5.2.4 Impacts on existing and proposed infrastructure

Existing infrastructure above the areas of secondary extraction is limited to an electrical power cable which runs along the lake bed from the pit top area to the Summerland Point ventilation fan site and a Testra fibre optic cable. The electrical power cable is now disused and the electricity service would not be impacted by subsidence, while the Telstra fibre optic cable is the subject of an approved management plan developed between LakeCoal and Telstra.

Also of relevance is a concept plan for the proposed Trinity Point Marina development which was approved by the then Department of Planning in September 2009 (concept approval MP 06_0309). The concept plan related to a mixed use marina/tourist/residential development with a 188 berth marina covering an area of approximately 59,000 m^2. A development application has recently been approved for Stage 1, consisting of the first 94 berths and associated buildings and services. Part of the proposed marina would traverse proposed Miniwalls 9 and 10. Should development of the marina commence prior to extraction within either of Miniwalls 9 or 10, LakeCoal would consult with the proponent to develop a specific built features management plan for the marina, as per the approved extraction plan.

Changes to the mine design, specifically the reorientation of miniwall panels in the northern mining area, will necessitate changes to the extent of the development consent boundary and will result in the inclusion of seven additional residential lots in the residential area of Sunshine on the northern side of area of CVC's existing development consent boundary (refer Figure 1.2). This has been reflected in the updated schedule of land (Appendix B). Mining in this area will be limited to first workings only, where subsidence is predicted to be less than 20 mm. As described in Section 5.2.2i, subsidence of less than 20 mm is widely adopted as being imperceptible for all practical purposes because the magnitude of natural, seasonal variations in ground level is commonly greater than 20 mm. Therefore, there will be no perceptible subsidence impacts on these residential lots as a result of the proposed modification.

5.2.5 Interactions with other environmental assessments

Subsidence will have the potential to influence other environmental aspects such as groundwater, marine ecology and wave climate. An assessment of these interactions forms part of this SEE. For example:

- subsidence can induce fracturing in overlying strata which can affect groundwater regimes and flows of water into the underground workings through increased hydraulic conductivity. The interaction between groundwater and subsidence is assessed in Section 5.3;

- subsidence can lead to less sunlight reaching seagrasses because of the increased depth of water. The amount of sunlight received can affect seagrass health and may affect the distribution and health of benthic communities. The impacts of subsidence on marine ecology are assessed in Section 5.4; and

- the Lake's wave climate could be altered as a result of increased depths of water in the Lake following subsidence which, in turn, could potentially affect shoreline erosion. The impact of subsidence on wave climate is assessed in Section 5.5.

5.2.6 Management and monitoring

i Adaptive management

It is predicted that the subsidence associated with extraction of the proposed miniwalls will not have any significant direct environmental impact. Rather it is the indirect environmental impacts that could be significant, such as the impact on the health of seagrasses and benthic communities, on groundwater and on wave climate and shore erosion. Where relevant, each of these environmental aspects will have monitoring regimes in place to determine whether actual impacts align with the relevant predictions and are acceptable. If an unacceptable impact is found that is attributed to subsidence, the mine design would be changed to moderate the subsidence impacts.

Independent of the flow-on environmental effects from subsidence, LakeCoal aims to ensure that the maximum subsidence levels do not materially exceed those predicted (within reason), noting that subsidence predictions use an upper 95% confidence limit. Should measured subsidence levels materially exceed those predicted, the mine design could be altered to ensure compliance with the predicted maximum levels.

LakeCoal will implement an adaptive management approach to ensure performance measures related to subsidence are achieved. Adaptive management will involve the monitoring and periodic evaluation of the consequences of mining, with possible adjustment of the mining layout and/or methods through the extraction plan process to achieve or exceed the required measure of performance where warranted.

ii Management in response to geological structures

The significance of the geological structures encountered during development (first workings) would be assessed. Prior to any authorisation given to undermine a significant geological structure, consideration in regards to its persistence and potential connectivity to the surface would occur based on the following key parameters:

- throw, trace, dip and dip direction;
- groundwater discharge rate change over time; and
- groundwater discharge chemistry.

It is unlikely that a significant structure will go undetected prior to the extraction of a miniwall as development headings will be formed along all sides of the panel prior to extraction (as was the case for the detection of the faulted area within the proposed Miniwall 4 panel).

Potential fault affected areas will be identified through activities associated with development headings. Undermining of significant faults, such as those that may cause higher continuous fracture connectivity will be avoided.

iii Monitoring

Subsidence development will continue to be measured using annual bathymetric surveys of the lake bed. Land based survey monitoring will also be used to confirm no subsidence impacts on the foreshore and other built features. Both the bathymetric and land based surveys will allow the measured subsidence to be reviewed against the predictions. Any significant deviations or exceedances in measured subsidence will be assessed and, where warranted, appropriate panel width or mining height reductions made to limit future impacts to acceptable levels. It should be understood, however, that adjustments to the mine plan requires a reasonable amount of forewarning due to the requirement that panels need to be developed several months in advance of miniwall extraction.

5.2.7 Conclusion

The revised panel layout has been designed to limit the potential for adverse impacts on the natural and built environments. All secondary extraction will remain limited to areas beneath Lake Macquarie with protection barriers for the foreshore and seagrass continuing to apply.

A rigorous assessment of the subsidence predictions was completed using calibrated models that incorporated all relevant information obtained since the development consent was granted in 2013, including the outcomes of the most recent, May 2015, bathymetric surveys.

The change in maximum vertical subsidence predictions is 160 mm for Miniwalls 9 to 31, and 340 mm, for Miniwalls 32 to 36.

The predicted subsidence will not impact on existing infrastructure beyond that previously considered. The mine design will continue to control subsidence levels so that there are no impacts on the land around the Lake, thus preventing any structural damage to buildings or other land-based features that could be attributed to subsidence from the planned mining operations.

Although the level of subsidence is unlikely to have any significant direct impact on the environment, possible flow-on or indirect effects related to groundwater, marine ecology and the wave climate have been assessed in Section 5.3, Section 5.4 and Section 5.5, respectively.

Monitoring of subsidence will generally be undertaken annually using bathymetric surveys. Should material exceedances of the predicted subsidence levels be identified and performance measures not be satisfied, the mine design will be adjusted to reduce these to an appropriate level.

5.3 Groundwater

5.3.1 Introduction

A groundwater assessment of the proposed modification was prepared by Geoterra Pty Ltd. The assessment is presented in full in Appendix E and a summary provided below.

5.3.2 Existing environment

i Geology

CVC is in the Sydney Basin which lies within the southern portion of the greater Sydney-Gunnedah-Bowen Basin.

The stratigraphy of the area consists of Triassic rocks of the Narrabeen Group Formation which in places is overlain by Quaternary deposits of terrestrial, lacustrine and marine origin. Underlying the Triassic sediments are the Permian Newcastle Coal Measures (see Table 5.3). The target seam for this assessment is the Fassifern Seam which has a depth of cover of between 130 m and 214 m in the area of planned mining.

Table 5.3 Stratigraphy of the site

Age	Group	Formation	Unit
Quaternary		Terrestrial and lacustrine marine sediments	
Triassic	Narrabeen Group (Clifton Sub Group)	Munmorah Conglomerate	
		Dooralong Shale	
Permian	Newcastle Coal Measures	Moon Island Beach Formation	Vales Point Seam
			Karignan Conglomerate
			Wallarah Seam
			Mannering Park Tuff
			Teralba Conglomerate
			Great Northern Seam
			Karingal Conglomerate
			Awaba Tuff
		Boolaroo	Fassifern Seam

ii Hydrogeology

The hydrogeology of the area comprises:

- a Quaternary terrestrial and marine/estuarine alluvial/colluvial aquifer system; and
- underlying Permian strata with low permeability interburden units (sandstone, siltstone, conglomerate and tuff) and low to moderately permeable coal seams.

The terrestrial alluvial aquifers are recharged by rainfall and hydraulically independent of the deeper Permian Coal aquifers (Geoterra 2013).

The permeability of the Permian strata is very low, with the main pathway for groundwater flow being lateral bedding planes, faults and cleats in the coal seams. Vertical percolation through the Permian strata is minimal and most recharge to deeper strata is likely to be via lateral flow through the coal seams themselves. The groundwater extraction records for mines in the area indicate that the Fassifern Seam is the driest of the seams that have been mined (Geoterra 2013).

As noted in Section 1.1, the coal seams historically mined at CVC comprise the Wallarah, Great Northern and Fassifern Seams of the Newcastle Coal Measures which are generally interbedded with tuffaceous claystone. The coal seams generally have a low primary or inter-granular porosity and permeability, with bedding planes, joints, fractures and cleating imparting an enhanced secondary permeability.

Historical and ongoing underground mining around Lake Macquarie has created a significant groundwater sink and generated a regional zone of depressurisation within the Permian Coal aquifers.

iii Groundwater monitoring

a. Mine water Inflow

Monitoring activities currently conducted at CVC principally involve recording the mine groundwater make (via water pumped in and out of the workings) and liaison with local bore owners when, or if, adverse effects are observed in the limited number of active bores in CVC's drawdown area.

Monitoring is limited, principally due to the fact that CVC's drawdown area is almost entirely covered by the surface of Lake Macquarie and that when landowners with registered bores were contacted as part of developing a groundwater monitoring program (GwMP) (required by conditions of SSD-5465), only one responded indicating that the bore was present and in use.

Monitoring data from between March 2013 and December 2014 indicates that an average of 118KL/day, or 43.07ML/year (of potable water is pumped into the underground mine, whilst over the 2009 to 2014 period, 2,305 to 2,536ML/year of groundwater was extracted from the mine via two pumps in the Great Northern Seam workings sump.

The net groundwater seepage into the workings is estimated from the difference between the annual potable water intake and the annual water volume extracted from the underground workings. Using this method, the annual groundwater make for the current CVC workings is estimated at approximately 2,440 ML/yr, or 6.7 ML/day.

b. Groundwater quality

Groundwater monitored within the current and historic underground mining areas at CVC indicates the inflow water is brackish to relatively saline in subsided areas over the Great Northern Seam workings (11,800–28,200 mg/L) with a circum-neutral to mildly alkaline pH (7.30 – 7.76).

Groundwater from a dyke toward the northern end of the current Fassifern Seam workings, within the main headings, had a brackish salinity of 2,390 mg/L and an alkaline pH of 8.63 as outlined in Geoterra (2013). However, given that typical monthly water quality monitoring results from April 2014 to March 2015 indicate an average electrical conductivity of 31,500 µS/cm (approximately 17,300 mg/L), it is likely that the majority of groundwater make is still occurring in overlying seams.

Water quality sampling and analysis outlined in the Geoterra (2013) assessment indicates that groundwater within sections of the underground workings is significantly above the Australian and New Zealand Environment Conservation Council (ANZECC) 2000 criteria (default trigger values for physical and chemical stressors in south-east Australian lowland rivers and 95% protection of freshwater species) for:

- pH;
- electrolytical conductivity;

- total nitrogen;
- total phosphorous; and
- filterable copper and zinc.

5.3.3 Impact assessment

Groundwater modelling was previously undertaken by Geoterra (2013) for the Mining Extension 1 Project. The groundwater assessment included a fully calibrated numerical groundwater model to predict the extent of groundwater drawdown.

The groundwater modelling assumed that the fracture height above the areas of secondary extraction (for miniwall widths between 72 m and 97 m) ranged between 66 m and 89 m above the Fassifern Seam. The median annual groundwater inflow to the Fassifern Seam workings at CVC is currently estimated at 2,440 ML, is predicted to ultimately increase to 3,832 ML once miniwall mining is approaching its fullest lateral extent.

The groundwater assessment for the proposed modification anticipates that there will be no perceptible change to the effects predicted in the Geoterra (2013) assessment for the following aspects, noting that the 3.8% reduction in the underground mine area is within the error constraints of the MODFLOW Surfact groundwater model that was used for the Geoterra (2013) assessment:

- hydraulic connection to Lake Macquarie;
- aquifer/aquitard Interconnection;
- regional groundwater depressurisation;
- private bore yields and serviceability;
- groundwater dependent ecosystems (GDEs);
- groundwater quality; and
- groundwater seepage to or from terrestrial streams.

As a consequence, no apparent observable changes are anticipated in the following:

- loss of lake water - or any significant loss of connate groundwater within the overburden to the underlying workings;
- vertical hydraulic connection to the workings - this will still be restricted by the Dooralong Shale and the Mannering Park Tuff aquitards which are still not anticipated to be breached by subsidence over the proposed modified Fassifern Seam workings; and
- horizontal permeability - above and between the aquitards will not be observably different as a result of the proposed modification and will still be enhanced after subsidence.

The original modelled mine groundwater inflow of 10.5 ML/day is, therefore, not anticipated to be observably different due to the proposed modification.

5.3.4 Legislative considerations

Water management in NSW is governed by both the Water Act, and the WM Act, with the main trigger for transitioning of licences from the Water Act to the WM Act being the commencement of a Water Sharing Plan for a water source.

There is currently no gazetted water sharing plan for the porous rock water source in the CVC lease holdings (which includes the Triassic and Permian rocks) and, therefore, the Water Act is the relevant legislation. The alluvial sediments, however, are managed under the WM Act via the Hunter Unregulated and Alluvial Water Management Plan which commenced in 2009.

The Aquifer Interference Policy (NOW 2012) under the WM Act provides the mechanism for NOW to clarify the requirements for obtaining water licences for aquifer interference activities, and also considers and defines minimal harm criteria for productive and less productive aquifers. In those areas not under the WM Act, the principles of the Aquifer Interference Policy still apply, but are not yet legislated.

The Aquifer Interference Policy classifies the Triassic and Permian rocks at the site as less productive based on the groundwater salinity being in excess of 1,500 mg/L and bore yields lower than 5 L/sec.

To allow for groundwater extraction at the CVC, LakeCoal applied for a licence under the Water Act. The licence, 20BL173107, was issued on the 12 March 2013 and is valid until 11 March 2018 with a volumetric limit of 4,443 ML in any 12 month period for the purposes of mine dewatering and industrial use.

Given that the volume licensed exceeds the predicted maximum inflow of 3,832 ML/yr associated with the approved CVC operations, the negligible change to groundwater inflow predicted under the proposed modification is to be managed under CVC's existing Water Act licence.

To determine if the proposed modification would have any impacts on matters of NES under the EPBC Act, including impacts on water resources, a review was undertaken against the *Significant Impact Guidelines 1.3: Coal Seam Gas and Large Coal Mining Developments – Impacts on Water Resources (*Department of the Environment 2013). Based on the results of the Geoterra (2013) groundwater assessment for the Mining Extension 1 Project, it was considered that the approved operations would not be classified as being likely to, or having a significant impact. Similarly, no impacts on groundwater levels and quality are expected from the proposed modification. Therefore, a referral of the proposed modification under the EPBC Act in relation to potential impacts on water resources is not considered necessary.

5.3.5 Mitigation and management

Groundwater impacts associated with CVC are managed through LakeCoal's water management plan (WMP) (including the GwMP) which was developed in consultation with NOW, OEH and DRE.

The WMP will be updated as required over the life of CVC, with daily and annual mine water pumping volumes and calculated groundwater inflows to the workings, mine water trends and mine water and discharge water chemistry reported in each annual review.

Any observable changes in the groundwater system will be reported as required, with any required ameliorative actions conducted as outlined in the GwMP.

5.3.6 Conclusion

The planned mine design changes were assessed by Geoterra, and the original assessment reviewed along with monitoring data available since approval of SSD-5465. It was concluded that there will be negligible change to groundwater flows and to the groundwater system under the proposed modification.

5.4 Marine ecology

5.4.1 Introduction

A marine ecology assessment of the proposed modification was prepared by JSA Environmental. The assessment is presented in full in Appendix F and a summary provided below.

5.4.2 Existing environment

Lake Macquarie is a large barrier estuarine lake with an open water area of 115 km^2, an average depth of 7 m and a relatively flat floor characterised by fine soft silt/mud sediments. The Lake is a wave-dominated estuary with a high sediment trapping efficiency, naturally low turbidity and partially mixed circulation where there is likely to be sedimentation (Cardno Ecology Lab 2011).

The northern extent of CVC's underground mining area is approximately 13 km from the entrance of the Lake is an area where the tidal range and influence is not as pronounced compared to near the Lake Entrance and ocean at Swansea. The average water depth ranges from 0.5 m to 8.5 m, and the depth of sediment varies in thickness up to approximately 10 m (AECOM 2011).

i Seagrass communities

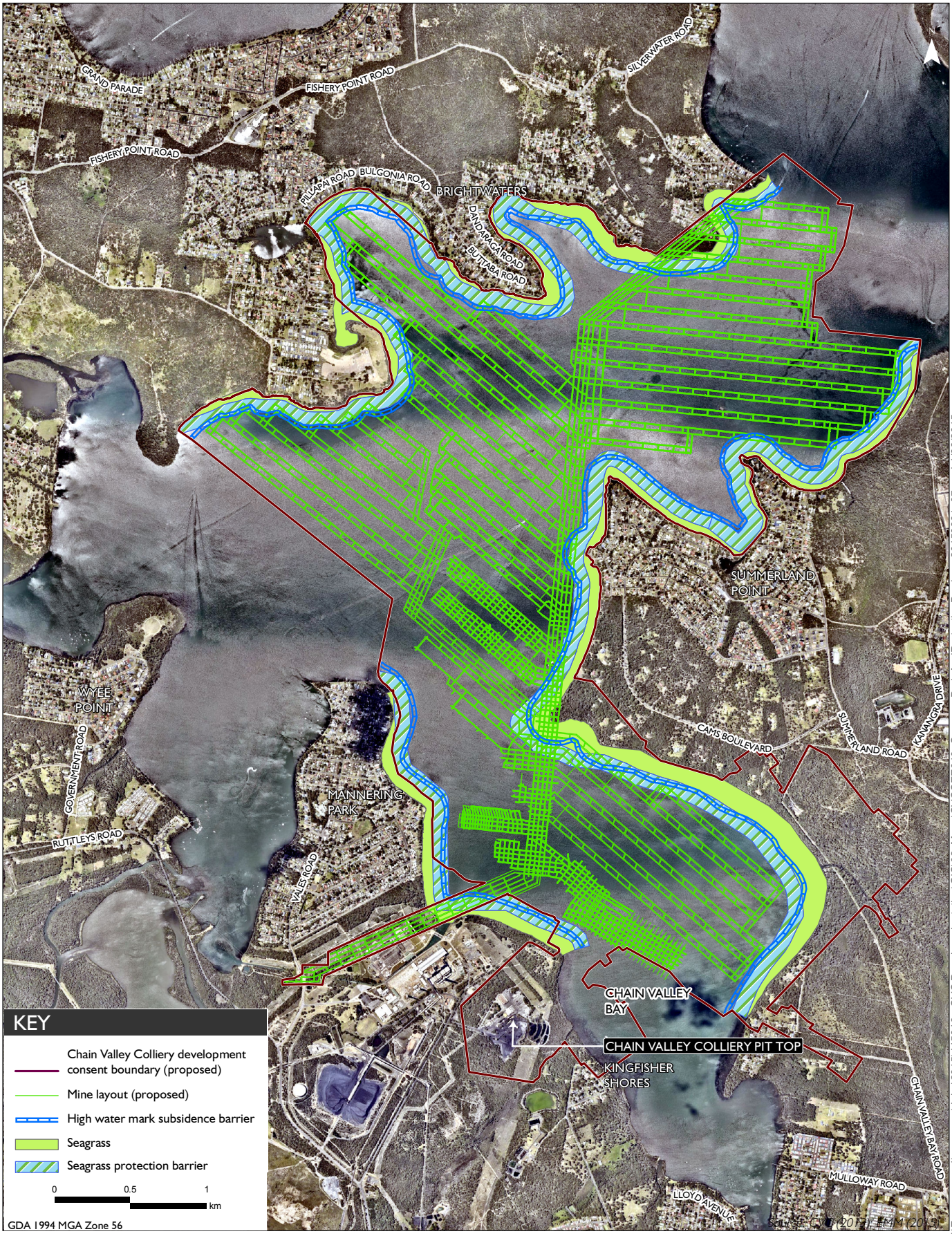
Lake Macquarie contains approximately 10% of the total area of seagrass beds in NSW Department of Primary Industries (DPI) 2007. Four species of seagrass occur in Lake Macquarie: eel grass (*Zostera capricorni*); paddle weed (*Halophila ovalis*); *Ruppia sp*; and strapweed (*Posidonia Australia*), which is listed as an endangered species under the FM Act. All seagrass species are protected in NSW and a permit under the FM Act is required from DPI to undertake works or activities that may harm them.

Seagrass distribution within estuaries is naturally influenced by light penetration, depth, salinity, nutrient status, bed stability, wave energy, estuary type, and the evolutionary stage of the estuary. Light is a major limiting factor for the growth of seagrasses and the effects of shading either by artificial structures or increased turbidity associated with sediment re-suspension are common light reducing factors in estuaries (BioAnalysis 2008).

Annual surveys of seagrass communities in Summerland Point, Chain Valley and Crangan Bay have been undertaken on behalf of LakeCoal since 2008 by Laxton & Laxton. Two species of seagrass are present in these areas, namely, eel grass and paddle weed. Reporting has identified that all seagrass beds have been expanding since 2011, with Laxton & Laxton (2014) noting that the cover and health of the seagrass communities at a number of monitoring stations were the best recorded since the surveys began in 2008. It was also considered that no further improvement in community health was possible in subsequent years. Laxton & Laxton (2014) postulated that the improvements in seagrass cover may be linked to the cessation of commercial fishing within the Lake as 'landing' of nets in the seagrass covered areas no longer occurs.

As described in Section 3.1.2, mining parameters at CVC include a SPB. Subsidence within the SPB is predicted to be less than 20 mm (ie a magnitude considered to be 'zero' subsidence). To achieve this, the extent of secondary extraction which would result in subsidence is routinely limited by an angle of 26.5 degrees from the seaward extent of the seagrass downwards to the coal seam to be mined, with localized increases to the controlling angle of draw adopted to protect the seagrass based on subsidence predictions. As an example, assuming an angle of draw of 26.5 degrees, at a depth of 200 m the secondary extraction activities cannot come closer than 99.7 m from the seaward edge of the seagrass.

Seagrass beds and the SPB are shown on Figure 5.9.



EMM
EMGA Mitchell McLennan

Seagrass beds and protection barriers

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Figure 5.9

ii Benthic communities

Unvegetated estuarine habitats such as shallow mud flats, sand flats and deeper soft substrate areas can contain significant food sources for many fish species, such as benthic communities and non-vascular plants (algae and cyanobacteria). The benthic communities in the mud basin zone of Lake Macquarie, within which the Site is located, are dominated by polychaetes and bivalve molluscs, with other benthic organisms present at various times in smaller numbers (The Ecology Lab 1991 and 2007; Laxton & Laxton 2009). Large scale extinctions of benthic organisms have been recorded historically, which could be attributed to events such as periodic anaerobic conditions as a result of major rainfall (Macintyre 1959; Roy 1981; The Ecology Lab 1991 and 2007; JSA 2012; Cardno Ecology Lab 2011).

5.4.3 Impact assessment

Subsidence is the principal mechanism by which the proposed modification could adversely affect marine ecology in Lake Macquarie.

To support the assessment of potential impacts on marine ecology arising from the proposed modification, worst case subsidence predictions derived from the subsidence assessment (Appendix D) and the extent of the planned mining areas have been considered in conjunction with outcomes of the marine ecology assessment (JSA 2013) of the Mining Extension 1 Project (EMM 2013) and subsequent benthic and seagrass monitoring.

i Impact on seagrass communities

In all mining areas, secondary workings will be set back to ensure that there is less than 20 mm subsidence within the SPB, with only first workings undertaken below the SPB. Though the angle of draw routinely adopted to define the SPB is 26.5 degrees, the subsidence assessment (Appendix D) has predicted that the angle of draw around the north-eastern limits of modified Miniwalls 34 and 35 may exceed 26.5 degrees slightly due to multi-seam effects. In these areas, the proponent will amend the mine design as necessary to ensure that no impact to the seagrass occurs.

Notwithstanding, the seagrass occurrence will continue to be surveyed annually to monitor the community assemblage and extent. Monitoring will be undertaken in accordance with the seagrass management plan, prepared in consultation with OEH, LMCC and DPI Fisheries and approved by the Secretary as part of the extraction plan.

ii Impact on benthic communities

The primary potential impact on benthic communities arising from subsidence of the lake floor is increased depth and consequent decreased light penetration of the water column, which may affect light dependent biota such as algae and biofilms on which benthic organisms feed.

The benthic community results from all surveys and annual monitoring undertaken have identified that while communities at some sites are defined by dominant species, the abundance and diversity of the communities did not identify clear links to location or impact type.

Monitoring of the sites over time has also established that water depth is not the primary determining feature of the benthic communities, and that physical variables such as salinity, conductivity, dissolved oxygen and turbidity had little influence on the species composition. While there were some differences in the relative abundance of organisms between the two monitoring events (JSA 2012) undertaken for the Mining Extension 1 Project (EMM 2013) and the seasonal monitoring since 2012 (Laxton and Laxton), further monitoring will be required to determine whether they represent seasonal fluctuations or overall patchiness of benthic communities.

As specified in the benthic communities management plan (BCMP), which was prepared in consultation with OEH, LMCC and DPI Fisheries and approved by the Secretary as part of the extraction plan, ongoing sampling, analysis and modelling of the communities will be undertaken to ensure any changes in community diversity and abundance do not result in greater than minor environmental consequences.

5.4.4 Management and monitoring

LakeCoal has previously made a number of commitments, and has processes in place, to monitor and manage potential impacts on marine ecology, each of which will continue to be implemented and are relevant to this modification. These measures include:

- annual bathymetric surveys covering active and previously mined areas, and land based subsidence monitoring near the foreshore areas to include the area of planned mining;
- six monthly/seasonal benthic monitoring as required by the BCMP;
- additional sampling and analysis to validate all results obtained, including assessment by an independent third party, if impacts due to the subsidence predictions are moderate or major as defined in the approved management plans (note: if moderate or major impacts are positively verified, the mine plan will be modified for future panels in order to achieve a minor or lower impact);
- annual seagrass surveys and monitoring as required by the seagrass management plan;
- the provision of the annual subsidence survey report on the LakeCoal website or in the annual review which is placed on the LakeCoal website; and
- inclusion of results from the BCMP/seagrass monitoring programs within the annual review.

5.4.5 Conclusion

The proposed mine design changes result in a minor change to the spatial extent of the planned mining activities, with all secondary extraction to remain limited to areas beneath Lake Macquarie and with protection barriers for the foreshore and seagrass continuing to apply. Given the maintenance of the SPB, no impact on the seagrass community is predicted.

Similarly, based on the monitoring undertaken to-date and the area and depth of the Lake in the areas of maximum predicted subsidence, it is not anticipated that any significant impact on benthic communities will occur as a result of the modification.

Notwithstanding, potential subsidence impacts on marine ecology (ie seagrasses and benthic communities) will continue to be managed in accordance with the seagrass management plan and BCMP and the future extraction plan will be developed to incorporate the proposed modification.

The seagrass management plan and BCMP include robust monitoring programs to provide a rigorous approach to determine the level of impact from subsidence. If impacts on seagrass communities are greater than of negligible environmental consequence or if impacts on benthic communities are greater than of minor environmental consequence, future miniwall panels would be modified to achieve a reduced impact.

5.5 Wave climate

5.5.1 Introduction

The Water Research Laboratory (WRL) of the School of Civil and Environmental Engineering at the University of New South Wales (UNSW) prepared an assessment of the predicted subsidence on the wave climate and associated foreshore erosion and recession within Lake Macquarie. The assessment is provided in Appendix G and summarised below.

5.5.2 Existing environment

Waves in the Chain Valley Bay area of Lake Macquarie are generated by local winds only with no penetration from ocean swells. Wave conditions are determined by the wind speed, direction and duration and the 'fetch', ie the length of water over which the wind blows. The limited fetch lengths of Lake Macquarie mean that wave heights will be far smaller than those encountered on open coasts. A detailed consideration of local wind speeds, wind wave conditions and wave classifications is provided in the wave climate assessment (Appendix G).

5.5.3 Impact assessment

Predicted worst case subsidence contours (including multi-seam effects) derived from the subsidence assessment (Appendix D) were used to inform the wave climate assessment, which focused on the Chain Valley Bay area, that being the area of underground mining with the greatest predicted subsidence. Therefore, the assessment is conservative in that it assesses the potential worse case impacts of subsidence on the wave climate.

A previous assessment (WRL 2013) of the predicted subsidence impacts on wave climate was undertaken for the Mining Extension 1 Project (EMM 2013). Where possible, the findings of that assessment have been compared to the current assessment to determine the incremental changes to wave climate as a result of the subsidence predictions.

i Impact of predicted subsidence on wave climate

Wind wave fetches were defined from two locations (Site A and Site B) as shown in Figure 5.10 which covers the majority of the modified mining area. Due to the irregular shoreline, the fetch for each primary direction was defined by using nine separate radials spaced at 3 degrees (centred on the primary direction) which were then averaged to define the average fetch length. The fetch length and fetch direction for both sites are provided in Table 5.4.

Table 5.4 Primary fetch lengths and direction

Site	Average fetch length (km)	Fetch direction
A	3.2	North-west
B	4.3	South-west

Typical long sections were derived for the north-west and south-west fetch showing the original and subsided profile, as shown in Figure 5.12 and Figure 5.14. The assessment on wave climate (Appendix G) notes of up to 1.2 m is predicted in limited areas within Chain Valley Bay due to multi-seam effects and up to 0.78 m elsewhere. However, in the location of the typical long sections (refer Figures 5.11 and 5.13) the maximum subsidence identified is 1 m for the north-west fetch and 0.7 m for the south-west fetch.

It is noted that the WRL (2013) assessment included an assessment of a north-west fetch only and, therefore, a comparison between the impacts of the approved operations and the proposed modification on wave climate only relate to this fetch.

Location of wind fetches

Chain Valley Colliery - Modification 2

Figure 5.10

a. North-west fetch (Site A)

Subsidence predictions along the north-west fetch long section (Figure 5.11) show a typical subsidence of 0.4 m with a maximum subsidence of 1.0 m where original bed levels were -3 to -5 m AHD. The short wind fetches associated with the north-west orientation leads to short wind waves. For the north-west fetch with the maximum worst case subsidence predictions, the waves generated by ambient wind conditions up to 11.8 metres per second (m/s) (30 min duration) are classified as deepwater waves. Deepwater waves, by definition, will not 'feel' the bottom. Waves generated by wind speeds greater than 11.8 m/s winds (30 min duration) for the subject fetch are classed as transitional and will begin to interact with the lake bottom. These waves will also respond to changes of the lake bed due to subsidence by increasing slightly in velocity and decreasing in height.

Under ambient conditions, and assuming a maximum wind speed of less than 11.8 m/s, there would be no change in wave velocity in the area of the north-west fetch based on the maximum subsidence prediction. However, under extreme (worst case) conditions (ie assuming 100 year average recurrence interval and wind speeds of 40.4 m/s) the increase in wave velocity in the area of the north-west fetch is predicted to be 2.7%. However, it is important to note that these wind conditions (> 11.8 m/s) occur infrequently (less than once a year) and any increase in wave velocity will reduce back to existing values in shallow water.

Under the WRL (2013) assessment, based on a maximum subsidence prediction of 0.8 m and assuming extreme conditions, the increase in wave velocity in the area of the north-west fetch was predicted to be 2.4%. Therefore, under extreme conditions and based on a maximum subsidence prediction of 1.0 m, the proposed modification is predicted to increase wave velocity in the area of the north-west fetch by 0.3%. However, as identified in both the WRL (2013) assessments wave velocity will again reduce back to existing values in shallow water.

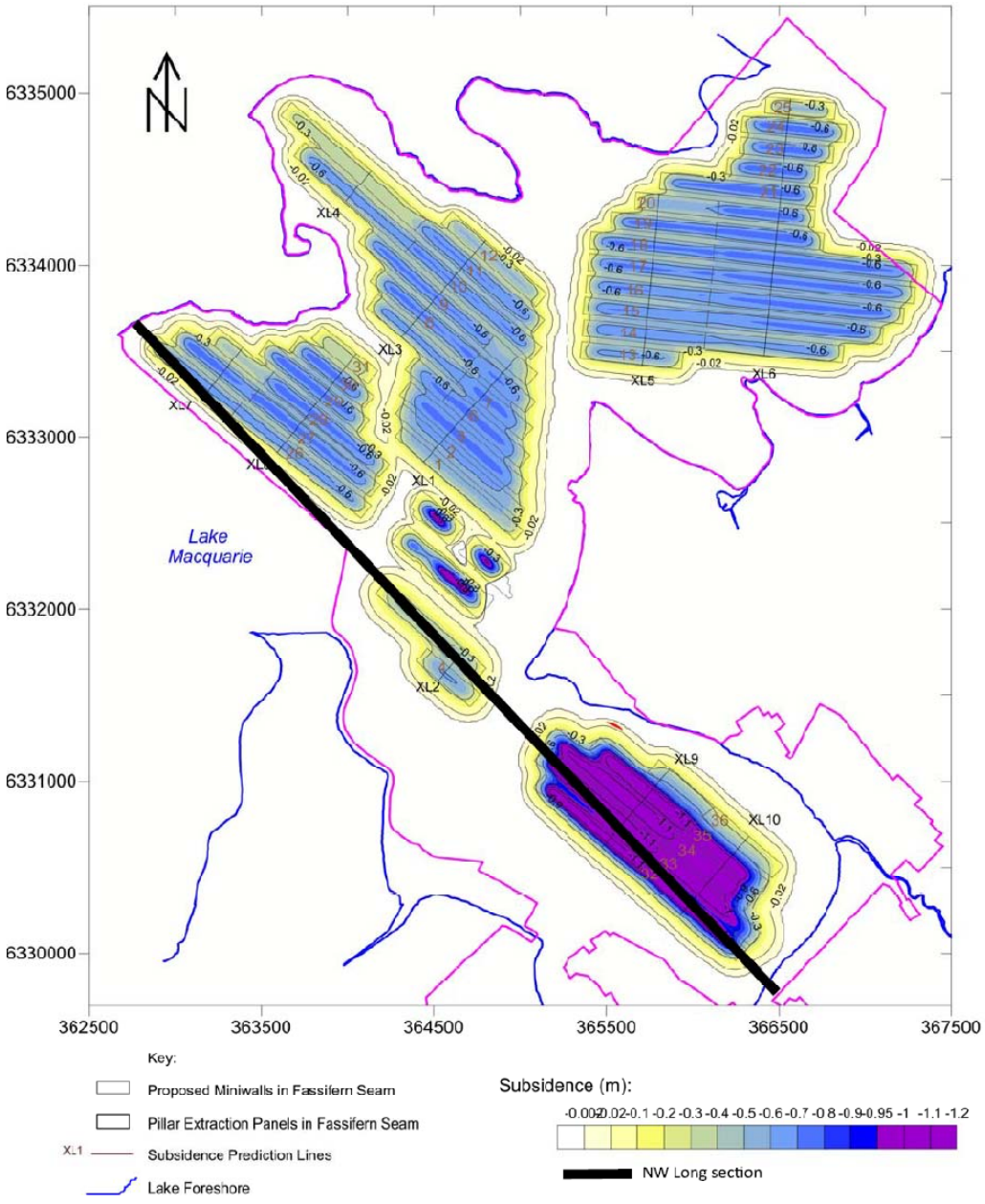

Figure 5.11 **North-west fetch long section (Source: DGS 2015)**

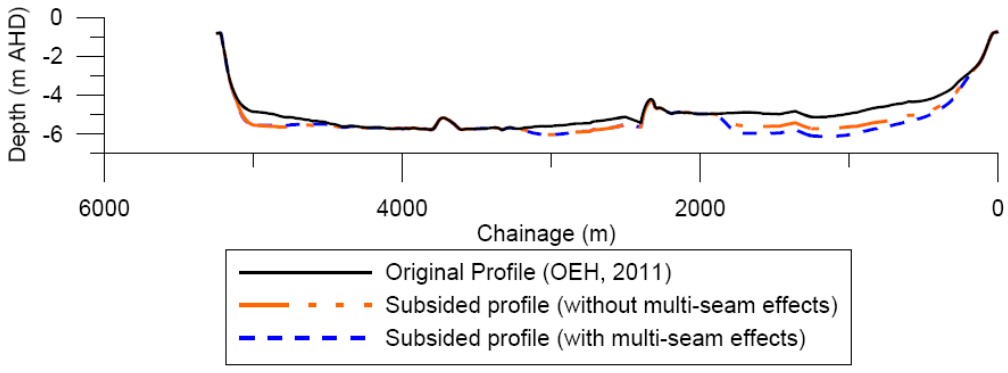

Figure 5.12 **North-west fetch original profile and subsided profile (Source: WRL 2015)**

b. South-west fetch (Site B)

Subsidence predictions along the south-west fetch long section (Figure 5.13) show a typical subsidence of 0.3 m with a maximum subsidence of 0.7 m where original bed levels were -4 to -8 m AHD (Figure 5.14). The short wind fetches associated with a south-west orientation leads to short wind waves. For the south-west fetch with the maximum worst case subsidence predictions, waves generated by ambient winds up to 19.4 m/s (30 min duration) are classified as deepwater waves and will have the same interaction with the lake bottom as with the north-west fetch.

Under ambient conditions and assuming a maximum wind speed of less than 19.4 m/s there would be no change in wave velocity in the area of the south-west fetch based on the maximum subsidence prediction. However, under extreme (worst case) conditions the increase in wave velocity in the area of the south-west fetch is predicted to be 0.8%. However, as with the north-west fetch, it is important to note that the wind conditions (> 19.4 m/s) occur infrequently (less than once a year) and any increase in wave velocity will reduce back to existing values in shallow water.

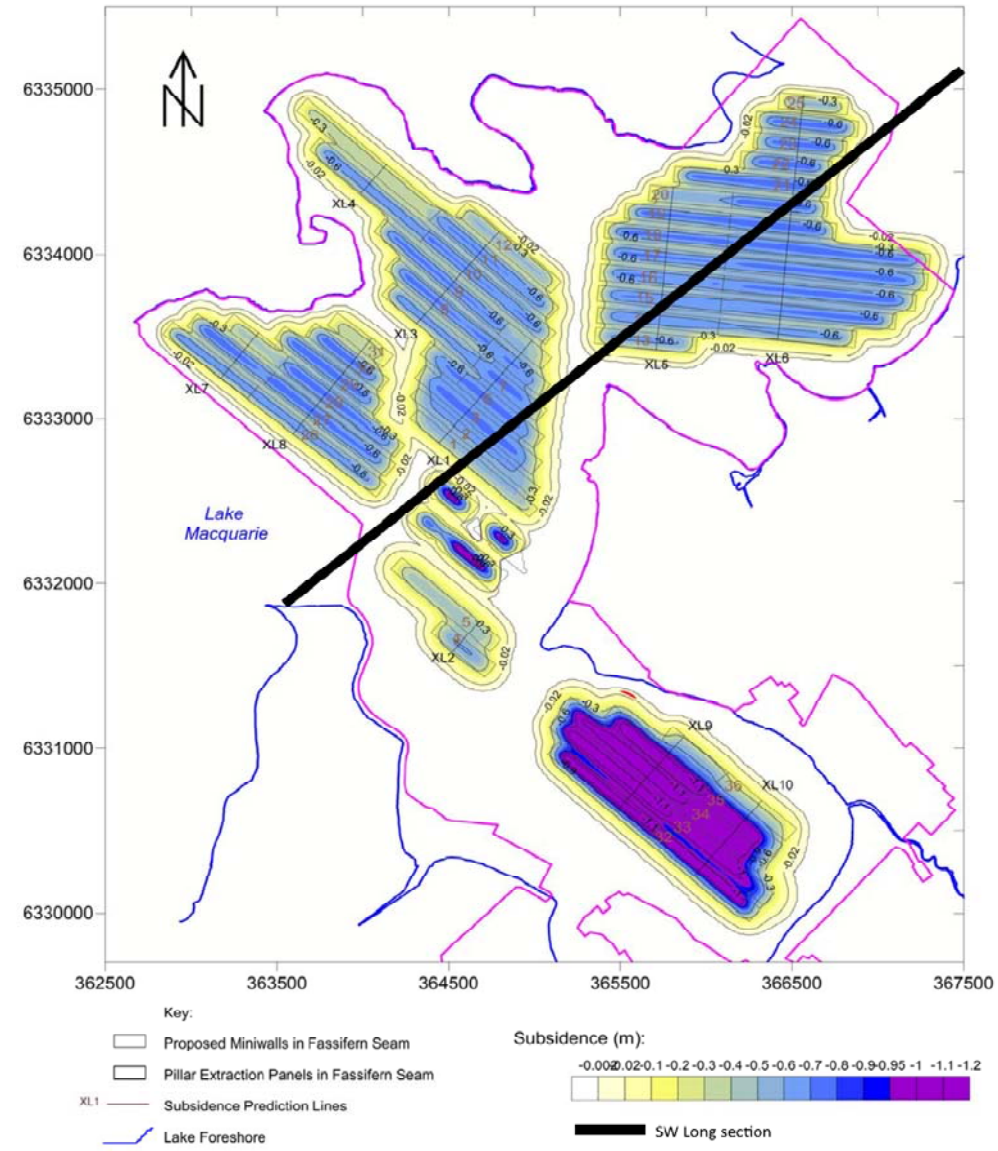

Figure 5.13 South-west fetch long section (Source: DGS 2015)

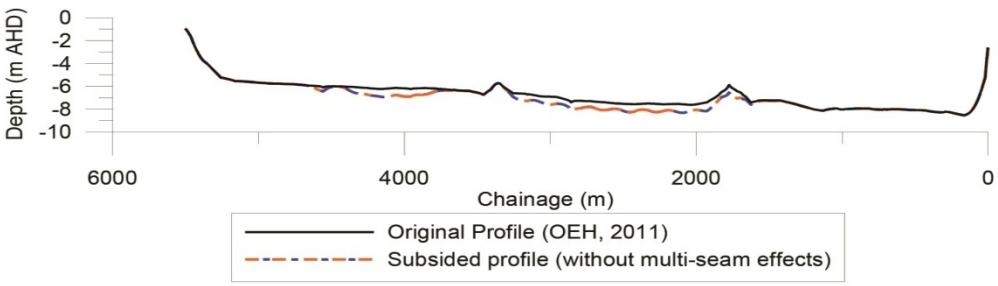

Figure 5.14 South-west fetch original profile and subsided profile (Source: WRL 2015)

ii Effect of predicted subsidence on tidal erosion and recession

Subsidence occurring underwater as a result of the planned mining activity will lead to an increase in the water volume stored in the lake; however, subsidence below the low tide level will not alter the tidal prism (the volume of water in an estuary between mean high tide and low tide) (Luketina, 1998). The typical tidal range of the lake is ±0.05 m and the average water level is 0.1 m AHD, meaning that subsidence below 0.05 m AHD does not affect the tidal prism. All subsided is modelled to occur well below this level.

The tidal range in Lake Macquarie is determined by frictional losses through the entrance at Swansea Channel. Initial construction of the training walls was completed in 1887. These have enhanced the hydraulic efficiency of the entrance and promoted inlet scour which is still progressing.

Analysis by Watterson *et al.* (2010) indicates that the tidal range within Lake Macquarie is likely to double in approximately 80 years. This change is reported to be driven equally by projected sea level rise and continuation of inlet scour presently occurring in response to the entrance training. The magnitude of this increase is likely to substantially outweigh any impacts on tidal erosion and recession that may be caused by the planned mining activity.

5.5.4 Mitigation and management

Potential impacts from the predicted subsidence will be managed in accordance with the approved SMP and/or extraction plans; however, based on the above assessment no specific mitigation measures will be required.

5.5.5 Conclusion

Worst case subsidence in association with potential changes to the lakes wave climate will not affect the wave climate sufficiently to have adverse shoreline impacts. Waves generated in Lake Macquarie are small and have short periods and, therefore, do not generally 'feel' the bottom in the subsided, deeper areas.

Under worst case conditions, wind waves from the north-west are predicted to increase in velocity by up to 2.7%, an increase of 0.3% from the worst case predictions (WRL 2013) for the Mining Extension 1 Project (EMM 2013). However, it is important to note that these velocities would prevail for a very small proportion of the time (less than one a year) and would return to pre-subsidence values in shallower water close to shore. Whilst a comparison between the potential impacts under the approved and planned mining layouts cannot be made for the south-west fetch, given the low predicted increase (0.8%) in wave velocity, the magnitude of change between approved mining layout and the planned mining layout is expected to be similar.

The predicted mine subsidence would not alter the tidal prism within Lake Macquarie with factors such as the increasing tidal range due to projected sea level rise and continuation of inlet scour presently occurring in response to the entrance training outweighing any potential impacts on tidal erosion and recession that may arise.

5.6 Bushfire

5.6.1 Introduction

As with all rural settings where vegetation is present, there is a risk that bushfires could occur in or near CVC. There is therefore a risk that a bushfire could damage assets and present a hazard to human life. This was brought into focus in October 2013 when the ventilation fan site and nearby MC pit top area were threatened by a bushfire that resulted in minor damage to assets at MC (as shown in Photographs 5.1 to 5.3). Accordingly, LakeCoal engaged EMM to assess this risk so that bushfire protection measures, such as APZs, could be determined and implemented at CVC.

The APZ assessment has been included in this SEE as implementation of APZs generally requires vegetation clearing/disturbance which, in turn, has the potential to cause ecological and Aboriginal cultural heritage impacts which require assessment.

This section summarises the bushfire hazard assessment and describes the resulting APZs. Outcomes of the ecological and Aboriginal cultural heritage assessments are provided in Sections 5.7 and 5.8, respectively.

Bushfire risks have been assessed in accordance with the PBP guideline. Although the PBP guideline focuses on protection of habitable buildings on bushfire prone land from bushfire, and the buildings at CVC are industrial in nature and are not permanently inhabited by people, the PBP guideline nevertheless represents the standard method for assessing bushfire risks in NSW and has been used in this instance.

This proposed modification does not seek approval for new surface infrastructure. Therefore, approval is not being sought for new buildings, and comprehensive reporting of the bushfire hazard assessment in this SEE is not required. Notwithstanding, a bushfire management plan will be prepared for CVC which will incorporate the risk assessment procedures and bushfire protection measures in the PBP guideline, RFS (2008) *Bushfire risk management planning guidelines for bushfire management committees* and RFS (2014) *Development planning:* a *guide to developing a bushfire emergency management and evacuation plan*.

Photograph 5.1 **MC bushfire damage – southern edge of the main car park**

Photograph 5.2 **MC bushfire damage – storage/laydown area looking south-west**

Photograph 5.3 MC bushfire damage – looking south-west to the main storage/laydown area

5.6.2 Existing environment

According to the PBP guideline, the vegetation surrounding CVC comprises forests and forested wetlands. The specific vegetation communities are shown in Figure 5.15. Forests are particularly vulnerable to bushfire.

5.6.3 Impact assessment

i Assessment method

Bushfire risks have been assessed in accordance with the PBP guideline. The aim of the PBP guideline is "*to use the NSW development assessment system to provide for the protection of human life (including fire-fighters) and to minimise impacts on property from the threat of bushfire, while having due regard to development potential, onsite amenity and protection of the environment*" (RFS 2006).

The objectives of the PBP guideline are to:

- afford occupants of any building adequate protection from exposure to a bushfire;
- provide for a defendable space to be located around buildings;
- provide appropriate separation between a hazard and buildings which, in combination with other measures, prevent direct flame contact and material ignition;

- ensure that safe operational access and egress for emergency service personnel and residents is available;
- provide for ongoing management and maintenance of bushfire protection measures, including fuel loads in the APZ; and
- ensure that utility services are adequate to meet needs of firefighters (and other assisting in bushfire fighting).

The NSW *Rural Fires Act 1997* requires the owners of land to prevent the ignition and spread of bushfires on their land. The measures to be adopted in the bushfire management plan for CVC will aim to ensure that the risk of bushfire ignition and spread will be as low as reasonably practicable.

Under Section 1.1 of the PBP guideline, CVC is categorised as 'other development', that is, development which is not an 'integrated development' such as residential/rural residential subdivision or special fire protection purposes. Notwithstanding, the APZ specifications for residential and rural residential subdivision purposes have been assessed to be more appropriate than those for 'other development' and have been used to determine the APZs: CVC's buildings are generally non-flammable (constructed of brick and metal) and there are large cleared areas near the centre of CVC where personnel can evacuate to quickly if there is an imminent bushfire emergency.

ii Asset protection zones

APZs for residential and rural residential subdivision purposes are designed to reduce heat flux at the facade of a building to not more than 29 kW/m^2. APZs provide fire vehicle access, reduce radiant heat, reduce convection winds, reduce ember attack and allow smoke to disperse. For forest vegetation, APZs are divided into an 'inner protection area' (IPA) and an 'outer protection area' (OPA).

The PBP guideline compares the PBP bushfire hazard vegetation classification, bushfire weather and slope classes on bushfire prone land to derive minimum APZs distances. The vegetation communities and slope classes were characterised in accordance with Appendix 4 of the PBP guideline.

a. Bushfire prone land

The majority of CVC is on land mapped as being in the 100 m buffer around category 1 bushfire prone vegetation on the Wyong Bushfire Prone Land Map.

Category 1 vegetation comprises areas of forest, woodlands, heaths (tall and short), forested wetlands and timber plantations (RFS 2014).

b. Vegetation

Between 2001 and 2004, Keith (2004) compiled broad scale native vegetation classifications and maps for NSW (the Keith formations). The PBP guideline uses the Keith formations to classify the bushfire hazard of vegetation (the PBP classifications). The bushfire hazard classification of the native vegetation surrounding CVC was determined based on the PBP classifications and site vegetation mapping.

Vegetation communities surrounding CVC, and their PBP classifications, are shown in Table 5.5 and on Figure 5.15. Where a mix of vegetation types exists, the type providing the greatest hazard predominates. Based on Table A2.1 in the PBP guideline, the predominant bushfire hazard vegetation formations are forests around the pit top area and forested wetlands around the ventilation fan site.

Table 5.5 Vegetation classifications

Surveyed vegetation communities	PBP classifications
Smooth-barked Apple Red Bloodwood Open Forest	Forest
Scribbly Gum red Bloodwood Heathy Woodland	Forest
Swamp Mahogany Forest	Forested wetlands
Disturbed vegetation	Managed land

Disturbed vegetation, regarded as managed land, occurs to the north and east of CVC's pit top area and is associated with a TransGrid high voltage powerline easement and water management dams. These areas are not considered further as they are sparsely vegetated.

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Bushfire hazard vegetation

Chain Valley Colliery - Modification 2

Figure 5.15

c. Slope

Slope is an important contributor to a bushfire's rate of spread. A bushfire will spread quicker up a steep slope compared to a gradual slope or across flat land. Slopes are classified according to the PBP guideline, and are combined with vegetation classes in an area to determine APZ requirements.

Slopes in and for 100 m around CVC were determined using a digital terrain model (1 m height resolution) based on the following PBP classifications:

i) All upslope vegetation (considered 0°);

ii) >0 to 5° downslope vegetation;

iii) >5 to 10° downslope vegetation;

iv) >10 to 15° downslope vegetation; and

v) >15 to 18° downslope vegetation.

The slope classes were calculated using the individual assets as reference points.

The topography of CVC's pit top area is relatively flat, with only the two lowest slope classes identified in the PBP guideline represented: class (i) (any vegetation upslope of a point or with a slope of 0°), to the north of the pit top area; and class (ii) (any vegetation greater than 0° and up to 5° downslope of a point), to the south, east and west of the pit top area.

Slopes around the ventilation fan site are class (i) to the north-west, north-east and south-east, and class (ii) to the south-west.

Slope classes for CVC's pit top and ventilation fan site are shown on Figure 5.16.

d. APZs

Based on the location of CVC in the Greater Hunter Fire Weather Area (Fire Danger Index 100), the slope class (>0 to 5° downslope vegetation) and the predominant bushfire hazard vegetation type (forests and forested wetland), APZs for CVC infrastructure at the main pit top area and the ventilation fan site have been determined and are identified in Table 5.6 and shown on Figure 5.17.

Table 5.6 shows that APZs for the pit top infrastructure are 25 m, comprising a 15 m IPA and a 10 m OPA, while the APZ for the ventilation fan site is 20 m with no requirement for an OPA. Where unimpeded access is not already available, the IPAs will also include the establishment of a 4 m wide fire trail around certain assets (ie structures, buildings and the ventilation fan site) to enable access for fire fighting vehicles.

Table 5.6 APZs

Predominant bushfire hazard vegetation	Slope	APZ	IPA	OPA
Pit top area				
Smooth-barked Apple Red Bloodwood Open Forest (forest)	ii	25	15	10
Scribbly Gum red Bloodwood Heathy Woodland (forest)	ii	25	15	10
Ventilation fan site				
Swamp Mahogany Forest (forested wetlands)	ii	20	20	-

Extension/establishment of the APZs will require both clearing and disturbance of exotic and native vegetation for the purposes of the APZs. Clearing is defined as the permanent removal of vegetation while vegetation disturbance will include maintaining different levels of canopy cover for the IPA (ie 15% of total surface area) and the OPA (ie 30% of the total surface area). Measures to achieve the required canopy cover are described in Section 5.6.4.

Approximately 0.09 ha of vegetation clearing and approximately 1.33 ha of vegetation disturbance will be required at CVC's pit top and ventilation fan site. The extent and type of vegetation proposed to be cleared/disturbed is described in Section 5.7.3 (Table 5.8) and shown in Figure 5.18 of the ecology section of this SEE.

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Slope classes

Chain Valley Colliery - Modification 2

Figure 5.16

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Asset protection zones

Chain Valley Colliery - Modification 2

Figure 5.17

5.6.4 Mitigation and management

The APZs will be managed generally in accordance with the PBP guideline. A bushfire management plan will be prepared that will describe measures to protect human life and minimise the risk of a bushfire damaging CVC assets, or activities at CVC igniting a bushfire. The measures will satisfy the PBP guideline specifications for electricity, gas and water services as appropriate.

The APZs will be maintained in a manner that prevents accumulation of fine flammable debris on the ground so that fuel quantities are reduced, thus lessening flame heights and potential crowning. General maintenance guidelines are described in Appendix 2 of the PBP guideline.

The PBP guideline nominates that APZs should be maintained as follows:

- IPAs
    - canopy cover kept at less than 15% of total surface area and at least 2 m from the roof line of a building;
    - garden beds and shrubs not to be located under trees and sited at least 10 m from any exposed windows or doors; and
    - lower limbs of trees up to 2 m above the ground are removed.
- OPAs
    - canopy cover kept at less than 30% of total surface area; and
    - understorey mowed annually before the fire season (usually September) to remove shrubs and long grasses.

It is noted that the management plan is separate to the modification process. Proposed management and mitigation for these impacts, which form part of the statement of commitments for the proposed modification, are provided in Table 6.1.

5.6.5 Conclusion

Bushfire risks at CVC were assessed and determined that 20 m wide APZs will be required in areas of class (ii) slopes for forested wetlands and 25 m wide APZs will be required in areas of class (ii) slopes for forest vegetation.

Implementation of the APZs will require vegetation clearing of approximately 0.09 ha and vegetation disturbance of approximately 1.33 ha. Assessments of the ecological and Aboriginal cultural heritage impacts of this vegetation clearing/disturbance are provided in Section 5.7 and Section 5.8, respectively.

Specifications for the APZs and other bushfire protection measures will be provided in a bushfire management plan to be prepared for CVC.

5.7 Terrestrial ecology

5.7.1 Introduction

A biodiversity investigation was completed by EMM to assess the impacts on terrestrial ecology arising as a consequence of the proposed modification; that is, the vegetation clearing/disturbance required to extend/establish and maintain APZs for bushfire protection purposes.

The investigation aimed to identify/assess:

- the presence and likely occurrence of common and threatened terrestrial flora and fauna species listed under the TSC Act and EPBC Act;
- potential impacts on biodiversity as a result of the proposed modification; and
- measures to avoid, minimise and mitigate potential impacts.

5.7.2 Existing environment

i Desktop assessment

A desktop assessment was undertaken to identify key biodiversity values of the area proposed to be cleared/disturbed for bushfire protection purposes around CVC's pit top and ventilation fan site (the survey area for the purpose of the terrestrial ecology assessment). This included:

- a search of the BioNet Atlas of NSW Wildlife (a 10 km radius from the survey area) for previous threatened species records (OEH 2015a);
- a search of the Commonwealth Department of Environment (DoE) Protected Matters Search Tool (a 10 km radius from the survey area) for matters of NES, including threatened species records (DoE 2015a); and
- a review of profiles for NSW and Commonwealth listed threatened biodiversity (OEH 2015b; DoE 2015b, Royal Botanic Gardens and Domain Trust (RBGDT) 2015).

Previous local studies and plans were also reviewed, comprising:

- *Vegetation Survey, Classification and Mapping: Lower Hunter and Central Coast Region* (Lower Hunter and Central Coast Regional Environment Management Strategy (LHCCREMS) 2000);
- *Flora and Fauna Investigations Vales Point Power Station Perimeter Lands Biodiversity Update* (Ecotone Ecological Consultants 2010);
- *Chain Valley Colliery biodiversity management plan* (EMM and LDO 2014); and
- *Vales Point Power Station Perimeter Lands Biodiversity Surveys* (EMM unpublished data 2014).

ii Field survey

Field investigations of the survey area were completed on 8 April 2015 by an EMM senior ecologist. The survey focussed on the areas proposed to be cleared/disturbed for bushfire protection purposes around CVC's pit top area and ventilation fan site (referred to as the survey area for the purposes of the terrestrial ecology assessment).

Weather conditions were warm during the survey, with a minimum temperature of 11.9°C and maximum of 23.4°C (Bureau of Meteorology (BoM) 2015). No rain was experienced during the survey.

iii Identification and mapping of vegetation communities

Existing vegetation mapping from *Vegetation Survey, Classification and Mapping: Lower Hunter and Central Coast Region* (LHCCREMS 2000) and the *Chain Valley Colliery biodiversity management plan* (EMM and LDO 2014) were verified in the field. The vegetation mapping and community descriptions were used as a guide to identifying plant community and biometric vegetation types present within the survey area.

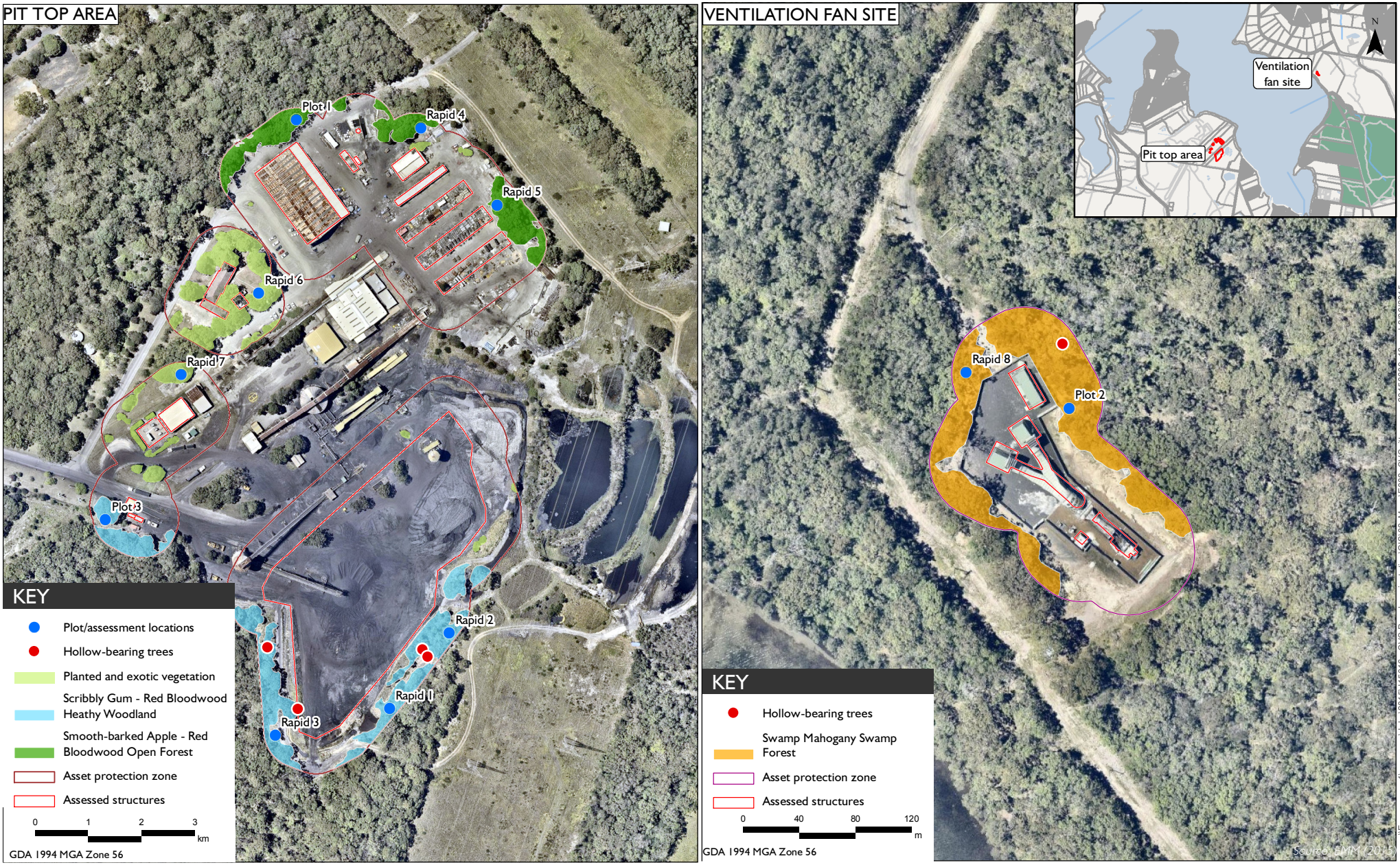
Floristic and structural vegetation data was collected from 20 x 20 m quadrats and 50 m transects in accordance with the BioBanking Assessment Methodology (OEH 2014). The number of plots and transects was determined by using mapped vegetation communities as stratification units. Three plots and transects were completed in the vegetation communities within the survey area (Plots 1 to 3 – Figure 5.18) to confirm the composition and condition of vegetation communities present. This information was also used to identify potential vegetation impacts from the proposed modification.

Nine rapid assessments were also completed to characterise vegetation communities in the areas of vegetation to be cleared/disturbed for bushfire protection purposes (Rapid 1 to 9 – Figure 5.18). The main canopy, mid and understorey species were recorded during the rapid assessments to characterise the vegetation communities present.

iv Targeted threatened flora searches

Targeted searches were carried out for threatened flora species previously recorded in or near the survey area that were considered likely to occur. This included searches for:

- Black-eyed Susan (*Tetratheca juncea*);
- Bynoe's Wattle (*Acacia bynoeana*);
- Charmhaven Apple (*Angophora inopina*); and
- Magenta Lilly Pilly (*Syzygium paniculatum*).



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Native vegetation communities and plot/assessment locations

Chain Valley Colliery - Modification 2

Figure 5.18

The survey was not completed during the flowering period for orchid species previously recorded near the survey area, namely:

- Leafless Tongue Orchid (*Cryptostylis hunteriana*);
- *Diuris praecox*; and
- *Genoplesium insignis.*

Given the survey timing, these species were conservatively assumed to be present where suitable habitat was available.

Systematic vegetation searches were completed in accordance with Cropper (1993) in areas of suitable habitat for each of the species identified as potentially occurring, with a total of 8 hours spent targeting threatened flora species.

v Habitat assessment and opportunistic sightings

Fauna habitat was assessed throughout the survey area. The location of any hollow-bearing trees, nests and burrows were recorded using a global positioning system (GPS).

Dedicated searches were also undertaken for scats, tracks and other fauna signs at each quadrat location. Opportunistic fauna sightings were also recorded.

vi Desktop assessment results

The LHCREMMS (2000) vegetation mapping indicates that the following vegetation types are present in and adjacent to the survey area:

- MU42 Riparian Melaleuca Swamp Woodland;
- MU30 Coastal Plains Smooth-barked Apple Woodland;
- MU31 Coastal Plains Scribbly Gum Woodland;
- MU37 Swamp Mahogany – Paperbark Swamp Forest; and
- MU40 Swamp Oak – Rushland Forest.

Sixteen threatened ecological communities (TECs) have been previously recorded within the Wyong subregion of the Hunter-Central Rivers Catchment Management Authority (CMA), in which the survey area occurs. Seven threatened plant, one frog, 24 bird and 12 mammal species listed under the TSC Act have been recorded in the Atlas of NSW Wildlife (OEH 2015a), as occurring within 10 km of the survey area. The Protected Matters Search Tool (DoE 2015a) predicts that 19 threatened plant, two bird, five frog and seven mammal species or their habitat may occur within 10 km of the survey area.

Ecotone Ecological Consultants (2010) completed detailed biodiversity surveys of the VPPS perimeter lands, which included CVC's pit top area. Ecotone found the following threatened communities and species in and around CVC's pit top area:

- Swamp Sclerophyll Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions EEC (listed under the TSC Act); and
- a Grey-headed Flying-fox (*Pteropus poliocephalus*). Grey-headed Flying-foxes are listed as vulnerable species under the TSC and EPBC Acts.

A migratory species, the White-bellied Sea Eagle (*Haliaeetus leucogaster*) was also recorded proximal to the ventilation fan site (EMM unpublished data 2014). Scats of the European Red Fox (*Vulpes vulpes*) and Feral Rabbits (*Oryctolagus cuniculus*) have also been recorded near the pit top and ventilation fan site (EMM unpublished data 2014).

vii Field assessment results

a. Flora and vegetation communities

A total of 50 plant species were recorded during the survey, comprising 44 native and six exotic species. In accordance with the *Noxious Weeds Act 1993,* the growth of these plants must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed. Lantana (*Lantana camara*), recorded during the surveys, is a weed of national significance. This should be controlled in accordance with best practice weed control methods for the species.

No threatened flora species were recorded during the survey. However, the survey areas contained potential habitat for the following species that are difficult to detect outside of their flowering periods:

- Black-eyed Susan (*Tetratheca juncea*);
- Leafless Tongue Orchid (*Cryptostylis hunteriana*); and
- Variable Midge Orchid (*Genoplesium insigne*).

Three native vegetation communities were recorded in the survey area. Table 5.7 describes the vegetation communities, their relationship to other vegetation types and the dominant plant species in each stratum.

Table 5.7 Vegetation communities in the areas to be disturbed

Vegetation community	Biometric Vegetation Type/ Plant Community Type	Dominant canopy species	Dominant midstorey species	Dominant understorey species
Scribbly Gum – Red Bloodwood heathy woodland on the coastal plains of the Central Coast, Sydney Basin	HU850 (previously HU610) PCT1636	Scribbly Gum (*Eucalyptus haemastoma*), Brown Stringybark (*E. capitellata*), Red Bloodwood (*Corymbia gummifera*)	Broad-leaved Hakea (*Hakea dactyloides*), Coastal Wattle (*Acacia longifolia*), Mountain Devil (*Lambertia formosa*)	Large-leaf Hop Bush (*Dodonaea triquetra*), Blady Grass (*Imperata cylindrica*), Bracken (*Pteridium escultentum*)
Smooth-barked Apple – Red Bloodwood open forest on coastal plains of the Central Coast, Sydney Basin	HU621 PCT1619	Red Bloodwood, Smooth-barked Apple (*Angophora costata*)	Black She-oak, Coffee Bush (*Breynia oblongifolia*), Cheese Tree (*Glochidion ferdinandi*)	Blady Grass, Bracken, Sand Couch (*Sporobolus virginicus*)
Swamp Mahogany Swamp Forest on coastal lowlands of the North Coast and northern Sydney Basin	HU833 (previously HU633) PCT1230	Swamp Mahogany (*E. robusta*), Broad-leaved Paperbark (*Melaleuca quinquenervia*)	Black She-oak (*Allocasuarina littoralis*)	Large-leaf Hop Bush, Blady Grass

Source: Vegetation community (LHCCREMS 2000), Biometric Vegetation Type (OEH 2012), Plant Community Type (OEH 2015c).

Plot and rapid assessment data was compared to the final determination for the EECs potentially occurring in the locality. Swamp Mahogany Swamp Forest on coastal lowlands of the North Coast and northern Sydney Basin meets the description of Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions (Swamp Sclerophyll Forest), an EEC listed under the TSC Act (New South Wales Scientific Community (NSWSC) 2011). This community meets the description of the EEC for the following reasons:

- it has a dense tree layer of eucalypts and paperbarks;
- the most dominant tree species are Swamp Mahogany and Broad-leaved Paperbark;
- a small tree layer is present, including Cheese Tree;
- small shrubs including Large-leaf Hop Bush are present; and
- groundcover species including *Stephania japonica* var. *discolor*, Bracken, Blue Flax Lily (*Dianella caerulea)* and Blady Grass are present.

The survey area contains potential habitat for the following threatened fauna groups and species previously recorded within a 10 km radius:

- owls: Barking Owl (*Ninox connivens*), Masked Owl (*Tyto novaehollandiae*) and Powerful Owl (*N. strenua*);
- woodland birds: Glossy Black-cockatoo (*Calyptorhynchus lathami*), Little Lorikeet (*Glossopsitta pusilla*), Scarlet Robin (*Petroica boodang*), Varied Sittella (*Daphoenositta chrysoptera*), Regent Honeyeater (*Xanthomyza phrygia*) and Swift Parrot (*Lathamus discolor*);

- microbats: Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*), Eastern Freetail Bat (*Mormopterus norfolkensis*) and Little Bentwing Bat (*M. australis*);
- flying mammals: Grey-headed Flying-fox;
- mammals: Spotted-tail Quoll (*Dasyurus maculatus maculatus*), New Holland Mouse (*Pseudomys novaehollandiae*) and Squirrel Glider (*Petaurus norfolcensis*); and
- migratory birds: White-bellied Sea Eagle, which was observed foraging near the ventilation fan site.

The Swamp Mahogany Swamp Forest contains Swamp Mahogany, a primary food tree species for the Koala on the Central Coast (Department of Environment and Climate Change (DECC) 2008). As the Swamp Mahogany comprises greater than 15% of the canopy cover, the Swamp Mahogany Swamp Forest is considered to be potential Koala habitat. Brown Stringybark, part of the Scribbly Gum – Red Bloodwood heathy woodland, is a supplementary food tree species for Koalas on the Central Coast (DECC 2008). However, as this species comprises less than 15% of canopy cover in the community, the community does not classify as potential Koala habitat.

5.7.3 Impact assessment

i Potential direct impacts

a. Loss of native vegetation

The areas of vegetation to be cleared/disturbed to extend/establish the APZs for bushfire protection purposes are provided in Table 5.8.

Native vegetation clearance will be restricted to a small area (approximately 0.03 ha) of the Swamp Mahogony Swamp Forest EEC to establish a fire trail around the ventilation fan site.

A total of approximately 1 ha of native vegetation will be disturbed to extend/establish IPAs (outside of the fire trails) and the OPAs, comprising approximately 0.22 ha of the Swamp Mahogony Swamp Forest EEC, approximately 0.48 ha of the Scribbly Gum Red Bloodwood Heathy Woodland and approximately 0.31 ha of the Smooth-barked Apple Red Bloodwood Open Forest. However, it should be noted that trees will only be selectively felled and important structural components of the communities prioritised for retention within the APZs. Therefore, the areas of vegetation disturbance identified in Table 5.8 are highly conservative.

Table 5.8 Vegetation to be cleared/disturbed

Vegetation community	EEC	Approximate area to be cleared (ha)	Approximate area to be disturbed (ha)
Swamp Mahogany Swamp Forest (native)	Swamp Sclerophyll Forest EEC	0.03	0.22
Scribbly Gum Red Bloodwood Heathy Woodland (native)	-	Nil	0.48
Smooth-barked Apple Red Bloodwood Open Forest (native)	-	Nil	0.31
Planted exotic	-	0.06	0.32
Total		**0.09**	**1.33**

b. Loss of fauna habitat

Five hollow-bearing trees could potentially be removed for the works. However, where possible, they will be retained as part of the allowable canopy cover requirements for the IPA (15%) and OPA (30%) of the APZs. These hollows are large and potentially suitable for threatened owls, the Glossy Black-cockatoo and hollow-dependent mammals (see sub-section d. below).

Small areas of the other habitat features will also be disturbed, namely:

- foraging habitats: flowering and fruiting trees and shrubs;
- shelter habitats: dense groundcover; and
- nesting habitats: dense shrubs that provide nesting opportunities for birds.

c. Fragmentation

Fragmentation will not result from the vegetation clearing/disturbance for the APZs. Vegetation clearing/disturbance will involve the selective felling/trimming of trees, shrubs and grasses located on the edge of larger patches of native vegetation, and therefore will not disrupt connectivity for fauna species.

d. Threatened biodiversity

Assessments of significance were completed in line with the Section 5A of the EP&A Act (and the EPBC Act where relevant) for the following fauna species and guilds (Appendix H):

- Swamp Sclerophyll Forest EEC;
- plants: Black-eyed Susan, Leafless Tongue Orchid and Variable Midge Orchid;
- owls: Barking Owl, Masked Owl and Powerful Owl;
- woodland birds: Glossy Black-cockatoo, Little Lorikeet, Scarlet Robin, Varied Sittella, Regent Honeyeater and Swift Parrot;
- microbats: Eastern Bentwing Bat, Eastern Freetail Bat and Little Bentwing Bat;
- flying mammals: Grey-headed Flying-fox;
- mammals: Spotted-tail Quoll, New Holland Mouse and Squirrel Glider; and
- migratory birds: White-bellied Sea Eagle.

Impacts are not predicted to be significant for the Swamp Sclerophyll Forest EEC given the small area to be impacted, the selective nature of vegetation disturbance, and the abundance of this community in the adjacent area which will remain unaffected by CVC operations.

Similarly, significant impacts are not predicted for threatened plant species given the small area of habitat to be cleared/disturbed, and the selective nature of proposed vegetation disturbance. Nonetheless, given their cryptic nature and the completion of surveys outside of the flowering period, pre-disturbance surveys will be completed during the flowering season for Black-eyed Susan, Leafless Tongue Orchid and Variable Midge Orchid to determine if they are in the area. If found during the pre-disturbance survey, threatened plant populations will be delineated with fencing to ensure protection during the extension/establishment of APZs.

Impacts are not predicted to be significant for threatened owls, woodland birds, microbats, flying mammals, mammals and migratory birds. Vegetation will be selectively removed from the small areas required for the APZs. Large trees that contain hollows will be prioritised for retention to ensure that shelter/roosting habitat is retained in the area. The removal of foraging habitat (ie shrubs, flowering trees) will not have a significant impact on these species because the areas being cleared/disturbed are adjacent to large patches of contiguous and suitable alternative foraging habitat.

Impacts will not be significant for the White-bellied Sea Eagle as the individual sighted is not part of an important population, and no nests will be removed.

e. Key threatening processes (KTPs)

Key threatening processes currently operating in the survey area include the '*invasion, establishment and spread of Lantana camara'* and '*invasion of native plant communities by Bitou Bush'.* These key threatening processes may be exacerbated by the disturbance of native vegetation for the APZs. These weeds will be controlled in the area prior to vegetation disturbance to minimise the risk of spread.

Key threatening processes related to introduced species including '*predation by the European Red Fox (Vulpes vulpes*)' and '*competition and grazing by the feral European Rabbit (Oryctolagus cuniculus)*' are also likely to be in operation within the survey area, as these species have been previously recorded in the area. Disturbance of native vegetation can lead to an increase in the abundance and extent of these species. As only small patches of native vegetation will be selectively disturbed on the edge of larger patches of native vegetation, it is unlikely that the proposed modification will exacerbate these key threatening processes.

The impacts on key threatening processes '*clearing of native vegetation*' and the '*loss of hollow-bearing trees*' have been considered as part of the proposed modification. Under the final determination (NSWSC 2011b), clearing is defined as the destruction of a sufficient proportion of one or more strata (layers) within a stand or stands of native vegetation so as to result in the loss, or long term modification, of the structure, composition and ecological function of stand or stands. The area of native vegetation that would be cleared is limited to approximately 0.03 ha and, given the small area of native vegetation to be disturbed (approximately 1 ha) and the selective nature of the vegetation disturbance, the proposed modification will not constitute this key threatening process.

Vegetation clearing/disturbance for bushfire protection will have a positive effect on the key threatening process, '*high frequency fire resulting in disruption of life cycle processes in plants and animals and loss of vegetation structure and composition*' by reducing the bushfire risk to the Swamp Sclerophyll Forest EEC in the event of a fire arising at CVC.

'*Loss of hollow-bearing trees*' has also been considered'. Hollow-bearing trees will be prioritised for retention in the APZs where possible. If retention is not possible, nest boxes will be placed in suitable areas adjacent to the APZs to compensate for lost hollows to minimise the impact of this key threatening process.

ii Potential indirect impacts

a. Introduced species

Given the relatively minor nature of vegetation clearing and disturbance, the proposed modification is unlikely to result in European Red Foxes and Feral Rabbit populations increasing beyond existing levels.

Ground clearing/disturbance for the extension/establishment of the APZs may result in increased weed invasion given the existing occurrence of some noxious and invasive weeds.

Ongoing weed maintenance and feral animal control activity will be completed in accordance with CVC's biodiversity management plan (BMP) to minimise the risk of further weed invasion into native vegetation and impacts from feral animal populations.

b. Noise and dust

Given that the proposed modification will result in only negligible noise and dust emissions (see Table 5.17), their potential impacts on biodiversity are not expected to exceed current levels.

iii Consideration of approved disturbance

Worthy of note is the retention of approximately 0.3 ha of Swamp Oak Floodplain Forest EEC approved for clearance under the current development consent (Appendix A).

LakeCoal has minimised the extent of clearing of this community during the construction of the approved new spillway and dam embankment upgrade. Although the current development consent (Appendix A) approved the removal of approximately 0.37 ha of Swamp Oak Floodplain Forest EEC (approximately 0.25 ha for embankment upgrade and approximately 0.12 ha for new spillway), the completed spillway and embankment works have resulted in only approximately 0.03 ha of Swamp Oak Floodplain Forest EEC removed for the spillway, with impacts largely avoided for the dam embankment upgrade by design refinements including the installation of a clay core in the existing dam embankment. The pipeline to the creek, as included in the development consent, has not yet been constructed. However, if completed, pipeline installation would result in only approximately 0.04 ha being removed. Accordingly, the total impact area for the activities approved under the current development consent would be approximately 0.07 ha, retaining approximately 0.3 ha more Swamp Oak Floodplain Forest EEC than was originally planned.

5.7.4 Mitigation and management

Native vegetation in CVC's pit top and ventilation fan site areas is currently managed under CVC's BMP. Current measures include:

- monitoring the condition, structure and composition of the Swamp Oak Floodplain Forest EEC east of the pit top area;
- monitoring the health of trees adjacent to the ventilation fan site; and
- monitoring and control of weeds and pests at both sites.

The BMP will be updated to include additional management measures to compensate for impacts potentially arising from the proposed modification, including:

- the completion of pre-disturbance surveys in the survey area for Black-eyed Susan, Leafless Tongue Orchid and Variable Midge Orchid during their flowering periods (July to December, November to February and September to October, respectively);
- pre-disturbance surveys by an ecologist to determine the important components of vegetation communities and fauna habitats that should be preferentially retained in the APZs;
- installation of delineation fencing around threatened flora populations (if found) to ensure their protection during development and maintenance of the APZs;
- condition monitoring for threatened flora populations (if found);
- retention of hollow-bearing trees in the APZs, where possible;
- installation of nest boxes to replace hollows where hollow-bearing trees cannot be retained in the APZs;
- measures for APZ maintenance that include weed control; and
- relocation of suitable felled trees adjacent to the APZs to create additional fauna habitat.

5.7.5 Conclusion

The impact of extending/establishing and maintaining APZs around CVC's main pit top area and ventilation fan site on terrestrial ecology has been assessed. There will be minor clearing (approximately 0.03 ha) and only limited disturbance (approximately 1 ha) of native vegetation as a result of the proposed modification.

The proposed modification will not have a significant impact on the threatened biodiversity recorded or predicted to occur. To the contrary, vegetation clearing/disturbance for bushfire protection will have a positive effect on the key threatening process, '*high frequency fire resulting in disruption of life cycle processes in plants and animals and loss of vegetation structure and composition*' by reducing the bushfire risk to the Swamp Sclerophyll Forest EEC in the event of a fire arising at CVC.

The implementation of the proposed safeguards will manage the potential impacts on terrestrial ecology from the proposed modification to an acceptable level.

5.8 Aboriginal heritage

5.8.1 Introduction

An Aboriginal cultural heritage assessment (ACHA) of the proposed modification was prepared by EMM. The assessment is presented in full in Appendix I and a summary provided below.

5.8.2 Existing environment

i Landscape context

CVC is located in a region known as the Central Coast Lowlands of NSW. This region is characterised by low lying terrain, alluvial plains and dune fields in coastal area. The Central Coast Lowlands are dominated by the coastal Macquarie, Tuggerah and Munmorah Lakes.

Climatic conditions in the Lake Macquarie area have been stable for approximately 10,000 years and would have provided a good environment for human habitation. Natural resources including the flora and fauna that may have provided food and material resources are linked to the hydrology, geology and soil types in a region.

The geology of the region includes sandstone, interbedded sandstone and siltstone. Caves and overhangs created in sandstone cliffs and boulders may have been used for shelter while Lake Macquarie and the creeks that feed into the lake would have provided an abundance of food resources for Aboriginal people. The soils within the region form part of two soil landscapes: the Doyalson and the Wyong.

ii Ethno-historical context

Discussions with relevant Aboriginal groups have identified that the Lake Macquarie region is of significance as it is a connection with ancestors and cultural heritage. The evidence of Aboriginal occupation in the landscape is highly valued and is a reminder to the Aboriginal community of their country and spirituality.

The dominant Aboriginal language group for the Lake Macquarie region was that of Awabakal-speaking people, though little was recorded about their territorial boundaries (Tindale 1974). The information recorded did suggest that the Hunter Valley Aboriginal groups, including the Awabakal, had a high level of interaction and intertribal relationships (Tindale 1974).

Extensive information about the Awabakal is available from the writings of L.E Threlkeld who established a mission in 1825 at Toronto on the shores of Lake Macquarie and, for seventeen years, recorded the language, traditions and material culture of the Awabakal people. He also observed the rich food resources of Lake Macquarie including fish, molluscs and wildlife. The Awabakal exploited this resource using canoes, spears, and wood and stone tools (Threlkeld in Gunson 1974).

iii Assessment method

The methods used to identify potential Aboriginal cultural heritage sites and/or values associated with the proposed modification comprised:

- a review of the previous archaeological investigations undertaken at CVC and its surrounds;
- consultation with the registered Aboriginal parties (RAPs); and
- conducting an extensive search of the Aboriginal Heritage Information Management System (AHIMS) database to identify previously recorded Aboriginal sites.

Potential impact on Aboriginal cultural heritage arising as a consequence of the proposed modification is limited to the mine design changes in CVC's northern mining area and minor vegetation clearing/disturbance (totalling approximately 1.42 ha) around CVC's main pit top area the ventilation fan site at Summerland Point, to enable the extension/establishment of APZs. For the purpose of this section, these areas are referred to as the 'proposed disturbance areas'. The proposed disturbance areas are shown on Figure 5.19.

Given the limited size of the proposed disturbance areas, the nature of that disturbance, the outcomes of preliminary investigations including AHIMS searches, and the minimal potential for impact from the above activities, it was not considered necessary to survey the areas being disturbed as part of the proposed modification.

a. Review of previous archaeological investigations

Extensive previous archaeological studies have been completed in the Lake Macquarie region. These studies have provided information on the types of sites present and their distribution in the landscape. Table 5.1 of the ACHA (see Appendix I) provides further information on the relevant archaeological reports.

b. Consultation

Detailed Aboriginal heritage consultation has been undertaken for previous CVC environmental assessments. Consultation was based on the most up-to-date guidelines at the time including the *Interim Community Consultation Requirements for Applicants* (ICCRs) (Department of Environment and Conservation (DEC) 2004), the *Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (DEC 2005) and the *Aboriginal cultural heritage consultation requirements for proponents* (DECCW 2010). This resulted in the identification of the following Aboriginal parties who registered for previous assessments (RAPs).

- Bahtabah Local Aboriginal Land Council;
- Darkinjung Local Aboriginal Land Council;
- Cacatua Culture Consultants;
- Awabakal Traditional Owners Aboriginal Corporation;
- Awabakal Descendants Traditional Owners Aboriginal Corporation; and
- Guringai Tribal Link Aboriginal Corporation.

A draft version of the ACHA was provided to the RAPs on 13 April 2015 and comments sought. The Darkinjung Local Aboriginal Land Council provided a response to the report on 1 May 2015 which is contained in Appendix A of the ACHA (Appendix I). The response noted overall satisfaction with the recommendations made by EMM and commented on the importance of the Lake Macquarie Aboriginal cultural landscape to the local Aboriginal community as a physical link to their ancestors and past. In addition the Darkinjung Local Aboriginal Land Council noted their desire to participate in the assessments of the vegetation clearing of the APZs and advocated for continued protection of Aboriginal sites in or within the vicinity of CVC. No objections to the proposed modification were raised.

As of 1 June 2015 no other comments had been received in relation to the proposed modification. All groups were sent a final copy of the report. A record of consultation and correspondence with the RAPs is provided in Appendix I.

c. Aboriginal Heritage Information Management System search

An extensive search of the AHIMS register was conducted on 17 August 2014 for an area of 5 km by 5 km surrounding CVC's pit top (the search area). The search revealed a total of 112 registered sites, the majority of which occurred along the Lake Macquarie foreshore. The AHIMS registered sites in the search area are summarised by type in Table 5.9 and those closest to CVC are shown on Figure 5.19.

Table 5.9 AHIMS registered sites within the search area

Site type	Number of sites	Percentage
Isolated find	18	14%
Open camp site	3	3%
Midden	65	59%
Scarred tree	10	9%
Midden/open camp site	3	3%
Unknown	3	3%
Grinding groove	2	2%
Aboriginal place	1	1%
Potential Archaeological Deposit (PAD)	5	4%
Ochre quarry	1	1%
Aboriginal place/PAD	1	1%
Total	**112**	**100%**

Two sites, 45-7-0157 and 45-7-0154, are located near the shore of Lake Macquarie, above the approved mining area. Both sites comprise middens.

There are also two sites, 45-7-0271 and 45-7-0273, in the vicinity of the ventilation fan site, again both comprising middens. These are located approximately 100 m to the south and south-east of the fan site, respectively.

With the exception of Site 45-7-0339 which was identified during prior on-site Aboriginal heritage surveys, there are no recorded sites in relative proximity to CVC's pit top area. Site 45-7-0339 is located adjacent to the sediment dams approximately 100 m from the nearest proposed APZ.

5.8.3 Impact assessment

The proposed mine design changes in CVC's northern mining area result in Site 45-7-0154 no longer being above the CVC mining area. Consequently, while negligible subsidence was previously predicted, the proposed modification gives certainty that Site 45-7-0154 will not be impacted.

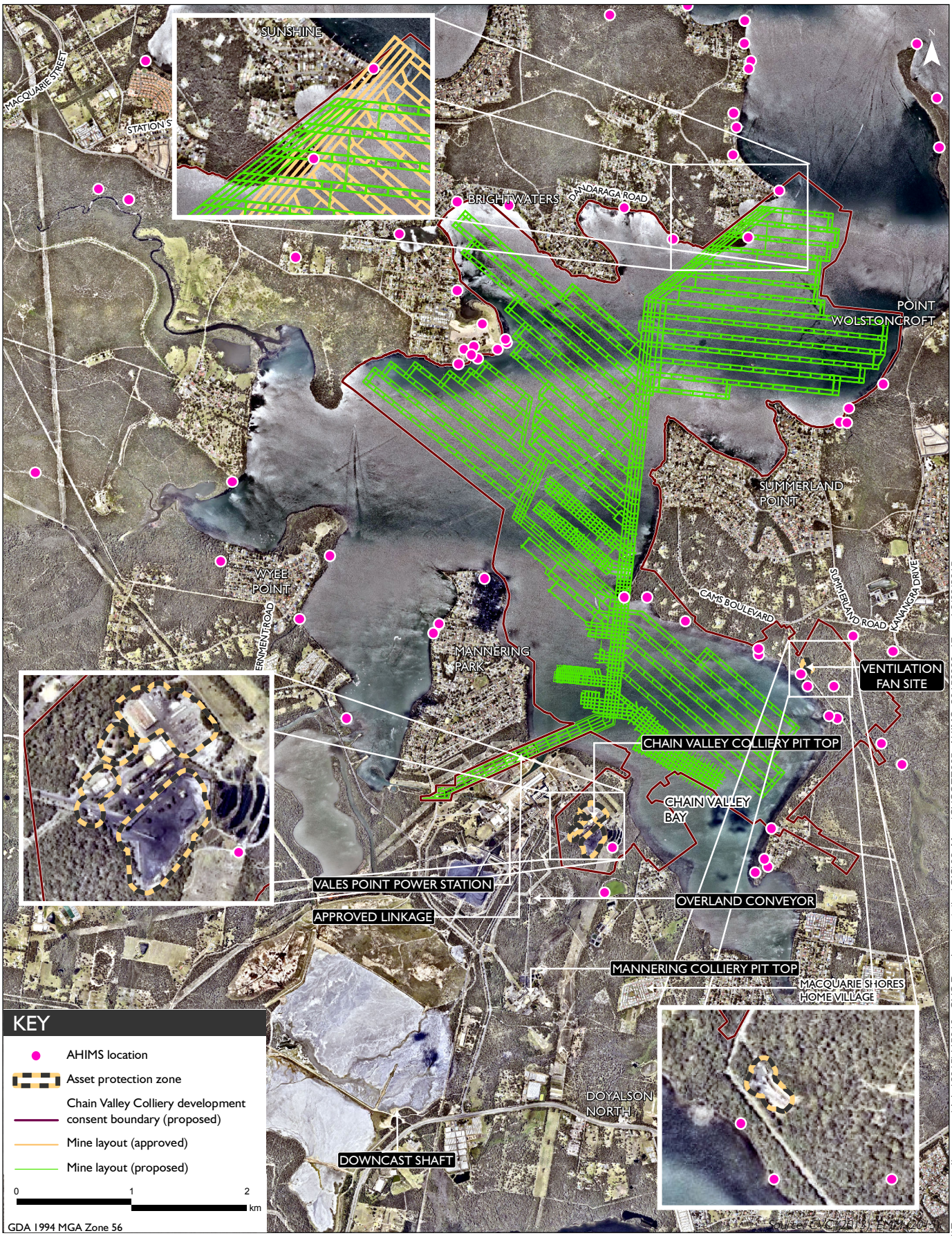
The mine design changes will result in a small additional encroachment of the underground mining area on Site 45-7-0157, which is predicted to be subject to negligible subsidence impacts from the currently approved miniwall panel layout.

This encroachment will not result in a change in the potential impact on this site as all secondary extraction will remain limited to areas beneath Lake Macquarie and the established protection barriers for the foreshore and seagrass will continue to apply. Therefore, Site 45-7-0157 will continue to be subject to negligible subsidence impacts as a result of the proposed modification.

The creation of APZs around areas of infrastructure will result in minimal surface disturbance (a maximum totalling approximately 1.42 ha) through the felling of trees and the operation of machinery. CVC's pit top area is highly disturbed and contains only one Aboriginal site, 45-7-0339, located approximately 100 m to the east from the nearest APZ, adjacent to the southern side of the sediment dam. There would be no impact on this site as a result of the proposed modification.

As noted previously, two Aboriginal sites, 45-7-0271 and 45-7-0154, identified as part of previous surveys, are located in the vicinity of the APZs for the ventilation fan site. However, these Aboriginal sites are over 100 m away from areas of proposed vegetation clearing/disturbance and will not be accessed during the extension/establishment of APZs. These sites will remain protected through the continued implementation of CVC's existing heritage management plan (HMP). As such, the creation of APZs around areas of infrastructure will not impact any Aboriginal sites.

No other Aboriginal objects or sites have the potential to be impacted by the proposed modification.



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AHIMS sites and proposed disturbance areas

Chain Valley Colliery - Modification 2

Figure 5.19

5.8.4 Mitigation and management

This ACHA has identified that, as is currently the case under SSD-5465, Aboriginal site 45-7-0157 may be subject to subsidence impacts at a negligible level as a result of the proposed modification. This site is currently included within the monitoring program identified in the approved HMP, with monitoring to commence at least 3 months prior to mining activities in the vicinity of the site. The monitoring will involve:

- establishing a fixed datum point with defined relative level to AHD by registered surveyor;
- placing stakes with horizontal markings on either extent of the site to enable accurate recording of landscape shifts;
- establishing a control reference point with defined Relative Level outside proposed subsidence areas, such as a building;
- photographing the site from the fixed datum point to enable photographic comparison. Photographs will be large format with clear distinguishable features; and
- producing a letter report to be retained by LakeCoal and provided to the RAPs as requested.

Consultation with the RAPs will continue to be undertaken in accordance with the consultation requirements prescribed in the approved HMP.

It is recommended that Site 45-7-0154 be removed from the monitoring program as it will no longer be undermined.

5.8.5 Conclusion

The impacts on Aboriginal cultural heritage items as a result of the proposed modification have been assessed as part of the ACHA. Aboriginal site 45-7-0157 may be subject to subsidence impacts at a negligible level. However, this was previously assessed as part of the ACHA for the Mining Extension 1 Project (EMM 2013). No other impacts on Aboriginal sites were identified.

The current monitoring at CVC as identified within the approved HMP, is assessed as sufficient to manage the potential impacts of the proposed modification. Accordingly, it is proposed that, with the exception of the removal of Site 45-7-0154 from the monitoring program, activities at CVC continue to be carried out in accordance with the HMP's existing monitoring and management regime, which includes measures for the discovery of unexpected Aboriginal heritage items. Consultation with the RAPs will continue to be undertaken in accordance with the consultation requirements stipulated in the approved HMP.

5.9 Traffic and transport

5.9.1 Introduction

A traffic and transport assessment of the proposed modification was prepared by EMM. The assessment is presented in full in Appendix J and a summary provided below.

5.9.2 Existing environment

i Local road network

The site and the surrounding road network are shown on Figure 5.20. Vehicle access to CVC is provided by Ruttleys Road and Construction Road.

Ruttleys Road is the major local road in the area and provides access to the Pacific Highway at Doyalson North, 1.4 km south of the southern end of Construction Road. To the north and west of the Colliery, Ruttleys Road continues for 7 to 8 km, past a number of dispersed residential and industrial developments to connect with Wyee Road, between Wyee and Morisset.

Construction Road is private road that also provides access to VPPS, a flyash cement processing plant (Morgan Ash) and indirectly to some residential dwellings (owned by LakeCoal). The road is straight and level in the vicinity of the three access driveway intersections and the sight distances for vehicular traffic meet all safety requirements.

The general weekday traffic usage for Ruttleys Road, south of Construction Road, was determined by a seven day tube traffic survey which was undertaken in August 2012 as part of the traffic assessment for the Mining Extension 1 Project (EMM 2013).

The Ruttleys Road traffic usage in 2012 was 8,507 vehicle movements of which approximately 7.7% were heavy vehicles. From the prevailing traffic growth rates for this area, which were determined as part of the earlier traffic assessment (EMM 2013a) as +2.3% per annum linear traffic growth, this daily traffic usage is predicted to be:

- 9,094 daily vehicle movements in 2015 (x1.069 increase since 2012);
- 10,464 daily vehicle movements in 2022 (x1.230 increase since 2012); and
- 11,442 daily vehicle movements in 2027 (x1.345 increase since 2012).

The year 2027 was assessed as this represents the end of the currently approved CVC mine life, which will not change as a result of the proposed modification.

These future base traffic growth projections for Ruttleys Road will not substantially change the general traffic flows and the levels of service for the traffic which is currently using Ruttleys Road.

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Local road network

Chain Valley Colliery - Modification 2

Figure 5.20