

7 IMPACTS, MANAGEMENT AND MITIGATION

The potential environmental impacts of this Modification has been assessed as part of this SEE. The findings of this assessment as well as a description of the measures that will be implemented to manage and mitigate potential impacts are presented below.

7.1 VISUAL ASSESSMENT

7.1.1 Impact Assessment

A Visual Impact Assessment has been undertaken for this Modification by VPA Visual Planning & Assessment and is provided in **Appendix B**. The purpose of the visual assessment completed for this Modification was to identify the character of the existing surrounding visual landscape and to quantify any additional visual impacts when compared to the existing approved final landform.

The existing Main OEA is the major mine component visible from surrounding viewing locations and has a currently approved maximum height of up to RL 270. The primary element of this Modification assessed as part of the Visual Impact Assessment is associated with the development of the Visual Relief Areas to change the level appearance of part of the Main OEA when viewed from primary viewing locations in and surrounding the township of Muswellbrook and Denman Road. The Visual Relief Areas located on the existing Main OEA are proposed to be constructed to a height greater than the levels previously approved including:

- The Northern Relief Area constructed to a maximum height of RL 300; and
- The Southern Relief Area constructed to a maximum height of RL 290.

The changes to the height of part of the Main OEA when compared to the currently approved landform (up to RL 270) represent a 30 m and 20 m increase for the Northern and Southern Visual Relief Areas respectively. It has been determined by the visual experts that this quantum of change in relief is required to accentuate relief at distance (4 km to 6 km) from the identified key viewing locations (see **Section 3.9**).

Background

The Primary Visual Catchment (PVC) represents the area where the majority of views of this Modification will occur. The visual settings surrounding this Modification are characterised by a range of different landscapes which vary as a result of topography, vegetation cover and land use types. This can create screening or visual buffers, or alternatively provide a viewing corridor to specific areas within the Project Boundary. The *Visual Impact Assessment* (JVP Planning and Design, 2013) undertaken for the Bengalla EIS (Hansen Bailey, 2013) characterised the local visual landscape within the vicinity of Bengalla as being that of a rural setting dominated by mining activities and agricultural activities associated with the Hunter River Floodplain.

This Modification PVC sits within the ranges to the west and north of the Project Boundary, Aberdeen 10 km to the north-east, Muswellbrook 4 km to the east, the hills behind the town and by the existing Mt Arthur Coal Mine to the south (see **Figure 12**). The small ridge located in the centre of Mt Arthur Coal Mine marks the south-eastern corner of the PVC. The PVC is strongly defined by the Hunter River Floodplain and the existing and approved mining operations in the area.

The Main OEA has two primary faces, the active face to the west and the outer edge to the south and east. The active face is unshaped, steep, angular and contains raw overburden material creating a high visual contrast and low integration with the environment, due to colour, form and scale. The outer edge has both rehabilitated and ongoing rehabilitation faces which are graded to a slope of approximately 10 degrees are revegetated and has less visual impact on the surrounding environment.

Methodology

The visual effect and sensitivity of the landscape was determined by considering the existing landscape settings and how those settings are seen from the various viewing locations. The visual effect of this Modification were assessed by considering the visual characteristics of this Modification in the context of the landscape within which it is seen. The overall visual impact of this Modification was then determined by assessing the interaction between visual sensitivity and visual effects (see **Table 8**).

The visual effect of this Modification elements will vary as seen from different locations around Bengalla. The visual effects were considered from a number of viewing locations in the Northern, Eastern, Southern and Western Sectors. Views from the Eastern and Southern sectors were subject to additional focus as Northern and Western view sectors have limited views from private receivers.

Visual Sensitivity

Visual sensitivity is a measure of how a change to the landscape is perceived by persons occupying the surrounding land. Viewing locations situated in residential, tourist and recreation areas generally have a higher visual sensitivity than locations in industrial, agricultural or transport areas. This is due to land being used as part of a leisure experience, making use of the scenic amenity values of the surrounding landscape and often over extended viewing periods.

Visual sensitivity may range from high to low and is affected by factors such as screening, distance and orientation of the receiver in relation to the Project. However, if views are completely shielded from a particular location, a visual sensitivity score will not be assigned.

Table 8
Visual Impact Assessment Matrix

Visual Sensitivity	Visual Sensitivity			
	High	Moderate	Low	Very Low
High	High Impact	High/Moderate Impact	Moderate/Low Impact	Low Impact
Moderate	High/Moderate Impact	Moderate Impact	Moderate/Low Impact	Very Low Impact
Low	Moderate/Low Impact	Moderate/Low Impact	Low Impact	Very Low Impact

Visual Effect

Visual effect measures the visual contrast and integration of this Modification with the existing environment; and the proportion of the Primary View Zone (PVZ) that is occupied by elements of this Modification. The PVZ is the critical part of a view.

If there is significant contrast between the elements of this Modification and surrounding landscape and a high percentage of this Modification in the PVZ, the visual effect will be high. Conversely, if the elements of this Modification can be substantially integrated into the existing landscape and the area occupied by the development forms only a small percentage of the total view, the visual effect will be low. The existing landscape contains visual elements of form, shape, line, colour and texture. In the case of this Modification the landscape includes the existing approved mining operations.

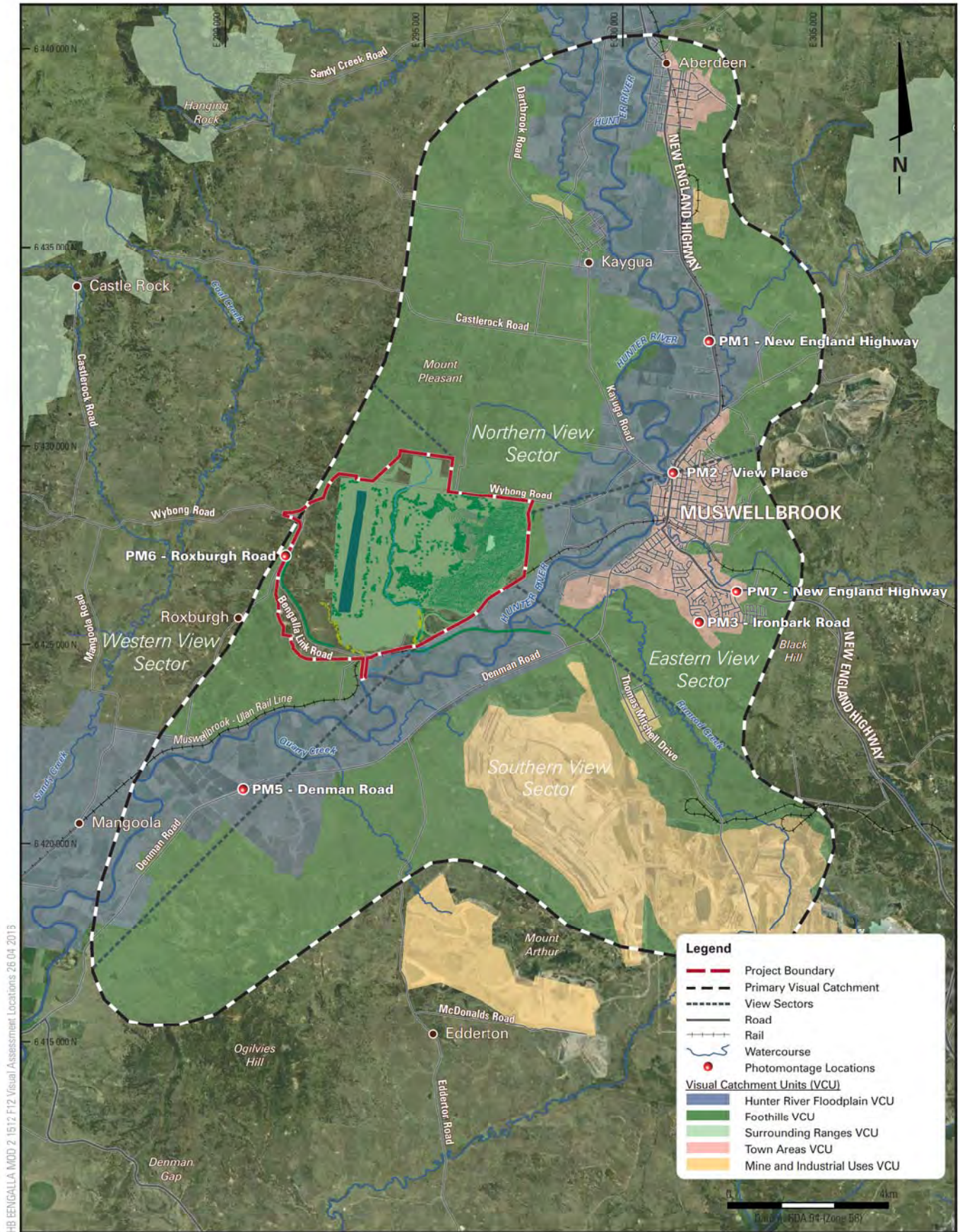
Representative Viewing Locations

In order to illustrate the views associated with this Modification, representative locations were selected where photomontages were developed including:

- New England Highway north of Muswellbrook (PM1);
- View Place (PM 2);
- New England Highway east of Muswellbrook (PM7);
- Ironbark Road view from the Ironbark Estate (PM3);
- Denman Road (PM5); and
- Roxburgh Road (PM6);

Photomontage locations are presented on **Figure 12**.

All photomontages are indicative. Actual results will depend on positions taken by various regulatory authorities on management plans and MOP, timing of commencement of rehabilitation and factors affecting rehabilitation establishment.



HB BENGALLA MOD 2 1512 F12 Visual Assessment Locations 26 04 2013

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Visual Assessment Locations

FIGURE 12



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All photomontages produced with the exception of New England Highway (PM7) east of Muswellbrook were locations previously utilised and assessed in the Bengalla EIS (Hansen Bailey, 2013). As a result, there is a suitable base case to compare this Modification to the already approved landform.

A new photomontage location situated on the New England Highway (PM7) in east Muswellbrook was also selected as it provides for a suitable westerly view directly towards the approved Bengalla Main OEA and this Modification Visual Relief Areas. It is also selected to represent primary views from Muswellbrook and stakeholders driving northbound on the New England Highway as they slow to 50 km per hour upon entry to the residential sector of town.

Northern View Sector

Views in the Northern View Sector include views from receptors along Wybong, Kayuga and St Heliers roads (and other minor roads) along with Aberdeen and the New England Highway. The visual effects of this Modification on the Northern View Sector are illustrated in a photomontage from PM1 New England Highway (see **Figure 13** and **Figure 14**).

Sensitive views to this Modification Visual Relief Areas will be limited due to distance and intermittent screening.

Eastern View Sector

To the east of Bengalla are the rural lands of the Hunter River floodplain. The Eastern View Sector contains the most sensitive land uses and is dominated by Muswellbrook. This sector has critical view locations and is representative of the greatest population.

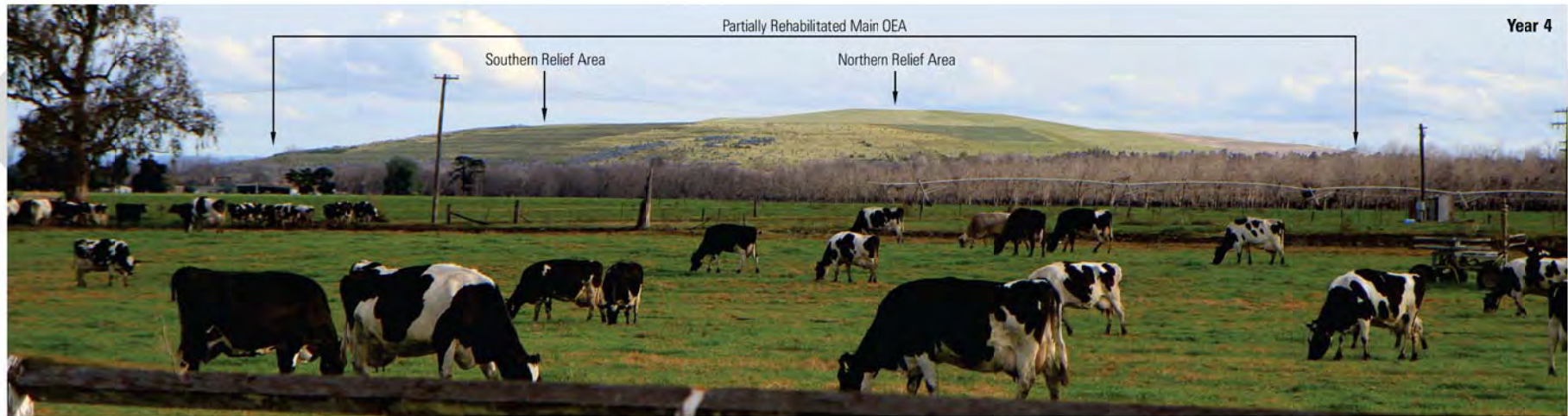
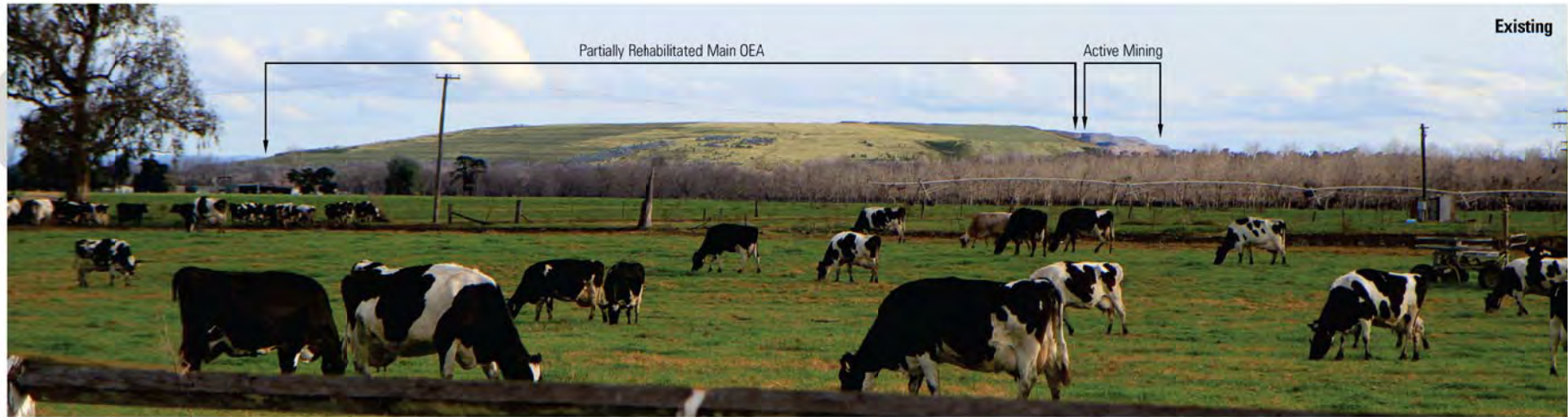
Photomontage locations within the Eastern Sector include View Place (PM 2), New England Highway east of Muswellbrook (PM7) and Ironbark Ridge (PM3). Photomontages for all these viewing locations are provided in **Figure 15** to **Figure 20**.

The existing views from all photomontage locations in this sector contain a moderate portion of the approved rehabilitated OEA eastern face. These views towards the eastern face illustrates the progressive rehabilitation to the approved Main OEA. The photomontage from Ironbark Road (see **Figure 19**) shows the formation of the existing southern faces of the OEA, with visible mining activities further to the west.

At approximately Year 4 the Northern and Southern Relief Areas on top of the approved OEA begin to take shape and the undulating profile begins to emerge. Rehabilitation is visible on the lower parts of the Visual Relief Areas.

By approximately Year 8, the undulating profile becomes more defined as the Visual Relief Areas reach their maximum heights (see **Figure 16**, **Figure 18** and **Figure 20**). The eastern face is rehabilitated with grass cover and trees planted on lower slopes. By Year 24 views from View Place, New England Highway and Ironbark Road toward the Main OEA present as dense vegetation which includes the Northern and Southern Visual Relief Areas.

The long term outcome better blends with surrounding rural areas. The requirement to achieve high density woody vegetation on the eastern face will provide moderate levels of visual integration as dense woodland vegetation contrasts with surrounding vegetation patterns which more reflect more open woodland.



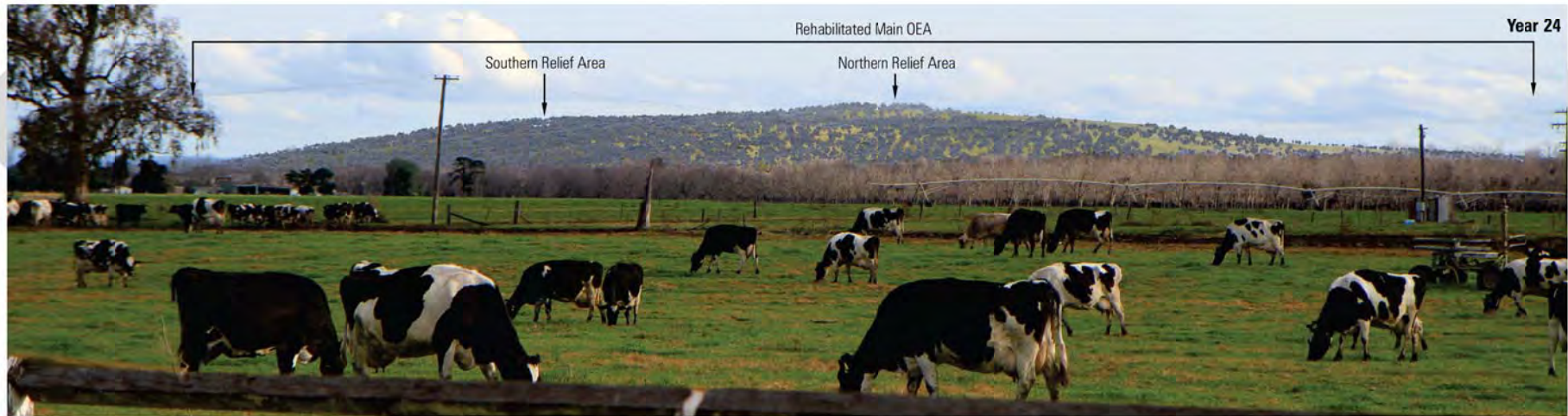
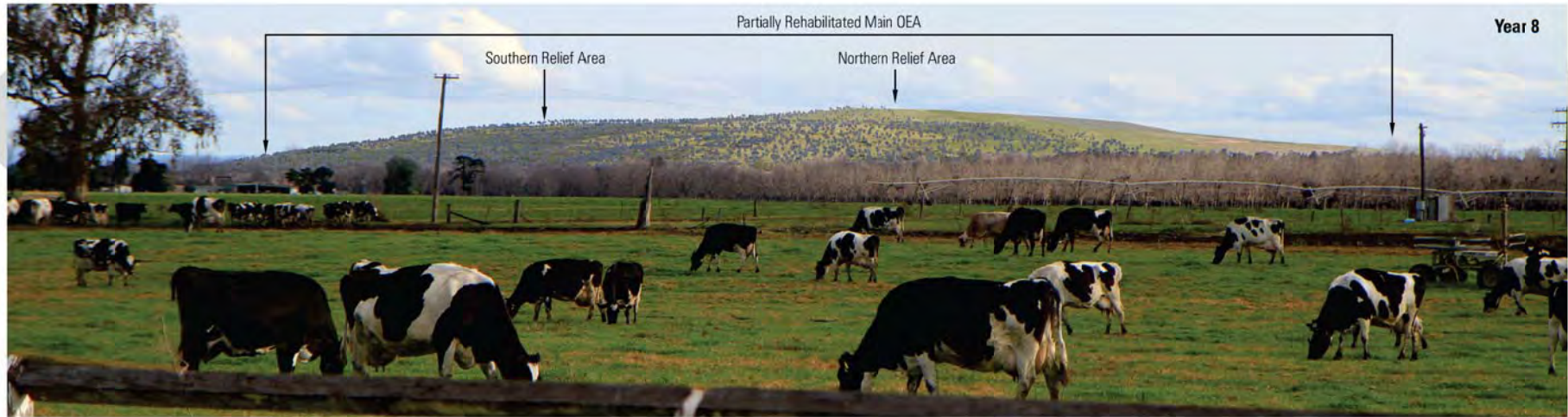
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Photomontage Location PM1 New England Highway Existing and Year 4



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FIGURE 13



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Photomontage Location PM1 New England Highway Year 8 and Year 24



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FIGURE 14



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Photomontage Location PM2 View Place Existing and Year 4

FIGURE 15



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Photomontage Location PM2 View Place Year 8 and Year 24

FIGURE 16



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Photomontage Location PM7 New England Highway Existing and Year 4



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FIGURE 17



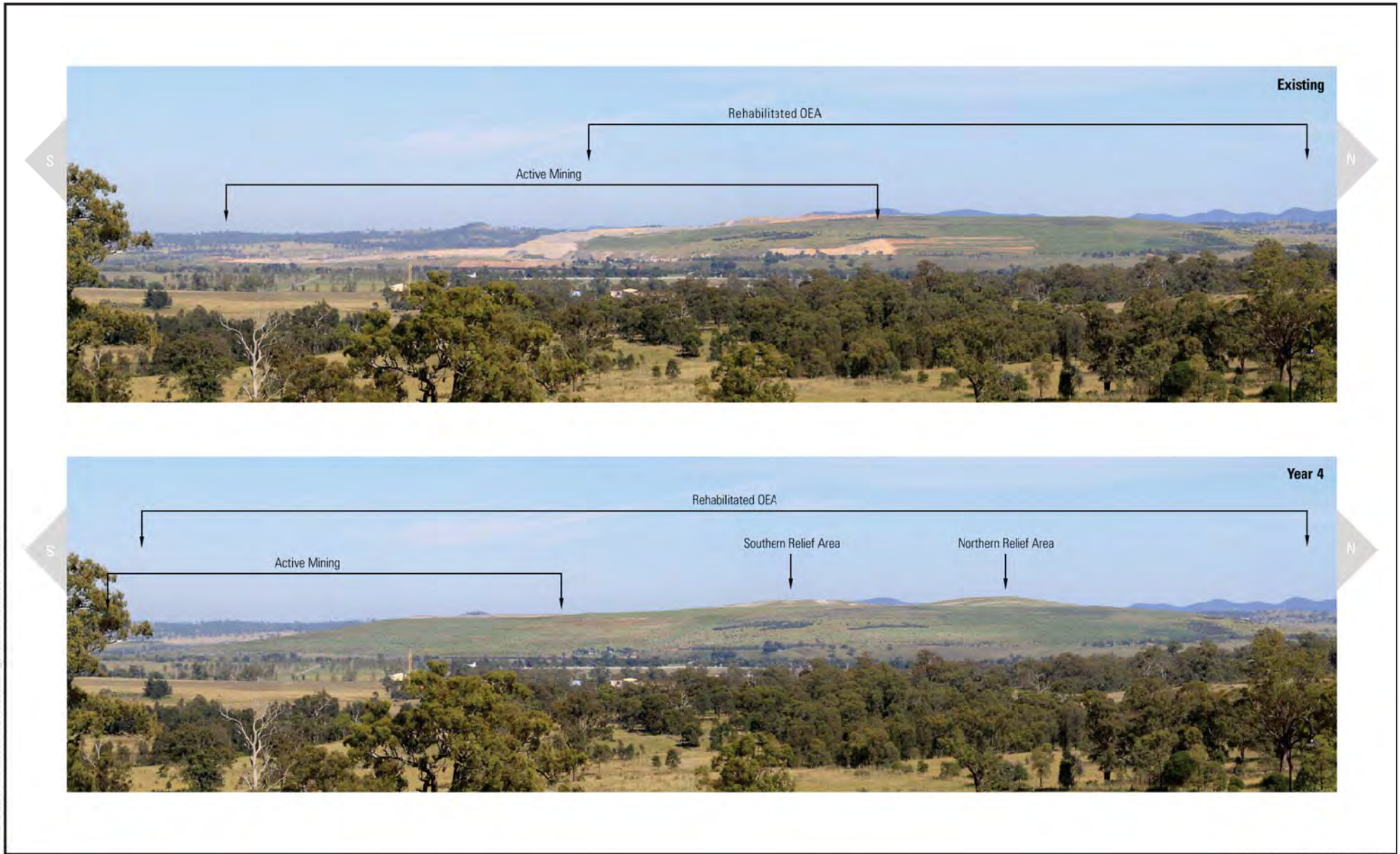
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Photomontage Location PM7 New England Highway Year 8 and Year 24



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FIGURE 18



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Photomontage Location PM3 Ironbark Road Existing and Year 4



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FIGURE 19



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Photomontage Location PM3 Ironbark Road Year 8 and Year 24

FIGURE 20

Southern View Sector

The Southern View Sector is dominated by rural lands. Along the Hunter River floodplain, improved pasture cropping and dairying are prominent with an olive tree orchard also occurring in this locality. The rolling rural hills to the south of Denman Road and west of Mt Arthur Coal support some vineyards and open grazing lands. There are a limited number of private residences within this sector and they occur in the western edge of the sector along Denman Road.

The visual effects on the Southern View Sector vary. The visual effects of this Modification on the Southern View Sector are illustrated in photomontage form from PM3 - Denman Road (see **Figure 21** and **Figure 22**). Views onto the approved operations in the western part of the sector remain unchanged with the view from this location onto existing operations having moderate to high visual effect. This view of the Southern Relief Area will be progressively rehabilitated leading to low visual effect (see **Figure 22**).

At approximately Year 4 the Southern Relief Area profile is visible above the approved Main OEA with areas of rehabilitation lowering the visual contrast and visual effect. Visual effect levels are low to moderate.

By Year 24 the conceptual final landform is achieved. The visual impact is further decreased as views are screened by intervening ridges and rehabilitated areas of the Southern Relief Area and Main OEA.

The long term outcome better blends with the surrounding rural areas. The requirement to achieve high density woody vegetation on the eastern face will provide moderate levels of visual integration as dense woodland vegetation contrasts with surrounding vegetation patterns which reflect more open woodland.

Western View Sector

Views in the Western View Sector are confined to views along Roxburgh Road, Wybong Road and Denman Road. The visual effects of this Modification on the Western View Sector are illustrated in a photomontage from PM6 Roxburgh Road (see **Figure 23** and **Figure 24**).



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Photomontage Location PM5 Denman Road Existing and Year 4

FIGURE 21



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Photomontage Location PM5 Denman Road Year 8 and Year 24

FIGURE 22



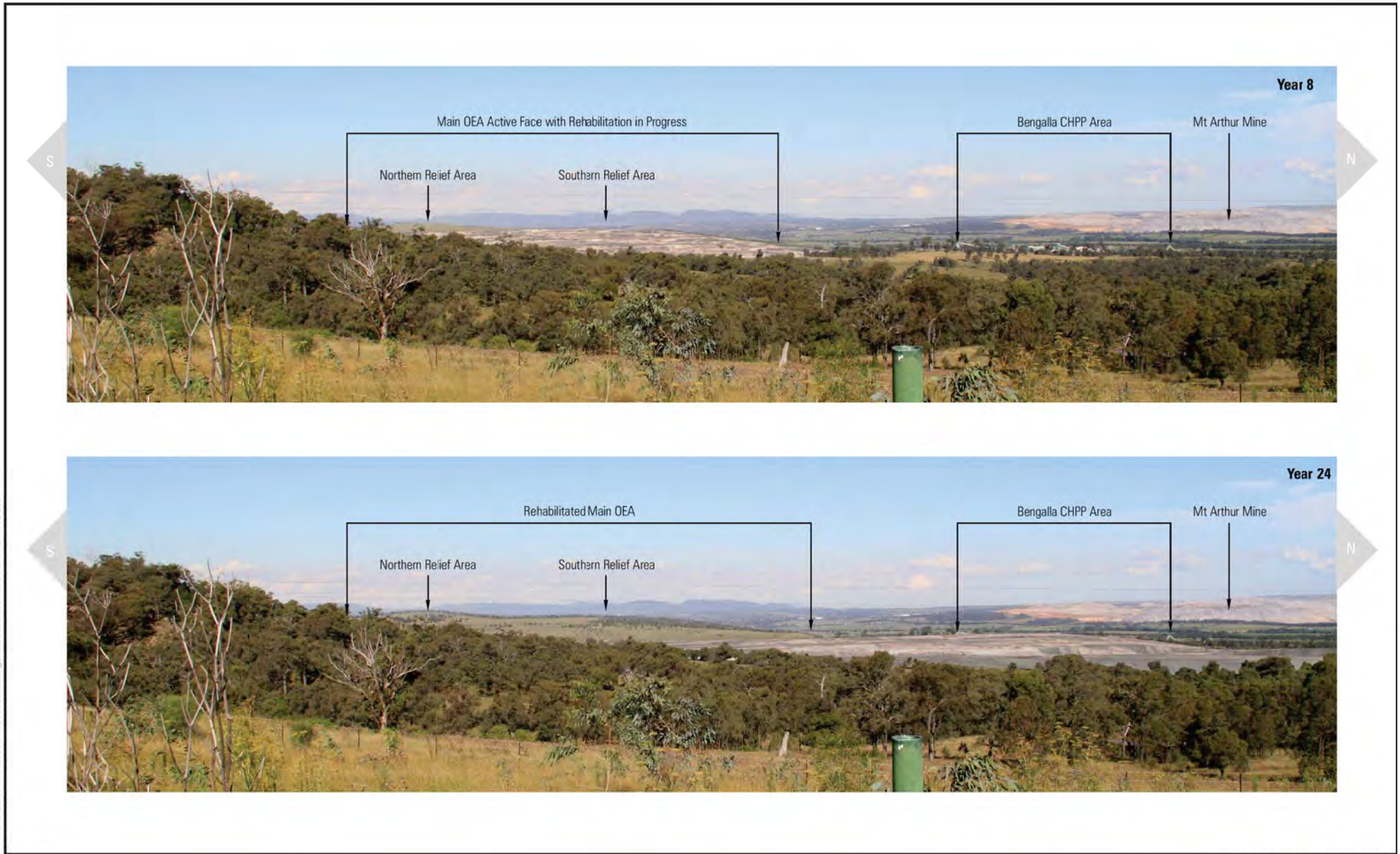
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Photomontage Location PM6 Roxburgh Road Existing and Year 4



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FIGURE 23



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Photomontage Location PM6 Roxburgh Road Year 8 and Year 24



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FIGURE 24

Visual Impact Summary

The primary visual element of this Modification is the alterations to the maximum approved height of the Main OEA in two distinct Visual Relief Areas. The visual impacts associated with the Visual Relief Areas are generally low to moderate on View Sectors as a result of the following:

- Scale of the new Visual Relief Areas in relation to the overall existing and approved Main OEA and surrounding mining activities is minor;
- Visual effects will lessen following rehabilitation; and
- Final landform of the modified OEA has a higher, more undulating natural profile which provides for improved visual integration with surrounding landscape elements and landforms.

The Visual Impact Assessment completed for this Modification has concluded that the Visual Relief Areas improve the appearance of the finished Main OEA profile from most sensitive receptors in the north-east, east and south-east.

Views to the Homestead Access are limited to elevated areas of Roxburgh Road and are consistent in character in relation to the overall scale and disturbance associated with the approved operations and no additional visual impact is anticipated.

7.1.2 Mitigation and Management

The progressive rehabilitation of the Main OEA is the most significant element in relation to visual effects and impacts on the surrounding landscape. The progressive rehabilitation will decrease the visual contrast of the operation relevant to the existing landscape which is in addition to rehabilitation strategies that seek to emulate patterns, shapes, line and colour of the existing landscape.

As currently required by SSD-5170 Schedule 3, Condition 44 the approved Main OEA will continue to be rehabilitated to achieve high density woody vegetation on the eastern face of the Main OEA exposed to Muswellbrook and Denman Road. This development consent requirement to achieve high density woody vegetation on the eastern face will provide moderate levels of visual integration as dense woodland vegetation contrasts with surrounding vegetation patterns which reflect more open woodland.

Schedule 3, Condition 37 of SSD-5170 requires development of additional visual impact mitigation plans for listed receivers located within the western and southern view sectors that may have views of Bengalla. This assessment will identify receivers that are likely to have significant views of the development and recommend site specific mitigation measures that could be implemented to reduce visual impacts.

BMC will also continue to implement all rehabilitation activities in accordance with the approved *Bengalla Rehabilitation Management Plan* (as Modified) and *Bengalla Mining Operations Plan* (BMC, 2015) (as Modified) which will be updated pending approval of this Modification. Relevant to this Modification the following on site rehabilitation and visual screening treatments will continue to be maintained:

- The implementation of dense woody vegetation across the eastern face of the Main OEA exposed to Muswellbrook and Denman Road;
- Progressive establishment and rehabilitation of the outer faces of the Main OEA, particularly the southern slopes adjacent to the Muswellbrook- Ulan Rail Line;
- Maintenance of existing tree planting areas; and
- Design drainage to vary with the topographic form of the Main OEA and avoid straight line drop downs where reasonable and feasible.

7.2 AIR QUALITY

7.2.1 Impact Assessment

An Air Quality Impact Assessment was completed by Todoroski Air Sciences for this Modification and is presented in **Appendix C**. The objective of the assessment was to quantify any change in air quality emissions associated with the proposed Modification. The assessment focused on the activity required for the alteration to the approved height of the Main OEA in comparison to the previous assessment completed in the *Bengalla EIS Air Quality and Greenhouse Gas Impact Assessment* (Todoroski Air Sciences, 2013).

Further comparison was also completed for this Modification to the predictions presented in a letter report to the DP&E titled *Bengalla Continuation Project (SSD-5170) Additional Information Request* (Hansen Bailey, 2014b) which was supported by *Bengalla Continuation – Dust mitigation strategy for short-term dust impacts* (Todoroski Air Sciences, 2014). Todoroski Air Sciences (2014) demonstrated that with the aid of appropriate dust mitigation measures, short term dust impacts can be further reduced.

The development of the Visual Relief Areas involves the staged emplacement of approximately 10 Mbcm of overburden material across two locations. No additional overburden material would be moved in any one year as a result of this Modification, material would only be redirected from that assessed in the *Air Quality and Greenhouse Gas Impact Assessment* (Todoroski Air Sciences, 2013).

As the Visual Relief Areas construction occurs over an approximate six year period only changes to the approved Years 4 and Year 8 mine plan are necessary. The modelling results associated with the existing approved Years 1, 15 and 24 will remain consistent with the predicted impacts in the *Bengalla EIS* (Hansen Bailey, 2013) *Air Quality and Greenhouse Gas Impact Assessment* (Todoroski Air Sciences, 2013) and as included in SSD-5170 (as Modified).

The Air Quality Assessment completed for this Modification included air dispersion modelling using the site specific model previously developed for the Bengalla EIS (Hansen Bailey, 2013). This model was updated to reflect the proposed features of this Modification to enable direct comparison to approved air quality predictions.

A comparison of the estimated total annual dust emissions in Year 4 and Year 8 for the approved mining operation and this proposed Modification indicate that emissions would increase by approximately 2.0% and 2.5% respectively relative to the approved operations in those two years of operations. The small increase in total annual dust emissions are primarily attributable to the additional haulage distances and the dozer activity required for shaping in the Visual Relief Areas. This change in dust emissions is considered to be within the degree of daily or annual variation that naturally occurs in background dust levels and the modelling accuracy. A detailed list of the emissions inventory utilised for this Modification is provided in **Appendix C**.

The predicted dust emission contours due to the proposed Modification for both Year 4 and Year 8 were overlaid with the predictions associated with the worst case all years from the *Air Quality and Greenhouse Gas Impact Assessment* (Todoroski Air Sciences, 2013). Overlaying these contours allows for a direct comparison of the change associated with the proposed Modification.

Results for $PM_{2.5}$, annual average total suspended particulates (TSP) and annual average dust deposition are unlikely to change significantly at any privately-owned receiver as a result of the proposed Modification in comparison with the results presented in Todoroski Air Sciences, 2013 which are presented as **Appendix C** of this SEE.

Results for project alone PM_{10} 24-hour average were overlaid on the predictions presented in *Bengalla Continuation – Dust mitigation strategy for short-term dust impacts* (Todoroski Air Sciences, 2014).

A discussion in regard to PM_{10} annual and 24-hour average for both modelled years is provided below.

Year 4 Results Discussion

The dispersion modelling results showing the predicted project alone maximum 24-hour average and cumulative annual average PM_{10} for Year 4 are presented on **Figure 25** and **Figure 26**.

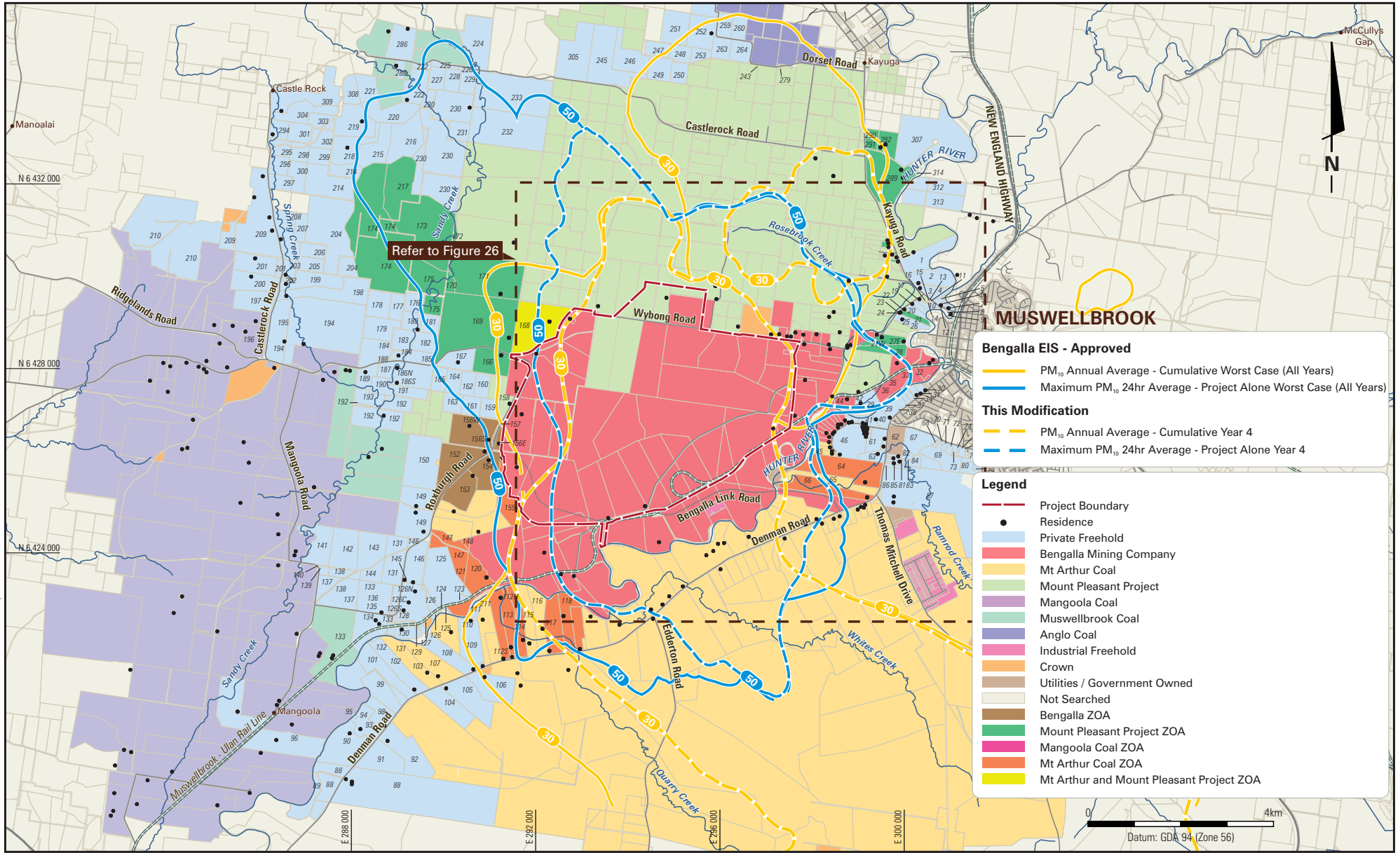
Results indicate that the predicted project alone maximum 24-hour average extent of short-term PM_{10} dust impacts for the proposed Modification would largely remain within the existing approved maximum envelope, with the exception of a relatively small area directly to the north and north-east of Bengalla. The small addition to the air quality impact envelope as a result of this Modification does not result in any exceedances of the maximum 24-hour average impact criteria at private receivers.

The results indicate that predicted cumulative annual average PM₁₀ dust levels are unlikely to change significantly at any privately-owned receiver as a result of the proposed Modification in comparison with the results presented in the *Air Quality and Greenhouse Gas Impact Assessment* (Todoroski Air Sciences, 2013).

Figure 27 presents a comparison of the predicted maximum project alone PM₁₀ 24-hour average impacts during Year 4 of this Modification and the maximum Year 4 Bengalla EIS envelope. Both scenarios include consideration of the dust mitigation strategy for short-term dust impacts (Todoroski Air Sciences, 2014).

No additional privately-owned receivers to those already predicted to be impacted as listed in SSD-5170 are predicted to exceed any of the relevant air quality criterion as a result of this Modification during Year 4.

HB BENGALLA MOD 2 - 1512 F25 Year 4 PM10 24hr Air Quality Contours 22 04 2016



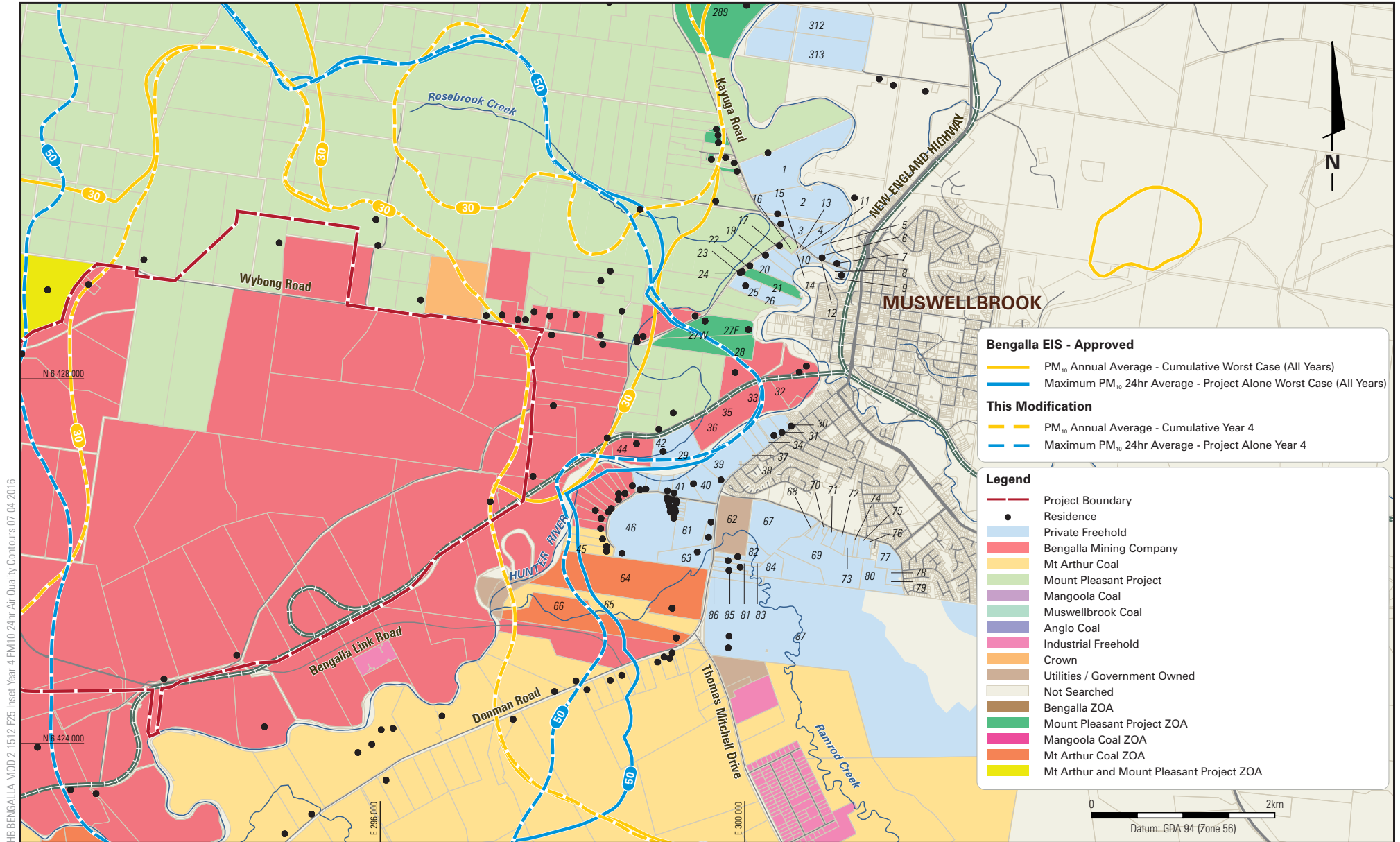
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Air Quality Impacts – Year 4 Analysis

FIGURE 25



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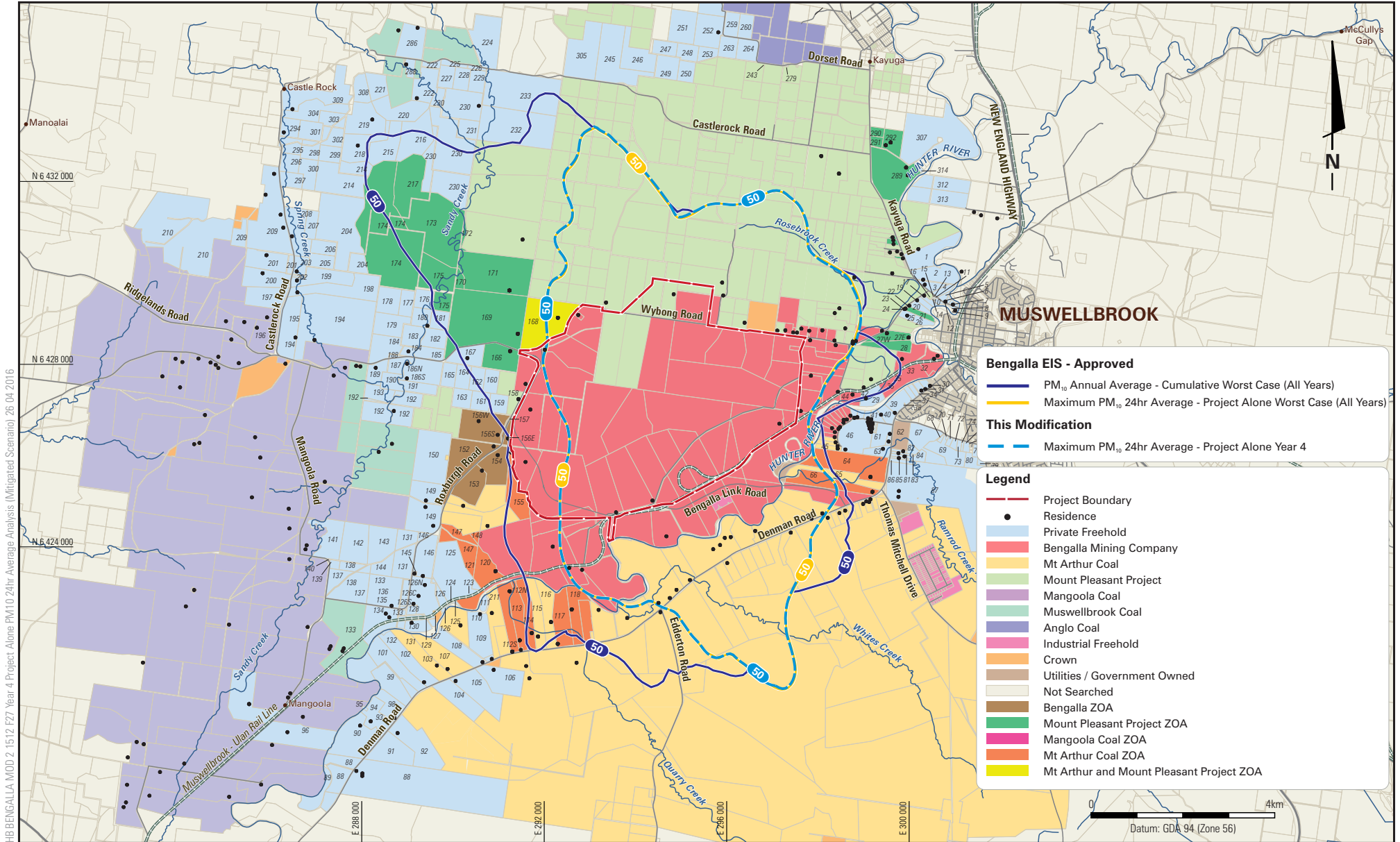
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Air Quality Impacts – Year 4 Analysis (Inset)

FIGURE 26



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Air Quality Impacts - Year 4 Project Alone PM₁₀ 24hr Average Analysis (Mitigated Scenario)

FIGURE 27