying the coal seam. It thus greatly reduces surface impacts and the volumes of groundwater that would otherwise flow out of the aquifer.

- Sealing panels with bulkheads after extraction and reject backfilling, which allows water to be injected and the early recovery of groundwater levels.

- Rejects will be placed underground, removing the need for a permanent surface emplacement.

- Full and empty coal wagons travelling to and from the mine will be covered.

A summary of the key findings of the environmental assessment is provided in Table 24.1. Hume Coal has committed to implementing appropriate mitigation measures where residual impacts have been identified, so that the residual impacts of the project are all within acceptable criteria, standards and guidelines.

Table 24.1 Summary of environmental impacts

Aspect	Key findings of environmental assessment
Water	• All potential impacts to surface water users and stream environments have been assessed as insignificant in accordance with the *Significant impact guidelines* (DoE 2013). • A temporary 0.8% reduction in the catchment area of Medway Rivulet will occur during the construction and operation phases, where the surface infrastructure area will be located, producing negligible impacts downstream in the substantially larger Lower Wingecarribee Management Zone. • During years with high rainfall, annual releases offsite from SB03 are expected to ranges from 29 ML to 31 ML, and 38 ML to 41 ML from SB04. During years with low rainfall, releases are expected to be less than 1 ML per year. • With constant low flow discharges from the Moss Vale STP, the flow regimes in Medway Rivulet for the existing and operation cases are similar; and alteration of the flow regime in Oldbury Creek during operation of the mine will be minor when compared to pre-mining conditions. • MUSIC modelling assessed the potential impacts of runoff from the two mine access roads outside the water management system. With appropriate vegetated swales used as a treatment measure, NorBE criteria will be met. • A minor change in the 100 year ARI flood extents is predicted for the operational phase compared to the existing situation. Changes in flood extents following mine rehabilitation, compared to the existing situation, are only predicted in the area where SB02 will be located during mine operation. • The flood levels during the operation of the mine are within the assigned assessment criteria, except for a localised flood level of up to 340 mm in Oldbury Creek on land owned by Hume Coal between the PWD and SB02. This flood height has been considered in the design of the surface infrastructure area and water management system so that flood levels will be effectively managed without any impact from the project infrastructure. • The maximum project impact drawdown of the water table of 45 m will be reached in year 17, but will be localised in a small area (less than a quarter of a hectare) above the western part of the mine workings. In year 17, the area where the water table is affected by 2 m or more total drawdown extends at most to 2 km beyond the mine footprint to the south-east. • Ninety-three private landholder bores on 71 properties are predicted to experience a groundwater level drawdown of 2 m or more as a result of the project. Impacts to private landholder bores have been assessed as significant in accordance with the *Significant impact guidelines* (DoE 2013). • Make good provisions have been proposed with reference to the AIP for these 93 bores. • The average duration of impact on the 93 affected bores is 36 years, with the maximum duration being 65 years; however, most of the recovery will occur in a far shorter time period. On average, a bore will recover by 75% within 23 years since it was first impacted. • Predicted impacts to other groundwater users (GDEs, watercourses, drainage lines, and swamps that receive baseflow) have been assessed as insignificant. • Hume Coal has already secured in excess of approximately 62% of the total licence requirement for the project, with a clear pathway for how the remaining licence volume is to be secured so that all water taken is adequately licensed.
Soils	• There is no BSAL present within the project area, as confirmed by the issuing of a SVC in 2016. • Due to the underground nature of the mine and using the first workings coal extraction method, impacts on soil resources will not be significant as a result of the project, as only localised land clearing will occur and subsidence will be negligible. • There will be a change to the land and soil capability class post-mining over 58 ha disturbed by the surface infrastructure area. • The original land class of these areas (3 ha of Class 3, 37 ha of Class 4 and 18 ha of Class 5) will change to Class 6 due mainly to a change in soil depth. However, Class 6 land will still be suitable for grazing and improved pasture, allowing agricultural land use to continue post-mining.

Table 24.1 Summary of environmental impacts

Aspect	Key findings of environmental assessment
Agricultural resources	• The potential disturbance of agricultural land from the project is limited to the temporary disturbance of the surface infrastructure area, which will occur wholly on Hume Coal affiliated land (with the exception of a downcast shaft, which will be in Belanglo State Forest). • Disturbed land will be returned to its pre-mining land use upon completion of mining; that is, agriculture comprising grazing on improved pasture. • There will be minor temporary foregone agricultural production values during the construction and operation of the project. However, this will be offset by the increase in productivity achieved on Hume Coal affiliated properties by applying leading practice management techniques when compared to the pre-Hume Coal affiliated property management regime.
Biodiversity	• Residual biodiversity impacts include the removal of 64 paddock trees. • Offsets have been calculated using the BioBanking Calculator. The project requires 101 ecosystem credits for the removal of vegetation and ecosystem credit species habitats, and a total of 582 species credits. • A biodiversity offset strategy has been proposed to source offset areas containing the required ecosystem and species credits; which will be finalised into a biodiversity offset package and submitted to DPE within 12 months of the date of development consent. • Areas of terrestrial vegetation along Belanglo Creek and Wells Creek were identified as having a higher risk of drawdown impact from underground mining. However, these areas have a facultative (opportunistic) dependence on groundwater, and will be able to respond to changes in the water table outside of periods of prolonged drought. Monitoring strategies have been proposed to manage these ecosystems in the event of prolonged drought. • Assessments of significance were completed for threatened species and communities. The project is not predicted to result in significant impacts for any of these species and communities.

Noise and vibration	• The operational noise assessment has identified that during adverse weather conditions and with all the feasible mitigations applied:
	  ○ eight assessment locations (nine dwellings) within the area modelled are predicted to experience residual noise levels between 3 dB and 5 dB above project-specific noise levels (PSNL) and are therefore entitled to voluntary mitigation upon request; and
	  ○ two assessment locations within the area modelled are predicted to experience residual noise levels greater than 5 dB above PSNLs and are therefore entitled to voluntary acquisition upon request.
	• Alternatively, Hume Coal may enter into amenity agreements with these landholders.
	• No privately owned land parcels are predicted to exceed the 25% area voluntary land acquisition criteria as defined in the Voluntary Land and Mitigation Policy.
	• The predicted internal noise levels at assessed privately owned residences will be well below those likely to cause sleep disturbance.
	• Construction noise levels during standard Interim Construction Noise Guideline construction hours will exceed the noise affected NML (noise management level) at several assessment locations. The 'highly affected' noise limit of 75 dB will not be exceeded at any time.
	• This is not uncommon for construction projects, and it is important to note that the NML is not a criterion (as are operational noise limits), but a trigger for when construction noise management is to be considered and implemented. It will be managed by limiting construction to standard hours only.
	• Underground mine construction will occur at around 110 m under the Hume Highway. Based on the structural vibration screening criteria of 7.5 mm/s and the identified vibration levels from similar construction activities (typically 0.1 mm/s at such distances), it is highly unlikely vibration levels will cause structural vibration impacts to the Hume Highway.

Air quality	• The underground nature of the project is a significant avoidance measure in relation to potential air quality impacts. • Accounting for the combination of project and neighbouring emission sources with ambient background levels, the potential to exceed applicable NSW EPA impact assessment criteria as a result of the project is very low, beyond those that would occur in the absence of the project (eg days influenced by bushfires, dust storms). • A review of best practice dust control measures found the measures incorporated into the project design are in accordance with or above accepted industry best practice dust control standards. Proposed mitigation measures will effectively control emissions to minimise impacts on the surrounding environment, and to levels that are within the applicable criteria.

Table 24.1 Summary of environmental impacts

Aspect	Key findings of environmental assessment
Greenhouse gas	• Greenhouse gas (GHG) emissions from the project are predicted to be minimal and make only minor contributions to the total GHG emissions for NSW and Australia. • A total of 1,795,965 t $CO_{2\text{-}e}$ (scope 1 and 2) GHG emissions will be emitted over the life of the project. The annual average scope 1, 2 and 3 emissions (excluding the end use of coal) from the project represent about 0.068% and 0.017% of total GHG emissions for NSW and Australia, respectively, based on the latest National Greenhouse Gas Inventory for 2014.
Subsidence	• The adopted first workings mining method and associated mine layout for the project will reduce the levels of surface and sub-surface subsidence from mining to the lowest practical impact level, while still allowing the productive and economic recovery of the coal. • The predicted maximum values of associated subsidence parameters are low enough that subsidence-related impacts on surface features will be imperceptible. • Construction of mine workings will need to comply with the layout presented in Chapter 2 and the design parameters adopted in the subsidence assessment so that the long-term stability of the workings is not inadvertently compromised. • In addition to the mine layout and the coal pillars being left in place, long-term stability will be assisted by placing rejects back into the mined-out voids, and the post-mining flooding of the mined workings and associated re-establishment of full hydrostatic water pressures.

Traffic and transport	• No significant adverse traffic impacts on the local and regional road network have been identified as a result of traffic movements the project will generate during both the construction and operation phases, based on:
	  ○ the road network traffic capacity;
	  ○ current intersection traffic operations; or
	  ○ the prevailing levels of traffic safety on the road network.

Visual amenity	• The project will not have significant adverse visual impacts on the locality. Due to existing mature vegetation in the landscape and the area's topography, the project will be relatively shielded from view. • Two viewpoints were assessed as having the potential to experience a moderate to high unmitigated visual impact as a result of the project; viewpoint 3 (private residence along Medway Road) and viewpoint 4 (also along Medway Road). • Vegetation screens have already been planted around the surface infrastructure area. These will take time to become established and fully effective but, once established, the measures will mitigate visual impacts for both residents in the locality and motorists.
Closure and rehabilitation	• The disturbance footprint of the mine will be rehabilitated once mining is complete, with the overarching goal of rehabilitation to restore the land to its pre-mining land use; that is, an agricultural land use comprising grazing on improved pasture. • Being an underground mine, disturbed areas on the surface requiring rehabilitation at the mine's closure will be limited, with the disturbance footprint comprising about 2% of the entire project area. • Underground voids will be progressively partially backfilled as mining progresses. This will assist in groundwater recovery, as well as eliminating the need for large surface reject emplacements that would otherwise require rehabilitation at mine closure. • The risk of subsidence-related impacts occurring above the underground mine is negligible, so it is expected there will be no requirement to remediate areas above the underground workings. However, regular inspections will monitor sensitive features above the underground mining area where land access can be reasonably obtained and identify remedial actions at the time, if required.

Table 24.1 Summary of environmental impacts

Aspect	Key findings of environmental assessment

Aboriginal heritage	• The project and Berrima Rail Project will have the following combined impacts:
	• The project's surface infrastructure area will directly impact 20 sites, of which there are:
	  ○ no sites of high significance;
	  ○ six sites of moderate significance, two of which are of higher moderate significance (HC_135 and HC_151); and
	  ○ 14 sites of low significance.
	• Eight sites will be directly impacted by the rail project, of which there are:
	  ○ no sites of high significance;
	  ○ two sites of higher moderate significance (HC_176 and HC_177); and
	  ○ six sites of low significance.
	• Eighty-nine sites are above the project's underground mine area, but no subsidence impacts are predicted to occur.
	• One hundred and two sites are outside the project's surface infrastructure disturbance footprint and underground mine area and the rail disturbance footprint. These sites will be avoided.
	• Taking the very low risk of subsidence impacts into account, it is very likely that 191 of the 219 sites (87%) assessed will not be impacted by either project.

Historic heritage	• Eight listed heritage items are, either wholly or partially, in the project area. • One occurs within the surface infrastructure area and the rest are over the underground mining area. All are listed on the Wingecarribee LEP. • In addition to the listed heritage items, there are two potential archaeological sites that (if present) may reach the threshold of 'relics' (HC_127 and Mereworth 1). • The project's design avoids physical impacts to most of the listed heritage items, with the exception of part of the listed LEP curtilage of Mereworth. However, Mereworth's actual house and garden will not be subject to physical impacts, nor will any significant structures in the project area be affected. • A construction management plan will be prepared and implemented for Mereworth's house and garden. The plan will record the significance of the house site in more detail than is now available and will identify areas that require immediate repairs, which will guide the property's maintenance and management, leading to a positive transformation.

In summary, the project's design adopts leading practice and avoids most potential environmental impacts, and where unavoidable (or residual) impacts occur they will be effectively managed to meet the applicable regulatory standards. It then follows that no impact deemed unacceptable by a regulatory agency will occur, meaning the project is clearly justified from an environmental perspective.

24.6 Ecologically sustainable development

The Commonwealth's *National Strategy for Ecologically Sustainable Development* defines ESD as 'using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased'. The NSW EP&A Act adds to this by providing a set of ESD principles. The project's compatibility with each of the above principles is considered below.

i Precautionary principle

The precautionary principle holds that where there are threats of serious or irreversible environmental damage, a lack of full scientific certainty should not be used as a reason for postponing measures to prevent such damage.

The proposed mine plan and overall project design were progressively devised over several years and based on detailed investigations of geological, environmental, engineering and financial considerations. The baseline environmental investigations began in 2011 and included groundwater, surface water, ecology, air quality, noise, soils, heritage, visual, social and economic conditions, and geologic factors relating to potential subsidence. All potential risks were identified and taken into account in the project design.

As explained in Chapter 6, project planning included multiple rounds of design, assessment and refinement to avoid impacts or, if unavoidable, minimise or offset them. A number of leading practice innovations have been incorporated into the proposal to either avoid or minimise impacts, including non-caving coal extraction, placing rejects underground and covering coal wagons to minimise dust generation.

The result is that for all potential impacts no serious or irreversible harm will occur. Unavoidable impacts will meet applicable regulatory criteria, such as for noise, air quality and water quality. In instances where no regulatory criteria exist, such as for social or land subsidence impacts, the project has been designed to avoid adverse impacts and in many instances will have a positive outcome. Therefore, the project fully addresses the precautionary principle because there will be no serious or irreversible environmental damage.

ii Inter-generational equity

Inter-generational equity is the concept that the present generation should ensure the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.

The only beneficial land use that could be affected is agriculture. In this regard the inherent agricultural capability of the land will either be maintained in areas where no surface disturbance will occur, or be reinstated at the end of the mine life in those areas where surface mine support infrastructure will be developed. More broadly, the area's agricultural potential will be improved by consolidating land ownership and introducing better management techniques, which has already begun on land owned by Hume Coal.

No meaningful loss of cultural resources will occur. The project has been designed to avoid most Aboriginal and historic heritage sites. In the minority of cases where avoidance is not possible, the affected items will be investigated and recorded.

As with cultural resources, most impacts on natural resources will be avoided or mitigated. The project's residual biodiversity impacts include the removal of 64 paddock trees. However, an offset strategy has been developed and, once implemented, will mean a net beneficial gain in biological resources.

Surface waters will be managed to achieve a neutral or better outcome in all creeks and rivers that receive runoff from the project area. There will be some effects on groundwater during and in the immediate years after mining. The impacts will be caused by water flowing into the mined-out voids from adjoining aquifers, resulting in an increase in the depth of the groundwater table. Recovery will be enhanced by capturing groundwater in the voids through sealing the entrances of the mine panels following extraction. While it will take an average of 45 years for the groundwater table in impacted bores to recover to within 2 m, no existing user will be disadvantaged because of make good measures that will be implemented.

The only natural resource that will be lost is the in situ coal. About 50 Mt of coal will be removed over the life of the mine. The majority of this will be used to produce steel. Steel is a recyclable metal that can be reused for generations, meaning there will be no disadvantage to future generations from the loss of valuable materials. Further, the revenue generated by the project will be used to employ and up skill the mine workforce and provide more community facilities and other social infrastructure (mainly through a VPA). This will allow natural capital (coal) to be transformed into economic capital (greater personal and public income), social capital (better public facilities) and human capital (a more skilled and wealthier workforce).

iii Conservation of biological diversity and maintenance of ecological integrity

The underground mine method to be used for the project means its surface disturbance will be minimal. The surface infrastructure area will be constructed on land that has been largely cleared for agriculture. Further potential impacts on biological diversity through surface disturbance have also been avoided by including the underground emplacement of rejects in the project design.

Where clearing of vegetation is required (ie 64 paddock trees), offsets will be provided to compensate. The overall outcome will be an increase in the area and quality of land conserved for biodiversity protection, meaning the ecological integrity of the area will be strengthened.

iv Improved valuation and pricing of environmental resources

The EIS provides estimates of the monetary value of all material costs and benefits associated with the project. It includes estimates of the value of intangible (or non-traded) factors, such as air or water quality impacts, that have been derived using current leading practice techniques. The costs and benefits have been compared transparently to provide an estimate of the project's net benefit.

The result is a reliable estimate of the project's economic value that provides useful guidance to decision-makers and other interested parties about the project's overall merit. It has also fully addressed the requirement for "improved valuation and pricing of environmental resources".

24.7 Conclusion

The project is clearly justified on economic, social and environmental grounds. This is demonstrated by its consistency with key objectives of the EP&A Act.

The project will develop a valuable, publically owned natural resource – Wongawilli Seam coal. At the same time valuable environmental and cultural resources will be managed effectively and will be protected. When the economic and social benefits of the project are also taken into account, it is evident that community welfare will increase. This means that the project will achieve "proper management, development and conservation of resources ... and promote social and economic welfare".

The project's design and proposed management procedures are based on a comprehensive understanding of environmental conditions in and around the project area. The design avoids threats of serious or irreversible environmental damage. Further, the project will achieve inter-generational equity by transforming natural capital (coal), into economic and social capital in the form of greater income and employment, and material capital in the form of steel and other products that are essential for everyday life.

The project is therefore consistent with the principles of ecologically sustainable development and will, for the reasons given above, serve the public interest.

Abbreviations, references and glossary

Abbreviations

AAQM	Ambient air quality measure
ABS	Australian Bureau of Statistics
ACARA	Australian Curriculum, Assessment and Reporting Authority
ACHA	Aboriginal cultural heritage assessment
ACHMP	Aboriginal cultural heritage management plan
ACT	Australian Capital Territory
ADW	Australian Drinking Water
AEP	Annual exceedance probability
AERMOD	Atmospheric Dispersion Modelling System
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
AHMP	Aboriginal Heritage Management Plan
AIP	Aquifer Interference Policy
AIS	Agricultural Impact Statement
ANSTO	Australian Nuclear Science and Technology Organisation
ANZECC	Australian and New Zealand Environment and Conservation Council
ANZMEC	Australian and New Zealand Minerals and Energy Council
ARI	Average recurrence interval
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ARMPS	Analysis of Retreat Mining Pillar Stability
ARTC	Australian Rail Track Corporation
AS	Australian Standard
ASC	Australian Soil Classification
ASRIS	Australia Soils Resource Information System
ASS	Acid sulphate soil
ASX	Australian Stock Exchange
AWBM	Australian Water Balance Model
AWS	Automatic weather station
bcm	Bank cubic metres
bgl	Below ground level
BMP	Biodiversity management plan
BNAC	Buru Ngunawal Aboriginal Corporation
BoM	Bureau of Meteorology
Boral	Boral Cement Ltd
BSAL	Biophysical strategic agricultural land
BTEX	Benzene, toluene, ethyl-benzene and xylene
CAV	Construction accommodation village
CBA	Cost/benefit analysis
CCD	Census collection district

CCL	Consolidated Coal Lease
CEEC	Critically endangered ecological community
CEMP	Construction Environmental Management Plan
CHL	Commonwealth heritage register
CHR	Commonwealth heritage register
CIC	Critical industry clusters
cm	Centimetres
CMP	Conservation management plan
CO	Carbon monoxide
CPP	Coal preparation plant
CRF	Concentration-response functions
Crown Lands Act	NSW *Crown Lands Act 1989*
CSG	Coal seam gas
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DA	Development application
Dams Safety Act	*NSW Dams Safety Act 1978*
dB	Decibels
DEC	NSW Department of Environment and Conservation
DECC	NSW Department of Environment and Climate Change
DECCW	NSW Department of Environment, Climate Change and Water
DEE	NSW Department of Environment and Energy
DEM	Dust extinction moisture
DLWC	NSW Department of Land and Water Conservation
DoE	Commonwealth Department of the Environment
DoEE	Commonwealth Department of the Environment and Energy
DP&E	NSW Department of Planning and Environment
DP&I	NSW Department of Planning and Infrastructure (now DP&E)
DPI	NSW Department of Primary Industries
DPI Water	NSW Department of Primary Industries – Water
DRE	NSW Division of Resources and Energy
Drinking Water SEPP	*State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011*
DSC	Dams Safety Committee
DSE	Dry sheep equivalent
EC	Electrical conductivity
EEC	Endangered ecological community
EIS	Environmental impact statement
EMM	EMM Consulting Pty Limited
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EP&A Regulation	NSW Environmental Planning and Assessment Regulation 2000
EPA	NSW Environmental Protection Authority
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EPI	Environmental planning instrument
EPL	Environment protection licence
ESD	Ecologically sustainable development

FBA	Framework for Biodiversity Assessment
FEL	Front end loader
FM Act	NSW *Fisheries Management Act 1994*
Forestry Act	NSW *Forestry Act 1916*
FoS	Factor of Safety
FTE	Full time equivalent
g	Grams
GAHA	Gundungurra Aboriginal Heritage Association Inc
GDE	Groundwater dependent ecosystem
GDP	Gross domestic product
GHG	Greenhouse gas
GIS	Geographic information system
GLVIA	*Guidelines for Landscape and Visual Impact Assessment*
GMMP	Groundwater monitoring and modelling plan
GOS	Gross operating surplus
GP	General practitioner
GPa	Gigapascal
GPS	Global positioning system
GSP	Gross state product
ha	Hectares
Heritage Act	NSW *Heritage Act 1977*
HHMP	Historic heritage management plan
HRA	Hazard and risk assessment
HRC	Healthy Rivers Commission
HSE	Health and Safety Executive
Hume Coal	Hume Coal Pty Limited
HWM	Highwall mining
Hz	Hertz
IBRA	Interim Biogeographic Regionalisation of Australia
ICI	Imperial Chemical Industries
ICNG	*Interim Construction Noise Guideline*
ICOMOS	International Council on Monuments and Sites
IEA	International Energy Agency
IESC	Independent Expert Scientific Committee
ILALC	Illawarra Local Aboriginal Land Council
IMT	Indurated mudstone/tuff
ING	*Industrial Noise Guideline*
Inghams	Inghams Enterprises Pty Limited
INP	*NSW Industrial Noise Policy*
Interim Protocol	*Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land*
ISC	Industrial Source Complex
ISO	International Organisation for Standardisation
K	Hydraulic conductivity

kg	Kilograms
KLC	Kinetic leachate columns
km	Kilometres
km^2	Square kilometres
KNAC	Koomurri Ngunawal Aboriginal Corporation
kPa	Kilopascal
kV	Kilovolts
LEA	Local effects analysis
LEP	Local environmental plan
LGA	Local government area
Local Government Act	NSW *Local Government Act 1993*
LoS	Level of service
LPG	Liquefied petroleum gas
LSC	Land and soil capability
LTAAEL	Long-term average annual extraction limit
m	Metres
m^2	Square metres
m^3	Cubic metres
mbgl	Metres below ground level
MCA	Minerals Council Australia
Metropolitan groundwater WSP	Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011
Metropolitan surface water WSP	Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2011
mg	Milligrams
MIC	Maximum instantaneous charge
Mining Act	NSW *Mining Act 1992*
Mining SEPP	*State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007*
ML	Megalitres
MLA	Mining Lease Application
mm	Millimetres
MNES	Matters of national environmental significance
MOP	Mining operations plan
MPa	Megapascal
Mt	Million tonnes
Mtce	Metric tonnes carbon equivalent
Mtpa	Million tonnes per annum
MUSIC	Model for Urban Stormwater Improvement Conceptualisation
MWD	Mine water dam
n	Number
NCA	Noise catchment areas
NEPC	National Environmental Protection Council
NEPM	National Environmental Protection Measures

NGAF	National Greenhouse Accounts Factors
NGERS Act	Commonwealth *National Greenhouse and Energy Reporting Act 2007*
NHL	National Heritage Register
NHMRC	National Health and Medical Research Council
NIAC	Northern Illawarra Aboriginal Collective Inc
NIOSH	National Institute for Occupational Safety and Health
NML	Noise management levels
NMP	Noise management plan
NMZ	Nepean management zone
NO	Nitric oxide
NO_2	Nitrogen dioxide
NorBE	Neutral or beneficial effect
NOW	NSW Office of Water
NPI	National Pollutant Inventory
NPV	Net present value
NPW Act	NSW *National Parks and Wildlife Act 1974*
NRMMC	Natural Resource Management Ministerial Council
NSW	New South Wales
NT	National Trust of Australia
NVA	Noise and vibration assessment
NV Act	NSW *Native Vegetation Act 2003*
NZS	New Zealand Standard
OEH	NSW Office of Environment and Heritage
OEMP	Operational environmental management plan
OHEW	Overhead earth wire
Omya	Omya Australia Pty Ltd
OU	Odour unit
PAC	Planning Assessment Commission
PADs	Potential archaeological deposits
PCT	Plant community type
PEL	Pacific Environment Limited
PHA	Preliminary hazard analysis
Pipelines Act	*NSW Pipelines Act 1967*
PM	Particulate matter
PM_{10}	Fine particulate matter 10 microns in diameter or less
$PM_{2.5}$	Fine particulate matter 2.5 microns in diameter or less
PMF	Probable maximum flood
POEO Act	NSW *Protection of the Environment Operations Act 1997*
POSA	POSCO Australia
ppm	Parts per million
pphm	Parts per hundred million
PPV	Peak particle velocity
PSNL	Project specific noise levels
PWD	Primary water dam

RAP	Registered Aboriginal party
RBL	Rating background level
RFS	NSW Rural Fire Service
RING	*Rail Infrastructure Noise Guideline*
RMS	NSW Roads and Maritime Services
rms	Root mean square
RNE	Register of the National Estate
RNP	*Road Noise Policy*
Roads Act	NSW *Roads Act 1993*
ROM	Run of mine
RTA	NSW Roads and Traffic Authority
RTS	Response to submissions
Rural Fires Act	NSW *Rural Fires Act 1997*
SAL	Strategic agricultural land
SB	Stormwater basin
SBS	Sydney Basin South
SCA	Sydney Catchment Authority
SEARs	Secretary's environmental assessment requirements
SEPP	State Environmental Planning Policy
SEPP 33	*State Environmental Planning Policy No. 33 – Hazardous and Offensive Development*
SEPP 44	*State Environmental Planning Policy No. 44 – Koala Habitat Protection*
SEPP 55	*State Environmental Planning Policy No 55 – Remediation of Land*
SES	State Emergency Services
SH	State highway
SHCAG	Southern Highlands Coal Action Group
SHI	State Heritage Inventory
SHR	State heritage register
SIA	Social impact assessment
SIMP	Social Impact Management Plan
SMH	Sydney Morning Herald
SMP	Subsidence management plan
SoHI	Statement of Heritage Impact
SO_2	Sulphur dioxide
SRD SEPP	*State Environmental Planning* Policy *(State and Regional Development) 2011*
SRG	Social reference group
SRLE	Southern Regional Livestock Exchange
SRLUP	Strategic Regional Land Use Policy
SSD	State significant development
STP	Sewage treatment plant
SVC	Site verification certificate
t	Tonnes
TAFE	Technical and Further Education
TAMP	The air model pollution
TDS	Total dissolved solids

TEC	Threatened ecological community
TEOM	Tapered element oscillating microbalance
TfNSW	Transport for NSW
TN	Total nitrogen
TP	Total phosphorus
tph	Tonnes per hour
TSC Act	NSW *Threatened Species Conservation Act 1995*
TSF_H	Tectonic Stress Factor for the major horizontal stress
TSF_h	Tectonic Stress Factor for the minor horizontal stress
TSP	Total suspended particles
TSS	Total suspended solids
UCS	Unconfined Compressive Strength
UK	United Kingdom
USA	United States of America
US EPA	United States Environmental Protection Agency
VDV	Vibration dose values
VIA	Visual impact assessment
VIS	NSW Vegetation Information System
VLAMP	Voluntary Land Acquisition and Mitigation Policy
VOC	Volatile organic compound
VPA	Voluntary planning agreement
VVVF	Variable voltage variable frequency
WAG	Water advisory group
WAL	Water Access Licence
Water Act	NSW *Water Act 1912*
WHO	World Health Organisation
WLEP	Wingecarribee Local Environmental Plan
WM Act	NSW *Water Management Act 2000*
WMP	Water management plan
WSC	Wingecarribee Shire Council
WSP	Water sharing plan
WTP	Water treatment plant
Yamanda	Yamanda Aboriginal Association

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Glossary of Terms

Arboreal: adapted for living and moving around in trees.

Adit: the entry to an underground mine which is horizontal or nearly horizontal, by which the mine can be entered, drained of water, ventilated, and minerals extracted.

Alluvium: unconsolidated sediments (clays, sands, gravels and other materials) deposited by flowing water. Deposits can be made by streams on river beds, floodplains, and alluvial fans.

Amenity noise criteria: the amenity noise criteria relate to existing industrial noise. Where industrial noise approaches base amenity noise criteria, then noise levels from new industries need to demonstrate that they will not be an additional contributor to existing industrial noise.

Amortised value: reducing the value of assets to reflect their declining worth over time. Amortising tends to be used for writing off intangible assets, such as goodwill.

Anion: an ion carrying a negative charge which moves towards the anode (positive electrode) during electrolysis.

Aquifer: rock or sediment in a formation, group of formations, or part of a formation that is saturated and sufficiently permeable to transmit economic quantities of water.

Ash content (of coal): the non-combustible residue left after coal is burnt; represents the bulk mineral matter after carbon, oxygen, sulphur and water has been driven off during combustion.

Basalt: a greenish- or brownish-black rock of compact texture and considerable hardness that is igneous in origin.

Bioturbation: the disturbance of sedimentary deposits by living organisms.

Bord and pillar: a method of mining where the coal seam is divided into a regular block like array by driving through it primary headings which are intersected at regular intervals by connecting cutthroughs.

Bulkhead: substantial water retaining plug, typically of concrete, designed to seal mine workings permanently.

Carcinogenic effects: capable of leading to cancer due to exposure to different substances.

Cation: an ion carrying a positive charge which moves towards the cathode (negative electrode) during electrolysis.

Curtilage: a small court, yard, garth, or piece of ground attached to a dwelling-house, and forming one enclosure with it, or so regarded by the law; the area attached to and containing a dwelling-house and its out-buildings.

Curvature: the rate of change of tilt calculated as the change in tilt between two adjacent sections of the tilt profile divided by the average length of those sections (also referred to as sagging).

Day period: Monday–Saturday: 7:00 am to 6:00 pm, on Sundays and public holidays: 8:00 am to 6:00 pm.

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.

Diatremes: a volcanic pipe formed by a gaseous explosion.

Diurnal: of or during the day.

Dolerite: a mineral allied to basalt.

Drift: an inclined tunnel, typically from the surface to an orebody or coal seam.

Drawdown: a lowering of the water table in an unconfined aquifer or the pressure surface of a confined aquifer caused by pumping of groundwater from bores and wells.

Drivages: horizontal or near-horizontal tunnels in coal.

Dry sheep equivalent: a standard unit used to compare the feed requirements of classes of livestock and to assess the carrying capacity of a farm or paddock.

Dyke: a sheet like, near vertical minor igneous instruction that cuts across horizontal to gently dipping planar structures in the country rock.

Edaphic: produced, or influenced by, soil.

Edge effects: refer to the changes in population or community structures that occur at the boundary of two habitats.

Ephemeral: lasting a very short time; short-lived; transitory.

Evening period: Monday–Saturday: 6:00 pm to 10:00 pm, on Sundays and public holidays: 6:00 pm to 10:00 pm.

Forage: search widely for food or provisions.

Full time equivalent: a unit used to indicate the hours worked by one employee on a full-time basis.

Gabbro: a dark, coarse-grained plutonic rock of crystalline texture, consisting mainly of pyroxene, plagioclase feldspar, and often olivine.

Geochemical Abundance Index: a measure of enrichment of elements in whole rock samples that compares the actual concentration of an element in a sample with the median abundance for that element in the most relevant media.

Goaf: the part of the mine from which coal has been partially or wholly removed, where the overlying ground typically collapses as mining progresses.

Gross state product: the sum of gross value added across all industries in a given state.

Gypsum: a soft white or grey mineral consisting of hydrated calcium sulphate.

Ha-ha: a boundary to a garden, pleasure-ground, or park, of such a kind as not to interrupt the view from within, and not to be seen till closely approached; consisting of a trench, the inner side of which is perpendicular and faced with stone or brick, the outer sloping and turfed; a sunk fence.

Highwall mining: a surface mining method that uses long, narrow unsupported drivages formed via remote control continuous miner and some form of continuous conveying system back to the surface.

Horizontal strain: caused by bending and differential horizontal movements in the strata, this strain is determined from monitored survey data by calculating the horizontal change in the length of a section of a subsidence profile and dividing this by the initial horizontal length of that section.

Interburden: the material that lies between two areas of geological interest, such as the material separating coal seams within strata.

Intrusive noise criteria: refers to noise that intrudes above the background level by more than 5 dB.

Isopach: contour lines on a map connecting all points of equal thickness of a particular geologic formation.

Laterite: a reddish clayey material, hard when dry, forming a topsoil in some tropical or subtropical regions and sometimes used for building.

L_{eq}: the energy average noise from a source. This is the equivalent continuous sound pressure level over a given period. The $L_{eq\ (15min)}$ descriptor refers to an L_{eq} noise level measured over a 15 minute period.

L_{max}: the maximum sound pressure level received during a measuring interval.

Longwall: noting or pertaining to a means of extracting coal or other minerals in an underground mine from a continuous face, the roof at the face being supported at intervals by temporary or movable artificial supports which allow the roof to collapse and form a goaf behind the face.

Luffing stacker: a stacking machine that travels along the entire length of the longitudinal stockpile conveyor and serves to build a stockpile on one side of the conveyor only.

Marcasite: an iron sulphide mineral with orthorhombic crystal structure consisting of iron pyrites.

Metallurgical coal: coal used in the production of steel; also known as coking coal.

Metasediment: sediment or sedimentary rock that appears to have been altered by metamorphism.

Net disposal value: the value of an asset or belonging where it can be sold or disposed of without suffering any loss.

Net present value: The net present value is the sum of a series of net cashflows, discounted over time to reflect the time-value of money. The discount rate used should reflect the utility value of money to the individual or group of individuals to whom the costs and or benefits will accrue.

Night period: Monday–Saturday: 10:00 pm to 7:00 am, on Sundays and public holidays: 10:00 pm to 8:00 am.

Non-fibrogenic dust: a type of inert or nuisance dust, which has low concentrations of silica.

Olivine: a magnesium iron silicate; common mineral in the Earth's subsurface; weathers quickly on the surface.

Opportunity cost: the true cost of something is what you give up to get it. This includes not only the money spent in buying (or doing) the something, but also the economic benefits that you did without because you bought (or did) that particular something and thus can no longer buy (or do) something else.

Overburden: the overlying rock, clay, etc., above the mineral of economic interest. In open cut mining this is the material that must be removed to access the mineral deposit.

Peat: a brown material consisting of partly decomposed vegetable matter forming a deposit on acidic, boggy, ground, which is dried for use in gardening and as fuel.

Permeability: the property or capacity of a porous rock, sediment, clay or soil to transmit a fluid. It is a measure of the relative ease of fluid flow under unequal pressure. The hydraulic conductivity is the permeability of a material for water at the prevailing temperature.

Perennial: lasting for an indefinitely long time; enduring.

Piezometer: an instrument for measuring the pressure of a liquid or gas, or something related to pressure (such as the compressibility of liquid).

Piling: the action of forming into a pile or piles; heaping or stacking up; accumulation.

Porosity: the proportion of open space within an aquifer, comprised of intergranular space, pores, vesicles and fractures.

Portal: provides access to a coal seam and, in general, are the first to be completed and the last to be sealed.

Project-specific noise levels: criteria for a particular industrial noise source or industry. The PSNL is the lower of either the intrusive criteria or amenity criteria.

Pyrite: a common iron sulphide mineral usually found associated with other sulphides or oxides in quartz veins, sedimentary rock, metamorphic rock, coal beds and as a replacement mineral in fossils.

Rating background level: an overall single value background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the average background levels.

Recharge: the process which replenishes groundwater, usually by rainfall infiltrating from the ground surface to the water table and by river water reaching the water table or exposed aquifers. The addition of water to an aquifer.

Recharge area: a geographic area that directly receives infiltrated water from surface and in which there are downward components of hydraulic head in the aquifer. Recharge generally moves downward from the water table into the deeper parts of an aquifer then moves laterally and vertically to recharge other parts of the aquifer or deeper aquifer zones.

Reclaimers: any machine used to recover items or bulk materials from an existing stockpile.

Sclerophyll: a type of vegetation that has hard leaves, short internodes (the distance between leaves along the stem) and leaf orientation parallel or oblique to direct sunlight.

Shale: an argillaceous fissile rock, the laminae of which are usually fragile and uneven, and mostly parallel to the bedding; often overlying a coal formation.

Silcrete: a strongly indurated siliceous material, that forms as a result of low-temperature silicification of weathered bedrock, regolith and/or sediments that are unconsolidated, at or near the surface.

Sill: a tubular or sheet like igneous body from a few centimetres to hundreds of meters in length.

Sound power level (L_W): a measure of the total power radiated by a source. The sound power of a source is a fundamental property of the source and is independent of the surrounding environment.

Stackers: any machine for raising individual items or bulk materials and depositing them on a stack or pile.

Stratigraphy: the branch of geology that is concerned with the order and relative position of the strata of the earth's crust.

Stygofauna: the animals that live in groundwater. The taxa predominantly comprise many kinds of crustaceans but includes worms, snails, insects, other invertebrate groups, and, in Australia, two species of blind fish.

Subsidence: mining-induced movements (both horizontal and vertical) and deformations of the ground surface.

Tailings: a combination of the fine-grained solid material remaining after the recoverable metals and minerals have been extracted from crushed and ground mined ore, and any process water remaining.

Tapered element oscillating microbalance: a machine used to measure the concentration of air particles.

Tectonic stress factor: a direct measure of the horizontal ‘tectonic strain’ contained within a rock measure.

Temperature inversion: a meteorological condition where the atmospheric temperature increases with altitude.

Thermal coal: coal used for power and heat generation.

Tilt: the change in the slope of the ground as a result of subsidence, and is calculated as the change in subsidence between two points divided by the distance between those points.

Transect: a straight line or narrow section through an object or natural feature or across the earth's surface, along which observations are made or measurements taken.

Unconfined/Uniaxial compressive strength: the maximum axial compressive stress that a right-cylindrical sample of material can withstand under confined conditions; mechanical property of rock mass determined on core samples obtained from exploratory boreholes; the strength of a rock or soil sample when crushed in one direction (uniaxial) without lateral constraint.

Veneering: a dust mitigation technique whereby a biodegradable starch-based polymer solution is applied to coal stockpiles. Once applied, the solution forms a crust on the surface of the stockpile, which prevents wind lift-off of fine particles.

Water table: the top of an unconfined aquifer. It is at atmospheric pressure and indicates the level below which soil and rock are saturated with water.

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