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Invincible Southern Extension Project

ENVIRONMENTAL ASSESSMENT

SECTION 75W MODIFICATION

CC
Castlereagh Coal

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September 2016

INVINCIBLE SOUTHERN EXTENSION PROJECT
ENVIRONMENTAL ASSESSMENT

Section 75W Modification

FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Castlereagh Coal Pty Limited

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Executive Summary

Castlereagh Coal, part of the Manildra Group (Manildra) of companies, acquired the Invincible Colliery (Invincible) in 2015. Castlereagh Coal proposes to modify the Invincible Project Approval in accordance with Section 75W of the *Environmental Planning and Assessment Act 1979* to extend open cut mining operations to the south of the existing approved mining area into the Southern Extension Area. The proposed modification is known as the Southern Extension Project.

The primary purpose of the Southern Extension Project is to obtain a reliable and cost effective source of specialty nut coal for use in Manildra's Shoalhaven Starches Plant located at Bomaderry on the NSW south coast. Ensuring reliable and cost effective sources of energy for the Shoalhaven Starches Plant assists Manildra in maintaining international competiveness in a wide variety of industries from food and confectionery to brewing and building.

Based on current coal quality information, only coal from the Lithgow Seam is of sufficient quality for use in the Shoalhaven Starches Plant. The Lithgow Seam resources, when washed, will provide approximately 300 thousand tonnes (kt) of nut coal for the Shoalhaven Starches Plant. The demand per annum for nut coal at Shoalhaven Starches is approximately 85 ktpa.

Castlereagh Coal are seeking approval for the extension of mining to occur over a period of up to 8 years to provide for flexibility in the supply of nut coal through:

- providing an option for Manildra to source all required nut coal directly from Invincible
- continuing to source nut coal from a range of other existing sources supplemented by supply from Invincible where necessary or cost effective to do so
- utilising a blended product using coal from the other seams within the Southern Extension Area where this can be used at the Shoalhaven Starches Plant.

The mining of coal in the target Lithgow Seam will necessarily involve the extraction of coal from the Lidsdale and Irondale Seams which are located above the Lithgow Seam. In total, there is an estimated 2.7 Million tonnes (Mt) of run-of-mine (ROM) coal in all seams down to, and including, the Lithgow Seam. Investigations are currently being undertaken to assess whether coal from the Lidsdale or Irondale Seams can be used at the Shoalhaven Starches Plant when washed and blended with coal from the Lithgow Seam. Surplus coal from the Lidsdale and Irondale Seams which is unable to be used in the Shoalhaven Starches Plant will be sold to Mt Piper Power Station for energy production consistent with the previous mining operations at Invincible.

The Southern Extension Project includes:

- Extending the period in which mining can continue for a period of 8 years from approval of the modification application.

- Extending the open cut mining area to mine down to, and including, the Lithgow Seam to the south of the existing mine in the Southern Extension Area. No highwall mining or open cut mining in any other areas of Invincible is proposed as part of the Southern Extension Project.

- Use of existing open cut voids and former underground workings for temporary water storage.

- Continued use of existing Invincible infrastructure (including maintenance work, and minor upgrades and operation of the existing Invincible Coal Preparation Plant (Invincible CPP)).

- Rehabilitation of the proposed Southern Extension Area and all existing disturbance areas at Invincible by reshaping mining areas to remove voids and revegetating the reshaped landform with locally endemic woodland and forest communities.

The Southern Extension Project does not seek any change to the currently approved:

- maximum mining and production rates of up to 1.2 Mtpa

- hours of operation through maintaining open cut mine and coal processing operations in day time with coal loading undertaken to 9.30 pm and maintenance activities up to 10.00 pm

- approved restrictions on blast times and numbers or

- product coal transport arrangements (with coal to be transported from the site by road truck to either the Shoalhaven Starches Plant or Mt Piper Power Station).

The Southern Extension Project does not seek any changes to the approved operations at Cullen Valley.

The maximum mining and production rates allowable under the current Invincible Project Approval conditions are required to account for the sale of surplus Lidsdale and Irondale Seam coal extracted in the process of obtaining sufficient nut coal product for use at the Shoalhaven Starches Plant. If a blended product utilising Irondale and/or Lidsdale coal can be utilised, overall mining and production rates at Invincible will be significantly lower than the current approved rate.

The flexibility being sought in this modification application is different to many coal mining projects in that its primary purpose is to provide Shoalhaven Starches with certainty of supply of specialty nut coal. The approach to the Environmental Assessment (EA) has been to assess potential impacts on the basis of a maximum production scenario to identify worse case impacts and define appropriate mitigation, management and offset measures.

Project Design

Castlereagh Coal have undertaken a detailed project design process to ensure that potential environmental and community impacts are avoided and minimised where practicable. This has included detailed consideration of environmental and community constraints associated with a range of mining alternatives and consideration of key community and stakeholder issues, including those raised in previous applications for mining in the area.

In recognition of these issues, the Southern Extension Project includes the following design features:

- The primary objective of the Southern Extension Project is to provide specialty nut coal to the Shoalhaven Starches Plant in Bomaderry, which can be met with comparatively lower total coal volumes and a small mining footprint.

- Mining operations will be further from private residences and the Cullen Bullen Township, located approximately 820m and 3km from the Southern Extension Area respectively, and in less exposed locations resulting in lower predicted noise, air quality, blasting and visual amenity impacts relative to past operations at Invincible.

- The Southern Extension Project has a substantially smaller disturbance area relative to recent applications for mining at Invincible. The additional disturbance proposed for the Southern Extension Project is located in areas that have been previously impacted through historical mining, forestry and infrastructure activities.

- The Southern Extension Project has been designed to avoid areas of threatened ecological communities and areas of comparatively diverse ecological and habitat value to the north and east of the existing Invincible site.

- The proposed extent of mining and associated disturbance has had regard to potential impacts on threatened flora and fauna species known or with potential to occur in the area around Invincible. Setbacks from prominent landscape and potential habitat features (pagodas) have been incorporated into the project design.

- Mining operations have been designed to minimise the risk of impact on significant landscape features to the east of Invincible, including pagoda formations, through design features to minimise potential impacts from blasting.

- The Southern Extension Project includes the rehabilitation of both the Southern Extension Area and the existing disturbance areas associated with past open cut mining operations at Invincible. The rehabilitated landform will blend with the natural landscape and no voids will remain in the final landform.

The incorporation of the above project design measures have resulted in the avoidance and / or minimisation of a range of potential environmental and community impacts associated with the Southern Extension Project. Notwithstanding this, the EA has undertaken a conservative approach to the assessment of impacts to provide a comprehensive assessment of potential worse case impacts associated with the Southern Extension Project.

Consultation

Consultation with the community and government agencies is a key component of the EA process. A comprehensive stakeholder engagement program was implemented to support Castlereagh Coal's aim of developing a project that can coexist with the local community.

Stakeholder engagement as part of the preparation of the EA commenced in 2015 and has continued through project design and environmental assessment phases. Community engagement for the Southern Extension Project has involved a phased program, initially focussed on stakeholder feedback on key issues and aspects of the project design and then presentation of the results and outcomes of the assessment and engagement process, including feedback on predicted impacts and proposed mitigation measures.

A range of mechanisms were used to engage the community and other stakeholders. Community consultation mechanisms included individual meetings with surrounding landholders, Community Information Sheets, presentations to stakeholder and community groups (including environmental and recreation groups), community information sessions and a number of briefings to the Invincible Community Consultative Committee. Other stakeholders consulted included registered Aboriginal parties, infrastructure providers, and local service providers.

Agency consultation included briefings with key government agencies at various stages of the Southern Extension Project to discuss key issues and outcomes of key studies, and proposed management measures and briefings to Lithgow Council.

Community Issues

Issues identified by the local community as most important were economic impacts (positive), blasting, rehabilitation and amenity (noise and air) impacts. In addition, engagement with environmental and recreational groups identified the economic rationale for the Southern Extension Project and potential impacts, including access, on conservation areas surrounding the Southern Extension Area as key issues. These key issues have been considered as part of the detailed assessments completed as part of the EA.

Economic discussions in the local community were positive, with continued local employment, business generation and investment in community activities and infrastructure identified as key benefits of the Southern Extension Project.

Broad Overview of Environmental and Social Impacts

This EA includes a detailed assessment of the potential environmental and social impacts of the Southern Extension Project and identifies the management and mitigation measures that will be implemented by Castlereagh Coal. A summary of the key environmental and social impact assessment findings are provided in **Table 1**.

Table 1 Summary of the Key Environmental and Social Impact Assessment Findings

Environmental/Social Issue	Overview of Potential Impacts
Land Use	The Southern Extension Project is an extension of an existing mine in an area that has a long history of mining. The Southern Extension Area is located in Ben Bullen State Forest and is not used for agricultural purposes. The Southern Extension Area will have negligible to no impact on agricultural productivity. A Site Verification Certificate confirming there are no areas of BSAL in the part of the Southern Extension Area where a new mining lease is required was granted in 2014. The forestry resources in the Southern Extension Area are largely limited to firewood and the removal of vegetation in this area will have negligible impact on the forestry value of the land as most of the easily accessible firewood resources have already been removed from this area due to its close proximity to the Castlereagh Highway. The Southern Extension Area is also occasionally used for trail bike riding and is located near tracks providing access to Ben Bullen State Forest to the east of the Southern Extension Area. The Southern Extension Area is located within the area proposed by conservation groups as a State Conservation Area as part of the Gardens of Stone Stage 2 proposal. The key conservation values associated with the Gardens of Stone Stage 2 proposal are located to the east of Southern Extension Area. Mining is a permissible land use (with a mining lease) within a State Conservation Area and the impacts of the Southern Extension Project on conservation values are similar to those of the existing Invincible open cut operations, much of which are also located in the area proposed as a State Conservation Area.

Environmental/Social Issue	Overview of Potential Impacts
Water Resources	Water will be required for coal washery processes, dust suppression and other operational purposes. Water removed from the former Ivanhoe underground workings in the Southern Extension Area will be transferred into the former Invincible underground working and void space associated with the existing Invincible open cut. Any water in excess of storage space or operational needs may need to be discharged to Cullen Creek in accordance with relevant approvals and licences. Detailed assessments of potential impacts on surface water and groundwater have been completed. The Southern Extension Project is not predicted to have a significant impact on downstream water users or environment. Aquifers in the local area been largely depressurised as a result of historical open cut and underground mining. The Southern Extension Project is not predicted to have any discernible impact on any groundwater resources. The Southern Extension Project includes transfer from and between water stored in former underground workings, surface storages and waterways. Net take from surface and groundwater systems will be licensed in accordance with the water sharing plans applicable to these surface water and groundwater systems in consultation with DPI Water.
Ecology	The Southern Extension Project includes specific design features to avoid and minimise potential impacts on biodiversity, The Southern Extension Project will result in the removal of an additional approximately 50 hectares of vegetation over that already disturbed or approved to be disturbed. The Southern Extension Project will not impact on any threatened ecological communities. A detailed Biodiversity Assessment Report has been completed in accordance with the NSW Framework for Biodiversity Assessment (FBA) and all biodiversity impacts associated with the Southern Extension Project will be offset in accordance with the FBA. Castlereagh Coal has committed to implement a biodiversity offset strategy as part of the Southern Extension Project to meet the requirements of the FBA.
Aboriginal Cultural Heritage	A comprehensive Aboriginal Cultural Heritage and Archaeological Assessment were completed for the Southern Extension Project in consultation with 6 registered Aboriginal parties. This assessment considered the potential impacts on Aboriginal cultural heritage within and outside the Southern Extension Area. The Southern Extension Project will impact on six Aboriginal sites located in the Southern Extension Area, consisting of isolated finds and artefact scatters. Management measures developed in consultation with the registered Aboriginal parties will be implemented in relation to these sites as well as any additional sites which may be identified during the life Southern Extension Project. The Southern Extension Project is not predicted to impact on any sites located outside of the Southern Extension Area.
Historic Heritage	No items of historic heritage are located within the Southern Extension Area and the Southern Extension Project is not predicted to have an impact on any heritage items in the local area.

Environmental/Social Issue	Overview of Potential Impacts
Air Quality	A detailed Air Quality Impact Assessment was undertaken for the Southern Extension Project. The Southern Extension Project is not predicted to result in any exceedance of air quality criteria at any private residences or sensitive receivers.
Blasting	A detailed Blasting Impact Assessment has been completed for the Southern Extension Project. An assessment of the stability of pagodas and cliff lines in proximity to the Southern Extension Area to blasting impacts has also been completed. The assessment has found that the impacts from blasting in the Southern Extension Area can be effectively managed though blast design to avoid impacts to pagodas and cliff lines. Blasts impacts can also be managed through blast design to ensure vibration and overpressure impacts do not exceed relevant criteria at all private residences, including Cullen Bullen, private and public infrastructure, heritage sites and other structures. Castlereagh Coal will use a variety of notification methods to advise users of the Castlereagh Highway and nearby areas of Ben Bullen State Forest of planned blasts to minimise any impacts associated with temporary road closures and access restrictions during blast periods.
Noise	A detailed Noise Impact Assessment has been undertaken for the Southern Extension Project. Project design features have been included as part of the Southern Extension Project which has resulted in predicted noise impacts being lower than currently authorised under the existing Invincible Project Approval. No privately owned residences are predicted to exceed the acquisition criteria set under the existing Invincible Project Approval. One property, which currently has acquisition rights under the Invincible Project Approval, is predicted to qualify for voluntary mitigation rights under the application of the NSW Voluntary Land Acquisition and Mitigation Policy.
Traffic	The Southern Extension Project will result in similar traffic movements to and from Invincible as the currently approved operations and will not increase operational coal haulage or employee traffic above levels currently authorised under the Invincible Project Approval. A detailed Traffic Impact Assessment has been undertaken for the Southern Extension Project to assess the impact of the Southern Extension Project on traffic flows which takes into account traffic growth since the previous assessment of impacts associated with maximum production rates. The Southern Extension Project is not predicted to have a significant impact on traffic in terms of performance (including at key intersections), infrastructure or road safety.

Environmental/Social Issue	Overview of Potential Impacts
Visual	Views of mining in the Southern Extension Area will be possible from a number of vantage points along the Castlereagh Highway and elevated areas to the east of Invincible in Ben Bullen State Forest. The locations within Ben Bullen State Forest where mining in the Southern Extension Area would be visible are not readily accessible. The existing Invincible operations are currently visible from these locations and views of mining in the Southern Extension Area will be similar to those of the existing operations. Vegetation and topography will screen views of the Southern Extension Area from most locations to the west of the Castlereagh Highway and there is unlikely to be any views of the Southern Extension Area from any residences. The Southern Extension Project includes the progressive rehabilitation of both the existing Invincible open cut mining area and the Southern Extension Area. This rehabilitation will reduce the visual impacts associated with mining at Invincible.
Rehabilitation	Castlereagh Coal will adopt a progressive approach to rehabilitation to ensure that completed areas are shaped and vegetated to provide a stable landform. The created landforms will blend with the surrounding landscape. No voids will remain in the rehabilitated final landform. Rehabilitation will return the majority of Invincible site to native woodland and forest generally consistent with ecological communities that would have historically occurred in the area.
Social and Economic	Detailed assessments of social and economic impacts have been undertaken for the Southern Extension Project. The additional employment generated by the Southern Extension Project will have both social and economic benefits in the local area which is currently experiencing the effects of closures (temporary and permanent) of a number of large employers in the region. This was seen as a key issue for the local community as part of extensive community consultation completed as part of the Southern Extension Project. The Southern Extension Project will have benefits to Manildra's Shoalhaven Starches Plant though improved reliability of energy supply and lower energy costs. These benefits are significant as they assist this large regional employer in maintaining international competiveness. The Southern Extension Project estimated to have economic benefits for the State of NSW of $79.7 million in net present value terms.

The Southern Extension Project is consistent with the principles of ecologically sustainable development and will have a range of positive benefits from the Southern Extension Project that will result at a local, regional and State level. These benefits include:

- employment of up to approximately 35 full time equivalent employees as part of the Southern Extension Project
- an estimated increased population in the local area of 16 people (dependent on location of employees)
- net benefit to NSW of $79.7 million (in Net Present Value Terms (NPV) using a 7% discount rate) consisting of $55.0 million of direct benefits to the State and $26.8 indirect benefits with indirect costs of $2.2 million and
- net benefit of $8.8 million to the Lithgow-Mudgee local area in NPV terms, consisting mainly as economic benefits of $4.85 million to employees and $4.15 million to suppliers located in the local area with indirect costs of $0.25 million.

The revenue, expenditure and employment associated with the operation of the Southern Extension Project will stimulate economic activity in the regional economy, as well as for the broader NSW economy. The Southern Extension Project will also have significant economic benefits for Manildra's Shoalhaven Starches Plant through improved reliability of energy supply and lower energy costs. These benefits are significant as they assist this large regional employer in remaining competitive in domestic and international markets and continuing the economic benefits that operation provides to NSW and the South Coast regional economy.

With the implementation of the management, mitigation and offset measures proposed by Castlereagh Coal, the Southern Extension Project will result in a substantial net benefit to the local, regional and NSW community.

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SECTION 1.0

Introduction

1.0 Introduction

Castlereagh Coal owns the Invincible Colliery (Invincible), a coal mine located approximately 25 kilometres (km) north-west of Lithgow in New South Wales (NSW) (refer to **Figure 1.1**). The town of Cullen Bullen is located approximately 3 km north-west of the Invincible mine infrastructure area.

Invincible is located in an area of historical mining operations associated with western coalfields of NSW, including the former mining operations at Cullen Valley, Baal Bone Colliery, Pine Dale and Ivanhoe Colliery. The Invincible site has had a long history of mining operations commencing in 1901. Open cut mining has been carried out at Invincible at various times ranging from the 1940s through to the mine being placed onto care and maintenance in 2013 when the available coal within the approved Invincible mining area was exhausted. The existing operations are shown in **Figure 1.2**. Further detail on the history of mining at Invincible is provided in **Section 2.0**.

Castlereagh Coal is the trading name for Shoalhaven Coal Pty Ltd which is part of the Manildra Group (Manildra), a family owned Australian group of companies providing integrated and diverse agribusiness operations. Castlereagh Coal purchased Invincible, and the nearby Cullen Valley mine, in 2015 to secure a continued supply of a speciality coal product, known as 'nut' coal, for Manildra's Shoalhaven Starches Plant located at Bomaderry on the NSW South Coast (refer to **Figure 1.1**). Shoalhaven Starches Plant previously sourced speciality nut coal from Invincible prior to cessation of mining in 2013.

The existing Invincible Project Approval 07/0127 (Invincible Project Approval) was granted on 4 December 2008 and currently limits mining to eight years from the date of grant of the approval (i.e. to 4 December 2016). The Invincible Project Approval continues to operate past this date to authorise ongoing rehabilitation activities after the completion of approved mining.

Castlereagh Coal seeks to modify the Invincible Project Approval to extend the life of mining operations at Invincible and obtain approval to extend the open cut mining operations to an area immediately south of the existing operations referred as the Southern Extension Area (refer to **Figure 1.2**). The Southern Extension Area is located within the Ben Bullen State Forest to the east of the Castlereagh Highway. The proposed modification which is the subject of this Environmental Assessment (EA) is referred to as the Southern Extension Project. The primary purpose of the Southern Extension Project will be to provide speciality nut coal to Manildra's Shoalhaven Starches Plant.

The Shoalhaven Starches Plant at Bomaderry is the largest wheat starch and gluten plant of its kind in the world and is a critical component of Manildra's integrated agribusiness. The Shoalhaven Starches Plant processes quality flour from Manildra's four flour mills in the NSW and supplies the domestic and export markets with a range of gluten, starch, glucose, ethanol and stockfeed products crucial to a wide variety of industries from food and confectionery to brewing and building.

The Shoalhaven Starches Plant is a complex, integrated production facility which maximises the value from all production streams by utilising waste products where possible. Flour, water and energy are the key inputs to the production process at the plant. A breakdown in the supply of one of these inputs significantly impacts on production of these key outputs, with significant upstream and downstream supply implications. Maintaining a consistent and reliable supply of energy is critical to ensuring the ongoing operation of the plant. The characteristics of speciality nut coal from Invincible meet the specific coal quality requirements for use in the Shoalhaven Starches Plant. Any change in the quantity or quality of this particular energy input would require significant capital and plant upgrades, in addition to material operational impacts. Accordingly, the ability to continue to source a reliable and cost effective supply of speciality nut coal is critical to the ongoing Shoalhaven Starches Plant operations.

Speciality nut coal required at the Shoalhaven Starches Plant will be sourced from the target Lithgow Seam within the Southern Extension Area. Further details on the Southern Extension Project and the project rationale are provided in **Section 1.1** and **Section 3.0**.

Approval for the Southern Extension Project is being sought under section 75W of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

Umwelt (Australia) Pty Limited (Umwelt) has prepared this EA on behalf of Castlereagh Coal to accompany an application to modify the Invincible Project Approval. A statement of authorship for the EA is provided in **Appendix 1**.

1.1 Overview of proposed S75W Modification

Castlereagh Coal proposes to modify the Invincible Project Approval to extend open cut mining operations to the south of the existing approved mining area into the Southern Extension Area (refer to **Figure 1.2**). The primary purpose of the Southern Extension Project is to provide speciality nut coal to Manildra's Shoalhaven Starches Plant in Bomaderry. Any coal extracted as part of the Southern Extension Project that is unsuitable for use in the Shoalhaven Starches operations (i.e. does not meet the strict coal quality specifications) will be supplied to the domestic power market, primarily the Mt Piper Power Station located approximately 3 km south of Invincible.

The proposed modification seeks to modify the Invincible Project Approval to authorise:

- open cut mining to the south of the existing mine into the Southern Extension Area (refer to **Figure 1.2**)
- extending the period in which mining is permitted at Invincible by a further eight years to provide flexibility in the period of time for mining to be completed
- minor changes to infrastructure
- an updated rehabilitation strategy.

As a result of the updated impact assessment and proposed management and mitigation measures for the Southern Extension Project, there are also a range of other proposed changes to the existing project approval conditions which are detailed through this assessment.

Section 3.1 contains further details regarding the Southern Extension Project.

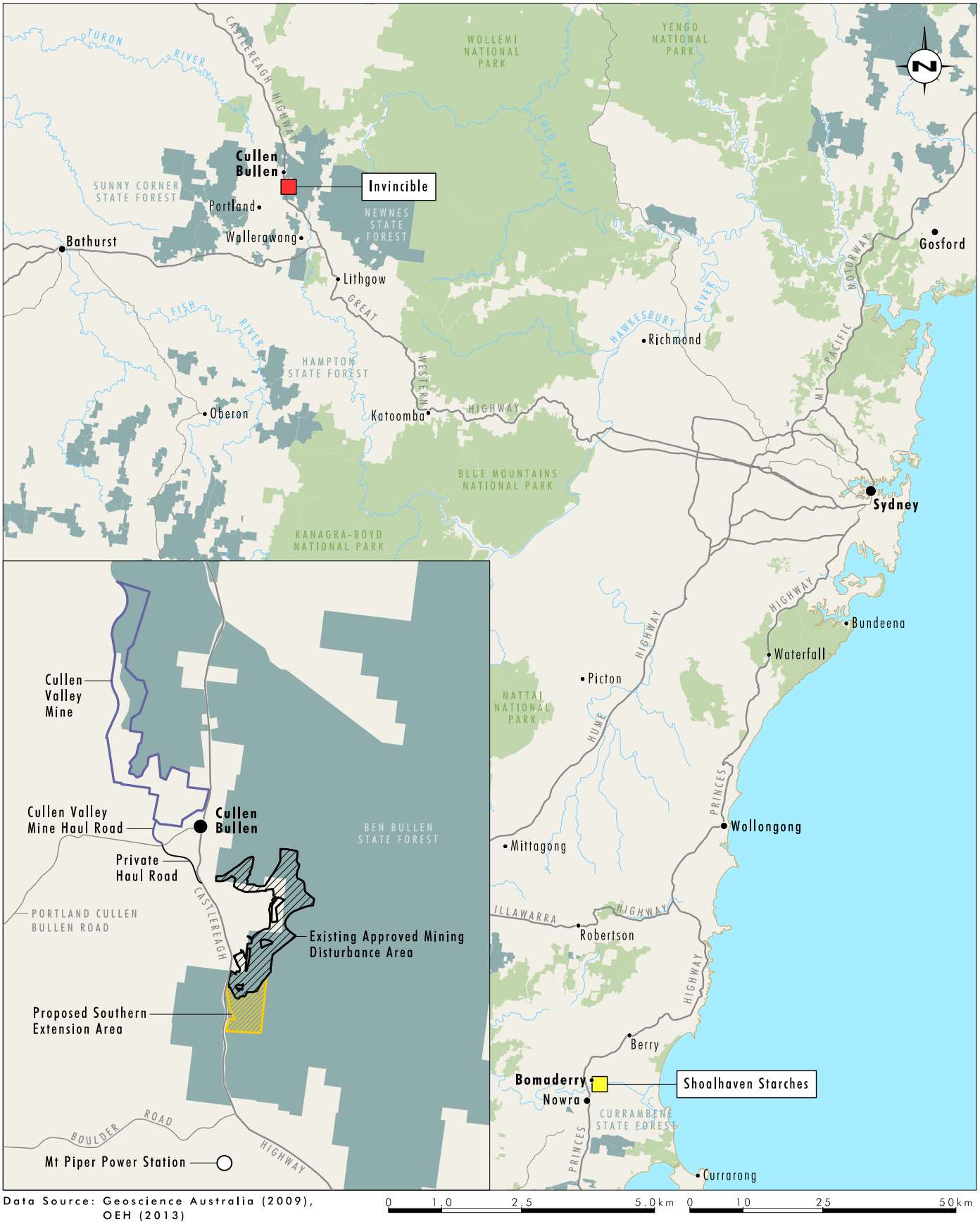

FIGURE 1.1

Locality Plan

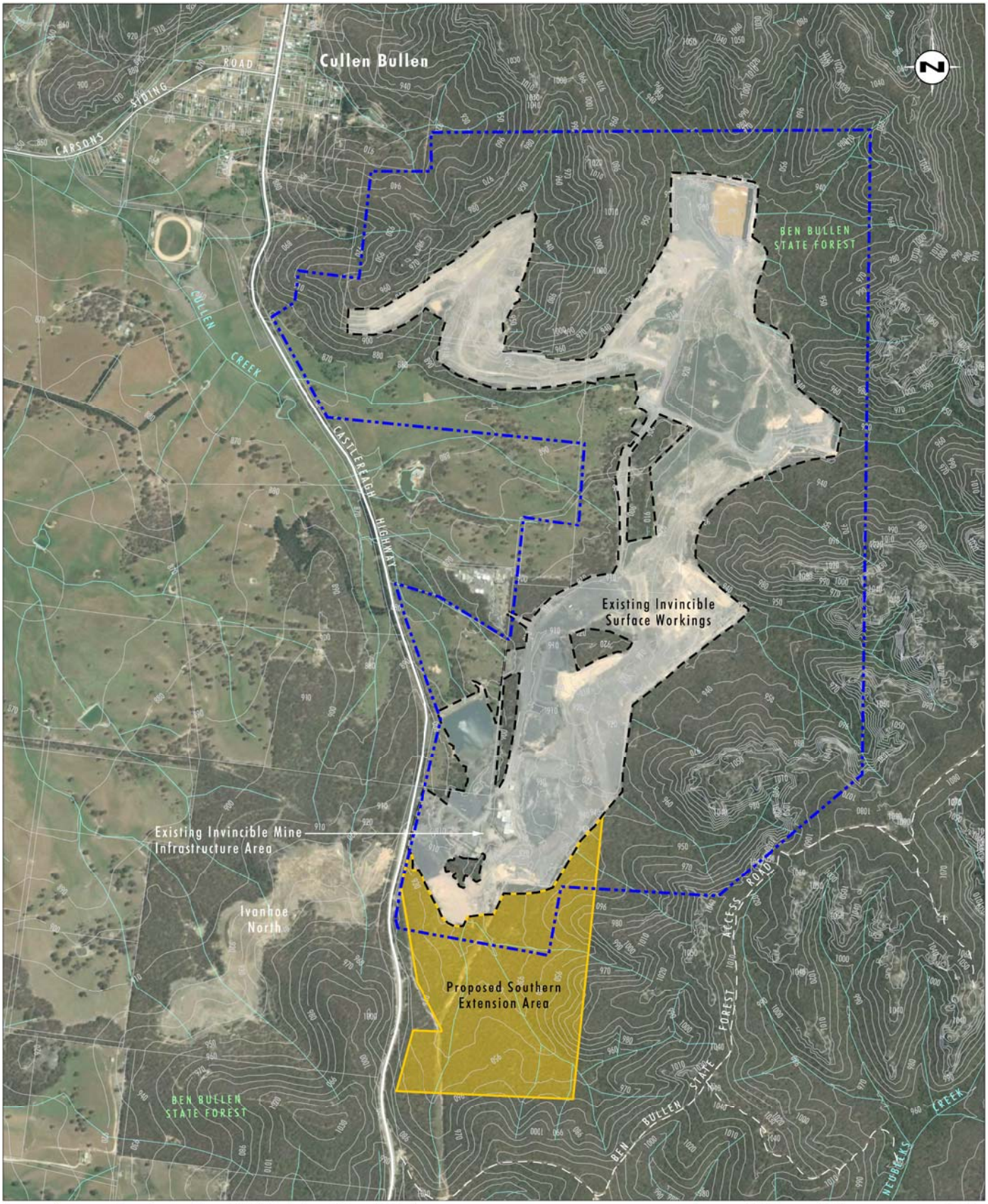

Image Source: Google Earth - CNES/Astrium (Nov 2014)
Data Source: LPI (2016), Forest Corporation of NSW (2015)
Note: Contour Interval 10m

0 0.25 0.5 1.0km

Legend

- Existing Approved Mining Disturbance Area
- Proposed Southern Extension Area
- Invincible Project Approval Boundary (PA07/0127)

FIGURE 1.2

Invincible Southern Extension Project

1.2 The proponent

The proponent for the Southern Extension Project is Castlereagh Coal. Castlereagh Coal is the trading name for Shoalhaven Coal Pty Ltd which is part of Manildra, an integrated and diverse agribusiness operation. Manildra is Australian owned and directly employs approximately 1600 people (1100 full time equivalent). Approximately 75 per cent of people employed by Manildra reside in NSW.

As outlined above, the primary purpose of the Southern Extension Project is to obtain a reliable and cost effective source of specialty nut coal for use in Manildra's Shoalhaven Starches Plant. Shoalhaven Starches has a diversified customer base across a wide range of industries and countries. Customers include Woolworths, Coles, Aldi, Bakers Delight, Cadbury, Fosters and Kellogg's. Ensuring reliable and cost effective sources of energy for the Shoalhaven Starches Plant assists Manildra in maintaining international competiveness in a wide variety of industries from food and confectionery to brewing and building.

Further details regarding the Southern Extension Project rationale are contained in **Section 3.6**.

1.3 Project design

The previous owners of Invincible, Coalpac, sought approval for extension and expansions of the Invincible and nearby Cullen Valley mining operations in 2012 and 2014. The first of these, the Coalpac Consolidation Project, was the larger of the two proposals. This proposal was recommended for refusal by the Planning Assessment Commission (PAC) and was withdrawn by Coalpac. Two smaller modification applications were then lodged, one for each of Cullen Valley and Invincible. Both of these modifications were refused by the PAC despite being recommended for approval by the Department of Planning and Environment (DP&E). Both of these previous proposals were developed around the objective of providing coal to the Mt Piper Power Station.

The Southern Extension Project has been designed to take account of the impact assessment considerations and reasons for the PAC recommending refusal of the Coalpac Consolidation Project and refusing approval of the previous modification applications. Castlereagh Coal has also undertaken extensive consultation with the local community and key stakeholders, including conservation groups opposed to the previous proposals, and the views of stakeholders have been considered in the detailed mine design process and proposed management and mitigation measures, as far as practicable.

The key features of the Southern Extension Project, which differentiate it from the previous Coalpac proposals at Invincible include:

- The primary objective of the Southern Extension Project is to provide specialty nut coal to the Shoalhaven Starches Plant in Bomaderry, which can be met with comparatively lower total coal volumes and a smaller mining footprint relative to previous proposals

- The Southern Extension Project is wholly within the development footprint of both of the previous proposals and has a substantially smaller disturbance area. The additional disturbance proposed for the Southern Extension Project is located in areas that have been previously impacted through historical mining, forestry and infrastructure activities

- The Southern Extension Project has been designed to avoid areas of threatened ecological communities and areas of comparatively diverse ecological and habitat value to the north-east of the existing Invincible site

- The extent of mining and associated disturbance has had regard to potential impacts on threatened flora and fauna species known or with potential to occur in the area around Invincible

- The disturbance footprint will be set back at least 210 metres (m) from all pagoda formations and, with the exception of a single isolated pagoda formation, will be at least 300 m from all pagodas

- Mining operations have been designed to minimise the risk of impact on significant landscape features to the east of Invincible, including pagoda formations, through design features to minimise potential impacts from blasting

- Mining operations will be further from private residences and the Cullen Bullen township, located approximately 820 m and 3 km from the Southern Extension Area respectively, and in less exposed locations resulting in lower predicted noise, air quality, blasting and visual amenity impacts relative to past operations and recent proposals.

A comparison of the proposed disturbance footprints for the previous proposals and the Southern Extension Project are shown in **Figure 1.3**.

Section 3.7 contains a detailed consideration of the mine design process and alternatives considered, including consideration of key issues leading to the withdrawal and refusal of the previous applications as well as issues raised by the community and other stakeholders during the consultation process undertaken for the Southern Extension Project.

1.4 Environmental context and land use

Invincible is located on the western slopes of the Great Dividing Range, approximately 25 km north-west of Lithgow, NSW (refer to **Figure 1.1**). The township of Cullen Bullen is located approximately 3 km north-west of the Invincible mine infrastructure area. The Southern Extension Project is located in an area of historical mining operations associated with western coalfields of NSW, including the former mining operations at Cullen Valley, Baal Bone Colliery, Pine Dale and Ivanhoe Colliery.

The Southern Extension Area and much of the existing Invincible operations are located within Ben Bullen State Forest. This area of the Ben Bullen State Forest is part of the approximately 40,000 hectare (ha) Gardens of Stone Stage 2 conservation proposal put forward by the Colong Foundation for Wilderness, Blue Mountains Conservation Society and The Colo Committee. The Southern Extension Project is located on the south-western edge of the approximately 7800 hectare Baal Bone and Long Swamp component of the Gardens of Stone Stage 2 Proposal area. This area has been proposed by the above groups to be made into a State Conservation Area under the *National Parks and Wildlife Act 1974* (NPW Act). It is noted that the Gardens of Stone Stage 2 proposal was lodged in October 2005 but has not been formally adopted by the NSW Government. Further, it is noted that should the site be declared a State Conservation Area, mining would be still permissible in this area in accordance with the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* (Mining SEPP) and NPW Act. The Gardens of Stone Stage 2 proposal is discussed further in **Section 6.2.3**.

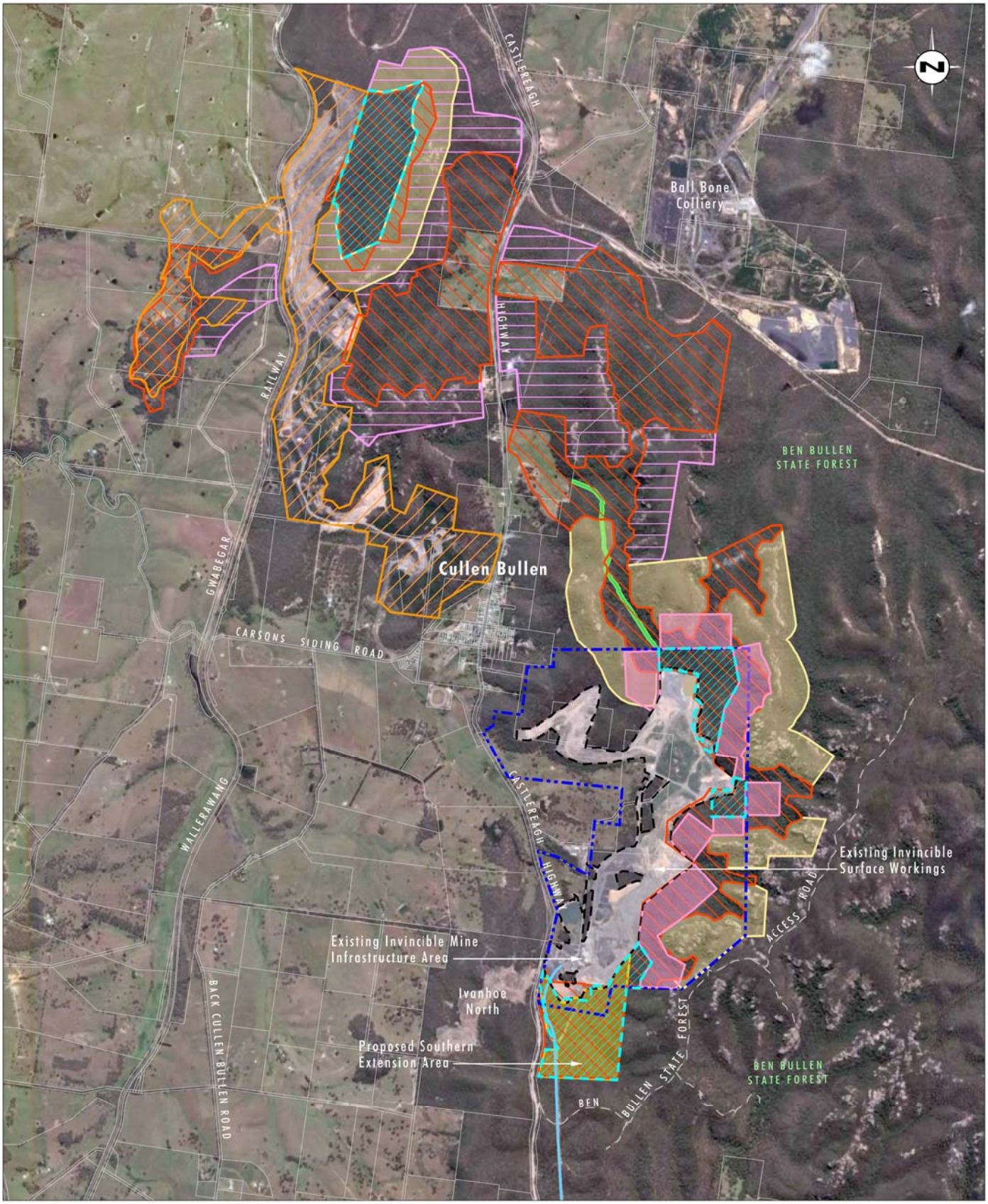

Image Source: Google Earth - CNES/Astrium (Mar 2015)
Data Source: LPI (2016), Hansen Bailey (2012,2013)

Legend

- Existing Approved Mining Disturbance Area
- Proposed Southern Extension Area
- Invincible Project Approval Boundary (PA07/0127)
- Cullen Valley Approved Disturbance Area
- Coalpac Consolidation Project - Open Cut
- Coalpac Consolidation Project - Highwall
- Coalpac Consolidation Project - Conveyor
- Cullen Valley Consolidation Project - Highwall
- 2014 Modification Project - Pipeline
- 2014 Modification Project - Open Cut
- 2014 Modification Project - Highwall

FIGURE 1.3

Previous Proposals Disturbance Footprints

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Parts of the Lithgow Seam in the Southern Extension Area have previously been mined as part of the adjacent Ivanhoe No 2 underground operations with parts of the Southern Extension Area affected by significant disturbance from subsidence associated with these historical operations (refer to **Figure 1.4**). Entry portals for the Ivanhoe No. 2 underground operations and the former Ivanhoe North open cut operations are located to the west of the Castlereagh Highway and are currently in the process of being rehabilitated. Past mining in the area is discussed in further detail in **Section 2.0**.

A power line easement runs through the Southern Extension Area from the south to the north. The Southern Extension Area is currently used primarily for firewood collection, and recreational use such as trail bike riding. Access to the Southern Extension Area for these uses is generally from the south via the power line easement. Located to the south and east of the Southern Extension Area are tracks providing access to areas of Ben Bullen State Forest which are located to the east and north of Invincible. These tracks are utilised for a variety of uses including recreation (i.e. bush walking, trail bike riding) and are accessed off the Castlereagh Highway to the south of the Southern Extension Area (refer to **Figure 1.2**). These tracks also serve as access points for forestry management purposes including bushfire management.

The closest privately owned residence is located approximately 820 m to the north of the proposed Southern Extension Area. Further to the north-west there are a range of private rural landholdings which extend to the township of Cullen Bullen. The areas to the south and east of the Southern Extension Area consist of vegetated areas of Ben Bullen State Forest, with the land immediately west includes the former Ivanhoe mine. Land ownership within and surrounding the Southern Extension Area is shown on **Figure 1.5**.

The topography surrounding the Southern Extension Area is generally characterised by steep forested slopes and escarpments within the Ben Bullen State Forest to the north, east and south and the Castlereagh Highway running along the western boundary. Sandstone cliff lines and pagoda formations are prominent landscape features of the terrain to the north and east of Invincible and these formations and related ecosystems are the key conservation feature and have been a key determinant in project design (refer to **Section 3.7**).

Elevations within the Southern Extension Area range from approximately 912 m Australian Height Datum (AHD) in the north to approximately 997 m AHD in the east. The terrain to the east of the Southern Extension Area rises to over 1050 m AHD. There are no cliff lines or pagodas located within the Southern Extension Area with the closest pagoda formation approximately 210 m to the east, and all other pagodas are at least 300 m to the east and north-east of the Southern Extension Area. The topography of the area and location of pagodas in the landscape is shown in **Figure 1.6**. To the north-west of the Southern Extension Area rise a number of steep slopes and a ridgeline located immediately west of the Castlereagh Highway (refer to **Figure 1.6**).

Invincible lies entirely within the upper catchment of Cullen Creek (refer to **Figure 1.6**). Cullen Creek is an ephemeral stream that rises in the steep hills of the Ben Bullen Range. It flows in a north-westerly direction before joining Delhuntys Creek approximately 4 km downstream of Invincible, which in turn joins Williwa Creek before discharging into the Turon River. The confluence with the Turon River is some 25 km downstream of the Southern Extension Area. The broader catchment forms part of the Murray Darling Basin.

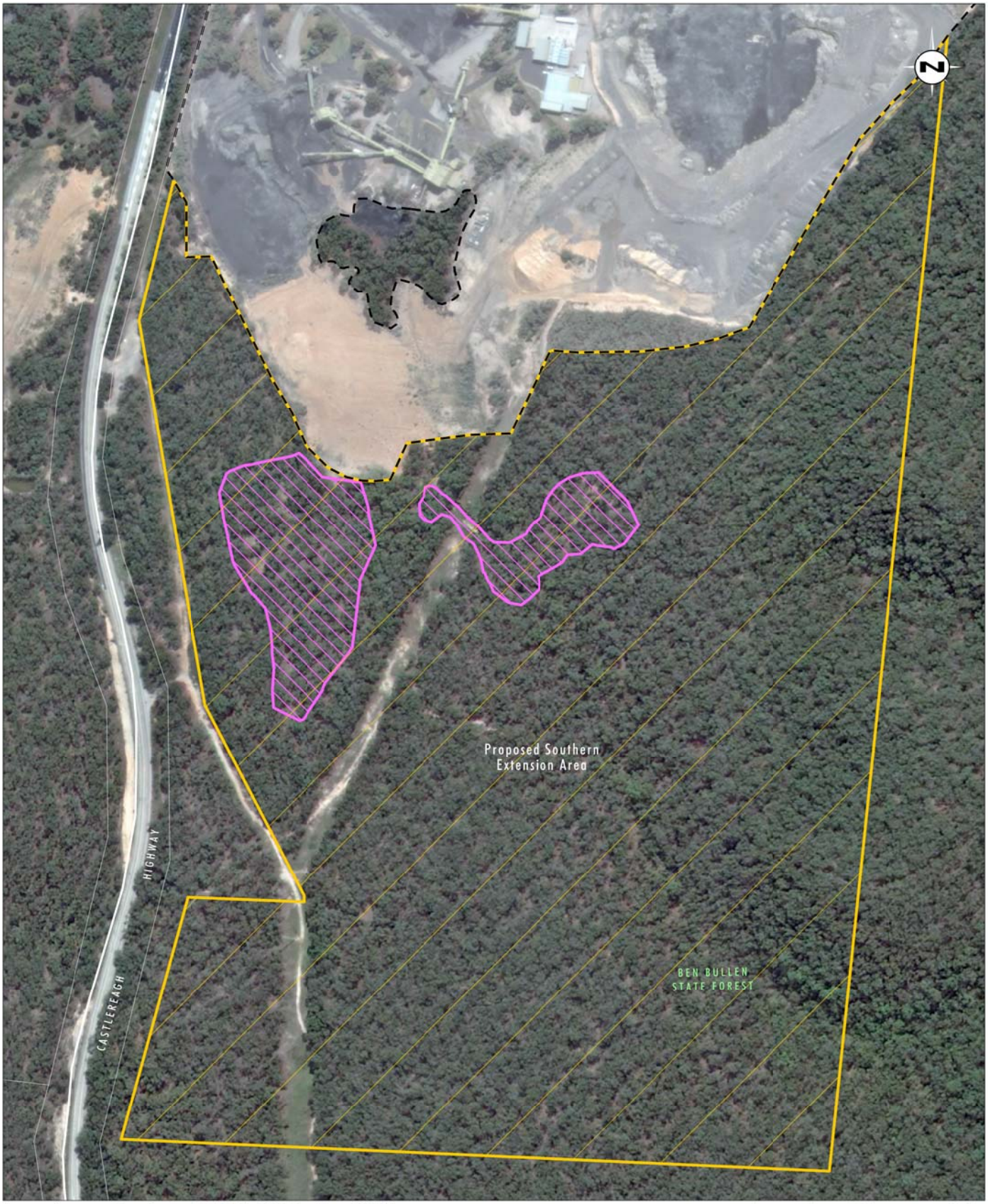

Image Source: Google Earth/DigitalGlobe (Mar 2015)
Data Source: LPI (2016)

0 50 100 200m

Legend

- Existing Approved Mining Disturbance Area
- Proposed Southern Extension Area
- Significant Subsidence Disturbance

FIGURE 1.4

Proposed Disturbance Area and Existing Subsidence Disturbance

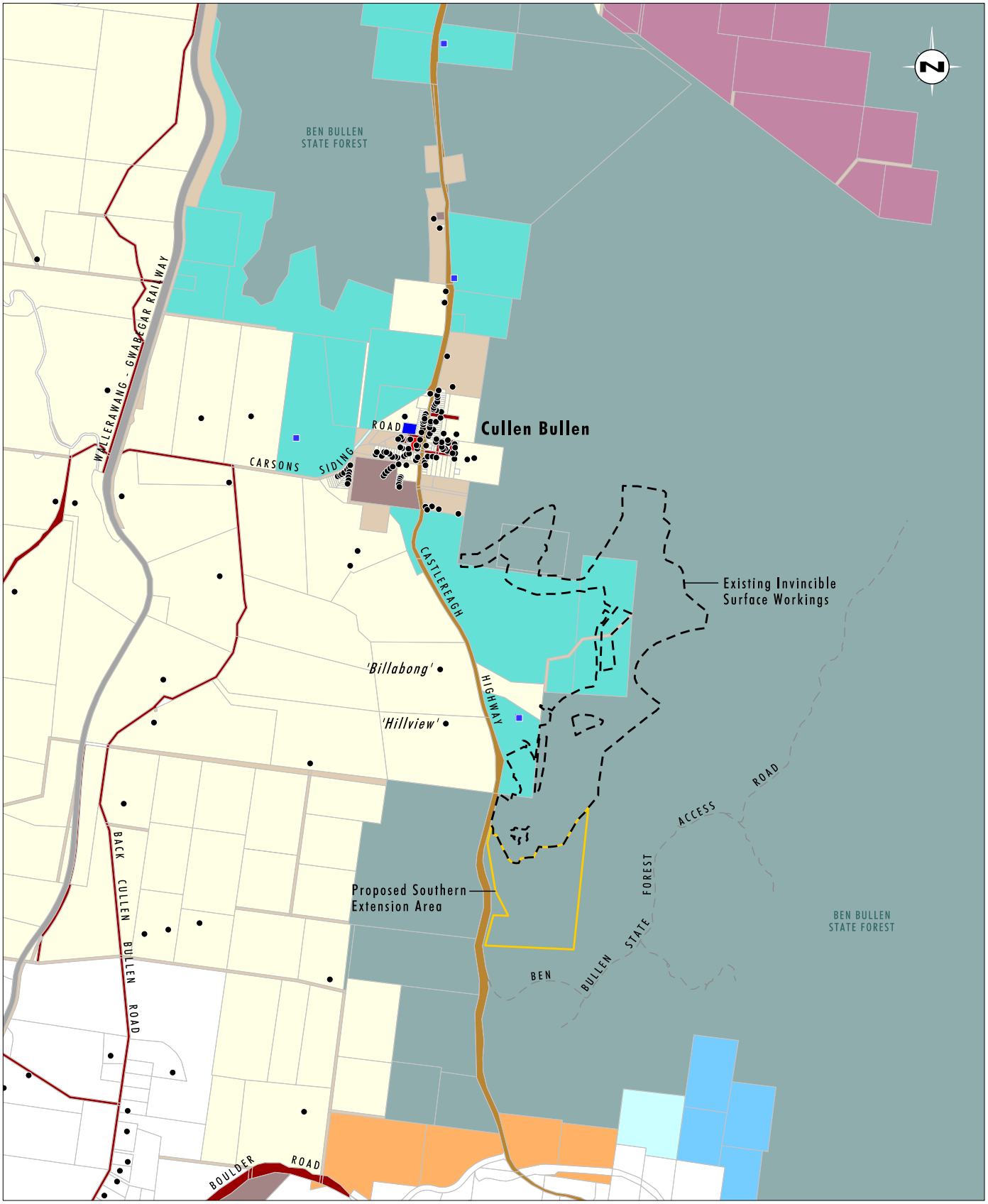

Image Source: Google Earth - CNES/Astrium (2015)
Data Source: Sedgman (2016), LPI (2016)

Legend

- Existing Approved Mining Disturbance Area
- Proposed Southern Extension Area
- Castlereagh Highway
- Centennial Pty Ltd
- Council
- Crown
- Cullen Bullen Primary School
- Energy Australia
- Industry
- Minister for Education
- Private
- Rail Corporation NSW
- Castlereagh Coal
- State Forest
- State Government
- Wallerawang Collieries
- Not searched
- Private Residence
- Mine Owned Residence

FIGURE 1.5

Land Ownership

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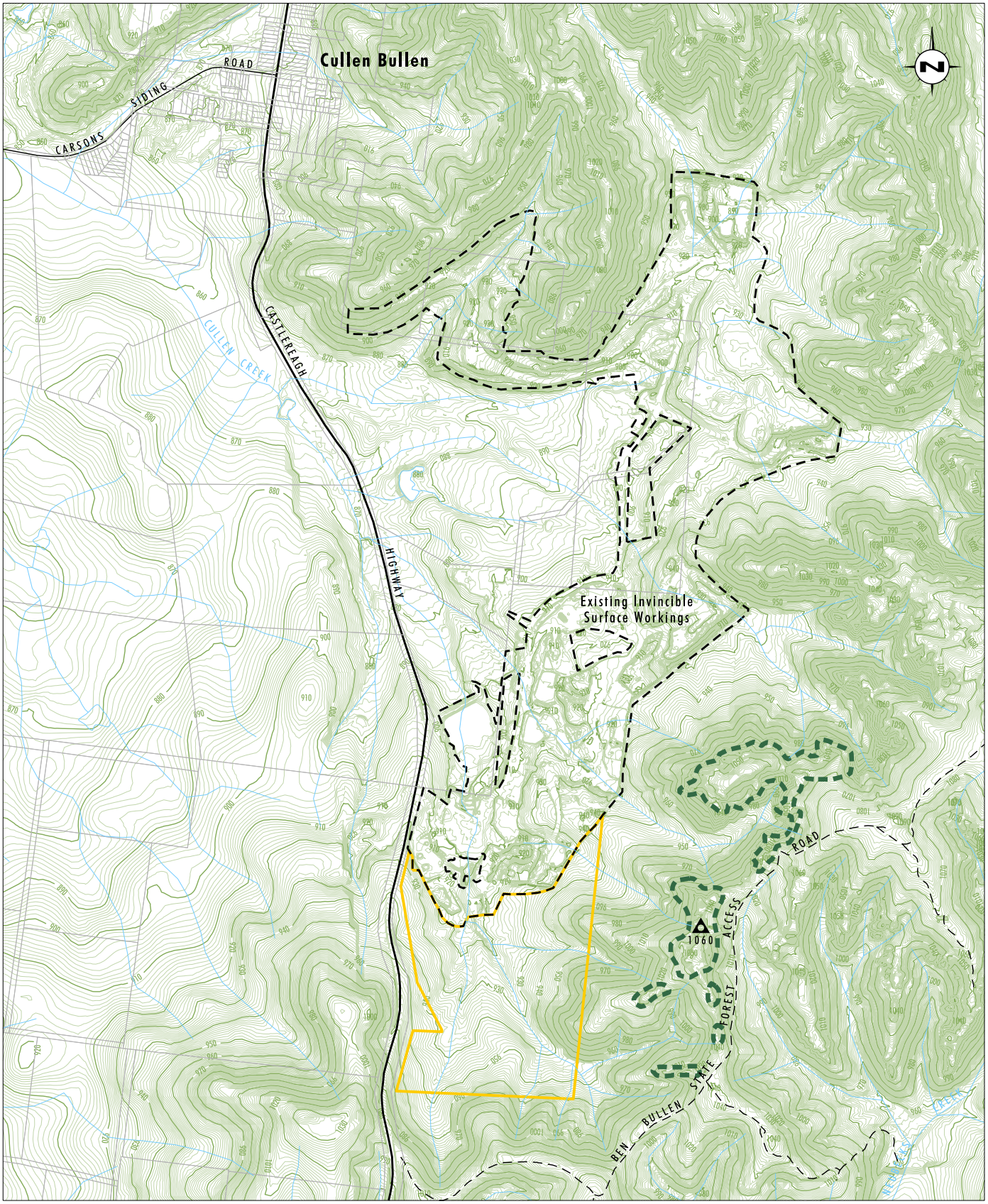

Data Source: LPI (2016), Shoalhaven Coal (2015)
Note: Contour Interval 1m

0 0.25 0.5 1.0km

Legend

- Existing Approved Mining Disturbance Area
- Proposed Southern Extension Area
- Pagodas in Close Proximity to Southern Extension Area

FIGURE 1.6

Current Topography

1.5 Environmental assessment team

This EA was prepared by Umwelt on behalf of Castlereagh Coal. The specialist assessments prepared for this EA and their authors are presented in **Table 1.1**.

Table 1.1 Specialist Reports included within this EA

Report	Author
Surface Water Assessment	Umwelt (Australia) Pty Limited
Groundwater Assessment	Australasian Groundwater and Environmental Consultants Pty Ltd
Biodiversity Assessment Report	Umwelt (Australia) Pty Limited
Aboriginal Cultural Heritage and Archaeology Assessment	Umwelt (Australia) Pty Limited
Air Quality Impact Assessment	Jacobs Group (Australia) Pty Ltd
Blasting Impact Assessment	Enviro Strata Consulting Pty Ltd
Noise Impact Assessment	Umwelt (Australia) Pty Limited
Social Impact and Opportunities Assessment	Umwelt (Australia) Pty Limited
Traffic and Transport Impact Assessment	Transport and Urban Planning Pty Limited
Economic Assessment	Cadence Economics Pty Limited
Greenhouse Gas Assessment	Umwelt (Australia) Pty Limited

A full listing of the Southern Extension Project team members and their respective roles is provided in **Appendix 2**.

1.6 Environmental assessment structure

This EA has been prepared in accordance with the EP&A Act and Regulation (refer to EA Statement of Authorship in **Appendix 1**). Prior to preparing the EA, Umwelt confirmed the approval pathway and approach to assessment through correspondence from the NSW Department of Planning and Environment (DP&E) dated 8 February 2016 (refer to **Appendix 3**). The EA comprises a main text component and supporting studies, which are included as appendices. An overview of the layout of the main text is presented in **Table 1.2** below.

Table 1.2 Environmental assessment structure

EA Section	Environmental Assessment Details
Executive Summary	Provides a brief overview of the Southern Extension Project, the major outcomes of the environmental assessment and key project commitments to mitigate potential impacts.
Section 1.0	Provides the background and context for the Southern Extension Project, key proposed modification details, the proponent, environmental context and the assessment team.
Section 2.0	Describes the existing Invincible operations and existing approvals including environmental management and monitoring at Invincible.
Section 3.0	Describes the Southern Extension Project, project rationale and alternatives considered in the development of the Southern Extension Project design.
Section 4.0	Provides a description of the current planning context for the Southern Extension Project.
Section 5.0	Describes the stakeholder consultation process undertaken as part of the Southern Extension Project design and environmental assessment process.
Section 6.0	Provides a comprehensive analysis and assessment of the potential environmental and community impacts of the Southern Extension Project, including the Southern Extension Project specific and cumulative impacts.
Section 7.0	Provides a summary of proposed management and mitigation commitments for the Southern Extension Project.
Section 8.0	Provides a conclusion and justification for the Southern Extension Project, including how the proposed modification meets the principles of ecologically sustainable development.
Sections 9.0 and 10.0	References and Abbreviations.

SECTION 2.0

Overview of Existing Operations

2.0 Overview of Existing Operations

2.1 Mine history

Mining has been undertaken in the areas around Cullen Bullen since the late 1800s. The Old Invincible Colliery, located east of Cullen Bullen, began operating around 1901 and continued until 1957, consisting initially of underground operations. At this time the mining operations (entry portal and coal handling facilities) were relocated approximately 4 km south, to the current Invincible location, where underground operations continued until 1998. A small area of open cut mining was undertaken to the south of the current Invincible Mine Infrastructure Area during the Second World War. Limited open cut mining at Invincible recommenced in 1998 and continued until 2001, when the site was placed on care and maintenance.

In 2005, an application for approval was sought an extension of the open cut operations at Invincible. Project Approval (PA 05_0065) was granted in 2006 and Invincible was taken out of care and maintenance. Invincible currently operates under PA 07_0127, granted on 4 December 2008 under Part 3A of the EP&A Act. PA 07_0127 enables open cut and highwall mining, and approves extraction from all seams down to and including the Lithgow Seam to a maximum production of 1.2 million tonnes per annum (Mtpa). Three modifications of PA 07_127 have been approved since it was granted.

A chronology of mining at the site and related activities is presented in **Table 2.1**. The locations of previous open cut and underground workings at Invincible are shown on **Figure 2.1**.

Table 2.1 Chronology of Mining at Invincible

Year	Event
1901 - 1957	Underground mining operations undertaken at the Old Invincible Colliery.
1940s	Open cut mining carried out in area to the south of the current Invincible mine infrastructure area (Cullen Main East).
1957 - 1998	The Old Invincible Colliery was relocated 4 km south to its current location.
1978	Invincible Coal Preparation Plant (CPP) approved (DA 219/78).
1998 - 2001	Open Cut operations undertaken in the Northern area of the site.
2001 - 2006	Invincible was placed on care and maintenance.
2006	Project Approval (PA 05/0065) was granted for an extension of open cut operations at Invincible which extended mining to the south of the previously mined area. Open cut operation recommenced in 2006.
2008 - 2016	Current operations were approved in 2008 under Part 3A of the EP&A Act (PA 07_0127). This approval extended open cut mining in four mining areas, The West Pit Area, North Pit Area, Renown (Central) Pit Area and the South Pit Area.
2009	Modification 1, an amendment to the schedule of lands, was approved.
2009	Modification 2, a modification of the project boundary, was approved.

Year	Event
2010	Modification 3, a modification to allow for an additional 300,000 tpa of product coal (up to total 1.2 Mtpa) to be transported by the public road network, was approved.
2012	A major project application was lodged pursuant to Part 3A EP&A Act, seeking approval to consolidate and extend coal mining operations and management of the Invincible and Cullen Valley Mine sites under one approval (Coalpac Consolidation Project). This application was recommended for refusal by the PAC and the application was subsequently withdrawn by Coalpac prior to determination. The primary reason for the PAC's recommended refusal of the application to modify the Invincible consent was due to the proximity of the project to the Pagoda landform complex (50 m) and the associated impacts from highwall mining beneath parts of the pagoda landforms.
2013	Invincible was placed in care and maintenance.
2014	A section 75W modification application (2014 Modification Project) was lodged seeking approval to modify the existing Cullen Valley and Invincible consents. Approval was sought for a reduced scale of mining relative to that proposed as part of the earlier Coalpac Consolidation Project. While these applications were lodged separately, they were jointly assessed. The NSW Department of Planning and Environment (DP&E) recommended that the modifications be approved; however, the applications were referred to the PAC for determination under delegation from the Minister and the PAC subsequently refused the applications. The primary reasons for the PAC's refusal of the application to modify the Invincible consent was due to the proximity of the project to the Pagoda landform complex and uncertainties regarding potential impacts from blasting and highwall mining on the pagoda landforms.
2015	Shoalhaven Coal purchased Invincible and Cullen Valley from Coalpac (in liquidation) in 2015.

2.2 Current mining operations

As noted in **Section 1.0**, Invincible currently operates under the Invincible Project Approval granted in December 2008. The Invincible Project Approval was granted under the now repealed Part 3A of the EP&A Act. The available coal within the approved mining area has been exhausted and the operation is currently on care and maintenance. **Table 2.2** describes the key features of the currently approved development under the Invincible Project Approval. **Section 2.2.1** describes the interactions between Invincible and the approved operations at Cullen Valley, which are also currently on care and maintenance.

The extent of existing approved disturbance areas is shown in **Figure 1.2**. **Figure 2.1** and **2.2** show the key existing mine infrastructure at Invincible.

The key components of the currently approved operations at Invincible are detailed in **Table 2.2**.

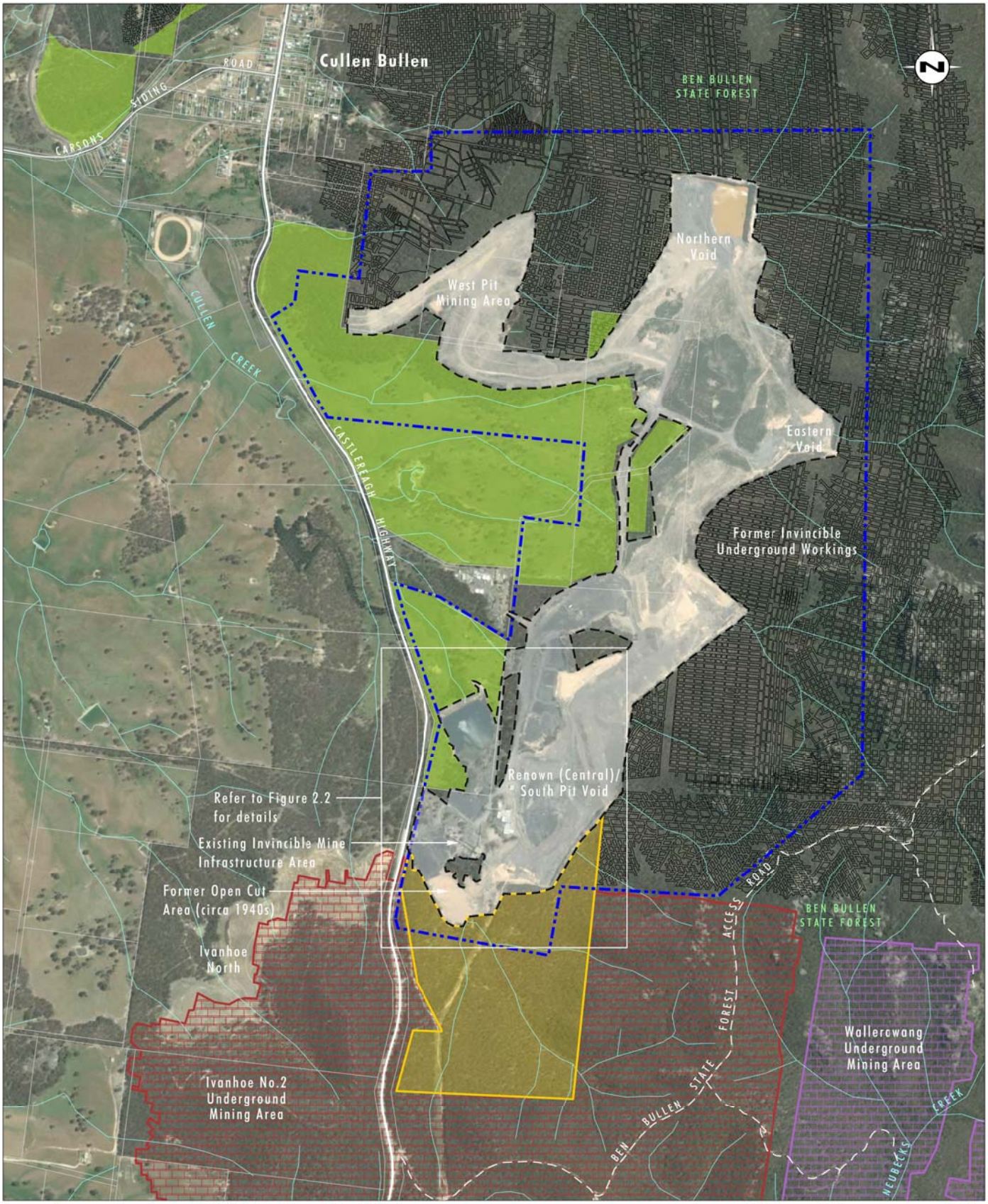

Image Source: Google Earth/CNES/Astrium (Nov 2014)
Data Source: LPI (2016), Sedgman (2014)

0 0.25 0.5 1.0km

Legend

- Existing Approved Mining Disturbance Area
- Proposed Southern Extension Area
- Former Invincible Underground Workings
- Invincible Project Approval Boundary
- Ivanhoe No.2 Underground Mining Area
- Wallerawang Underground Mining Area
- Existing Conservation and Offset Areas

FIGURE 2.1

Invincible Existing Approved Operations

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Table 2.2 Key Components of Existing Approved Operations at Invincible

	Existing Approved Invincible Operations (PA07_0127)
Resource Tonnes	7 Mt ROM
Mining Methods	Highwall and Open Cut
Mining Rate	1.2 Mtpa ROM Coal
Production Rate	1.2 Mtpa Product Coal
Mining Life	To December 2016 (8 years from date of approval)
Approved Disturbance Area	165 ha
Operational Workforce	35 full time personnel
Hours of operations	7.00 am to 10.00 pm Monday to Saturday (excluding public holidays). Mining in south pits not permitted between 6.00 pm and 10.00 pm.
Blasting	Blasting between 9.00 am and 5.00 pm Monday to Saturday, inclusive. No more than: • 2 blasts per day; or • 5 blasts per week averaged over a 12 month period
Transport	Transport 7.00 am to 9.30 pm Monday to Saturday, excluding Sundays and public holidays. No more than 146 laden coal truck movements from the site per day (averaged over a week) No more than 16 laden coal truck movements per hour.
Minimum distance to pagoda formations	Existing pit extends to within 230 m of some formations. Highwall mining extended to within approximately 100 m of pagodas.

While mining activities under the Invincible Project Approval are approved to December 2016, the project approval remains in force and rehabilitation activities can continue under the approval and the Invincible Coal Preparation Plant (Invincible CPP) and loading facilities can continue to process coal after that date subject to any restrictions on the receipt of coal from other operations.

The Castlereagh Coal land to the west of the Invincible Open Cut mining operations are managed as offset areas for the existing approved operations in accordance with the requirements of the Invincible Project Approval (refer to **Figure 2.1**).

Image Source: Google Earth/Digitalglobe (Mar 2015)
Data Source: LPI (2016)

0 50 100 200m

Legend

Existing Approved Mining Disturbance Area
Proposed Southern Extension Area

FIGURE 2.2

Invincible Existing Mining Infrastructure

2.2.1 Relationship with Cullen Valley Mine

Castlereagh Coal also acquired the Cullen Valley Mine and associated assets from Coalpac in 2015. Cullen Valley is currently on care and maintenance. There are remaining approved resources at Cullen Valley however Castlereagh Coal does not have any immediate plans to recommence mining operations at Cullen Valley. Under its existing project approval, Cullen Valley could operate up to its approved capacity of 1 Mtpa saleable coal with no more than 200 ktpa transported to domestic destinations other than Mt Piper Power Station. When operational, all product coal from Cullen Valley is transported by truck via the private haul road to the south of Cullen Bullen and then via the Castlereagh Highway. When both Cullen Valley and Invincible were operational up to 5000 tonnes per month (maximum of 60,000 tpa) of ROM coal from Cullen Valley was transported to Invincible for blending with the lower ash Invincible coal in accordance with the existing Cullen Valley and Invincible project approvals.

The Southern Extension Project does not seek any changes to the approved operations at Cullen Valley. It is noted that as part of the EA the approach to a number of assessments has been to assume Cullen Valley, along with other mining operations currently on care and maintenance, as being operational up to the limits of the relevant existing project approvals. This has been undertaken to provide for an assessment of potential cumulative impacts of the Southern Extension Project along with the approved mining operations in the area surrounding Invincible. This is outlined in the relevant detailed assessments in **Section 6.0**.

2.3 Environmental management of existing operations

Environmental management of the existing approved operations at Invincible is undertaken within the framework of the *Environmental Management Strategy for the Invincible Open Cut Coal Mine Extension* (EMS) (Coalpac 2009) and supporting management plans, *the Invincible Colliery Care and Maintenance Mining Operations Plan* (MOP) (Sedgman 2016) and approvals. The current environmental and planning related approvals held in relation to Invincible are listed in **Table 2.3**.

Table 2.3 Existing Invincible Planning and Environment Approvals

Legislation	Approval	Details
EP&A Act	**Project Approval 07/0127**	Granted on 4 December 2008 Mining operations permitted to 4 December 2016 with rehabilitation to occur after this date.
Mining Act 1992	**Mining Lease ML 1635**	Held by Castlereagh Coal. Extends to the surface and covers the existing open cut mining areas at Invincible
	Mining Lease ML 1638	Held by Castlereagh Coal. Extends to the surface and covers the existing open cut mining areas at Invincible. ML 1638 extends into the northern end of the Southern Extension Area.
	Mining Lease CCL 702	Held by Castlereagh Coal. Variable depth.
	Mining Lease CCL 712	Subsurface lease CCL 712 held by Ivanhoe Coal Pty Limited

Legislation	Approval	Details
Protection of the Environment Operations Act 1997	Environment Protection Licence 1095	Held by Shoalhaven Coal Pty Ltd over the Invincible premises
Water Management Act 2000	Groundwater Licences WAL 35978	Held by Shoalhaven Coal and authorises the extraction of 26 units from the NSW Murray-Darling Porous Rock Groundwater Sources Water Sharing Plan.

2.3.1 Environmental management and monitoring

The Invincible EMS and supporting environmental management and monitoring plans provide a methodical and integrated approach to fulfilling Castlereagh Coal's environmental objectives and ensuring the ongoing management of the site in accordance with the principles of ecologically sustainable development.

Current environmental management and monitoring plans developed in accordance with the Invincible Project Approval include:

- Environmental Management Strategy
- Environmental Monitoring Program
- Air Quality Monitoring Plan
- Blast Management Plan
- Landscape Management Plan
- Noise Monitoring Program
- Aboriginal Cultural Heritage Management Plan
- Particulate Pollution Reduction Program
- Pollution Incident Response Management Plan
- Road Closure Management Plan
- Water Management Plan
- Mining Operations Plan (MOP).

Castlereagh Coal's environmental management plans have been prepared and implemented in accordance with the conditions of the Invincible Project Approval, where appropriate. The MOP is approved by the NSW Department of Industry, Division of Resources and Energy (DRE), and is discussed further in **Section 2.3.2.1**.

Noise, dust, blast, surface water and groundwater monitoring is undertaken for the existing operations at the monitoring points as shown on **Figure 2.3**. There is also a detailed rehabilitation and flora and fauna monitoring program in place which is discussed further in **Section 6.18**.

Annual review and reporting of environmental performance is provided in the Annual Environmental Management Report (AEMR) and the annual return prepared for the Environment Protection Licence (EPL) (refer to **Section 2.3.3**).

2.3.2 Mining leases

Castlereagh Coal hold three mining leases relevant to Invincible (refer to **Figure 2.4**). ML 1635 (23 ha) and ML 1638 (450 ha) both extend to the surface and cover the existing open cut mining areas at Invincible. ML 1638 also extends into the northern end of the Southern Extension Area. Consolidated Coal Lease 702 (CCL 702) (1,840 ha) is a subsurface mining lease which underlies much of the area to the north and east of Invincible.

The Southern Extension Area extends into an area currently subject to the subsurface lease CCL 712 held by Ivanhoe Coal Pty Limited. Mining Lease Application 431 (MLA 431) was lodged on 24 July 2012 and covers approximately 41 ha of CCL 712 to the south of the existing Invincible open cut area and extends to the surface of the land. The Southern Extension Area is located wholly within ML 1638 and MLA 431. Castlereagh Coal has an agreement with Ivanhoe Coal Pty Limited consenting to the lodgement of MLA 431. This agreement also includes a royalty arrangement for coal recovered from the area of CCL 712 currently within MLA 431.

2.3.2.1 Invincible mining operations plan

The operations at Invincible are currently on care and maintenance and are managed in accordance with the current Invincible Care and Maintenance MOP, which was approved by the DRE in 2016. The MOP covers a two year period from February 2016 to February 2018. The MOP encompasses all activities undertaken at Invincible such as water management and sediment control, rehabilitation and maintenance works, maintenance of existing site infrastructure and the storage of mining plant.

2.3.3 Environment Protection Licence 1095

Shoalhaven Coal Pty Ltd holds Environment Protection Licence 1095 (EPL 1095) over the Invincible premises. The scheduled activities covered by EPL 1095 include coal works (up to 2 Mt handled) and mining for coal (up to 2 Mt produced).

EPL 1095 requires dust monitoring at five locations and water monitoring at the licensed discharge point. The licensed discharge point and monitoring locations are shown on **Figure 2.3.** EPL 1095 is discussed in further detail in **Section 4.0** and **Section 6.0**

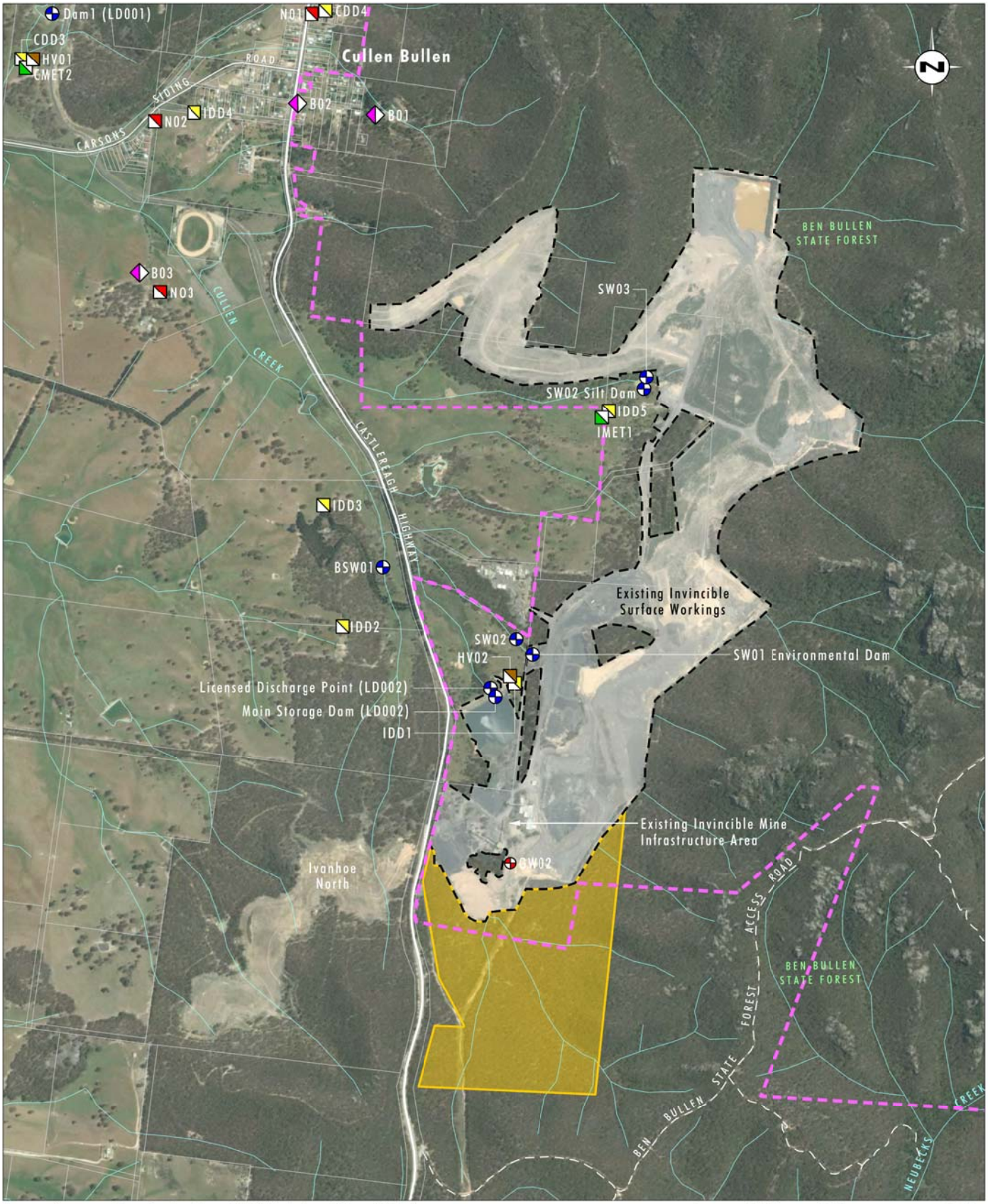


Image Source: Google Earth - CNES/Astrium (Nov 2014)
Data Source: LPI (2016), Sedgman (2014)

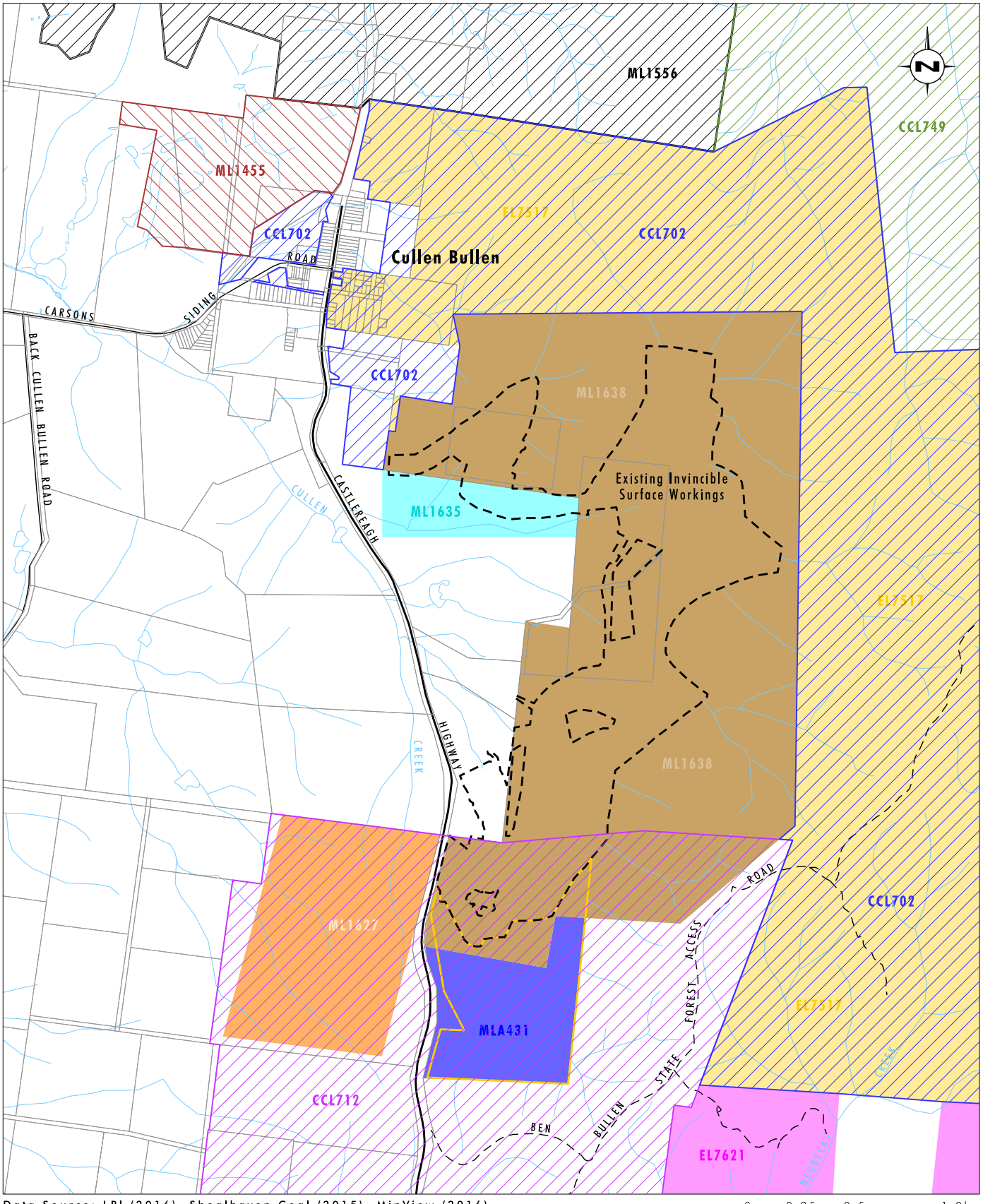
Legend

- Existing Approved Mining Disturbance Area
- Proposed Southern Extension Area
- Existing EPL Boundary
- Blast Monitor
- Depositional Dust
- Meteorological Station
- Noise Monitor
- PM_{10} Monitor
- Surface Water
- Groundwater Bore

FIGURE 2.3

Existing Environmental Monitoring Locations

File Name (A4): R02/3622_075.dgn
20160915 15.30



Legend

- Existing Approved Mining Disturbance Area
- Proposed Southern Extension Area
- CCL702
- CCL712
- CCL749
- EL7517
- EL7621
- ML1455
- ML1556
- ML1627
- ML1635
- ML1638
- MLA431

FIGURE 2.4

Invincible Mining Titles

2.3.4 Rehabilitation

The Invincible Project Approval details the proposed final landform for the existing approved operations. This current approved final landform does not include any voids remaining in the final landform.

Rehabilitation at Invincible has been completed progressively as part of approved operations with the current rehabilitation requirements detailed in the MOP as approved by DRE. The rehabilitation of disturbed land is designed around returning the majority of Invincible to woodland habitat generally consistent with ecological communities that would have historically occurred in the area.

Past experience at the site has demonstrated that this objective is best achieved through aerial seeding of endemic tree, shrub and grass species onto a growing medium established using soil removed during pre-stripping operations and/or where conditions permit, directly onto overburden. Existing rehabilitation efforts at Invincible are shown in **Plates 2.1** to **2.3**. As can be seen from these plates, both early succession species and future canopy species have become well established in the rehabilitated landform and the vegetation is progressing on a succession pathway that will return the area to woodland vegetation similar to that which would have existed pre mining. Logs salvaged from pre-strip activities have also been utilised to provide habitat for fauna in the rehabilitated landscape.

Plate 2.1

Invincible Rehabilitation
Planted in 2008

Plate 2.2

Invincible Rehabilitation Planted in 2011

Plate 2.3

Rehabilitation Area at Invincible. Planted in 2008 (background) and 2012 (foreground)

SECTION 3.0

Description of Proposed Modification

3.0 Description of Proposed Modification

3.1 Overview

Castlereagh Coal proposes to modify the Invincible Project Approval to extend open cut mining operations to the south of the existing approved mining area under Section 75W of the EP&A Act. The primary objective of the Southern Extension Project is to secure a reliable supply of specialty nut coal for use at Manildra's Shoalhaven Starches Plant.

Nut coal is a specialty coal resource which can only be economically sourced at a few existing mining operations in NSW. As noted in **Section 1.0**, Manildra was previously a customer of Invincible prior to cessation of mining and the operation being placed on care and maintenance. At present, Manildra sources its nut coal from Clarence Colliery located to the east of Lithgow and Whitehaven's operations in northern NSW. Further detail on the supply arrangements for speciality nut coal is provided in **Section 3.6**.

The Southern Extension Project includes:

- Extending the period in which mining can continue for a period of eight years from approval of the modification application
- Extending the open cut mining area to mine down to, and including, the Lithgow Seam to the south of the existing mine in the Southern Extension Area (refer to **Figure 1.2**). No highwall mining or open cut mining in any other areas of Invincible is proposed as part of the Southern Extension Project
- Use of existing open cut voids and former underground workings for temporary water storage
- No change to currently approved maximum mining production rates
- Continued use of existing Invincible infrastructure (including maintenance work and minor upgrades, and operation of the existing Invincible CPP
- No change to currently approved product coal transport arrangements with coal to be transported from the site by road truck to either the Shoalhaven Starches Plant or Mt Piper Power Station
- Rehabilitation of the proposed Southern Extension Area and all existing disturbance areas at Invincible by reshaping mining areas to remove voids and revegetating the reshaped landform with locally endemic woodland and forest communities.

The Southern Extension Project will provide access to an additional 2.7 Mt of run-of-mine (ROM) coal from all seams down to, and including, the Lithgow Seam. Based on current coal quality information, only coal from the Lithgow Seam is of sufficient quality for use in the Shoalhaven Starches Plant. The Lithgow Seam resources, when washed, will provide approximately 300 kt of nut coal for the Shoalhaven Starches Plant. The demand per annum for nut coal at Shoalhaven Starches Plant is approximately 85 ktpa. Castlereagh Coal will undertake further coal quality testing to assess whether coal from other seams within the Southern Extension Area could meet the quality requirements for the Shoalhaven Starches Plant, when mixed with Lithgow Seam nut coal.

Castlereagh Coal is seeking approval for the extension of mining to occur over a period of up to eight years to provide for flexibility in the supply of nut coal through:

- providing an option for Manildra to source all required nut coal directly from Invincible

- continuing to source nut coal from a range of other existing sources supplemented by supply from Invincible where necessary or cost effective to do so

- utilising a blended product using coal from the other seams within the Southern Extension Area where further assessment of coal quality indicates this can be used at the Shoalhaven Starches Plant.

The nut coal resource available in the Lithgow Seam in the Southern Extension Area equates to approximately four years supply of nut coal for the Shoalhaven Starches Plant if Invincible is the sole source of supply. Mining rates will vary at Invincible based on the supply needs for the Shoalhaven Starches Plant.

The mining of coal in the Lithgow Seam will necessarily involve the extraction of coal from the Lidsdale and Irondale Seams which are located above the Lithgow Seam. Investigations are currently being undertaken to assess whether coal from the Lidsdale or Irondale Seams can be used at the Shoalhaven Starches Plant when washed and blended with coal from the Lithgow Seam. Surplus coal from the Lidsdale and Irondale Seams which is unable to be used in Manildra's Shoalhaven Starches Plant will be sold to local power stations for energy production consistent with the previous mining operations at Invincible. The maximum production rates under the current Invincible Project Approval conditions are required to account for the sale of surplus Lidsdale and Irondale Seam coal extracted in the process of obtaining sufficient product for use at the Shoalhaven Starches Plant. If a blended product utilising Irondale and/or Lidsdale coal can be utilised, overall mining and production rates at Invincible will be significantly lower than the current approved rate.

The flexibility being sought in this modification application is different to many coal mining projects in that its primary purpose is to provide Shoalhaven Starches Plant with certainty of supply of specialty nut coal.

In recognition of the different production options, this EA and associated detailed studies have assumed worst case production scenarios for each of the impact types. For all assessments, the scenario assessed includes all nut coal for Shoalhaven Starches Plant being sourced from the Lithgow Seam at Invincible, commencing in the early years following approval of the Southern Extension Project. The studies undertaken for the Southern Extension Project have therefore assumed operations being undertaken at maximum approved production rates to identify the possible maximum extent of potential environmental and community impacts and to identify applicable mitigation measures. All other production scenarios either have the same or reduced impacts relative to the maximum production scenario assessed as part of the EA.

An overview of the Southern Extension Project, relative to existing approved operations is provided in **Table 3.1**, with further detail of the proposed modification provided in the following sections.

Table 3.1 Comparison of Existing approved operations at Invincible and the Southern Extension Project.

	Existing Approved Operations	Southern Extension Project
Resource Tonnes	Defined by existing footprint. Approved reserves have been mined.	Approximately 2.7Mt ROM coal
Mining Methods	Highwall and Open Cut	Open Cut only
Target Seams	All seams down to Lithgow Seam (Irondale, Lidsdale and Lithgow)	All seams down to Lithgow Seam (Irondale, Lidsdale and Lithgow)
Mining Rate	Up to 1.2 Mtpa ROM Coal	Up to 1.2 Mtpa ROM Coal

	Existing Approved Operations	Southern Extension Project
Production Rate	Up to 1.2 Mtpa Product Coal	Up to 1.2 Mtpa Product Coal
Mining Life	To December 2016 (8 years from date of approval)	Up to 8 years from date of approval
Disturbance Area	165 ha	Approximately 50 ha of additional disturbance
Operational Workforce	35 full time personnel	Approximately 35 full time personnel
Hours of operations	7.00 am to 10.00 pm Monday to Saturday (excl. public holidays). Mining in south pits not permitted between 6.00 pm and 10.00 pm.	7:00 am to10.00 pm Monday to Saturday (excl. public holidays). Mining and coal washery operations will not occur between 6.00 pm and 10.00 pm (operations limited to truck loading and maintenance activities only during this period).
Blasting	Blasting between 9.00 am and 5.00 pm Monday to Saturday, inclusive. No more than: • 2 blasts per day; or • 5 blasts per week averaged over a 12 month period.	Blasting between 9.00 am and 5.00 pm Monday to Saturday, inclusive. No more than: • 2 blasts per day; or • 5 blasts per week averaged over a 12 month period. Blasts sizes limited to manage potential risks to private residences, pagoda and cliff line formations, historical sites and other infrastructure.
Transport	Road Transport 7.00 am to 9.30 pm Monday to Saturday, excluding Sundays and public holidays. No more than 146 laden coal truck movements from the site per day (averaged over a week). No more than 16 laden coal truck movements per hour.	Road Transport 7.00 am to 9.30 pm Monday to Saturday, excluding Sundays and public holidays. No more than 146 laden coal truck movements from the site per day (averaged over a week). No more than 16 laden coal truck movements per hour.
Tailings Management	Coarse tailings are co-disposed with overburden. Fine tailings are dried in drying ponds; dry tailings are then either mixed with product coal or co-disposed with overburden.	Coarse tailings are co-disposed with overburden. Fine tailings are dried in drying ponds; dry tailings are then either mixed with product coal or co-disposed with overburden.

Aside from minor upgrades and maintenance to the Invincible CPP and associated infrastructure, as well as changes to the water management system associated with the changes in disturbance area, no other changes to the approved mining operations or existing surface facilities are proposed as part of the modification. These facilities will be utilised over the life of the Southern Extension Project.

3.2 Interaction with Cullen Valley Mine

As discussed in **Section 2.2.1**, Castlereagh Coal also own Cullen Valley mining operations located approximately 3.5 km north-west of Invincible and currently on care and maintenance. The Southern Extension Project does not propose any changes to the approved operations at Cullen Valley. While Castlereagh Coal does not have any immediate plans to recommence mining at Cullen Valley, the Cullen Valley approval remains current and authorises continued extraction of coal to 2024.

The approved operations at Cullen Valley include the transport of up to 60 ktpa of coal to Invincible for blending with lower ash coal mined at Invincible. Should mining recommence at Cullen Valley, it is expected that this blending at Invincible would also recommence. The blended Cullen Valley/Invincible product would be included as part of the Invincible production for the purposes of approved production rates, and has been considered as part of relevant impact assessments in **Section 6.0**. There would be no other interactions between the two operations other than the use of the Cullen Valley magazine for the storage of explosives for use at Invincible (refer to **Section 3.5.7.1**).

As outlined in **Section 2.2.1**, for the purposes of cumulative impact assessment a number of assessments in **Section 6.0** have assumed Cullen Valley, and a number of other approved mining operations on care and maintenance, are operating in accordance with relevant approvals.

3.3 Geology and resource description

Invincible is located within the Western Coalfield of NSW on the western edge of the Sydney Basin. The Sydney Basin consists of a series of gently dipping sedimentary beds of shale and sandstone of Permo-Carboniferous age capped by massive sandstones of Triassic Age (Yoo *et al* 2001). Directly beneath the Triassic sandstone these beds contain coal seams and form the Upper Coal Measures. The measures extend from the western boundary of the Western Coalfield in an easterly direction, dipping generally at an angle of 1 degree to 3 degrees to the north-east, towards the coast, and extending out to sea (Yoo *et al* 2001).

The Western Coalfield is characterised by the prominent cliffs and eroding plateaus of the Triassic age sandstone and shale Narrabeen Group which overlies the shale, sandstone, conglomerate and coal of the Permian aged Illawarra Coal Measures. These form the slopes which fall away from the sandstone and shale cliffs (Yoo *et al* 2001). **Figure 3.1** shows a cross section of the geology in the Southern Extension Area.

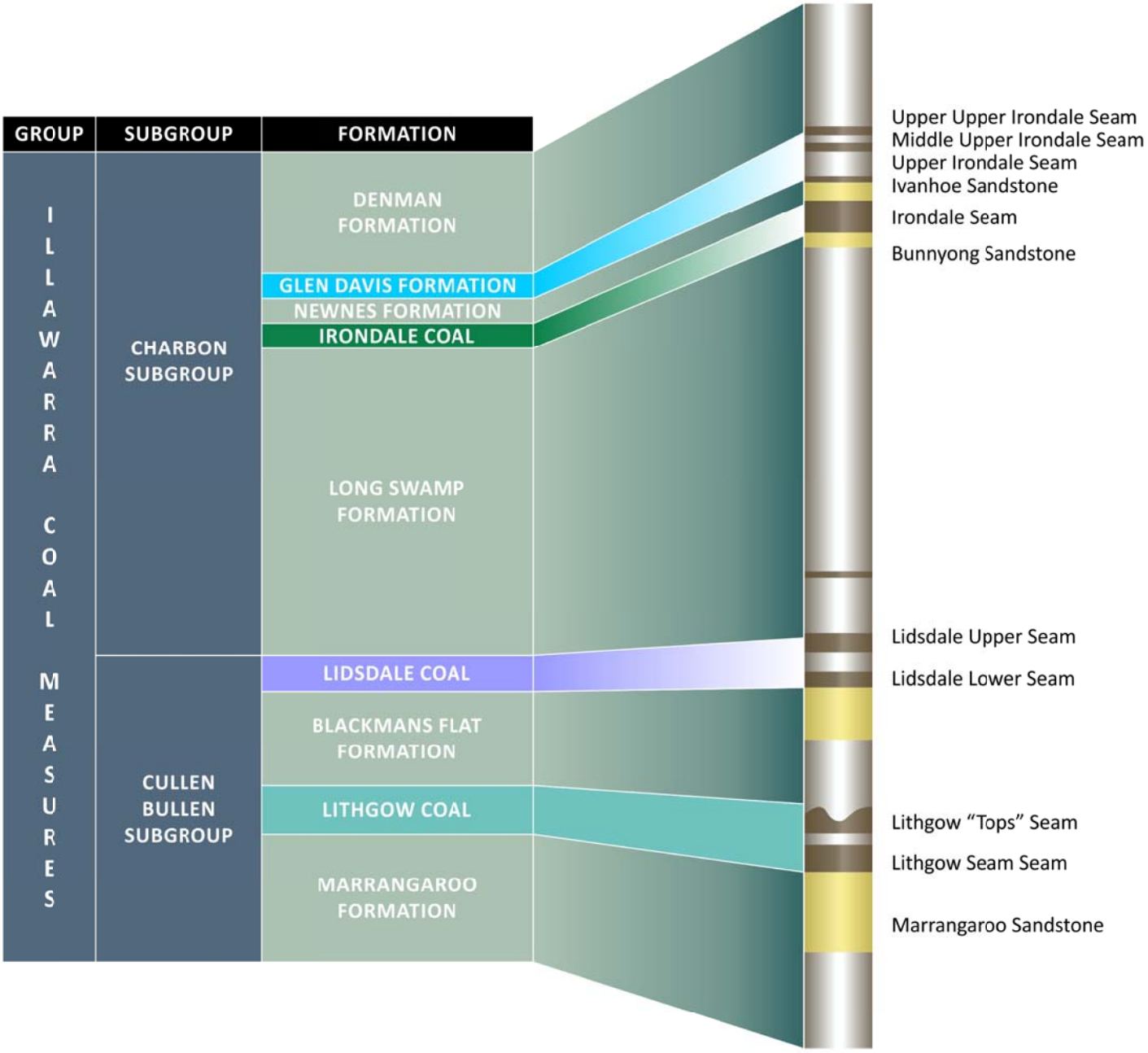


FIGURE 3.1

Southern Extension Area
Indicative Stratigraphic Column

Image Source: Hansen Bailey (2012)

The majority of the Southern Extension Area has been previously mined by bord and pillar methods within the Lithgow Seam associated with the former Ivanhoe No 2 Colliery. Approximately 35 per cent of the Lithgow Seam resources are estimated to remain in the Southern Extension Area. The total quantity of product nut coal in the Southern Extension Area is estimated to be approximately 300 kt. There is an estimated 2.7 Mt of recoverable ROM coal within the Irondale, Lidsdale and Lithgow Seam located in the Southern Extension Area.

Recovery varies with each seam group as shown:

- Irondale 94 per cent
- Lidsdale 75 per cent
- Lithgow 35 per cent (seam previously mined with bord and pillar methods).

The coal seams in the Southern Extension Area are generally horizontal with a slight dip towards the north-east.

The geochemistry of coal seams and overburden is discussed in further detail in **Section 6.18**.

3.4 Project disturbance area

The Southern Extension Area is approximately 50 ha in area. No additional vegetation disturbance outside of the Southern Extension Area or existing approved disturbance area (refer to **Figure 1.4**) is proposed as part of the Southern Extension Project. The total disturbance area has been identified as being approximately 215 ha, of which, approximately 165 ha has been previously disturbed by mining or is approved for disturbance under the current approvals. Approximately 71 ha of the currently approved disturbance area is in the process of being rehabilitated. There is no intention to disturb this existing rehabilitation, however some parts of this rehabilitation may need to be disturbed to develop a free draining landform around the Eastern and North Voids (refer to **Sections 3.5.9** and **6.18**).

The majority of the Southern Extension Area has been previously undermined as part of the former Ivanhoe underground operations (refer to **Figure 2.1**) and approximately 3.2 ha are impacted significantly by existing subsidence as a result of these former workings and will require a high level of disturbance in the future to rehabilitate and make these areas safe irrespective of the Southern Extension Project proceeding (refer to **Figure 1.4**). A further 1.6 ha in the Southern Extension Area has been cleared for the powerline easements which run through the area. The breakdown of the disturbance footprint in terms of vegetation communities impacted is discussed further in **Section 6.4**.

3.5 Proposed mining operations

3.5.1 Mine plan development

Castlereagh Coal has undertaken detailed concept design and environmental and community constraints studies as part of the Southern Extension Project's design phase to identify the optimal balance between accessing nut coal resources and potential environmental and social impacts. Issues identified in the previous assessments of the Coalpac Consolidation Project and 2014 Modification Project have been considered in both the selection of mining areas and the mine plan design. Stakeholder comments previously raised during consultation processes have also been considered in the mine design process and through further engagement with the community regarding the Southern Extension Project (refer to **Section 5.0**).

Integration of the operations with the rehabilitation of former mining areas has also been a key design consideration. The mine plan enables rehabilitation of previously disturbed areas and areas disturbed by the proposed mining operations soon after disturbance. This limits dust and visual impacts from the Southern Extension Project and minimises the duration of ecological impacts.

Significant impact mitigation design features included in the Southern Extension Project include:

- limiting proposed mining operations to the south of the existing Invincible open cut which has comparatively lower ecological and habitat values and is located at greater distance from surrounding private residences and Cullen Bullen relative to other potential coal resources at Invincible
- limiting the Southern Extension Project's disturbance footprint to avoid threatened ecological communities and areas of higher habitat value
- incorporating setbacks from pagodas to minimise impacts on potential threatened species habitat
- identifying blast management controls to avoid adverse impacts on dwellings, structures, private infrastructure and geological features such as cliff lines and pagodas
- mine planning and equipment selection which reduce noise and air quality impacts associated with continuing operations at Invincible.

Section 3.7 provides further details regarding the different options considered during the mine planning process and other measures included in the mine design to avoid or minimise impacts.

3.5.2 Proposed mine plan

3.5.2.1 Mining areas and methods

The Southern Extension Project limits all extraction activities to the Southern Extension Area and area between the existing Southern Void and the Southern Extension Area. Extraction will by open cut mining methods, progressing south from the existing disturbance area into unmined areas of ML 1638 and MLA 431. Coal will be extracted by conventional open cut truck and shovel operations.

Figures 3.2 and **3.3** present the indicative mine plans for the representative stages of the Southern Extension Project. As shown in **Figures 3.2** and **3.3**, mining will advance to the south from the existing disturbance area with the active high wall generally parallel to the southern boundary of MLA 431. As mining progresses deeper, benches will be developed for both highwall stability and mining access purposes.

The post mining landform will be progressively developed and rehabilitated as mining advances to the south (refer to **Section 3.5.9** and **Figure 3.3**).

The progressive stages of mining include:

- Indicative Stage 1 (Stage 1 Mine Plan) – occurs early in the Southern Extension Project life and represents a maximum production scenario (refer to **Figure 3.2**). Mining during this stage will be at its closest location to privately owned residences, and Cullen Bullen, with overburden emplacement and land shaping activities at the most exposed location for the closest residences. This stage includes the rehabilitation and shaping of the former open cut mining areas in the south of the former mining area. The northern and eastern voids in the former mining area will be used for temporary water storages as part of the Southern Extension Project

- Indicative Stage 2 (Stage 2 Mine Plan) – occurs later in the Southern Extension Project life, with mining at its furthermost limit with overburden emplacement primarily in-pit behind the active face. During this stage, overburden will also be hauled to fill the north-eastern void in the former mining area (refer to **Figure 3.3**). Significant areas of previous disturbance will have been reshaped and will be in various stages of rehabilitation.

Figure 3.4 shows the conceptual final landform for the Southern Extension Project. As can be seen from **Figure 3.4**, the southern extent of the Southern Extension Area and the Northern Void in the former mining area will be reshaped following the cessation of mining to remove the voids in this area.

The conceptual mine plans which form the basis of this assessment have been designed in consideration of current mining techniques and technologies and are based on Castlereagh Coal's current understanding of local geology. Mining operations are, however, dynamic and the specific mine plan layout and sequence shown in the indicative mine plans may be subject to changes due to specific coal supply requirements of the Shoalhaven Starches Plant, economic conditions, technological advances, operational needs or as further geological data is gathered.

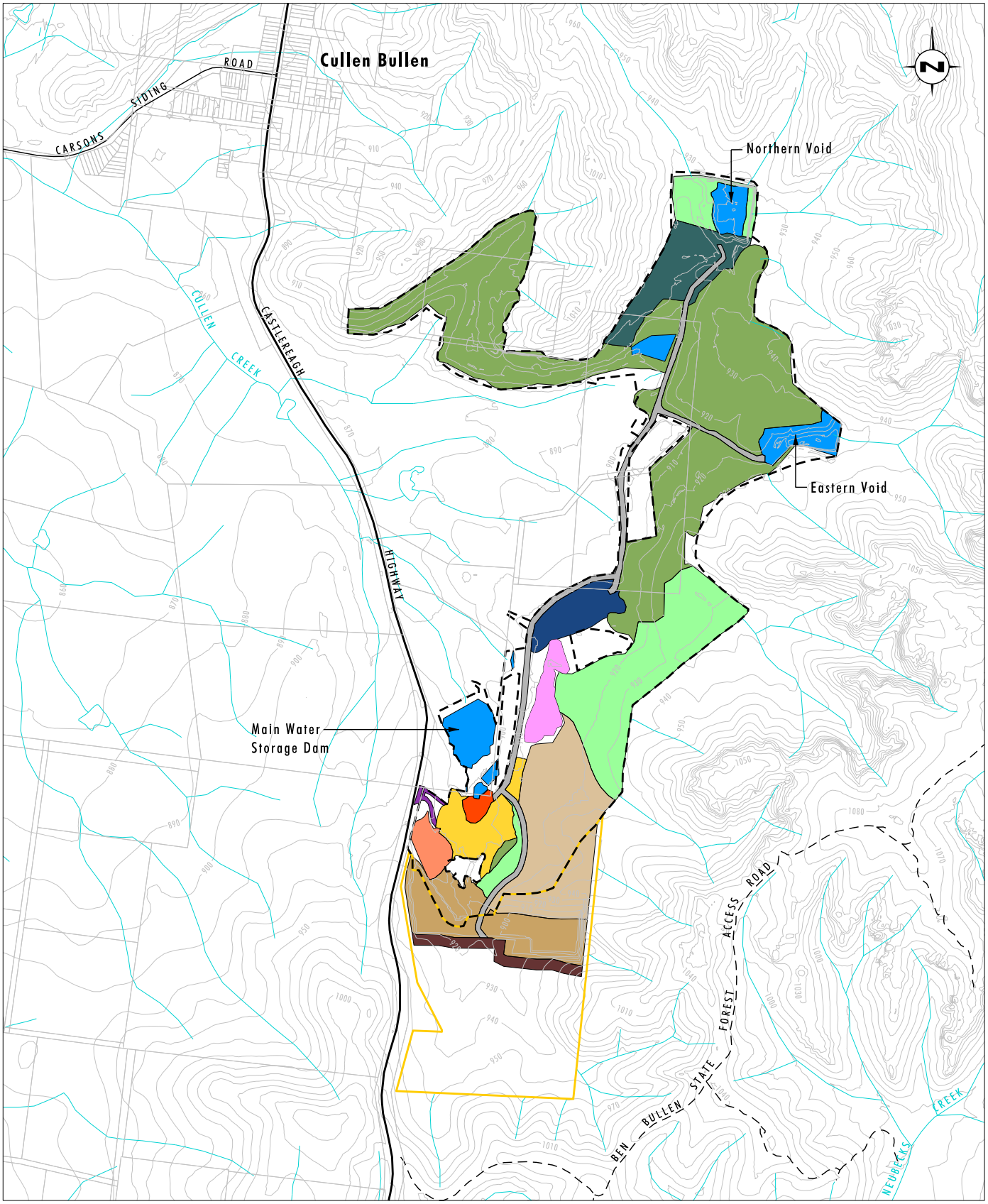
3.5.3 Mining fleet

The typical mining fleet that will be used over the life of the Southern Extension Project is outlined in **Table 3.2.**

Table 3.2 Indicative Mining and Key Ancillary Equipment

Equipment Type	Indicative No.	Key Ancillary Equipment	Indicative No.
Excavator (Overburden)	2	Rear dump truck (Coal)	2
Excavator (Coal)	1	Drill	1
Small Excavator	2	Grader	1
Dozers	3	Water cart	1
Rear dump truck (Overburden)	7	Loaders (at Coal stockpiles)	1

Note: The table outlines typical numbers of equipment for the maximum production scenario. There may be variation in numbers, size and types of equipment used to suit operational needs, provided that the relevant limits and environmental impact criteria are maintained.



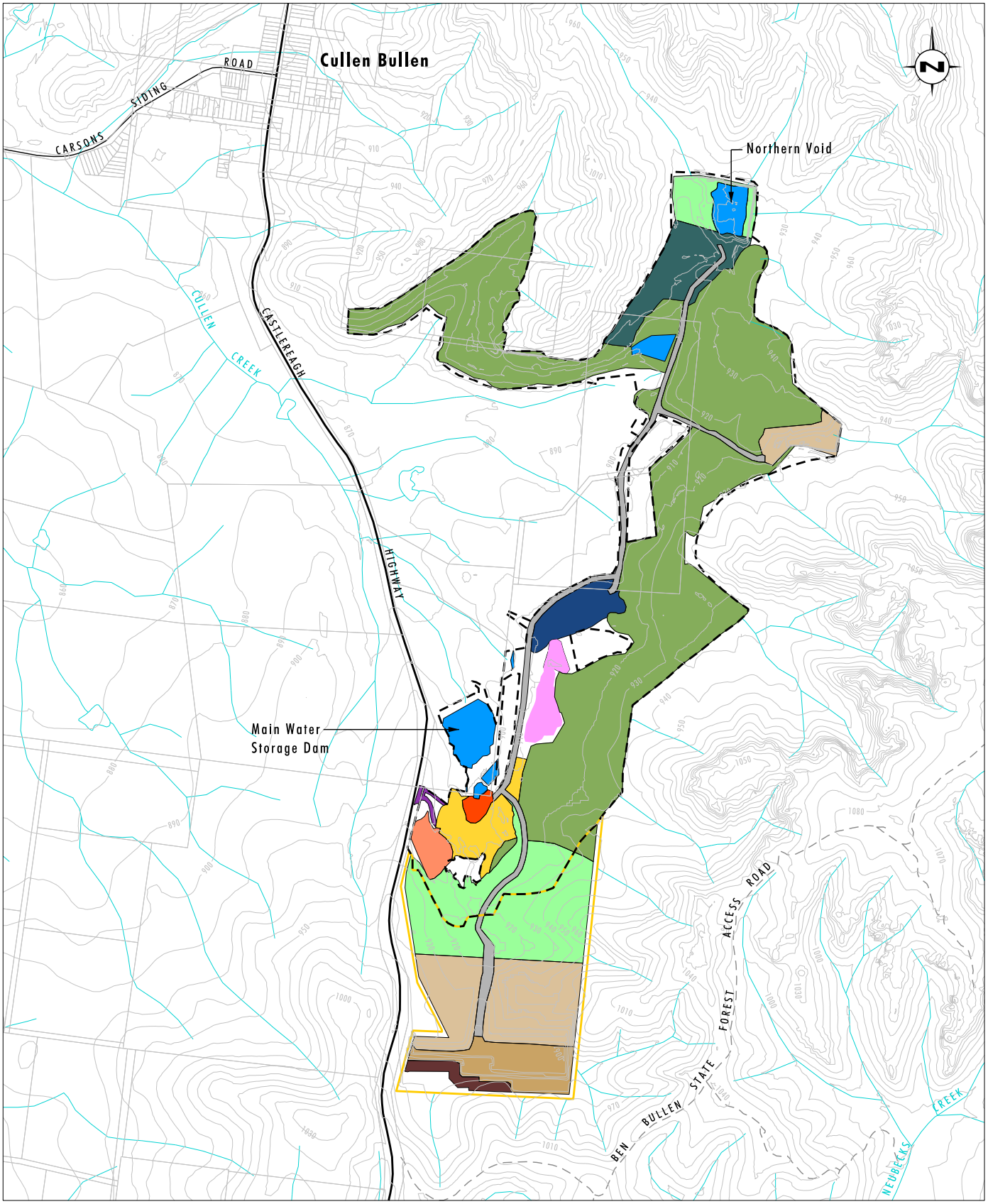
Data Source: LPI (2016)
Note: Contour Interval 10m

Legend

- Existing Approved Mining Disturbance Area
- Proposed Southern Extension Area
- Active Mining
- Active Overburden Emplacement Area
- Pre Strip
- Rehabilitation - Vegetated
- Shaped Not Seeded
- Coal Stockpile - Product
- Coal Stockpile - ROM
- Haul Road/Access Road
- Sealed Access Road
- Infrastructure/Laydown Area
- MIA/Administration
- Water Management Area
- Tailings Drying Area
- Temporary Stabilisation Area

FIGURE 3.2

Indicative Mine Plan Stage 1



Data Source: LPI (2016)
Note: Contour Interval 10m

0 0.25 0.5 1.0km

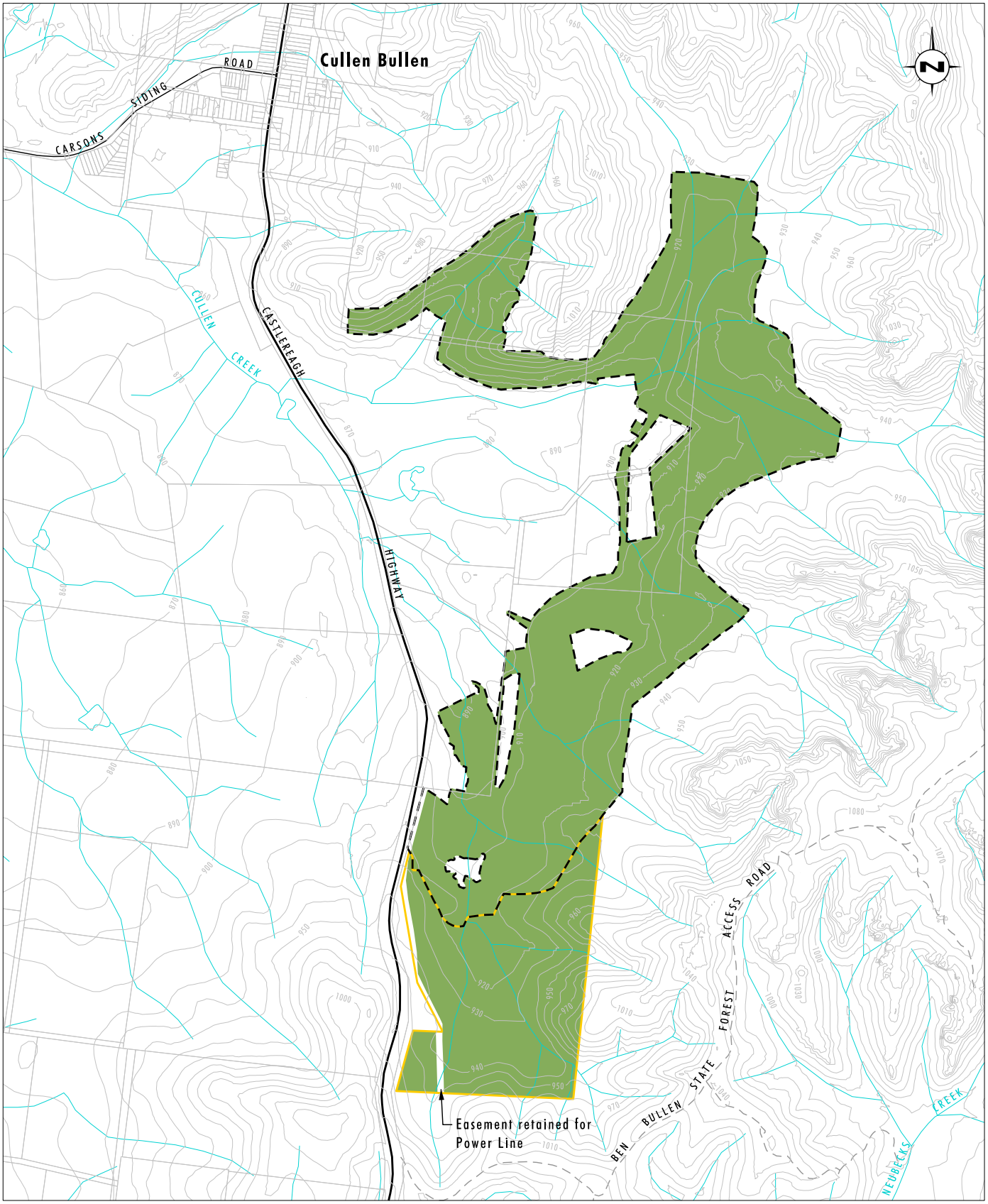
Legend

- Existing Approved Mining Disturbance Area
- Proposed Southern Extension Area
- Active Mining
- Active Overburden Emplacement Area
- Pre Strip
- Rehabilitation - Vegetated
- Shaped Not Seeded
- Coal Stockpile - Product
- Coal Stockpile - ROM
- Haul Road/Access Road
- Sealed Access Road
- Infrastructure/Laydown Area
- MIA/Administration
- Water Management Area
- Tailings Drying Area
- Temporary Stabilisation Area

FIGURE 3.3

Indicative Mine Plan Stage 2

File Name (A4): R02/3622_037.dgn
20160915 16.10



Data Source: LPI (2016)
Note: Contour Interval 10m

0 0.25 0.5 1.0km

Legend

- Existing Approved Mining Disturbance Area
- Proposed Southern Extension Area
- Rehabilitation - Vegetated

FIGURE 3.4

Proposed Invincible Conceptual Final Landform

3.5.4 Mining process

3.5.4.1 Pre-strip activities

Pre-strip operations include the removal of vegetation and topsoil ahead of the active mining operation and overburden emplacement for later use in the rehabilitation of disturbed areas. Pre-strip activities will generally be restricted to approximately 50 m in advance of the active highwall.

Trees will be felled with controls implemented during the felling process to minimise impacts on arboreal fauna which may be present. Fallen trees and previously fallen timber which may have potential habitat value in the rehabilitated landform will be salvaged and either stockpiled for later use in rehabilitation or placed directly on reshaped and topsoiled overburden areas for habitat establishment purposes.

Following the removal of vegetation, topsoil will be stripped and either stored in topsoil stockpiles for later use or placed directly on shaped overburden areas for rehabilitation purposes. Temporary stockpiles will be located within existing disturbed areas.

Vegetation clearance activities and associated management controls are discussed further in **Section 6.4.** Management of soil resources for use in rehabilitation is discussed further in **Section 6.2** and **6.18.**

3.5.4.2 Overburden removal and management

Once the mining area is cleared of vegetation and topsoil, the material lying above the target coal seams, known as overburden, is broken up through drilling and blasting to enable it to be removed. The top layer of overburden close to the surface is generally weathered material that may not require blasting and may be able to be removed using dozers prior to blasting. Deeper layers of overburden will be drilled and blasted.

Overburden material from the Southern Extension Area will be loaded onto trucks by excavators and hauled to emplacement areas. Some overburden may be pushed directly by dozer to areas behind the active mining area rather than being hauled via truck. Overburden is removed down to the top of target seams to enable the removal of coal (refer to **Section 3.5.4.2**).

The sequence of mining and emplacement of overburden has been designed to allow early and progressive final rehabilitation as shown on **Figures 3.2** to **3.4**. The overburden emplacement areas will be progressively shaped and rehabilitated to minimise visual impacts, dust generation and prevent erosion. The rehabilitation process is discussed in further detail in **Sections 3.5.9** and **Section 6.18**.

3.5.4.3 Blasting

Overburden will generally be blasted prior to removal. Weathered overburden material close to the surface may be ripped using dozers prior to removal.

Castlereagh Coal will undertake blasting in accordance with a detailed design process that considers operational, geological and environmental constraints. Blasts are designed such that potential impacts on surrounding features, such as residences, infrastructure, and sensitive locations such as heritage items or pagoda / cliff line structures in the vicinity of the proposed mining operations are appropriately managed and comply with relevant criteria. Previous blast monitoring from the site and surrounding area provides valuable historical information with which to appropriately design future blasts to minimise impacts. All blasts will be monitored with ongoing blast design being revised in light of monitoring results and any changed geological conditions.

Blasting will take place between the hours of 9.00 am and 5.00 pm Monday to Saturday, with no more than 2 blasts per day, or 5 blasts per week averaged over any 12 month period. No blasting will be undertaken on Sundays or public holidays.

Where blasting is to be undertaken within 500 m of publicly accessible areas, precautionary measures, such as the temporary closure of roads including the Castlereagh Highway adjacent to the site, will be implemented to ensure public safety is not put at risk as a result of blasting operations (refer to **Section 6.8**). There is a long history of successfully implementing road closures due to blasting at the site and Castlereagh Coal will conduct its operations in a manner that minimises impacts on the community. Blasts will also be designed to minimise the likely occurrence of blast fume generation.

Further details of blast design and management is provided in **Section 6.8**.

3.5.4.4 Coal removal

Mining operations will occur down to the base of the Lithgow Seam to a depth of approximately 900 m AHD, which is between 12 and 97 m below natural ground surface. Coal from each seam will be removed as mining progresses deeper. Exposed coal will be either blasted or ripped using dozers before being loaded onto trucks by excavators. Trucks will haul coal to the ROM stockpile located at the Invincible Mine Infrastructure Area (refer to **Figure 2.2**).

3.5.5 Proposed coal handling and processing

The Southern Extension Project will utilise the existing coal handling and coal processing infrastructure within the Invincible mine infrastructure area. The location of the existing Invincible CPP and related stockpile and coal loading facilities is shown on **Figure 2.2**.

Coal handling systems at Invincible include a Centralised Coal Crushing and Screening Area for sizing and screening of ROM coal, with stockpiling capacity of 15,000 tonnes of ROM coal and 10,000 tonnes of product coal. Separate ROM and product stockpiles are maintained for the screening plant and crusher, with a further product stockpile maintained for the loading of road trucks for the transportation of product coal.

At the Invincible CPP, ROM coal is fed to a primary breaker for size reduction prior to being transported by conveyor to the Bradford Breaker for sizing and separation from coarse rejects. Sized coal <100 mm from the Bradford Breaker can be fed to the washery via a small surge bin, which further separates coal into either of the four local product bins or the 5000 tonne capacity conical stockpile. Excess coal from the conical stockpile can be pushed to the adjacent product coal stockpile area, as required (refer to **Figure 2.2**).

ROM coal will be crushed to the size requirements of the different products. Coal from the Lithgow Seam will be washed and screened (and re-crushed and washed if necessary), with coal meeting nut coal specifications segregated for transport to the Shoalhaven Starches Plant. Washed and crushed coal from the Lidsdale and Irondale Seams may also be blended with nut coal from the Lithgow Seam if the washed and/or blended product meets the specifications for the boilers used at the Shoalhaven Starches Plant.

Undersize washed coal from the Lithgow Seam will be blended with surplus crushed ROM coal from the Lidsdale and Irondale Seams and stockpiled prior to transport to the Mt Piper Power Station.

This application is seeking to maintain the currently approved maximum production limits at Invincible of 1.2 Mtpa product coal. As discussed earlier, the removal of coal from the Lidsdale and Irondale Seams is required to access the Lithgow Seam and this level of production may be necessary to access the required volumes of nut coal for the Shoalhaven Starches Plant in a given year.

The washery component of the Invincible CPP will only operate when enough Lithgow Seam coal (and suitable coal from other seams) has been stockpiled to produce nut coal which meets Shoalhaven Starches specifications and requirements. This will occur on a regular basis over the life of the Southern Extension Project. The Invincible CPP will only operate between 7.00 am and 6.00 pm Monday to Saturday.

3.5.5.1 Invincible CPP maintenance and upgrades

Maintenance works at the Invincible CPP will be required to ensure the plant is operational. If future studies indicate Irondale or Lidsdale Seam coal can be used at the Shoalhaven Starches Plant if washed and/or blended with Lithgow Seam coal, some upgrade works may be required at the Invincible CPP. These upgrades will largely be internal within the existing Invincible CPP structure however some minor changes to the exterior of the Invincible CPP may be required. All upgrade works will be located within the existing infrastructure area and would be expected to be completed within three months of the upgrade works commencing.

If any upgrades are required, exterior cladding on the Invincible CPP, crushers and hoppers will be neutral in colour to minimise the visual impact of the infrastructure where it is visible from the Castlereagh Highway. Any upgrade works to the Invincible CPP would be carried out between 7.00 am and 6.00 pm Monday to Saturday. Ongoing maintenance works during the life of the Southern Extension Project may extend to 10.00 pm Monday to Saturday.

3.5.5.2 Product coal transportation

Product coal is approved for transportation by road-registered highway trucks to domestic destinations at a rate of up to 1.2 Mtpa. The Southern Extension Project does not seek to change the approved maximum production rates. All product coal will leave the site via the access road onto the Castlereagh Highway (refer to **Figure 2.1**). Product coal from the coal crushing and screening area will be loaded onto highway trucks via a front end loader. Washed coal from the Invincible CPP will be loaded onto the highway trucks from an overhead bin located near the site access road. Castlereagh Coal will operate a wheel wash facility to minimise the amount of material tracked out onto the Castlereagh Highway.

3.5.5.3 Proposed rejects and tailings management

The nut coal required by Shoalhaven Starches is a washed coal product. Coal from seams unsuitable for use in the Shoalhaven Starches Plant will not be washed. During the processing of washing coal at the Invincible CPP, waste product or reject will be generated. This will be separated into a coarse and fine fraction. Approximately two thirds of the reject material will be coarse reject and one third fine fraction or tailings. Based on current coal quality information approximately 35,000 tonnes of coarse rejects and fine tailings would be generated in each year of production.

Coarse rejects will be conveyed from the Invincible CPP Jig Washer to a reject bin. Coarse rejects of appropriate quality will be re-washed and combined with the product coal. The remainder will be loaded onto empty trucks returning to the open cut mining areas for co-disposal with overburden.

Fine tailings from the washery have historically been pumped to a series of drying ponds (refer to **Figure 2.2**) where the tailings are dried. Consolidated fines in these areas are then excavated for coal blending purposes or co-disposal with overburden, which allows for new material to be stored as additional space is created. The dry tailings currently in tailings drying area will be removed and either co-disposed with overburden or blended with coal destined for the Mt Piper Power Station. Fine rejects from the washing of nut coal from the Southern Extension Project will be pumped to these drying ponds for drying prior to further blending or co-disposal with overburden. This process is discussed in further detail in **Section 6.18**. Due to the low tonnages of coal which requires washing, and the process of blending or co-disposal of dried tailings, there is sufficient storage dam capacity to handle the tailings which would be created as part of the Southern Extension Project.

3.5.6 Proposed exploration and monitoring boreholes

Castlereagh Coal will continue to undertake exploration drilling within the Southern Extension Area to obtain further information regarding the resources to be mined as well as geological and geotechnical information relevant to the mining activities that will be undertaken. Additional drill holes to install groundwater monitoring bores may also be required.

The exploration holes will be installed using drilling rigs and generally be up to 400 millimetres in diameter. Boreholes will be fully grouted upon abandonment with all metal casing removed from potentially mineable coal seams. Construction, sealing and abandonment of boreholes will be in accordance with relevant standards and guidelines published by the DRE and in force at the time.

Surface disturbance associated with exploration and groundwater monitoring activities (refer to **Section 6.3**) will be minimised with drilling undertaken on existing disturbed areas or within the proposed disturbance footprint where practicable. All exploration and groundwater monitoring boreholes will be undertaken in accordance with relevant requirements and standards under the *Mining Act 1992, Water Management Act 2000* and the *Water Act 1912,* as applicable.

3.5.7 Surface facilities and infrastructure

The existing and approved mine infrastructure and facilities will be utilised over the life of the Southern Extension Project. Existing facilities are shown on **Figures 2.1** and **2.2** and include, but are not limited to:

- Administration offices
- Bathhouse
- Car park
- Workshop
- Coal stockpile areas
- Warehouse
- Laydown area
- Fuel and lubrication storages
- Refuelling facilities
- Wash down facilities
- Security fencing
- Internal access roads
- Sewage treatment system
- Water management infrastructure
- Power reticulation and infrastructure
- Communications infrastructure
- Dust suppression
- Firefighting facilities
- Environmental management and monitoring systems.

Primary access to Invincible is achieved via the existing two way access from the Castlereagh Highway. Due to height restriction at the main access, oversize equipment and deliveries will enter the via the Big Rim access road located approximately 1 kilometre to the north of the Invincible access road (refer to **Figure 2.1**) in accordance with agreements with this landholder.

Other than potential upgrades to the Invincible CPP and associated infrastructure (refer to **Section 3.5.5.1**) and changes to the water management system (refer to **Section 3.5.7.3**), no additional surface infrastructure or facilities are proposed as part of the Southern Extension Project.

3.5.7.1 Magazine

Explosives will either be delivered to Invincible on an as needs basis direct from the licensed supplier or will be stored at a magazine located at Cullen Valley in accordance with existing approvals. Explosives stored at the Cullen Valley mine would be transported to Invincible when required for use. The transport, storage and handling of explosives would all be undertaken in accordance with the Australian Code for the Transport of Dangerous Goods, the Australian Code for the Transport of Explosives and relevant NSW legislation.

3.5.7.2 Electricity infrastructure

Two power lines pass through and are adjacent to the Southern Extension Area (refer to **Figure 3.5**). The 66 kilovolt (kV) power line is a private line owned by Castlereagh Coal and runs through the centre of the Southern Extension Area. The 11 kV power line is owned by Endeavour Energy and services Cullen Bullen. This power line runs adjacent to the western edge of the Southern Extension Area in the north and then turns east until it joins the 66 kV power line easement and crosses the south of the Southern Extension Area. Options are available to either mine around the power line towers or relocate (either temporarily or permanently) part or all of sections of the lines in the Southern Extension Area. If the powerlines were kept in place, the poles would be retained on pillars approximately 40 m in diameter. Castlereagh Coal have consulted with Endeavour Energy regarding the proposed mining activities in proximity to the 11kV power line and confirmed that any impacts on this infrastructure can be appropriately managed as has been previously demonstrated as part of previous mining operations at Invincible. Castlereagh Coal will undertake further consultation with Endeavour Energy on detailed mine design prior to undertaking mining in close proximity to the 11kV power line.

If required, any relocation of power lines would be within the proposed disturbance area associated with existing and proposed mining operations The relocation of the 66 kV power line, owned by Castlereagh Coal, may take place at any time over the life of the Southern Extension Project. The location of the 11 kV power line in the south of the Southern Extension Area means that mining would not impact this area until the later stages of the mine life should the option of mining around the 11kV power line not be achievable.

As detailed in **Section 6.8**, blasting can be managed to meet relevant criteria to protect the 11 kV power line infrastructure over the life of Southern Extension Project and Endeavour Energy have confirmed acceptance of this aspect of the mine design. Should the 11 kV power line require relocation, this will be subject to detailed design in consultation with the Endeavour Energy. The relocation of any part of the 11 kV power line would occur prior to decommissioning for continuity of supply to other users. Castlereagh Coal has consulted with Endeavour Energy regarding the potential need to relocate the 11 kV power line in the later stages of the Southern Extension Project and further discussions on detailed design will be undertaken should the relocation be needed.

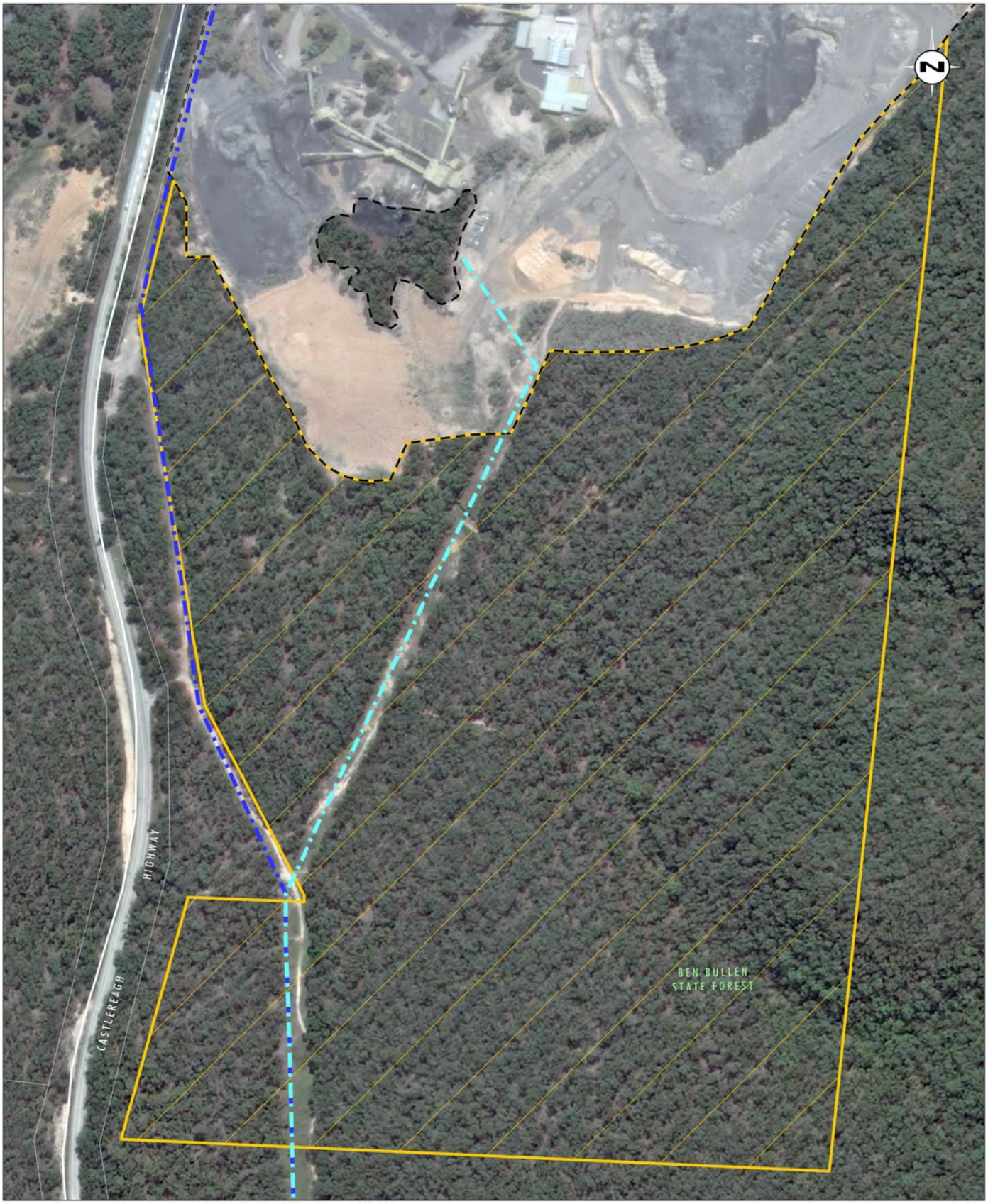


Image Source: Google Earth/DigitalGlobe (Mar 2015)
Data Source: LPI (2009)

0 50 100 200m

Legend

- Existing Approved Mining Disturbance Area
- Proposed Southern Extension Area
- 11kV Powerline
- 66kV Powerline

FIGURE 3.5

Powerlines within Southern Extension Area

3.5.7.3 Water Management Infrastructure

The Southern Extension Project will result in changes to the Site Water Management System (SWMS). The Mine Storage Dam located north of the Invincible Mine Infrastructure Area will be the primary source of water for the Invincible CPP. The Northern Void will be the primary source of water for dust suppression and other operational purposes (refer to **Figure 2.1**).

At Invincible the seams dip to the north-east, and the low point of the existing open cut operations is the base of the Lithgow Seam. The Northern Void is the lowest point of the existing open cut workings and is hydraulically connected to the former Invincible underground workings which mined the Lithgow Seam (refer to **Figure 2.1**). The former Invincible underground workings are partly flooded and elevation of water in the Northern Void aligns with the elevation of flooding in the former workings. Water captured in the pit areas or infiltrating through spoil will migrate to the north of the former workings and gradually increase the height of water in the former underground workings. This will result in an increase in depth of water in the Northern Void.

During the life of the Southern Extension Project, water captured in sedimentation dams will be pumped to either the Northern Void or the Eastern Void (refer to **Figure 2.1**). The former Ivanhoe underground workings in the Lithgow Seam in the Southern Extension Area are likely to be partly flooded and will require dewatering prior to open cut mining in this area. Water from the dewatering of the former Ivanhoe underground workings, and surplus water captured on site, will be transferred to the Invincible underground workings or discharged into the Cullen Creek catchment in accordance with EPL requirements.

Both the Northern Void and Eastern Void will be filled and reshaped as part of the rehabilitation of Invincible.

The water management system and the interaction between underground and open cut storages is discussed further in **Section 6.3.**

3.5.7.4 Other ancillary infrastructure

Various ancillary infrastructure associated with the operation of an open cut mine will be required including internal access tracks, fences and gates, fire trails, telecommunications, water pipelines, communications systems and other infrastructure. The exact location of these facilities will be determined as the Southern Extension Project progresses depending on mining operational needs and environmental and social considerations. The specific locations will be determined as part of the detailed mine planning process for each stage and will be detailed as part of the MOP. All infrastructure will be located within the identified Southern Extension Project disturbance area (refer to **Section 3.4**).

3.5.8 Operational workforce and hours of operation

3.5.8.1 Employment

The proposed modification will require approximately 35 full-time equivalent (FTE) employees at peak production. Additional contractors may be required on a part-time basis.

Employment numbers are estimated based on Invincible operating on 10 hour shifts on a 5 day (Monday to Friday) basis. An allowance for additional overtime shifts on Saturdays has been included to enable nut coal production targets to be met in the event of production delays such as equipment downtime or wet weather. Accordingly, continuation of the currently approved Monday to Saturday operating hours is sought.

3.5.8.2 Hours of operation

The proposed modification does not seek any change to the approved operating hours for Invincible which are Monday to Saturday, 7.00 am to 10.00 pm. Some prestart checks on machinery may occur prior to 7.00 am and all noise from operations prior to 7.00 am would be managed to meet night time noise criteria of 35 dB(A).

Mining extraction and CPP operations would be limited to 7.00 am to 6.00 pm. Transportation activities may also extend to 9.30 pm and maintenance activities may extend to 10.00 pm. Trucks would not be permitted into the site prior to 7.00 am.

While mining and transport operations will not occur on Sundays or after 10.00 pm, some site maintenance activities such as water management activities and site security works will continue on the site outside these hours on an as needs basis.

3.5.9 Rehabilitation activities

3.5.9.1 Temporary stabilisation

Disturbed areas which will not form part of the active mining operations for periods of 12 months or more will be seeded with groundcover to reduce potential wind erosion and associated dust emissions.

Indicative temporary stabilisation areas are shown on the indicative stage plans provided in **Figures 3.2** and **3.3**.

3.5.9.2 Progressive rehabilitation of disturbed areas

Rehabilitation of areas previously disturbed by mining at Invincible form part of the Southern Extension Project. The conceptual mine plan has been developed to optimise the efficient rehabilitation of the entire mine site.

As shown in **Figures 3.2** and **3.3** the former mining void in the south of the existing Invincible mining area will be backfilled using overburden from mining in the Southern Extension Area as well as existing overburden stockpiles from previous mining in this area. The final landform will be progressively developed as mining progresses to the south and will build on rehabilitation previously completed at Invincible. The void created as a result of mining in the Southern Extension Area will be filled and shaped to blend with the surrounding terrain following the completion of mining. Progressive rehabilitation of disturbed areas will reduce dust impacts and limit the duration of visual impacts. Progressive rehabilitation also mitigates ecological impacts associated with the Southern Extension Project as woodland areas are progressively re-established across Invincible.

The existing void in the east of the existing mining area (Eastern Void) will be filled during the final stages of mining (refer to **Figure 3.3**). Access to the void in the north (Northern Void) will be maintained as a point for accessing water stored in the underground workings and voids. Following the cessation of mining, the final void in the Southern Extension Area and the Northern Void will be backfilled and shaped. No voids will remain in the final landform which will be shaped to blend with the surrounding terrain.

Following land shaping works, stockpiled soil resources from pre-stripping activities will be spread over shaped areas and stockpiled logs scattered over the area for habitat enhancement purposes. These areas will then be seeded and/or direct planted.

The 11kV transmission line easement through the Southern Extension Area and western edge of the Invincible MIA will remain cleared in the rehabilitated final landform to meet ongoing requirements of the infrastructure owner Endeavour Energy.

Rehabilitation of disturbed land is designed around returning the majority of the Southern Extension Area to native woodland and forest generally consistent with ecological communities that would have historically occurred in the area. Past experience at the site has demonstrated that this objective is best achieved through aerial seeding of endemic tree, shrub and grass species onto a growing medium established using soil removed during pre-stripping operations and/or where conditions permit, directly onto overburden. The species mix will be based on previously successful mixes which are designed to simulate natural succession processes. For this reason, fast growing pioneer species which can improve soil health through soil biota relationships will form a key component of this species mix.

Completion criteria and performance measures for the rehabilitation will be developed and included in the MOP developed for the Southern Extension Project. Performance measures for the establishment of woodland and forest communities will be developed and have regard to the succession processes expected in rehabilitating vegetation. The rehabilitation process will be informed by previous experience at Invincible, Cullen Valley and other mining operations in the local area. The strategy and rehabilitation practices will evolve as further information or improved understanding of rehabilitation becomes available, including consideration of various research into rehabilitation across mining areas of NSW.

Ongoing monitoring of rehabilitation and comparison with analogue sites will continue to be undertaken and the MOP will include Trigger Action Response Plans (TARPs) which cover unexpected deviations from the expected successional pathways in rehabilitation areas.

3.5.9.3 Infrastructure areas

As part of the closure process, infrastructure which is not able to be utilised by subsequent approved land uses will be removed. Soils within and surrounding former infrastructure areas will be assessed for potential contamination. Any contamination present will be remediated and contaminated material treated or disposed of at an appropriately licensed facility. As with other disturbed areas, former infrastructure areas will be revegetated unless proposed for other land uses.

3.5.9.4 Waterbodies

Dams forming part of the mine water management system will be removed unless utilised for habitat purposes or subsequent land uses. Desilting of sediment dams and the removal of sediment from mine water dams will occur where necessary as part of the closure and rehabilitation processes regardless of the suitability of the dams for other purposes.

3.6 Project rationale

As discussed in **Section 1.0,** the primary purpose for the Southern Extension Project is the requirement for a reliable and cost effective source of thermal energy for Manildra's Shoalhaven Starches Plant located at Bomaderry on the NSW South Coast.

The Shoalhaven Starches Plant is a complex, integrated production facility which maximises the value from all production streams by utilising waste products where possible. Flour, water and energy are the key inputs to the process and a breakdown in the supply of one of these inputs significantly impacts on production at the plant, with the potential for significant upstream and downstream supply implications. Maintaining a consistent and reliable supply of energy is critical to ensuring the ongoing operation of the plant.

Nut coal currently accounts for approximately 25-30 per cent of the energy costs for the plant with gas (30-35 per cent) and electricity (35-39 per cent) being the two other major energy sources. Energy from woodchip combustion accounts for approximately 1-3 per cent of energy costs. While nut coal currently represents the lower of the three main energy costs, coal has a lower cost per gigajoule (GJ) than both gas and electricity and represents approximately 35-40 per cent of overall energy production at the Shoalhaven Starches Plant. Accordingly, while supply risks are reduced (but not eliminated) by transitioning away from coal to gas or electricity, the costs of production are increased by doing so, which limits the ongoing competitiveness of the plant's operations.

Shoalhaven Starches Plant is one of the largest exporters of starch products in the world and is exposed to international markets, and reducing production costs is critical to maintaining international competitiveness. Energy is one of the largest production inputs for Shoalhaven Starches Plant in terms of cost and there are limited opportunities for lowering costs in terms of gas and electricity prices.

Shoalhaven Starches Plant has considered a range of options to meet the requirements for maintaining a reliable and cost effective source of energy for the plant, including:

- maintaining existing energy supply options for the Shoalhaven Starches Plant
- alternative energy sources or different supply mixes
- obtaining a new source of nut coal
- a mix of the above options.

Section 3.6.1 outlines the current supply arrangements for Shoalhaven Starches Plant. The options of using alternative energy sources or different nut-coal supply mixes is considered in **Section 3.6.2**.

3.6.1 Existing energy supply arrangements

Shoalhaven Starches Plant currently source nut coal from Centennial's Clarence operation located to the east of Lithgow and from Whitehaven's operations in the Gunnedah Basin. This coal is transported to Shoalhaven Starches Plant by truck. The majority of the supply is from Clarence Colliery which has significantly lower transport costs. The current supply arrangements meet technical requirements for the Shoalhaven Starches Plant boilers.

As identified above, both reliability of supply and cost effectiveness for coal are critical to the ongoing operation of Shoalhaven Starches Plant, as detailed further in the sections below.

3.6.1.1 Reliability of supply

While there is no suggestion that Centennial or Whitehaven are unable to continue to supply nut coal into the foreseeable future, the current depressed market price for coal has placed increased pressure on a large number of coal suppliers. The volume of coal required by Shoalhaven Starches alone is not sufficient to justify the continued operation of either Clarence or Whitehaven's operations and any further deterioration in the price received for other coal products places at risk the reliability of ongoing supply to Shoalhaven Starches. This would have significant operational implications for Shoalhaven Starches.

Should Shoalhaven Starches be unable to source coal from one or both suppliers, alternate supply arrangements would need to be identified and due to the speciality nature of nut coal, Shoalhaven Starches would be in a difficult negotiating position should this situation eventuate, meaning prices may significantly increase over existing rates. As other known sources of nut coal are located further from Bomaderry than

Clarence, transport costs would also be higher. These issues are discussed further in **Section 3.6.2**. The Southern Extension Project is therefore seen as a means for Shoalhaven Starches to minimise energy supply risks for its operations through increasing reliability of this energy supply.

3.6.1.2 Cost effectiveness

The coal price being paid for coal from Clarence and Whitehaven's operations is significantly higher than Castlereagh Coal's expected costs of production for the same product as part of the Southern Extension Project. The higher price being charged by the current suppliers is partly driven by the fact that it is a niche product which involves different production and handling requirements which increase costs. However, these suppliers are also considered to be at a competitive advantage in that there are few suppliers of nut coal in NSW and, in the case of Clarence, the transports costs from other suppliers are considerably higher.

As the costs of production for nut coal at Invincible are considerably lower than Shoalhaven Starches obtaining coal from Clarence or Whitehaven, the Southern Extension Project has significant economic advantages for Shoalhaven Starches over maintaining current nut coal supply arrangements.

3.6.2 Alternative coal / energy supply options

As an alternative to either supply from Clarence and Whitehaven or sourcing coal from Invincible, Shoalhaven Starches could:

- obtain coal from other existing suppliers in NSW
- purchase suitable ROM coal and process the coal for its purposes
- use a different energy supply mix at the Shoalhaven Starches Plant.

These options are considered further in the following sections.

3.6.2.1 Other existing NSW suppliers

Shoalhaven Starches Plant obtained nut coal from Invincible, prior to it going on care and maintenance. Shoalhaven Starches has also obtained coal from Ulan coal mine near Mudgee in the past. Ulan no longer produces a nut coal product and, other than Clarence and Whitehaven's Gunnedah operations, the only other producers of a nut coal product suitable for use in the Shoalhaven Starches boilers is Ashton, located in the Hunter Valley.

Ashton is restricted to rail transport only and the Shoalhaven Starches facility at Bomaderry is not equipped to receive coal by rail. Any arrangement from Ashton would require transferring coal from rail to road at a separate facility at additional cost. Preliminary investigations indicate the delivered price for coal obtained from Ashton would be higher than the current cost of supply.

3.6.2.2 Process purchased ROM Coal

Shoalhaven Starches has investigated the possibility of purchasing ROM coal destined for the export market and crushing and washing it at the washery located at Port Kembla to obtain nut coal. Any surplus coal could then be remixed with export coal and sold while the nut coal could be trucked to Shoalhaven Starches. The logistics of undertaking this operation at Port Kembla are considered not operationally viable due to the relatively small scale of nut coal supply required.

3.6.2.3 Other energy sources

As noted above, the primary energy sources used by Shoalhaven Starches is coal, gas and electricity. Woodchips are also used however there is insufficient volume of woodchip available to meet demands should coal be unavailable as an energy source.

Electricity is currently more expensive than either coal or gas as an energy source in terms of cost per gigajoule (GJ). Any increase in electricity use at the expense of either coal or gas would significantly increase energy costs at the plant which would, in turn, decrease international and domestic competitiveness.

Gas and coal are currently comparable in terms of energy costs per GJ. Current projections however indicate that gas prices are likely to rise in the short to medium term, which would increase energy costs at the Shoalhaven Starches Plant if these increases cannot be offset through lower energy costs elsewhere. Increasing the percentage of energy sourced from gas would also necessitate additional plant being installed which would involve additional capital costs and potentially reduced production rates due to other facilities needing to be decommissioned to make room for the additional gas boilers. Overall, the costs associated with transitioning to gas as the primary thermal energy source are considered to significantly outweigh the costs associated with the continued sourcing of speciality nut coal. Additionally, increased reliance on a single thermal energy source does not achieve the overall objective of obtaining a reliable supply of energy as operations would be at risk if there was a disruption of supply in gas for any reason.

3.6.3 Mixed coal supply options

Castlereagh Coal has considered the possibility of a mixture of the coal options as a means of reducing the long term operational risks to Shoalhaven Starches Plant. The options include:

- Supplement production from Invincible with supply from other sources and extend the life of the resource in the Southern Extension Area

- Investigate options of using coal from other seams in the Southern Extension Area at the Shoalhaven Starches Plant and reduce the volume of coal sold to the Mt Piper Power Station. Options considered include:

    - Investing in new boilers at the Shoalhaven Starches Plant that can utilise varying quality coal from Invincible

    - Investigate options for using coal from the higher ash and lower thermal value coal in the Lidsdale and Irondale Seams through washing techniques and/or blending with Lithgow Seam nut coal.

Maximising the value of the resources from the Invincible asset has positive environmental and economic benefits. If the life of the project can be extended:

- it reduces the need for new areas to be mined

- it prolongs the employment and investment opportunities in the local area (although lower numbers of employees would be required due to lower production rates)

- amenity (noise, air quality, traffic and blasting) impacts would be lower due to reduced production rates.

Castlereagh Coal is currently undertaking testing of coal from other seams at Invincible to assess its potential for use in the existing Shoalhaven Starches boilers. The results of this testing will also inform decisions regarding investment in new boilers which, if needed, would be designed to maximise usage of coal from other seams at Invincible.

The Southern Extension Project is seeking up to an eight year extension of the life of mining at Invincible to enable the above options to be further investigated and pursued if possible. Eight years is considered to be sufficient time to investigate boiler and coal options and utilise a mix of supply options from other sources of nut coal. If the coal from other seams can be successfully used at the Shoalhaven Starches Plant, a further extension of the period in which mining can occur in the Southern Extension Area may need to be sought in the future to obtain maximum value from the resource for Shoalhaven Starches.

3.6.3.1 Project rationale summary

Overall, maintaining a mix of coal, gas and electricity as the primary sources of energy at the Shoalhaven Starches Plant enables energy supply risks to be managed.

The Southern Extension Project will provide Shoalhaven Starches with an additional source of speciality nut coal at lower cost and with increased reliability relative to current coal supply options. The supply of coal from the Southern Extension Project will also be vertically integrated into the Shoalhaven Starches business which provides Shoalhaven Starches with greater control over its energy supply options; this reduces the level of uncertainty in the supply chain and reduces potential significant operational disruption at the plant should there be any variation to energy supply.

3.7 Project alternatives and project design considerations

The following section discusses the different development options at Invincible which were considered by Castlereagh Coal in its decision making process in relation to the design of the Southern Extension Project.

3.7.1 Do nothing

The ‘do nothing’ option consists of the rehabilitation of Invincible and no further mining at the Invincible site. Under the existing requirements of the Invincible Project Approval, no further mining activities can occur at invincible after December 2016, however the site must be rehabilitated pursuant to the requirements of the Invincible Project Approval and the existing leases. As noted in **Section 2.2**, the Invincible CPP could continue to operate after this date however ROM coal would need to be transported to the site for processing. Further modifications to the Invincible Project Approval and other consents may be needed for this to occur.

The following sections discuss the likely outcomes of the ‘do nothing’ scenario relative to the Southern Extension Project.

3.7.1.1 Rehabilitation of Invincible disturbance area

If the Southern Extension Project does not occur, the existing disturbed areas of Invincible will be progressively rehabilitated over time. Due to the manner in which previous mining operations were undertaken at Invincible, there is currently insufficient overburden in emplacement areas to fill all of the voids currently present on the site without disturbing some of the areas that have already been rehabilitated. Reshaping and revegetation works to fully rehabilitate the site are likely to take several years.

Given the relative short duration of the Southern Extension Project, there will be little difference between the 'do nothing' option and the Southern Extension Project in terms of rehabilitating the existing Invincible disturbance area. Indeed, some parts of the existing rehabilitation are likely to reach completion criteria faster under the Southern Extension Project scenario as there would be no need to disturb existing rehabilitation to fill existing voids. Overall, the Southern Extension Project is likely to achieve a rehabilitated free draining final landform within the existing disturbance area at Invincible in a similar time period to the 'do nothing' option.

3.7.1.2 Remediation of subsidence impacts in Southern Extension Area

Parts of the Southern Extension Area are significantly impacted by subsidence from the former Ivanhoe No. 2 underground operations (refer to **Figure 1.4**) and need to be remediated. While there are no detailed remediation plans for this area, the works would require the clearing of vegetation in and around the affected areas and land shaping works to facilitate the free drainage of this area. Further subsidence impacts in the Southern Extension Area are likely as a result of further pillar failures in the underground workings and these subsidence impacts would require ongoing remediation works over time for both environmental and safety reasons. The Southern Extension Project will mine through the previous underground workings and reinstate a stable landform in this area. In the areas which are mined and rehabilitated as part of the Southern Extension Project, there would be no risk of subsidence impacts in the future. Accordingly, the 'do nothing' scenario does not mean that there is no impact in the Southern Extension Area, at least in and around areas significantly impacted by subsidence. Moreover, the Southern Extension Project, through removing areas of previous underground mining, reduces the need for ongoing management of potential future subsidence impacts within the Southern Extension Area.

3.7.1.3 Sterilisation of coal resources

If the Invincible site was fully rehabilitated and closed in accordance with existing approvals and lease requirements, it is unlikely that the coal resources in the Southern Extension Area would ever be extracted due to the upfront costs that would be involved in the development works. The Southern Extension Project results in complete extraction of coal resources in the Southern Extension Area using the existing infrastructure with no additional surface disturbance associated with mining infrastructure. Under the 'do nothing' scenario, rehabilitation areas or other intact areas would need to be impacted to access these existing coal resources in the future.

3.7.2 Mining area alternatives

As outlined in **Section 2.2.1**, Castlereagh Coal owns both the Invincible and Cullen Valley mining operations. Accordingly, the potential for both mining operations to meet coal supply needs at Shoalhaven Starches Plant has been considered. The approved resources at Invincible have largely been mined however there are approved resources remaining at Cullen Valley. Further, the relatively small scale of nut coal production required means that a smaller, well designed project could extract sufficient resources to supply the Shoalhaven Starches Plant for the short to medium term.

Figure 3.6 shows the potential areas that were considered and **Table 3.3** sets out the approval status of the reserve, potential mining methods for each area and the nut coal and thermal coal resources available in each area. As noted in **Table 3.3**, the options considered are part of existing approved operations at Cullen Valley or have been previously proposed as part of the proposals which have been refused or withdrawn based on PAC assessments.

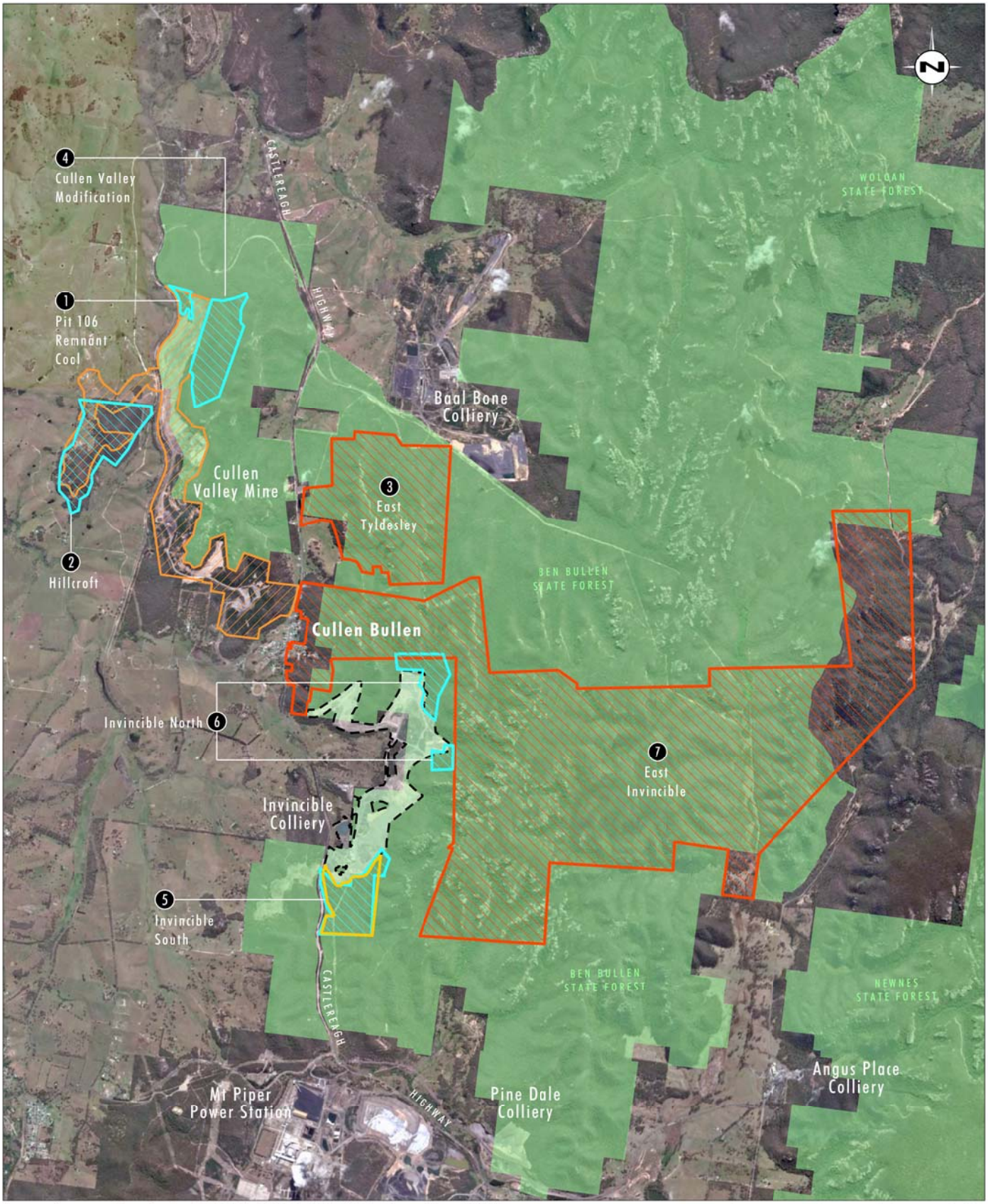


Image Source: Google Earth/DigitalGlobe/CNES/Astrium (Mar 2015)
Data Source: Coalpac Pty Ltd (2014), Forest Corporation of NSW (2014)

Legend

- Existing Approved Mining Disturbance Area
- Proposed Southern Extension Area
- Cullen Valley Approved Disturbance Area
- Open Cut Project Alternatives
- Underground Project Alternatives
- State Forest

FIGURE 3.6

Project Alternatives

Table 3.3 Potential mining reserves and options investigated as part of project design

Potential Mining Area	Name	Approval Status	Mining Method	Estimated Coal Reserves (tonnes)	
				Nut Coal	Power Station
Cullen Valley					
1	Pit 106, Remnant Coal	Approved	Open Cut	0	240,000
2	Hillcroft	Approved	Open Cut	112,000	2,800,000
3	East Tyldesley	Approved	Underground	1,600,000	2,200,000
4	Cullen Valley Modification	Refused (Consolidation and 2014 Modification Project)	Open Cut	0	3,100,000
Invincible					
5	Invincible South	Refused (Consolidation and 2014 Modification Project)	Open Cut	370,000	2,700,000
6	Invincible North	Refused (Consolidation and 2014 Modification Project)	Open Cut	350,000	1,600,000
7	East Invincible	Part Refused (Consolidation and 2014 Modification Project)	Underground	4,000,000	4,000,000

Accessing areas of existing approved mining operations at Cullen Valley (options 1 to 4 in **Table 3.3**) for nut coal is not considered viable at this time and Castlereagh Coal has no immediate plans to recommence approved mining operations at Cullen Valley. In relation to potential mining operations at Invincible, all options provide access to nut coal reserves (refer to **Table 3.3**). It is noted the costs associated with underground mining as well as the surface constraints above the potential mining area (East Invincible) make the mining of this area unviable at this time.

Accordingly the viable options for mining to access nut coal resources at Invincible are limited to the two open cut areas of Invincible North and Invincible South (refer to **Table 3.3**). Whilst these options provide similar potential nut coal resources, there are substantial differences in terms of relative mining constraints and potential environmental and community impacts. These mining constraints and potential environmental and community impacts have been considered through the design of the Southern Extension Project, and are discussed in the following sections.

3.7.2.1 Invincible North

Invincible North involves open cut mining to the north and east of the Northern Void and east from the Eastern Void (refer to **Figure 3.6**). Underground mining was not an option in these areas as the Lithgow Seam had already been largely extracted as part of the former Invincible Underground workings and open cut mining was required to extract the remnants of the pillars that remained.

While this area contains over 300 kt of nut coal resources, mining in these areas was not considered currently viable for the following reasons:

- The mining areas were located in highly visible areas
- The mining areas were proximate to significant pagoda formations and included the mining of valley areas between prominent pagoda formations which was identified as contributing to the biodiversity values of the pagoda formations and associated areas
- The mining areas were located closer to Cullen Bullen and would have greater amenity impacts (noise, air quality and blasting) on the community
- The former Invincible Underground workings would require dewatering to allow mining of the target Lithgow Seam which would require substantive management based on the potential volumes stored in the former underground mine workings.

Overall, the impacts associated with open cut mining in the Invincible North area were such that it was considered unlikely to be viable at this time.

3.7.2.2 Invincible South

While the Lithgow Seam had previously been mined in the Invincible South area as part of the former Ivanhoe underground operations, there was estimated to be over four years of nut coal resources remaining in the unmined remnant pillars.

The Invincible South area also had a number of design advantages over the Invincible North area in that;

- it does not involve mining between pagoda formations and the pagodas to the east of the Invincible South area were not associated with the steep valley environments that are found in relation to the pagoda formations further north. Accordingly, the biodiversity values in the southern area were considered to be less significant than those associated with the larger pagodas to the north and further east of this area
- the area is located further from Cullen Bullen and, with the exception of overburden hauls and earthmoving associated with the remediation of the Northern and Eastern Voids, did not involve works in close proximity to the town or locations that were likely to cause significant noise and air quality impacts
- blasting impacts on Cullen Bullen are reduced due to increased separation distance
- parts of the Invincible South area had already been significantly disturbed by subsidence associated with the former Ivanhoe workings and power line easements as well as forestry activities
- the former Ivanhoe No. 2 workings would need to be dewatered, however, given the potential volumes, the management of this water is considered viable as part of mining in this area.

Internal assessment of potential costs identified that nut coal could be mined from the Invincible South area at a cost that was significantly lower than the costs currently being paid by Shoalhaven Starches, even with rehabilitation obligations of both Cullen Valley and Invincible factored in. The Invincible South area was therefore identified by Castlereagh Coal as a potentially viable and approvable resource and forms the basis of the detailed design process for the Southern Extension Project as discussed further in **Section 3.7.3**.

3.7.3 Design refinement of the Southern Extension Project

As part of the conceptual design of the Southern Extension Project further environmental constraints studies and mine design work was undertaken to refine the mine plan for the Invincible South area. As shown on **Figure 3.6**, the Southern Extension Area has a smaller footprint than the previously proposed Invincible South area, which was necessary to maintain an appropriate setback to pagoda structures in proximity to the Southern Extension Area (refer to **Section 3.7.3.2**). The key issues addressed through refinement of the Southern Extension Project were:

- ecological constraints including potential impacts on threatened species and communities, and significant impacts on the biodiversity values associated with pagoda formations
- impacts on the stability of the pagoda formations associated with potential blasting impacts
- potential amenity (noise, air quality, blasting and traffic) and health impacts (predominantly air quality) on the local community.

Key to these considerations was the life of the project and extraction rate. As noted in **Section 3.7.2**, extending the life of the resource at Invincible has significant economic and environmental advantages and the mine plan considerations factored in the flexibility necessary to enable the resource to be extracted over a longer period, if necessary. The design considerations discussed below have led to the final design of the Southern Extension Project as presented in the EA.

3.7.3.1 Ecological design considerations

Broad-headed snake

A key issue in the PAC assessment of the 2014 Modification Project and the Coalpac Consolidation Project was the potential impact of mining on the broad-headed snake which is listed as endangered under the NSW *Threatened Species Conservation Act 1995* (TSC Act). The snake has previously been found approximately 1.5 km from the Southern Extension Area and is associated with rocky sandstone escarpments where flat rocks lay on exposed rock shelves which are used as habitat in winter months. It is noted that despite extensive surveys of the Southern Extension Area and the nearest pagoda formations no broad-headed snakes were identified and the nearest exposed rock shelves were identified as having no or only sparse winter habitat for the species (refer to **Section 6.4**).

Based on research regarding the broad-headed snake's foraging habitats, the PAC previously recommended a minimum setback for mining of 300 m from all pagodas. To address the key concerns the PAC had regarding potential impacts on the broad-headed snake the limit of disturbance associated with mining was initially set back at least 300 m from all pagoda formations to the east of the Southern Extension Area. The setback to one single nearest pagoda was reduced to approximately 210 m following further investigations which identified that winter habitat features for the species at the pagoda were generally absent at this location. Notwithstanding, a conservative approach to this assessment has been completed (refer to **Section 6.4**), which has identified tree hollows for the species during spring and summer foraging periods within the Southern Extension Area. Residual potential impacts on this species have been assessed in accordance with the Framework for Biodiversity Assessment and are discussed in **Section 6.4**.

The setback has resulted in an area of potentially mineable resources in the north-east of the Southern Extension Area not being mined (refer to **Figure 3.6**). Future extraction of the coal in this area is unlikely once the disturbed areas to the west of it are rehabilitated as part of the Southern Extension Project.

Other threatened species

Detailed flora and fauna surveys were undertaken in the Southern Extension Area and have identified a number of threatened fauna and flora species in the area. A number of other threatened species have potential to occur in the Southern Extension Area. Residual potential impacts on these potentially impacted species have been assessed in accordance with the Framework for Biodiversity Assessment and are discussed in **Section 6.4**.

Threatened ecological communities

Detailed vegetation surveys have been undertaken throughout the Southern Extension Area and no threatened ecological communities have been identified in the area of impact (refer to **Section 6.4**).

Ecological impacts generally

Other than as discussed above, no significant ecological constraints have been identified in relation to the Southern Extension Area. As noted above, the Southern Extension Project does not impact on the steep valleys between pagoda formations and the area does not hold the same high biodiversity values as areas to the north where the terrain features result in a diverse range of vegetation communities and rocky habitat features being in close proximity. Similarly the pagodas located directly to the east of the Southern Extension Area are typically smaller in scale and are associated with much drier vegetation communities than the more significant terrain features associated with the more northerly pagodas.

Ecological impacts and proposed mitigation measures for the Southern Extension Project are discussed in more detail in **Section 6.4**.

3.7.3.2 Impacts on Pagodas

Detailed geotechnical assessments have been undertaken on the pagoda formations closest to the Southern Extension Area (refer to **Section 6.8**). These geotechnical assessments have informed conservative blast criteria that have been adopted for the Southern Extension Project. All blasts will be designed to meet the vibration criteria for pagodas and no impacts on any pagodas are expected with these controls in place. Further to this, the detailed geotechnical assessments completed will form a baseline assessment of the current conditions of these structures, which will be regularly monitored over the life of the Southern Extension Project. Blasting impacts and proposed mitigation measures for the Southern Extension Project are discussed in more detail in **Section 6.8**.

The Southern Extension Project does not include any highwall mining or other underground mining and will not have any subsidence impacts that may affect the stability of pagodas.

3.7.3.3 Amenity design considerations

While the Southern Extension Area is located further from residences than other potential mining areas, mining still has potential to have amenity impacts. Noise and air quality modelling have been undertaken assuming worst case production scenarios (refer to **Section 6.7** and **Section 6.9**).

The existing Invincible Project Approval already contains a number of conditions which assist in regulating noise and air quality impacts. Limiting mining operations to day time only is a key noise mitigation measure and impacts on evening and night time amenity are significantly reduced or avoided through this measure. Given the objective of the Southern Extension Project to provide speciality nut coal, and the associated low production rates, this also limits the overall scale of the operation which reduces noise and dust impacts.

Notwithstanding the conditions limiting operations to day time only, two properties, Hillview and Billabong, currently have acquisition rights under the Invincible Project Approval due to predicted noise impacts at the residences at these properties which are both located on the ridge directly to the west of the existing Invincible operations (refer to **Figure 1.5**).

Preliminary noise modelling indicated that mining in the Southern Extension Area would still result in exceedances of the acquisition criteria at these residences under certain operating scenarios; primarily related to overburden haulage and emplacement. The mine plan was reviewed and smaller overburden trucks selected to minimise potential noise impacts. While this mine plan resulted in additional trucks being used, the overall predicted noise impacts at both properties are now predicted to be below the current acquisition criteria in the Invincible Project Approval with only one of the properties having mitigation rights under the NSW Voluntary Land Acquisition and Management Plan (VLAMP) (refer to **Section 6.9**).

Air quality impacts associated with mining in the Southern Extension Area are well below adopted impact assessment criteria at surrounding private residences. Air quality impacts and proposed mitigation measures for the Southern Extension Project are discussed in more detail in **Section 6.7**.

Blasting impacts at all residences are predicted to be well within adopted impact assessment criteria due to controls on blast sizes necessary to meet criteria for mine infrastructure, power poles, pagodas and cliff lines which are located closer to blast areas than residences. Blasting impacts and proposed mitigation measures for the Southern Extension Project are discussed in more detail in **Section 6.8**.

3.7.3.4 Comparison with previous projects

Table 3.4 provides a comparison of the key features of the existing approved operations, the two previous proposals and the Southern Extension Project.

As detailed earlier, the Southern Extension Project is of a significantly smaller scale than previous mining proposals. Assessment findings in relation to the consideration of those projects by regulators and the PAC have informed the mine design process and significant design features have been incorporated into the Southern Extension Project to minimise environmental impacts.

Table 3.4 Comparison of existing approved operations at Invincible, Southern Extension Project, and previous Mining Proposals

	Existing Approved (Invincible)	Previous Proposals		Southern Extension Project
		Consolidation Project (Cullen Valley and Invincible)	2014 Modification (Invincible)	
Resource Tonnes	7 Mt ROM	108 Mt ROM	9 Mt ROM	2.7 Mt ROM
Mining Methods	Highwall and Open Cut	Highwall and Open Cut	Highwall and Open Cut	Open Cut only
Mining Rate	Up to 1.2 Mtpa ROM Coal	Not defined	Up to 1.2 Mtpa ROM Coal	Up to 1.2 Mtpa ROM Coal
Production Rate	Up to 1.2 Mtpa Product Coal	3.5 Mtpa Product Coal + up to 0.45 bcm sand per annum (combined with Cullen Valley)	Up to 1.2 Mtpa Product Coal	Up to 1.2 Mtpa Product Coal
Mining Life	To December 2016 (8 years from date of approval)	Additional 21 years from approval	To December 2020	Up to 8 years from approval depending on production rate
Open Cut Mining Area	165 ha.	The area to be impacted over the life of the project was approx 958 ha (Cullen Valley and Invincible).	Additional 88 ha plus 86 ha highwall mining (253 ha surface disturbance in total) at Invincible	Approximately 50 ha of additional disturbance (215 ha in total)
Operational Workforce	35 full time personnel.	120 full time personnel, plus additional contractors	80 direct and 165 indirect jobs.	35 full time personnel.
Hours of operations	7.00 am to 10.00 pm Monday to Saturday (excluding public holidays). Mining in south pits not permitted between 6.00 pm and 10.00 pm.	24 hour operation, 7 days a week.	7.00 am to 10.00 pm Monday to Saturday (excl. public holidays). Mining in south pits not permitted between 6.00 pm and 10.00 pm.	7:00 am to 10.00 pm Monday to Saturday (excl. public holidays). Mining and coal washery operations will not occur between 6.00 pm and 10.00 pm (operations limited to truck loading and maintenance activities only during this period).

	Existing Approved (Invincible)	Previous Proposals		Southern Extension Project
		Consolidation Project (Cullen Valley and Invincible)	2014 Modification (Invincible)	
Blasting	Blasting between 9.00 am and 5.00 pm Monday to Saturday, inclusive.	Blasting between 9.00 am and 5.00 pm Monday to Saturday, inclusive.	Blasting between 9.00 am and 5.00 pm Monday to Saturday, inclusive.	Blasting between 9.00 am and 5.00 pm Monday to Saturday, inclusive.
Transport	Transport 7.00 am to 9:.30 pm Monday to Saturday, excluding public holidays. No more than 146 laden coal truck movements from the site per day (averaged over a week). No more than 16 laden coal truck movements per hour.	Transport 7.00 am to 9.30 pm Monday to Saturday, excluding public holidays.	Transport 7.00 am to 9:30 pm Monday to Saturday, excluding public holidays. No more than 146 laden coal truck movements from the site per day (averaged over a week). No more than 16 laden coal truck movements per hour.	Transport 7.00 am to 9:30 pm Monday to Saturday, excluding public holidays. No more than 146 laden coal truck movements from the site per day (averaged over a week). No more than 16 laden coal truck movements per hour.
Minimum distance to pagoda formations	Existing pit extends to within 230 m of some formations	Minimum of 50 m setback for open cut footprint. Highwall mining under pagoda formations.	Minimum setback of 200 m from escarpments and 300 m from 'significant pagodas'.	Southern Extension Area will have a minimum setback of 210 m from a single small pagoda with the remainder of pagoda formations being in excess of 300 m from Southern Extension Area.