Mt Arthur Coal

bhpbilliton
resourcing the future

Appendix H – Landscape and Visual Impact Assessment

Mt Arthur Coal Open Cut Modification

Landscape and Visual Impact Assessment

Prepared for Hunter Valley Energy Coal

January 2013

urbis

URBIS STAFF RESPONSIBLE FOR THIS REPORT WERE:

Director	Peter Haack
Associate Director	Alistair Towers
Senior Consultant	Ashley Poon
Consultant	Nathaniel Jeffrey
Job Code	MD3212

URBIS
Australia Asia Middle East
urbis.com.au

TABLE OF CONTENTS

APPENDICES:

FIGURES:

TABLES:

DIAGRAMS:

1 Introduction

Hunter Valley Energy Coals own and operates the Mt Arthur Coal Open Cut and Underground Mines[1] (Mt Arthur Coal Mine) and is seeking approval for a modification to their approved operations (the Mt Arthur Coal Consolidation Project [the Consolidation Project] [Project Approval 09_0062]) under the New South Wales (NSW) *Environmental Planning and Assessment Act, 1979*.

The Mt Arthur Coal Mine is located approximately 5 kilometres (km) south-west of the township of Muswellbrook in the Upper Hunter Valley of NSW (Figure 1).

The Mt Arthur Coal Open Cut Modification (the Modification) will include the following:

- a four year continuation of the open cut mine life from 2022 to 2026 at the currently approved maximum rate of 32 million tonnes per annum (Mtpa);
- an increase in open cut disturbance areas;
- use of the conveyor corridor for overburden emplacement;
- duplication of the existing rail loop;
- an increase in the maximum number of train movements per day from 24 to 38;
- the relocation of the load point for the overland conveyor which delivers coal to Macquarie Generation's Bayswater Power Station;
- the relocation and upgrade of the explosives storage, magazine and associated facilities; and
- the construction of additional offices and a control room and a small extension to the run-of-mine (ROM) coal stockpile footprint.

In accordance with the Director-General's Requirements (DGRs) issued by the NSW Department of Planning and Infrastructure on 30 April 2012, the preparation of a visual assessment is required for the Environmental Assessment (EA) for the Modification. ***Table 1*** identifies each of the relevant DGRs and where they are addressed within this visual assessment.

TABLE 1 – DIRECTOR-GENERAL'S REQUIREMENTS – REFERENCE TABLE

DIRECTOR-GENERAL'S REQUIREMENTS	VISUAL ASSESSMENT SECTION
Visual *– including:* - *a detailed assessment of the:* o *changing landforms on the site during the various stages of the project; and*	Section 2
o *potential visual impacts of the project on private landowners in the surrounding area as well as key vantage points in the public domain, including lighting impacts; and*	Section 4
- *a detailed description of the measures that would be implemented to minimise the visual impacts of the proposal.*	Section 6

[1] The underground mine has not yet commenced.

HVE-11-01 OCM EA_App Visual_001B

This report has been prepared by Urbis Pty Ltd (Urbis) to provide a visual assessment for inclusion in the EA for the Modification. The methodology is based on a comparison of the visual impacts of the Modification with the currently approved Mt Arthur Coal Mine.

The following study components were included as part of this visual assessment:

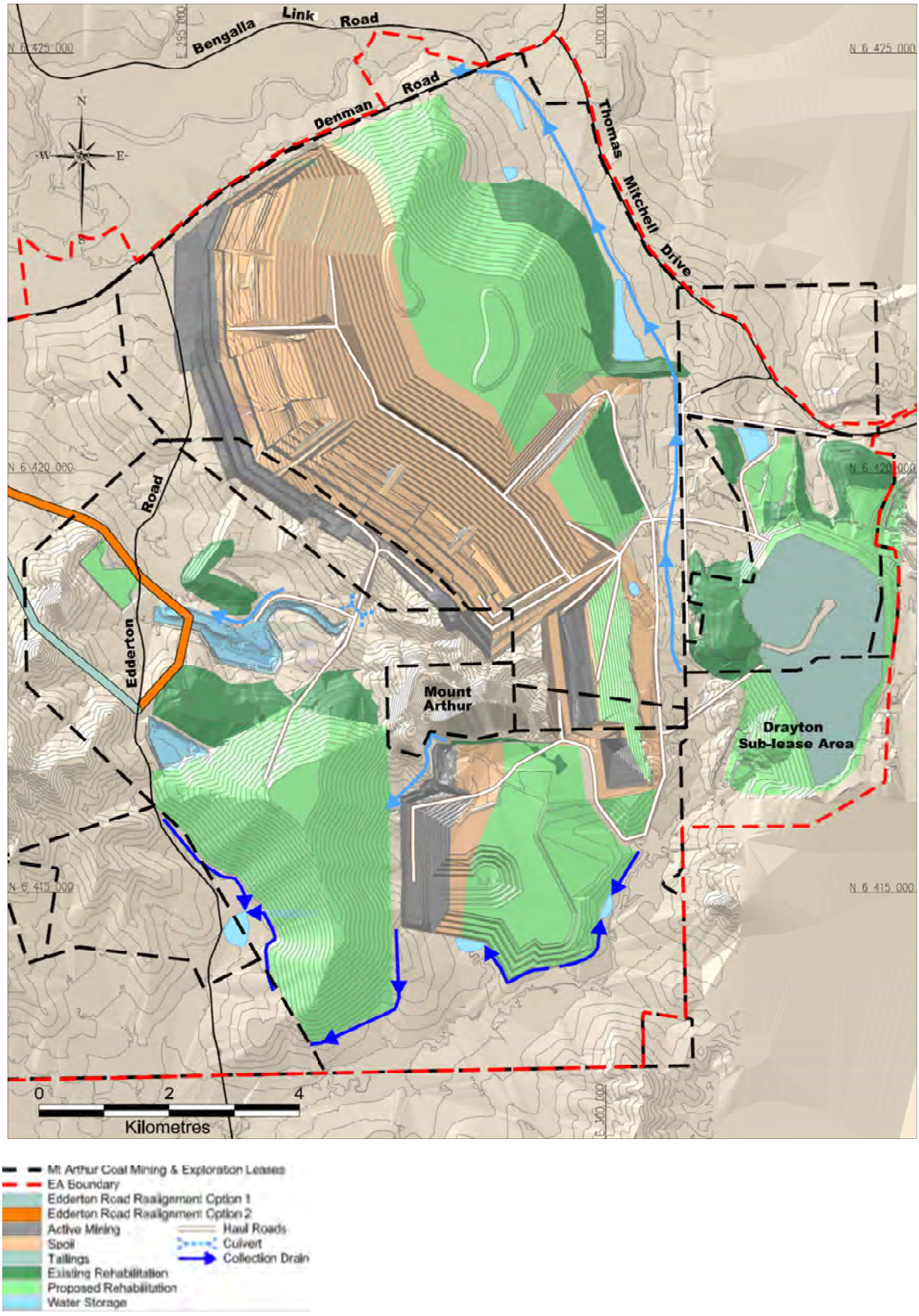
- Review the main aspects of the Modification in regard to potential visual impacts (***Section 2***).
- Characterisation of the existing landscape and visual setting (***Section 3***).
- Preparation of a Zone of Visual Influence (ZVI) analysis which compares the viewsheds of the existing approved Mt Arthur Coal Mine and the Modification to identify new potential viewpoints (***Section 4.3***).
- Qualitatively assess (***Section 4***):
  - Visual modification at key viewpoints – *How would the Modification contrast with the landscape character of the surrounding setting?*
  - Visual sensitivity at key viewpoints – *How sensitive would viewers be to the Modification?*
  - Potential night-lighting impacts.
  - Potential cumulative impacts (***Section 5***).
- Propose visual impact mitigation and management measures (***Section 6***).

The Consolidation Project – 2009 Visual Impact Assessment Study (2009 VIA) (Integral, 2009) has been referenced throughout this study as the base case against which to assess any change to the visual setting as well as any change in visual impact. The approved Mt Arthur Coal Mine is shown on ***Figure 2***.

1.1 STUDY METHOD

The study approach has been based on an analysis of the visual setting and assessment of the potential impacts of the development of the Modification. The methodology is comprised of a number of components. These are:

- **Qualitative Assessment – Visual Modification and Visual Sensitivity**
  - Visual Modification – How does the proposed development contrast with the landscape character of the surrounding setting?
  - What is the quality of the landscape setting?
  - Visual Sensitivity – How sensitive will viewers be to the proposed development?
- **Quantitative Assessment – Visual Prominence**
  - How much of the proposed development is visible from particular viewpoints?
- **Cumulative Assessment**
  - Consideration of the potential visual impacts associated with the Modification in addition to the impacts associated with adjacent mines.



Source: (Hansen Bailey, 2009)

FIGURE 2 – CURRENTLY APPROVED OPERATIONS GENERAL ARRANGEMENT - YEAR 2022

1.1.1 APPROACH TO ASSESSMENT

The methodology employed by Urbis is based on the Visual Management System (VMS) (United States Department of Agriculture [USDA] Forest Service, 1974) methodology. The basis of this methodology is that the visual impact of a proposed development is determined by evaluating the degree of visual modification/fit of the development in the context of the visual sensitivity of surrounding land use areas, from which a proposed development may be visible. The visual impact resulting from the combination of visual modification and visual sensitivity, or viewer sensitivity, is illustrated in ***Table 2*** and ***Diagram 1***.

TABLE 2 – VISUAL IMPACT MATRIX

Level of Visual Impact VL = Very Low, L = Low, M = Moderate, H = High		**Viewer Sensitivity**		
		H	M	L
Level of Visual Modification	H	H	H	M
	M	H	M	L
	L	M	L	L
	VL	L	VL	VL

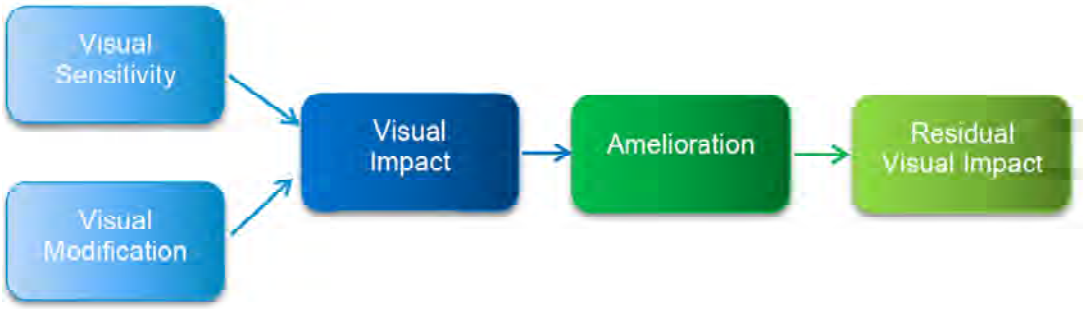


DIAGRAM 1 – VISUAL ASSESSMENT PROCESS

1.1.2 VISUAL MODIFICATION

The visual modification level of a proposed development can be best measured as an expression of the visual interaction, or the level of visual contrast between the development and the existing visual environment (Zube *et al.*, 1976).

A high degree of visual modification will result if the major components of the development contrast strongly with the existing landscape.

A low or very low degree of visual modification occurs if there is little or minimal visual contrast and a high level of integration of form, line, shape, pattern, colour or texture values between the development and the environment in which it sits. In this situation the development may be noticeable, but does not markedly contrast with the existing modified landscape.

Throughout the visual catchment (or ZVI) the degree of modification will generally decrease as the distance from the development site to various viewing locations increases.

1.1.3 VISUAL SENSITIVITY

Visual sensitivity is a measure of how critically a change to the existing landscape will be viewed from various use areas (Brush and Shafer, 1975). Different activities undertaken within the landscape setting have different sensitivity levels. For example, tourists who are using the surrounding landscape as a part of the holiday experience will generally view changes to the landscape more critically than agricultural or industrial workers in the same setting. Similarly, individuals will view changes to the visual setting of their residence more critically than changes to the visual setting of the broader setting in which they travel or work.

The visual sensitivity of a proposed development depends on a range of viewer characteristics. The primary characteristics used in this study are:

- land use;
- distance of the development from viewers;
- its visibility from critical viewing areas; and
- view angle.

The visual sensitivity of land uses was assessed to assist in determining the visual impact of the development. As distance from the viewer to the proposed development increases, the level of sensitivity reduces.

Typical levels of viewer sensitivity for the study area are based on levels of visual significance as described in the VMS, and are outlined in ***Table 3***.

TABLE 3 – TYPICAL VISUAL (VIEWER) SENSITIVITY

VISUAL USE AREA	FOREGROUND		MIDDLEGROUND		BACKGROUND
	Local Setting		Sub–Regional Setting		Regional Setting
	0 – 0.5 km	0.5 – 1 km	1 – 2 .5 km	2.5 – 5 km	> 5 km
Residences/Townships	H	H	H	M	L
Tourist/Recreation Areas	H	M	M	L	L
Highways/Tourist Routes	H	M	M	L	L
Secondary Roads	M	M	L	L	VL
Local Roads	L	L	L	VL	VL
Industrial Areas	L	L	L	VL	VL
Agricultural Areas	L	L	L	VL	VL
Mining Areas	VL	VL	VL	VL	VL
Legend - H = High, M = Moderate, L = Low, VL = Very Low					

Source: USDA (1974)

1.1.4 VISUAL PROMINENCE – RELATIONSHIP WITH VIEWSHEDS

This report defines a number of viewpoints within viewsheds based on distance from the Modification, for the purposes of assessment. The methodology is based on the reduction of impact with an increase in distance between a given viewpoint and the Modification. The potential visual impact of the Modification will also, to a large extent, depend on how much of the central field of vision it occupies (Refer to ***Table 4***, ***Table 5***, ***Table 6*** and ***Appendix A***).

Throughout the visual catchment (or ZVI) the degree of visual prominence will generally decrease as the distance from the development site to various viewing locations increases.

The quantitative assessment of visibility, i.e. how much is potentially visible, is intertwined with the distribution, height and density of vegetation throughout the visual catchment as well as topography.

TABLE 4 – HORIZONTAL LINE OF SIGHT – VISUAL IMPACT/VISUAL PROMINENCE

Degrees of Field of View Occupied	Potential Visual Prominence – Horizontal Field of View
Less than 5 degrees (^{o})	***Insignificant – Low Visual Prominence*** The development may not be highly visible in the view unless it contrasts strongly with the background.
5^o – 30^o	***Potentially Noticeable – Moderate Visual Prominence*** The development may be noticeable. The degree that it intrudes on the view will be dependent on how well it integrates with the landscape setting.
Greater than 30^o	***Potentially Dominant – High Visual Prominence*** The development will be highly noticeable.

TABLE 5 – VERTICAL LINE OF SIGHT – VISUAL IMPACT/VISUAL PROMINENCE

Degrees of Field of View Occupied	Potential Visual Prominence – Vertical Field of View
Less than 0.5^o	***Insignificant - Low Visual Prominence*** A small thin line in the landscape.
0.5^o – 2.5^o	***Potentially Noticeable – Moderate Visual Prominence*** The development may be noticeable. The degree that it intrudes on the view will be dependent on how well it integrates with the landscape setting.
Greater than 2.5^o	***Potentially Dominant – High Visual Prominence*** The development will be highly noticeable, although the degree of visual intrusion will depend on the landscape setting and the width/spread of the object.

TABLE 6 – VISUAL PROMINENCE IN RELATION TO DISTANCE AND VIEWSHED SETTINGS

Distance from Object	Potential Visual Prominence
5000 metres (m) (Regional viewshed)	***Visibility Diminishing*** The visual prominence of the element progressively diminishes over distance.
1000 – 5000 m (Sub-regional viewshed)	***Potentially Noticeable*** The development will be noticeable. The degree that it intrudes on the view will increase as distance reduces.
Less than 1000 m (Local viewshed)	***Potentially Dominant*** The development may be highly noticeable.

Source: University of Newcastle (2002).

To determine the overall potential level of visual prominence, the values from the vertical and horizontal prominence calculations are combined. Refer to ***Table 7***.

The vertical angle value has a weighting applied that is double that of the horizontal angle value. This reflects that fact that the human eye is accustomed to a strong horizontal line within the visual landscape. Any strong vertical element is therefore more visually prominent or apparent in views and horizontal elements are more influenced by the screening effects of intervening vegetation between the viewer and the object subject to assessment.

TABLE 7 – DETERMINATION OF VISUAL PROMINENCE

Vertical Angle (Weighted Value x 2)

Horizontal Angle	H (6)	M (4)	L (2)
H (3)	H (9)	H (7)	M (5)
M (2)	H (8)	M (6)	L (4)
L (1)	H (7)	M (5)	L (3)

L = Low (Insignificant)
Total score = 3 - 4
M = Moderate (Potentially Noticeable)
Total score = 5 - 6
H = High (Potentially Dominant)
Total score = 7 - 9

Level of Visual Prominence

1.1.5 IMPACTS OF NIGHT-LIGHTING

Given the lack of Australian standards for the assessment of lighting impacts relating to mining projects, the assessment of the impacts of lighting at night-time has been based on the UK's *Guidance Notes for the Reduction of Obtrusive Light* (The Institution of Lighting Engineers [ILE], 2005) (***Appendix B***).

While *Australian Standard (AS) 4282:1997 – Control of obtrusive effects of outdoor lighting*, is appropriate for the management of light spill from smaller scale developments, it does not provide a reference framework for the definition of regional night time lighting settings.

2 Modification Description – Visual Character

2.1 OVERVIEW

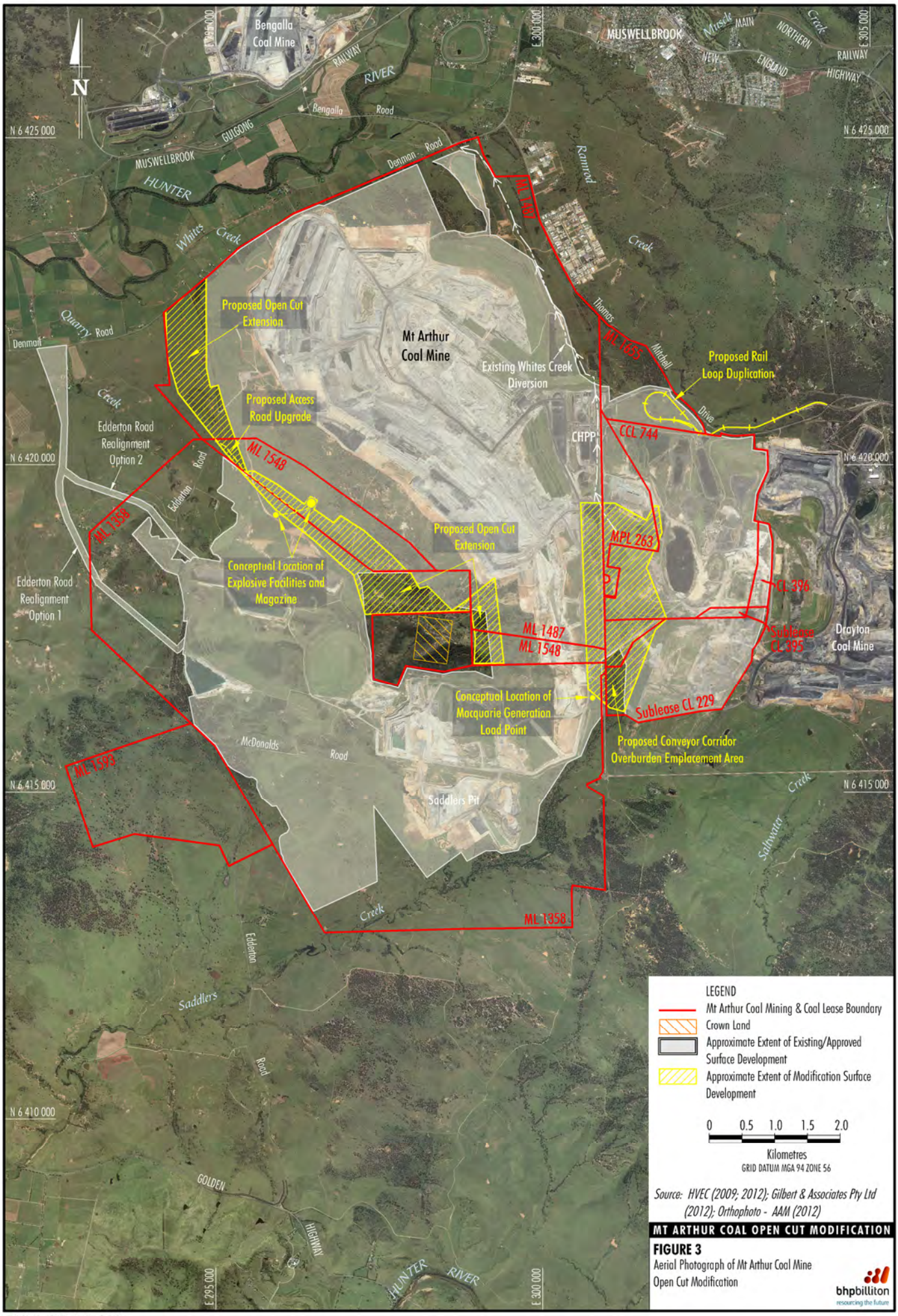
The Modification would involve an extension of the existing pit to the west, and an increase in the area of in-pit emplacement consistent with an increase in the open cut footprint and the construction of a new emplacement in the existing conveyor corridor, integrated with the existing Drayton sub-lease, to a height of 360 m Australian Height Datum (AHD).

The Modification would extend the life of the currently approved operations at the Mt Arthur Coal Mine by approximately four years (i.e. until 2026).

The major aspects of the Modification considered to have the potential to impact on the visual landscape include:

- modification of topographic features, including:
  - extension of the open cut;
  - increase in the western extent of Mt Arthur Northern Open Cut overburden emplacement in-line with an increase in the open cut footprint; and
  - use of the conveyor corridor for overburden emplacement.
- duplication of the existing rail loop;
- additional vegetation clearance; and
- extension of lighting associated with extended landforms.

The major differences between the approved operations and the modification are described in ***Table 8***, and shown on ***Figures 2*** and ***3***.



MT ARTHUR COAL OPEN CUT MODIFICATION

FIGURE 3

Aerial Photograph of Mt Arthur Coal Mine Open Cut Modification

bhpbilliton resourcing the future

HVE-11-01_OCM EA_App Visual_102A

TABLE 8 – SUMMARY COMPARISON OF APPROVED MT ARTHUR COAL MINE AND THE MODIFICATION

Development Component	Approved Mt Arthur Coal Mine[1]	Mt Arthur Coal Mine including the Modification
Life of Mine	• Approval for open cut mining to 2022.	• Extension of life-of-mine to 2026.
Annual ROM Coal Production Rate (Open Cut)	• Up to 32 Mtpa.	• No change.
Coal Processing Rate	• Upgrade of coal handling and preparation plant (CHPP) to facilitate processing of up to 36 Mtpa (including underground coal).	• No change.
Mining Areas	• Open cut mining areas including Mt Arthur Northern Open Cut, South Pit, Saddlers Pit and Belmont Pit.	• No change.
Disturbance Areas	• Total Mt Arthur Coal Mine disturbance area of approximately 6,400 ha.	• Increase of total disturbance areas of approximately 240 ha (open cut and overburden emplacement areas).
Overburden Emplacement	• Development of Mt Arthur Northern Open Cut overburden emplacement height to an average of 360 m AHD (maximum height of 375 m AHD). • Development of Bayswater No 3 (Saddlers Pit) overburden emplacement height up to 250 m AHD (no change to existing approval). • Development of Drayton sub-lease emplacement area up to 290 m AHD (part of South Pit extension). • Development of an out-of-pit overburden emplacement area up to 360 m AHD.	• Increase in in-pit emplacement in-line with increase in open cut footprint. • Use of existing conveyor corridor for overburden emplacement, including integration with existing Drayton sub-lease emplacement area to a height of 360 m AHD. • No other changes to out-of-pit emplacements.
Coarse Rejects and Tailings Management	• Tailings will continue to be disposed of in the tailings emplacement area at Bayswater No 2. Approval to dispose tailings in Drayton sub-lease void will be maintained. The tailings emplacement area will be extended (up to 280 m AHD). • Coarse reject will continue to be co-disposed within overburden emplacement areas (consistent with existing approval).	• Additional tailings and coarse rejects disposed of in existing/approved emplacement areas.
Product Coal Transport	• Transport of up to 27 Mtpa product coal via rail. • Construction and commissioning of an additional loading facility. • Maximum of 24 rail movements per day (no change to existing approval). • Use of the existing overland conveyor to Macquarie Generation's Bayswater Power Station, as required.	• Increase in maximum rail movements from 24 to 38 movements per day. • Duplication of the existing Mt Arthur Coal Mine rail loop. • Relocation of load point for the overland conveyor which supplies coal to Macquarie Generation's Bayswater Power Station. • No change to maximum total product coal transportation rate of 27 Mtpa.

TABLE 8 CONT' - SUMMARY COMPARISON OF APPROVED Mt ARTHUR COAL MINE AND THE MODIFICATION

Development Component	Approved Mt Arthur Coal Mine[1]	Mt Arthur Coal Mine including the Modification
Employment	• Total workforce of approximately 2,600 full-time equivalents employees during peak production. • A workforce of approximately 240 full-time equivalent employees during peak construction phases.	• No change.
Hours of Operation	• All coal operations and associated activities will continue to be undertaken 24 hours per day, seven days a week. • Construction onsite may be on a 24 hour, seven day roster consistent with operational requirements. • Construction hours for the proposed Edderton Road realignment are 7.00 am to 5.00 pm Monday to Saturday (except in the case of an emergency).	• No change.
Coal handling Infrastructure changes/upgrades	• Development of infrastructure such as workshop and bathhouse, additional ROM coal hoppers and the extension of ROM and product coal stockpiles.	• Minor changes to layout, including ROM coal stockpile extension and additional facilities (control room and offices). • No change to CHPP throughput rate.
Explosives facilities	• Fully bunded onsite explosives magazine for the storage of detonators and other materials.	• Relocation of and upgrade of explosives facility and magazine.
Final Voids	• Final voids proposed for the Mt Arthur Northern Open Cut and Saddlers Pit.	• Saddlers Pit to be backfilled.
Site Entrance	• Via site access road from Thomas Mitchell Drive.	• Additional access road via Edderton Road to allow access to relocated explosives facility.

[1] As described in the Consolidation Project EA (2009 EA) and approved under Project Approval (09_0062).

2.2 MODIFICATION LANDFORMS

The existing open cut would be increased by the Modification, extending to the west by approximately 400 m in the area adjacent to Denman Road and up to approximately 1 km in the vicinity of Mount Arthur.

The existing Mt Arthur Northern Open Cut overburden emplacement would be retained to an average height of 360 m AHD (maximum height of 375 m AHD comprised of two additional crests incorporated on the overburden emplacement area for visual amenity).

The proposed overburden emplacement, to be located within the existing 'conveyor corridor', would be integrated with existing Drayton sub-lease emplacement area to a height of 360 m AHD.

The rehabilitation of mine overburden emplacements would be undertaken on a progressive basis in order to improve integration of the Modification landforms with the surrounding environment and mitigate potential visual impacts.

Mine overburden emplacements would, over time, vary in appearance from freshly placed rock and soil material to rehabilitated landforms. As such, the level of visual modification created by these landforms would change, reducing as vegetation becomes established and matures. The landforms would continue to be managed in accordance with the methods currently in place at the Mt Arthur Coal Mine under the Environmental Management System.

2.3 VEGETATION CLEARANCE

A large proportion of the Modification disturbance area is already extensively grazed agricultural land or areas previously subjected to mining activities. The surface disturbance associated with the Modification would involve minimal clearance of canopy vegetation.

2.4 NIGHT–LIGHTING

Night-lighting is currently emitted from the following key sources at the Mt Arthur Coal Mine:

- overhead lighting of the mine infrastructure area, including feed bins and rail facilities;
- mobile lighting plants (floodlights) used on the emplacements and the open cut; and
- mobile vehicle-mounted lights (e.g. haul trucks, loaders, coal trucks, and other heavy and light vehicles in various locations within the mining lease [ML]).

The Modification would vary the potential effects of existing night-lighting over the life of the Modification. Lighting from the Modification may be visible at additional locations due to the increased extent of light sources on the increased extent/number of the mine overburden emplacements.

3 Existing Landscape and Visual Setting

3.1 SUMMARY OF FINDINGS OF THE 2009 VIA

3.1.1 THE FORM OF THE CONSOLIDATION PROJECT

The main components of the proposed Consolidation Project assessed by the 2009 VIA were:

- The Overburden Emplacement Area (OEA) at the Mt Arthur Northern Open Cut increased to an average height of 360 m AHD. Additional crests on the OEAs were incorporated to a maximum height of 375 m AHD in two locations as a result of design workshops with mine planners and visual impact specialists in order to improve visual amenity through a less engineered appearance of the final landform.

- An out-of-pit OEA was to be established in the south-west of the operation, above the approved Mt Arthur Underground Mine development area.

- The eastern and inner OEAs were to be merged to become one large emplacement area to the north of the major haul road.

- One minor emplacement area was to be developed to the south.

3.1.2 APPROACH TO THE VIA

The primary method of assessment in the 2009 VIA was the definition of what percentage of the Primary View Zone (PVZ) the proposed components of the Consolidation Project occupied.

The PVZ was defined as the area that is occupied by an arc created by sight lines from the eye radiating out vertically and horizontally at angles of 30º around a centre view line. The percentage of the PVZ occupied was then calculated.

3.1.3 2009 VIA FINDINGS

The 2009 VIA determined that the Consolidation Project would increase the extent of seen areas due to the increased elevation of the OEA. However, these additional areas were generally not in sensitive locations. The identified significant view locations were found to be mostly the same as for the previously approved mine plans.

It was determined that the Consolidation Project would create visual impacts beyond those experienced by the previously approved mine plans. However, it was found that these impacts would be reduced over the life of the Consolidation Project and would occur within the same timeframe as the previous approvals. Additionally, it was determined that the larger landforms and plantings proposed would create landscape elements that were more in keeping with the existing landscape than those of the previously approved mine plan.

The rehabilitated Consolidation Project would create a new, but different landscape that was in character with its existing setting.

3.2 EA COMMITMENTS RELATING TO VISUAL ISSUES

The Consolidation Project EA proposed key measures to manage and mitigate impacts. Those relating to landscape and visual issues are:

- Management Plans will be revised and/or prepared in consultation with relevant regulators for approval by the NSW Department of Planning and Infrastructure for the following areas:

  – Water Management;

  – Flora and Fauna;

- Rehabilitation and Landscape (including Void Management); and
- Aboriginal Archaeology and Cultural Heritage.

- Hunter Valley Energy Coal will progressively rehabilitate the mining and overburden emplacement areas.

- Upon Project Approval, guidelines will be prepared to include: treatment methods for primary and secondary view areas from affected residences; consultation requirements with residents in those key areas of high sensitivity, and action plans to mitigate visual impacts of the Project (depending on extent of visibility and its sensitivity). This will be detailed in a report to be submitted to the Department of Planning and Infrastructure.

The 2009 VIA report describes crests that would be built into the final OEA landform as a visual mitigation measure:

The OEA at Mt Arthur North will be increased to an average height of RL 360 m. Additional crests on the OEAs have been incorporated to a maximum height of RL 375 m in two locations as a result of design workshops with mine planners and visual impact specialists in order to improve visual amenity and result in a less engineered appearance of the final landform.

Section 9 of the Consolidation Project EA and Appendix 3 of the Consolidation Project Approval contains a Statement of Commitments including:

Mt Arthur Coal will minimise views from the Woodlands Property within the Primary View Zone to active overburden faces on the out of pit emplacement areas of the Project to ensure the extent of any primary view is less than 2.5%, as described in Appendix 1 of the EA Report.

3.3 LOCAL LANDSCAPE CHARACTER

The area surrounding the Mt Arthur Coal Mine is comprised of a number of distinct land use types and landscape units of varying levels of landscape quality. These have been previously defined in the 2009 VIA as follows:

- Hunter Valley Flood Plain;
- Foothills;
- Rural Lands;
- Mine and Industrial Areas;
- Town Areas;
- Surrounding Ranges; and
- Lake Areas.

These units have not fundamentally changed subsequent to the granting of Project Approval 09_0062. Minor changes are summarised in ***Section 3.4***.

3.4 CHANGES TO THE LANDSCAPE SETTING AND VIEWPOINTS

Following the granting of Project Approval 09_0062 in September 2010, there have been limited changes to the existing landscape setting. These include the following land use activities:

Mine Areas - the existing mines in the region have continued to progressively modify and reinstate/ rehabilitate the landscape. In a number of areas, visual amelioration/screen planting has grown and reduced the visibility of the Mt Arthur Coal Mine from adjacent roads. An example of this is views from Denman Road to the open cut and Mt Arthur Northern Open Cut overburden emplacement.

Town Areas – the South Muswellbrook residential area (Ironbark Estate) has expanded to the south-east, effectively flanking the eastern edge of the Mt Arthur Coal Mine. This has resulted in an extension of residential landscape character as well as an increase in the number of sensitive viewpoints.

4 Assessment of Potential Impact

4.1 IDENTIFICATION OF VIEWPOINTS

For consistency, sensitive viewpoints identified and assessed as part of the 2009 VIA have been selected to assess the relative difference in impact between the current approved operation and the Modification.

The critical issues to consider in the assessment of visual impact are:

- the number of sensitive viewing locations; and
- the degree to which the proposed works are visible.

The method assumes that if the works are not seen, then there is no resulting impact.

Analysis was undertaken to identify sensitive viewpoints in the vicinity of the Mt Arthur Coal Mine. Six viewpoints located within the sub-regional and regional settings, and previously identified in the 2009 VIA, were chosen for detailed assessment based on their higher levels of viewer sensitivity and/or their representativeness of a range of locational aspects ***(Figure 4)***:

- Northern Sector – Roxburgh Road[2], Racecourse Road, South Muswellbrook - Ironbark Ridge Estate;
- Western Sector – Denman Road, Roxburgh Vineyard; and
- Southern Sector – Golden Highway/ Saddlers Creek.

[2] The viewpoint location on Roxburgh Road is adjacent to a residence that was privately-owned at the time of the 2009 VIA. This dwelling is now owned by Coal and Allied (C&A). However, the viewpoint is still considered to be generally representative of receivers on Roxburgh Road and has therefore again been included for assessment in this report.

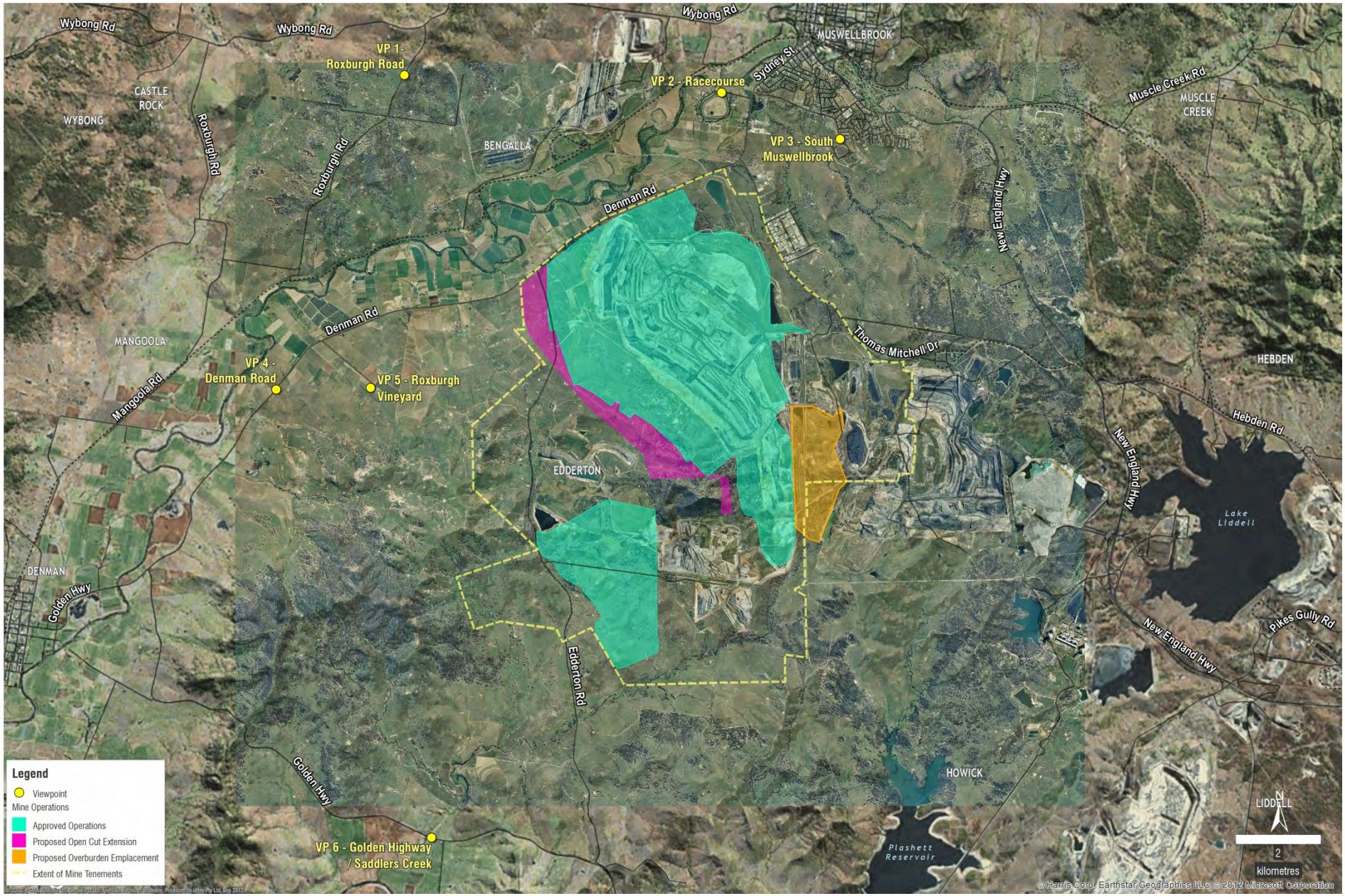


FIGURE 4 – VIEWPOINT LOCATIONS

4.2 VISUAL SIMULATIONS

Visual simulations (based on a computer generated three dimensional [3D] model) have been created for the locations shown on ***Figure 4***. Visual simulations were prepared using the Modification landforms during year 2026 of operations, when the landforms would be at their maximum heights and the open cut pit at its greatest extent, representing the greatest potential for visual impact. A post-mining simulation was also developed to illustrate the conceptual landform following completion of mining and rehabilitation activities. The simulations take into account the rehabilitation and final land use objectives for the current approved operations, as described in the 2009 EA (Hansen Bailey, 2009).

Photomontages are representations of the Modification that are superimposed onto a photograph of the site. The process for generation of these images involves computer generation of a wire frame perspective view of the Modification and the existing topography from each viewpoint. To produce the wire frame images, the computer program 3D Studio is used, employing a digital terrain model with a 2 m resolution, to create views of the existing topography and position the components of the Modification at the correct locations and heights. Correct field of view is established by matching the viewing angle of the camera and lens used for photography and its position (both horizontal and vertical) with the wire frame view.

Once the wireframe/rendered views have been created they are taken into Adobe Photoshop, where they are combined with photographs taken from the specified viewpoints (location recorded with Global Positioning System). The images are then adjusted by the operator to exactly fit the digital terrain model and rendered for realism.

The photo simulations based on photography from typical sensitive viewpoints are included within the following analysis section. The images that the photo simulations have been based on have been captured with a Canon 20D single lens reflex (SLR) digital camera with a lens of 32.5 millimetres (mm) focal length with a crop factor of 1.5, which is equivalent to a 48.75 mm lens on a 35 mm format film SLR which would result in an image very close to the recognised 50 mm standard that closely represents the central field of vision of the human eye. Photomontages have been prepared for a range of indicative sensitive viewpoints that represent a variety of distances from the Modification as well as locations with differing viewing aspects.

4.3 QUANTITATIVE VISUAL IMPACT – PRIMARY VIEWPOINTS

The quantitative assessment process has focussed on the visual prominence or the visual modification to the landscape setting that may result for views from the most sensitive visual settings/land uses, applying the visibility method as described in ***Section 1.1.4*** and ***Appendix A***. Low sensitivity visual settings, such as agricultural or other mining areas, have not been considered. The quantification of vertical angle is based on the height of the tallest elements of the Modification (e.g. emplacements and exposed pit faces). The quantification of vertical and horizontal prominence assists with the determination of visual modification. However, it does not take into account aspects such as visual contrast or visual integration which are assessed as part of the qualitative assessment process.

Distances expressed in the quantitative assessment are based on those from the viewpoint to the most visible components of the Modification, either an emplacement or open cut.

A quantitative assessment of these viewpoints is shown in ***Table 9***.

TABLE 9 – QUANTITATIVE ASSESSMENT

VIEWPOINT *(REFER TO FIGURE 4)*	VIEWSHED	HORIZONTAL DISTANCE FROM VIEWER*	HORIZONTAL ANGLE	*HORIZONTAL POTENTIAL VISUAL PROMINENCE*	VERTICAL ANGLE	*VERTICAL POTENTIAL VISUAL PROMINENCE*	*OVERALL VISUAL PROMINENCE LEVEL*
Viewpoint 1 Roxburgh Road	Regional	5.6 km (Open Cut)	11°	Potentially Noticeable – Moderate Visual Prominence	2°	Potentially Noticeable – Moderate Visual Prominence	Potentially Noticeable – Moderate Visual Prominence
Viewpoint 2 Racecourse	Regional	7.8 km (Conveyor Corridor Overburden Emplacement)	17°	Potentially Noticeable – Moderate Visual Prominence	<0.5°	Insignificant – Low Visual Prominence	Insignificant – Low Visual Prominence
Viewpoint 3 South Muswellbrook (Ironbark Ridge Estate)	Regional	6.3 km (Conveyor Corridor Overburden Emplacement)	24°	Potentially Noticeable – Moderate Visual Prominence	1°	Potentially Noticeable – Moderate Visual Prominence	Potentially Noticeable – Moderate Visual Prominence
Viewpoint 4 Denman Road	Regional	5.9 km (Open Cut)	N/A - Screened by topography	N/A - Screened by topography	N/A - Screened by topography	N/A - Screened by topography	N/A - Screened by topography
Viewpoint 5 Roxburgh Vineyard	Sub-Regional	3.8 km (Open Cut)	4°	Insignificant – Low Visual Prominence	<0.5°	Insignificant – Low Visual Prominence	Insignificant – Low Visual Prominence
Viewpoint 6 Golden Highway/Saddlers Creek	Regional	11.3 km (Conveyor Corridor Overburden Emplacement)	N/A - Screened by topography	N/A - Screened by topography	N/A - Screened by topography	N/A - Screened by topography	N/A - Screened by topography

*Distance to closest visible component

N/A = Not Applicable

4.3.1 VIEWSHED

The viewshed or ZVI is the area from which views of a particular proposed development may be possible. The extent of coverage of the ZVI analysis is based on the availability of reliable digital topographic data.

The ZVI has been generated for the upper and side slopes of the emplacements and the pit, given they are the most visible elements of the Modification.

The ZVI could be considered to be a worst case scenario, with a greater extent of viewshed identified than would actually exist, as it does not take into account the effects of screening of views by vegetation. Its primary purpose is to identify locations from which a proposed development may be visible. The viewshed of the Modification is shown on ***Figure 5***.

CUMULATIVE/COMPARATIVE IMPACT

To determine the change to the regional visual setting the extent of viewshed for the existing mine and the proposed Modification have been calculated for a 10km radius from the ML boundary to define the exact order of change the setting would experience. Refer to ***Table 10***.

TABLE 10 – COMPARATIVE ASSESSMENT OF VIEWSHEDS – APPROVED AND PROPOSED

	Area of ZVI within 10 km radius of ML	**% of total 10 km radius of ML**
Approved Mt Arthur Coal Mine (Consolidation Project)	344 square kilometres (km^2)	50%
Proposed Modification	22 km^2	3%
Combined – Approved Mine and Proposed Modification	366 km^2	53%
Total of 10 km Viewshed	692 km^2	

The ZVI analysis indicates that the proposed components as proposed in the Modification will only result in a very slight increase in the viewshed, that is, locations from where the mine is visible.

The effective increase in disturbance area is 240 ha in addition to an existing approved disturbance area of 6,400 ha. This is a 4% increase in total area and will result in a 3% increase in area of viewshed from which the modified Mt Arthur Coal Mine will be visible. Given much of the increase in the area of disturbance results from the increase in the size of the open cut, which is not seen from many areas, the overall potential cumulative impact is considered to be very low.

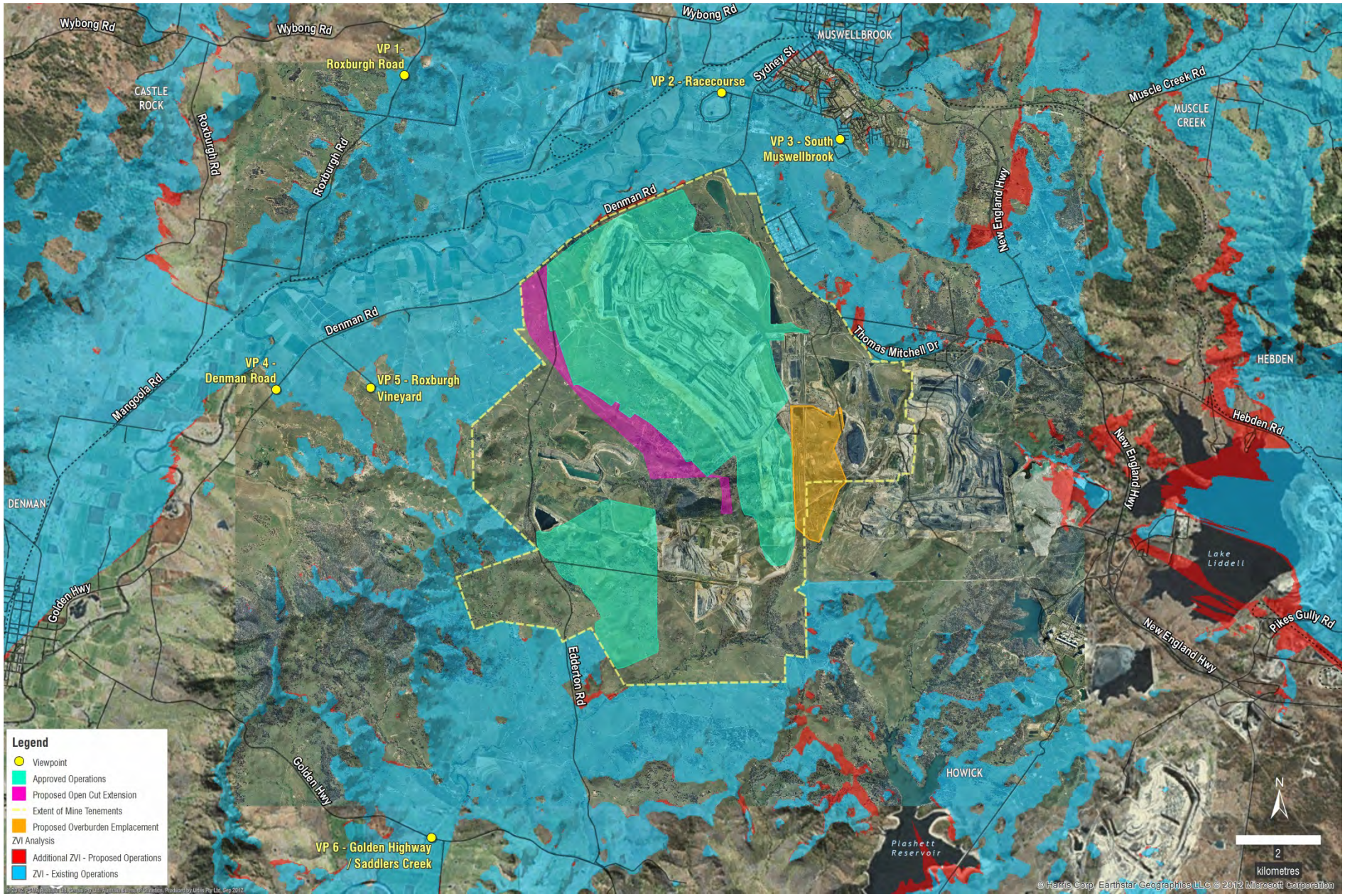


FIGURE 5 – COMPARATIVE AREA OF ZVI OF APPROVED MINE AND PROPOSED MODIFICATION

4.4 QUALITATIVE VISUAL IMPACT – PRIMARY VIEWPOINTS

Historically, the Hunter Valley region has been subject to modifications to the landscape resulting from mining and the adjacent and broader setting of the Mt Arthur Coal Mine includes a number of mines and associated mine infrastructure.

The Hunter Valley region is also a tourist attraction and the users of the highways throughout the region will have varying expectations, ranging from appreciation of its landscape and vineyards to the fascination with its large scale mines.

The following section assesses the potential visual impact of the Modification on sensitive viewpoints described in ***Section 4.1***. Distances expressed in the qualitative assessment, and the designation of visual setting (regional, sub-regional and local), are based on those from the viewpoint to the most visible components of the Modification, either an emplacement or open cut. The level of visual modification of the Modification is assessed comparatively against the approved Mt Arthur Coal Mine.

4.4.1 NORTHERN SECTOR

VIEWPOINT 1 – ROXBURGH ROAD – RESIDENCE	
Viewing Location	Roxburgh Road adjacent to residence (***Figure 4***).
Viewing Distance	5.6 km to the approved mine (Open Cut) and 5.6 km to the Modification (Open Cut).
Visual Setting	Regional.
Visual Modification	The residence, which has recently been purchased by Coal &Allied, has established vegetation surrounding it which heavily screens views to the Mt Arthur Coal Mine (***Figure 6*** and ***Figure 7***). From the local road, and away from the screening vegetation of the residence, the existing and proposed operations will be potentially noticeable. The modified open cut will not be located any closer to the viewpoint than the existing open cut. The proposed activities will appear as a slight westward extension of the approved open cut and be consistent with its appearance in terms of colour and pattern (***Figure 8***). Views to the conveyor corridor overburden emplacement will be obscured by the Mt Arthur Northern Open Cut overburden emplacement. As a result, the visual modification level is considered to be low to moderate.
Land Use	Residence located on a local road.
Visual Sensitivity	Low due to distance.
Duration of View	Static.
Potential Visual Impact	Overall Visual Prominence – Moderate. The low visual sensitivity, due to distance from the Modification, combined with a low to moderate visual modification level, will result in a low visual impact. This will reduce from low, to very low, as landform rehabilitation measures are established.

FIGURE 6 – VIEW FROM ROXBURGH ROAD TO RESIDENCE

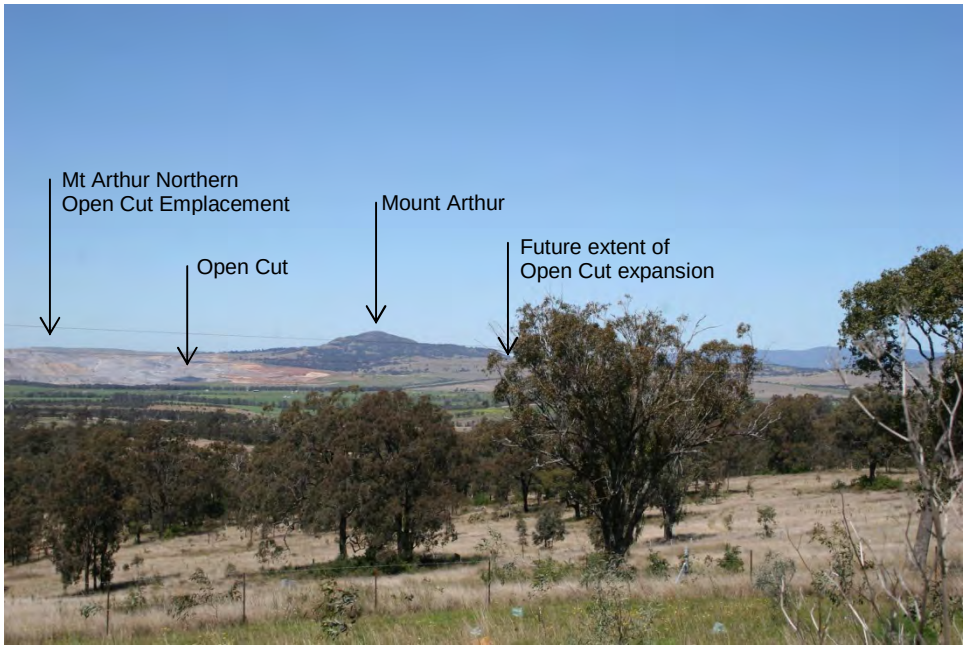


FIGURE 7 – VIEW SOUTH TOWARDS MODIFICATION

FIGURE 8 – PHOTOSIMULATION VIEW TOWARDS MODIFICATION – YEAR 2026. THE OPEN CUT EXPANSION RESULTS IN A SLIGHT INCREASE IN ITS OVERALL AREA.

VIEWPOINT 2 – RACECOURSE	
Viewing Location	Northern perimeter of racetrack (***Figure 4***). Location selected due to viewer orientation towards the track and Modification area.
Viewing Distance	3.2 km to the approved mine (Mt Arthur Northern Open Cut overburden emplacement). 5.8 km to the Modification (Open Cut) and 7.8 km to the Modification (conveyor corridor overburden emplacement).
Visual Setting	Regional.
Visual Modification	The racecourse is located on the low-lying flood plain adjacent to the Hunter River. Views to the site are depressed and existing vegetation located between the Modification area and the viewpoint screen views to the lower portion of the Mt Arthur Northern Open Cut overburden emplacement and the area of the proposed open pit extension (***Figure 9***). The upper portion of the existing Mt Arthur Northern Open Cut overburden emplacement is visible above the band of existing vegetation and views to the open cut are obscured by the band of vegetation. The visible component of the Modification, the conveyor corridor overburden emplacement, will be located an additional 4.6 km away from the viewpoint than the closet point of the approved Mt Arthur Northern Open Cut overburden emplacement. It will appear as a slight eastward extension of the approved Mt Arthur Northern Open Cut overburden emplacement and be consistent with its appearance in terms of colour and pattern (***Figure 10***). Therefore, the visual modification level is considered to be low.
Land Use	Recreation/Tourism.
Visual Sensitivity	Low due to distance.
Duration of View	Static.
Potential Visual Impact	Overall Visual Prominence – Low. The low visual sensitivity, due to distance from the Modification, combined with a low visual modification level, will result in a low visual impact, reducing to very low as landform rehabilitation measures are established.

FIGURE 9 – VIEW SOUTH-WEST TO MODIFICATION FROM NORTHERN PERIMETER OF RACETRACK

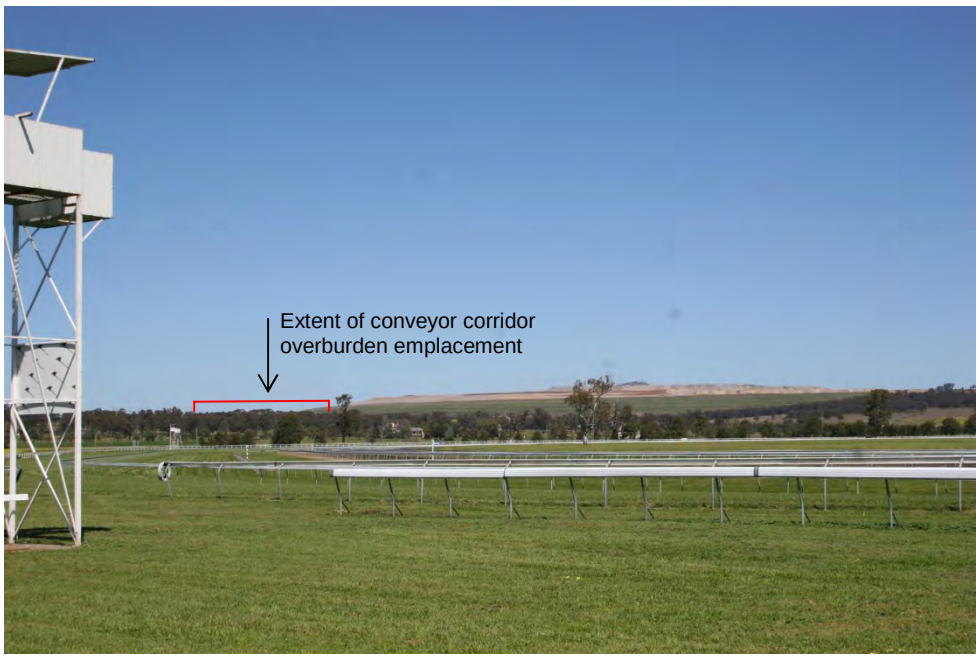


FIGURE 10 – VIEW SOUTH TO MODIFICATION FROM NORTHERN PERIMETER OF RACETRACK

VIEWPOINT 3 – SOUTH MUSWELLBROOK	
Viewing Location	Ironbark Ridge Estate (***Figure 4***).
Viewing Distance	3.2 km to the approved mine (Mt Arthur Northern Open Cut overburden emplacement). 6.3 km to the Modification (conveyor corridor overburden emplacement).
Visual Setting	Regional.
Visual Modification	The residential edge of South Muswellbrook is located along a low rise oriented approximately north-south. Views to the Modification area are afforded over an intervening, and less elevated, rolling agricultural landscape of pasture grass with scattered stands of trees (***Figure 11***). The approved Mt Arthur Northern Open Cut overburden emplacement is visible between breaks in the existing vegetation. The visible component of the Modification, the conveyor corridor overburden emplacement, will be located an additional 3.1 km away from the viewpoint than the closet point of the approved Mt Arthur Northern Open Cut overburden emplacement. It will appear as a southerly extension of the approved Mt Arthur Northern Open Cut overburden emplacement and be consistent with its appearance in terms of colour and pattern (***Figure 12***). As a result, the visual modification level is considered to be moderate.
Land Use	Residences/Township.
Visual Sensitivity	Low due to distance.
Duration of View	Static.
Potential Visual Impact	Overall Visual Prominence – Moderate. The low visual sensitivity, due to distance from the Modification, combined with a moderate visual modification level, will result in a low level of visual impact, reducing to very low as landform rehabilitation measures are established.

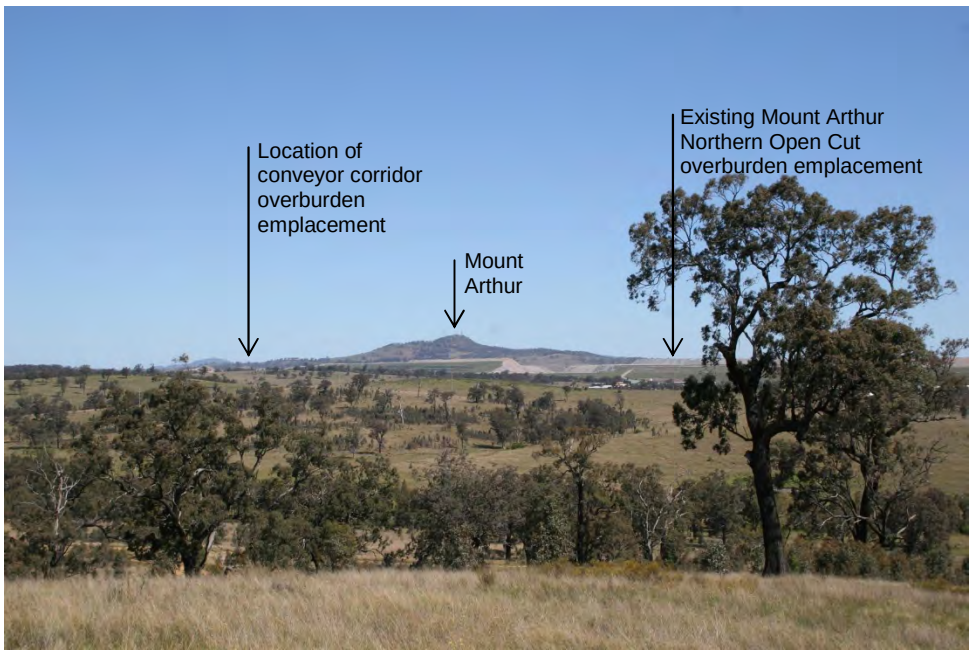


FIGURE 11 – VIEW WEST TO MODIFICATION FROM IRONBARK ESTATE, SOUTH MUSWELLBROOK

FIGURE 12 – PHOTOSIMULATION VIEW TOWARDS PROJECT – YEAR 2026 .THE MODIFICATION IS VISIBLE TO THE FAR LEFT AS A SLIGHT EXTENSION TO THE EXISTING NORTHERN OVERBURDEN EMPLACEMENT

4.4.2 WESTERN SECTOR

VIEWPOINT 4 – DENMAN ROAD	
Viewing Location	Denman Road. (***Figure 4***).
Viewing Distance	6.4 km to the approved mine (Open Cut). 5.9 km to the Modification (Open Cut).
Visual Setting	Regional.
Visual Modification	Approaching from the west, Denman Road crests a low rise and elevated views are afforded of the Modification area as well as the Bengalla Coal Mine located 2 km to the north of the approved mine (Open Cut) (***Figure 13***). Rising topography located between the viewpoint and the Modification will obscure views of the proposed mine extension area as well as the conveyor corridor overburden emplacement (***Figure 14***). Therefore, the visual modification level is considered to be very low to non-apparent for this location.
Land Use	Secondary Road.
Visual Sensitivity	Very low due to distance.
Duration of View	Dynamic (moving).
Potential Visual Impact	Overall Visual Prominence – N/A – Screened by topography. The very low sensitivity, due to distance from the Modification, combined with a very low to non-apparent visual modification level, will result in very low or no visual impacts.

FIGURE 13 – VIEW EAST TO MODIFICATION FROM DENMAN ROAD

FIGURE 14 – PHOTOSIMULATION VIEW TOWARDS MODIFICATION – YEAR 2026. ONLY THE APPROVED MINE IS VISIBLE

VIEWPOINT 5 – ROXBURGH VINEYARD	
Viewing Location	Vineyard property (***Figure 4***).
Viewing Distance	4.3 km to the approved mine (open cut). 3.8 km to the Modification (open cut).
Visual Setting	Sub-regional.
Visual Modification	Located to the west, the vineyard is sited on a slope with a north-easterly aspect and slightly elevated views are afforded of the Modification area as well as the Bengalla Coal Mine located 2 km to the north of the approved mine (Open Cut). Rising topography located between the viewpoint and the Modification will obscure views of the open cut expansion. The conveyor corridor overburden emplacement will be visible as a thin line on the horizon, extending from the Mt Arthur Northern Open Cut overburden emplacement to behind Mount Arthur itself. It will be consistent in appearance in terms of colour and pattern with the existing mine landforms. The visual modification level is considered to be low in views from this location.
Land Use	Agricultural Production – Vineyard (owned by BHP Billiton).
Visual Sensitivity	Very low due to distance.
Duration of View	Static.
Potential Visual Impact	Overall Visual Prominence – Low. The very low sensitivity, due to distance from the Modification, combined with a low visual modification level, will result in a very low level of visual impact.

4.4.3 SOUTHERN SECTOR

VIEWPOINT 6 – GOLDEN HIGHWAY/SADDLERS CREEK	
Viewing Location	Golden Highway adjacent to creek (***Figure 4***).
Viewing Distance	5.9 km to the approved mine (south-west of out-of-pit overburden emplacement area). 11.3 km to the Modification (conveyor corridor overburden emplacement).
Visual Setting	Regional.
Visual Modification	This depressed viewing location has direct views to the Modification area and Mount Arthur along the Saddlers Creek valley (***Figure 15***). The currently approved emplacement will result in a partial loss of these views. Notwithstanding, the Modification would not change this impact. The approved out-of-pit south-west overburden emplacement, located between the viewpoint and the Modification, will obscure views of the proposed mine extension areas as well as of the conveyor corridor overburden emplacement (***Figure 16***). Therefore, the visual modification level is considered to be very low to non-apparent in views from this location.
Land Use	Highway/Tourist Route.
Visual Sensitivity	Low due to distance.
Duration of View	Dynamic (moving).
Potential Visual Impact	Overall Visual Prominence – N/A – Screened by topography (existing mine components). The low sensitivity, due to distance from the Modification, combined with a very low to non-apparent visual modification level, will result in a very low or no visual impact.

EA Commitments	Appendix 3 of the Consolidation Project Approval contains a Statement of Commitments including: ▪ *20. Mt Arthur Coal will minimise views from the Woodlands Property within the Primary View Zone to active overburden faces on the out of pit emplacement areas of the Project to ensure the extent of any primary view is less than 2.5%, as described in Appendix 1 of the EA Report.* An assessment was undertaken for the viewpoint on the Golden Highway, just to the south of Saddlers Creek, which is the same viewpoint assessed in the 2009 VIA report. A viewcone with the same viewing angles as specified in the 2009 VIA was generated to ensure that a direct comparison was possible between the Modification and the approved mine. Based on the Modification's end of Project Year 22 mine plan dataset, the visible face would total 0.028% of the 30^{o} primary view cone, well within the 2.5% as described in the 2009 VIA (***Figure 17***). The two additional crests (maximum height of 375 m AHD) incorporated for visual amenity on the approved Mt Arthur Northern Open Cut overburden emplacement, and as outlined in ***Section 3.2***, are of particular relevance to views from Saddlers Creek as they mitigate views to the overburden emplacement which, from this location will be viewed in profile in the distance.

FIGURE 15 – VIEW EAST TO MODIFICATION FROM GOLDEN HIGHWAY ADJACENT TO SADDLERS CREEK

FIGURE 16 – PHOTOSIMULATION VIEW TOWARDS MODIFICATION – YEAR 2026. ONLY THE APPROVED MINE IS VISIBLE

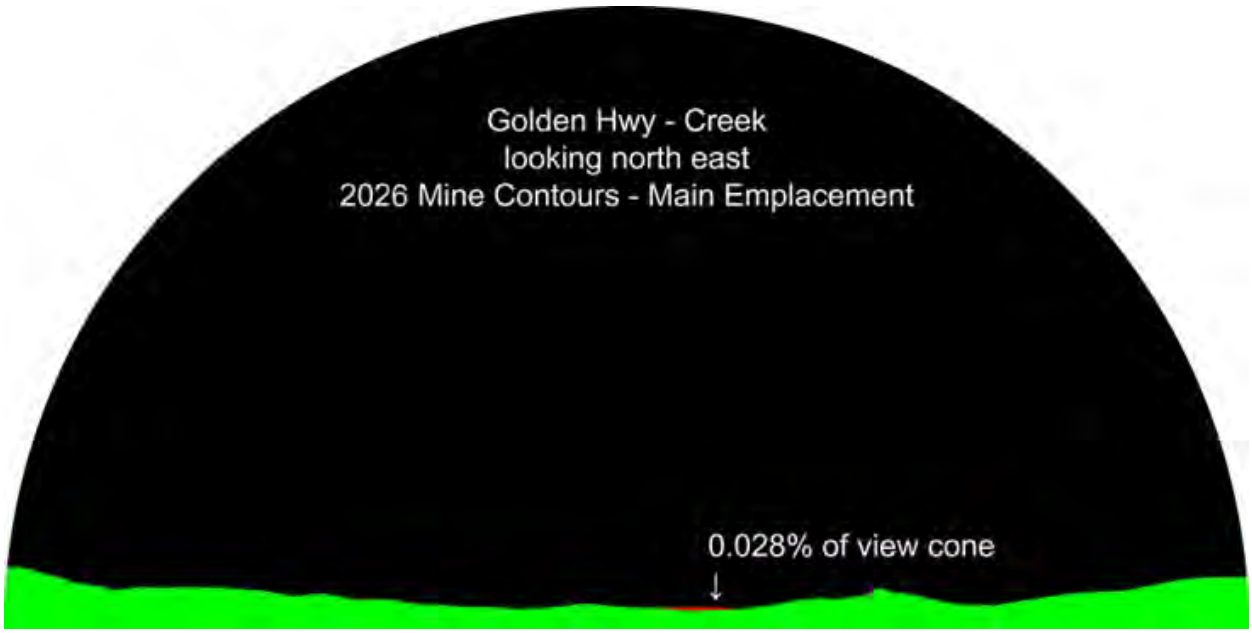


FIGURE 17 – PRIMARY VIEW CONE COMPARISON

4.5 NIGHT-LIGHTING

Over the life of the Modification, the effects of night-lighting would vary from the approved Mt Arthur Coal Mine. The nature of the night-lighting for the Modification would be of a similar intensity when compared to the approved. However, there is the potential for fixed and mobile lights to be visible from a wider area surrounding the Modification as a result of an increase in the extent of emplacements, primarily the conveyor corridor overburden emplacement, and the increase in the footprint of the open cut. There is no increase in the elevation of landforms.

The assessment of the impacts of lighting at night-time has been based on the UK's *Guidance Notes for the Reduction of Obtrusive Light* (ILE, 2005) (***Appendix B***), which includes a range of categories with which to describe the lit situation of the landscape. These environmental zones are supported by design guidance for the reduction of light pollution which can then inform proposed mitigation techniques (***Appendix B***).

The existing operations within the sub-regional and regional settings are currently subjected to the effects of localised night-lighting sources associated with mining activities, industrial estates and residential areas. Therefore, the surrounding lighting environmental zones of the Modification are varied and include the following settings as identified in the *Guidance Notes for the Reduction of Obtrusive Light* (ILE, 2005):

- Southern and Western Sectors: Environmental Zone E1 – Intrinsically Dark Landscapes.
- Northern Sector (excluding Muswellbrook Township): Environmental Zone E2 – Low district brightness areas.
- Northern Sector - Muswellbrook Township: Environmental Zone E3 – Medium district brightness areas.

The notes recommend that lighting for developments in Environmental Zone E1 – Intrinsically Dark Landscapes should have minimal illumination into the sky as well as to adjacent viewpoints in order to maintain the night-time setting.

4.6 SUMMARY OF VISUAL IMPACT

Following is a summary of the analysis process for the most sensitive, representative viewing points. The impact level of the Modification is shown prior to any amelioration and then for the period after completion of rehabilitation works, primarily consisting of surface shaping and cover crop and tree establishment (five years).

TABLE 11 – SUMMARY OF VISUAL IMPACT – PRIMARY VIEWPOINTS

Viewing Location	Sensitivity	Visual Modification Level	Initial Visual Impact	Final Visual Impact (Post Amelioration)
Sub-Regional Setting 1 – 5 km				
VP 5- Roxburgh Vineyard	**VL**	**L**	**VL**	**VL**
Regional Setting > 5km				
VP 1 - Roxburgh Road - Residence	**L**	**L - M**	**L**	**VL**
VP 2 - Racecourse	**L**	**L**	**L**	**VL**
VP 3 - South Muswellbrook	**L**	**M**	**L**	**VL**
VP 4 - Denman Road	**L**	**VL - No Impact**	**VL - No Impact**	**No Impact**
VP 6 - Golden Highway/Saddlers Creek	**L**	**VL - No Impact**	**VL - No Impact**	**No Impact**
(H = High, M = Moderate, L = Low, VL = Very Low)				

The elements of the Modification represent a relatively minor increase in the overall extent of the mine disturbance area – 240 ha in addition to an existing mine disturbance area of 6,400 ha.

The elements of the Modification are consistent with those of the approved mine in terms of form, colour and texture and are read visually as small extensions of the existing mine character.

The extension of the open cut, an element that is depressed below the ground plane, is generally not seen from surrounding areas due to the lack of accessible elevated viewpoints. From Viewpoint 1, the residence on Roxburgh Road, from which overlooking of the Modification area is possible, the only visible change will be a slight westwards extension in the open cut which is assessed as having a low impact.

The conveyor corridor overburden emplacement area is the most visible component of the Modification, visible from locations within the northern sector. From Viewpoint 2 – the Racecourse, the Mt Arthur Northern Open Cut overburden emplacement obscures views to most of the conveyor corridor overburden emplacement area. The visual impact is assessed as low. From Viewpoint 3 – the residential edge of South Muswellbrook, the conveyor corridor overburden emplacement area is at its most visible, however, the impact is assessed as low due to the distance of the viewpoint from the Modification.

The approved Southern Emplacement conceals views from the west and south to the conveyor corridor overburden emplacement. From Viewpoint 5 – Roxburgh Vineyard, the impact on views is assessed as very low due to the limited extent of the emplacement visible. From Viewpoint 4 – Denman Road, and Viewpoint 6 – Golden Highway/Saddlers Creek, there will be no impact on views as the approved southern out-of-pit emplacement conceals all views of the conveyor corridor overburden emplacement.

5 Cumulative Impacts

The assessment of cumulative visual impacts has considered the combined effects of the Modification with the effects of the proposed Drayton South Coal Project.

The proposed Drayton South Coal Project is located immediately south/adjacent to the Mt Arthur Coal Mining and Coal Lease boundary. The *Drayton South Coal Project Environmental Assessment* (Hansen Bailey, 2012) indicates the following with respect to potential visual impacts:

- The operational areas of the Drayton South Coal Project have been designed to remain behind existing topography in order to conceal them from views at the most sensitive locations to the south.

- A visual bund would be constructed to screen views to the operational areas. Receivers located to the south of the Drayton South Coal Project including residences within Jerrys Plains, parts of Coolmore Stud and motorists on the Golden Highway would experience views of the visual bund during construction. During this time (estimated 16 months) the visual impacts for these areas would be high, reducing to moderate and then low for the remainder of the Drayton South Coal Project.

- Since the dominant sources of light are located at the existing Drayton Mine, mobile equipment operating within the Drayton South Coal Project area would not significantly increase the overall diffuse light effect. Lighting impacts within the Drayton South Coal Project area would predominantly be caused by lights fitted to mobile equipment operating outside of active mining areas and in most cases, would be limited as a result of existing topography and vegetation.

The potential for cumulative visual impacts on sensitive viewpoints in the southern sector (including motorists on the Golden Highway) would be limited given the visual impacts assessed for viewpoints in these areas are low for both the Modification (Section 4.6) and proposed Drayton South Coal Project (following amelioration) (Hansen Bailey, 2012).

Based on review of the above, no significant cumulative visual impacts are anticipated to arise from the coincident development of the Modification and the proposed Drayton South Coal Project should it be approved.

As described in Section 4.5, the nature of night-lighting for the Modification is expected to be of a similar intensity when compared to the existing night-lighting at the Mt Arthur Coal Mine, although there is the potential for fixed and mobile lights to be visible from a wider area. If approved, the Drayton South Coal Project would result in limited night-lighting impacts (caused by lights fitted to mobile equipment operating outside of active mining areas) that may result in limited cumulative night-lighting impacts. For example, there may be increased night-time lighting effects on motorists using the Golden Highway.

6 Mitigation Measures and Management

The rehabilitation and final land use objectives for the mine landforms would continue to be managed in accordance with the methods currently in place at the Mt Arthur Coal Mine under the Environmental Management System and would be reviewed and updated for the Modification, subject to the conditions of any Project Approval.

6.1 PROGRESSIVE REHABILITATION

Progressive rehabilitation of mine emplacements would be undertaken in order to reduce the contrast between the Modification landforms and the surrounding environment. This would include progressive rehabilitation with selected grass, shrub and tree species. The final void would be generally screened from public view by the other mine landforms and surrounding visual bunding and screen planting.

6.2 FOREGROUND VEGETATION SCREENING

Vegetation screening areas, comprised of endemic plants that are compatible with the existing surrounding vegetation, could be considered to mitigate views from sensitive dwellings. Maintenance of the vegetation screens (e.g. addition and replacement of plants where required) should continue to be undertaken in these areas over the life of the Modification.

6.3 NIGHT-LIGHTING

Measures that would be employed to mitigate potential impacts from night-lighting would include one or more of the following, where relevant:

- Restriction of night-lighting to the minimum required for operations and safety requirements.
- Use of directional lighting techniques to direct light away from sensitive viewpoints.
- Use of light shields to limit the spill of lighting. Additional mitigation measures at affected residences such as screening, may be developed in consultation with individual landholders.

7 References

Brush, R.O. and Shafer, E.L. (1975) *Application of a Landscape-Preference Model to Land Management*. In *Landscape Assessment: Values, Perceptions and Resources* (eds. Zube, E.H., Brush, R.O. and Fabos, J.G.), p168-181, Halstead Press.

Hansen Bailey (2009) *Mt Arthur Coal Consolidation Project - Environmental Assessment*.

Hansen Bailey (2012) *Drayton South Coal Project Environmental Assessment*.

Integral (2009) *Mt Arthur Coal Consolidation Project, Visual Impact Assessment Study – Volume 1*.

United Kingdom The Institution of Lighting Engineers (2005) *Guidance Notes for the Reduction of Obtrusive Light*.

United States Department of Agriculture Forest Service (1974) *National Forest Landscape Management*, Volume 2, Chapter 1, The Visual Management System. Agricultural Handbook No. 462.

University of Newcastle (2002) *Visual Assessment of Windfarms Best Practice*. Scottish Natural Heritage Commissioned Report F01AA303A – page 13.

Zube, E.H., Anderson, T.W. and MacConnell, W.P. (1976) *Predicting Scenic Resource Values*. In: *Studies in Landscape Perception*. Edited by Ervin H.

8 Glossary of Terms

Absorptive Capability – An assessment of how well a landscape setting is able to accommodate change or a development

Amelioration – The ability to reduce the visual impact of a development through siting, design, colour or screening.

Viewer Perception – The way in which people respond to what they are seeing as influenced by things other than purely visual, – i.e. noise and economic benefits.

Viewshed – The area visible from a particular viewing location.

Visual Amenity – The qualities of a landscape setting that are appreciated and valued by a viewer.

Visual Impact – The result of assessing the sensitivity level of a viewer and the modification level of a development.

Visual Modification Level – The degree to which a development contrasts or blends with its setting.

Visual Sensitivity – The degree to which various user groups will respond to change based on their expectation of a particular experience in a given setting, i.e. the expectation of a high level of visual amenity in a national park.

Zone of Visual Influence (ZVI) – The area over which an object can be seen within the landscape

Appendix A Visibility Rationale

VISIBILITY – RELATIONSHIP WITH VIEWSHEDS

The report defines a number of viewsheds based on distance from the development for the purposes of assessment. The methodology is based on the reduction of impact with an increase in distance between a given viewpoint and the development. These viewsheds or settings are:

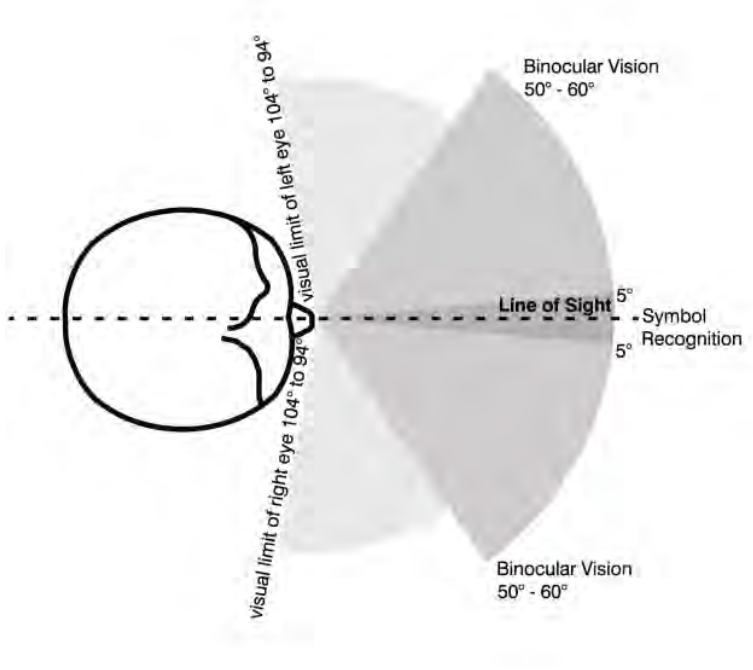
- **Local Setting** – up to 1 km from the development.
- **Sub-regional Setting** – between 1 km and 5 km from the development.
- **Regional Setting** – beyond 5 km of the development.

These distances have been established based on previous studies undertaken by Urbis. They are based on the reduction of visibility of objects in the distance as the field of view reduces.

HORIZONTAL LINE OF SIGHT

It is generally accepted that the central field of vision for the human eye covers a horizontal angle of approximately 50 degrees to 60 degrees. Given both eyes see simultaneously and that there is a degree of overlap, a central field of view results in a person looking straight ahead ***(Figure A.1).***

HORIZONTAL LINE OF SIGHT FIGURE A.1



In the production of visual simulations, a 50 mm lens on a 35 mm film format is most widely used as it captures a field of view of approximately 46 degrees, similar to that of the view from one eye. Two photos taken with a 50 mm lens produced as a panorama, with a degree of central overlap, capture the central field of view in a similar way to that of the human binocular view (binocular field).

Within the central field of vision, the viewed image is sharp, colours are separately defined and depth perception occurs.

VISUAL IMPACT/VISUAL PROMINENCE

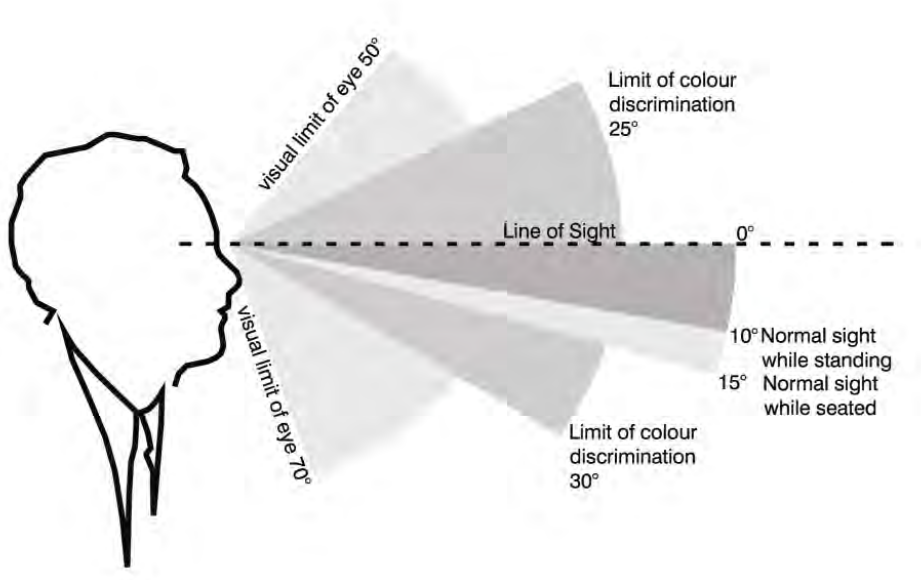
The potential visual impact of a development will, to a large extent, depend on how much of the central field of vision that it occupies. In relation to the assessment of mining sites that often extend across the landscape, the calculation of horizontal view angle is not the only factor to be considered.

DEGREES OF FIELD OF VIEW OCCUPIED	POTENTIAL VISUAL PROMINENCE – HORIZONTAL FIELD OF VIEW
Less than 5^o	**Insignificant** The development will not be highly visible in the view, unless it contrasts strongly with the background.
5^o – 30^o	**Potentially Noticeable** The development may be noticeable. The degree that it intrudes on the view will be dependent on how well it integrates with the landscape setting.
Greater than 30^o	**Potentially Dominant** The development will be highly noticeable.

VERTICAL LINE OF SIGHT

As for the horizontal line of sight, there is also a vertical central field of view. If we assume that the horizon is 0^o then the eye clearly defines colour, field of view and has image sharpness for an angle of approximately 25^o upwards and 30^o downwards. However, in reality, the typical line of sight for a standing person at ground level is approximately 10^o below the horizon line ***(Figure A.2).***

VERTICAL LINE OF SIGHT FIGURE A.2



VISUAL IMPACT/VISUAL PROMINENCE

Objects that occupy a small proportion of the vertical field of view are visible but not dominant, particularly when they occur within landscapes that have been modified by human activity.

DEGREES OF FIELD OF VIEW OCCUPIED	POTENTIAL VISUAL PROMINENCE – VERTICAL FIELD OF VIEW
Less than 0.5^{o}	**Insignificant** A small thin line in the landscape.
0.5^{o} – 2.5^{o}	**Potentially Noticeable** The development may be noticeable. The degree that it intrudes on the view will be dependent on how well it integrates with the landscape setting.
Greater than 2.5^{o}	**Potentially Dominant** The development will be highly noticeable, although the degree of visual intrusion will depend on the landscape setting and the width/ thickness of the object.

VISUAL PROMINENCE IN RELATION TO DISTANCE AND VIEWSHED SETTINGS

The following distances relating to visual prominence are based on the previous field of view exercises. The distances also relate to the distances for the setting types in the visual assessment methodology.

DISTANCE	POTENTIAL VISUAL PROMINENCE – DISTANCE
5000 m	**Insignificant** Visually insignificant.
1000 – 5000 m	**Potentially Noticeable** The development may be noticeable. The degree that it intrudes on the view will increase as distance reduces.
Less than 1000 m	**Potentially Dominant** The development will be highly noticeable.

Appendix B

Guidance Notes for the Reduction of Obtrusive Light

GUIDELINES PREPARED BY THE INSTITUTION OF LIGHTING ENGINEERS, UK.

The Institution of Lighting Engineers

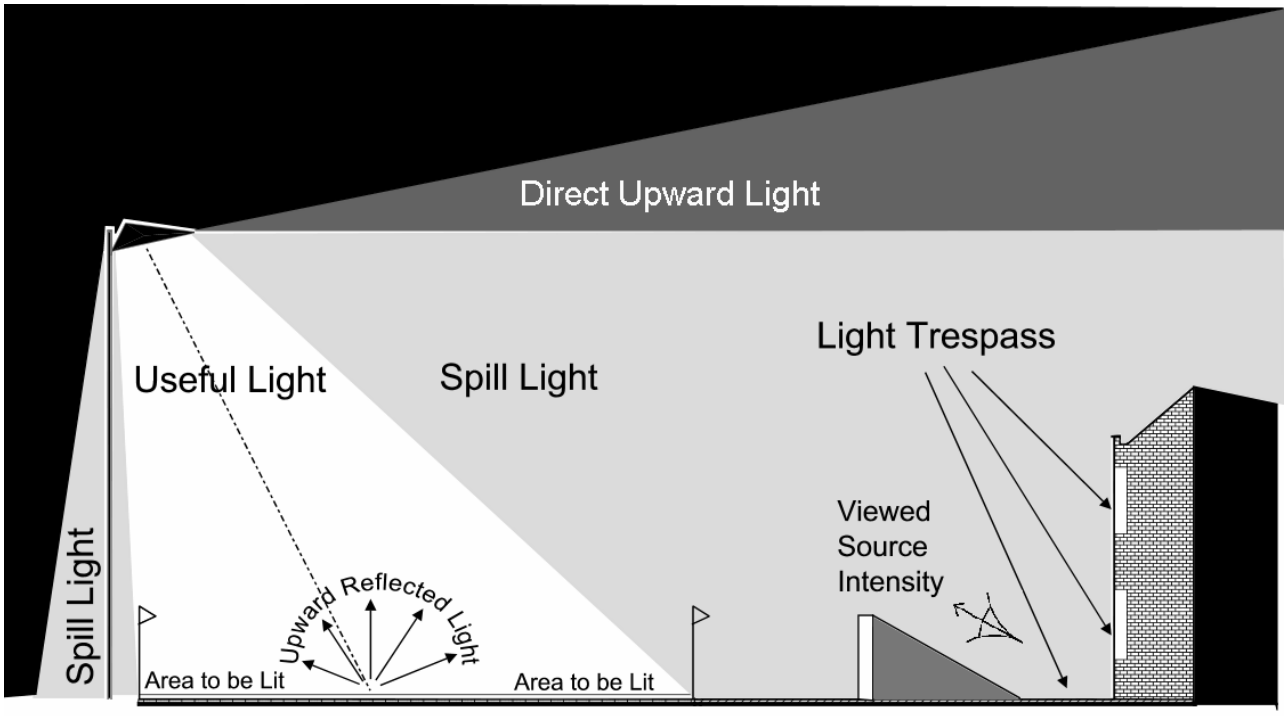
E-mail ile@ile.org.uk Website www.ile.org.uk

GUIDANCE NOTES FOR THE REDUCTION OF OBTRUSIVE LIGHT

ALL LIVING THINGS adjust their behaviour according to natural light. Man's invention of artificial light has done much to enhance our night-time environment but, if not properly controlled, **obtrusive light** (commonly referred to as light pollution) can present serious physiological and ecological problems.

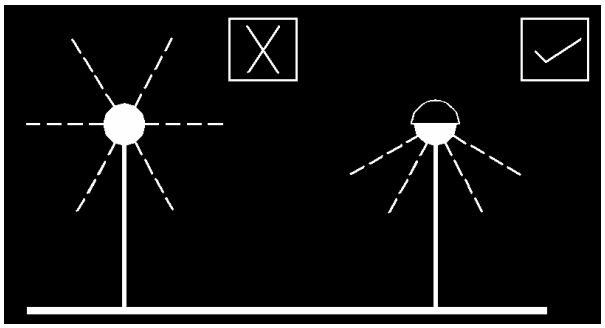
Obtrusive Light, whether it keeps you awake through a bedroom window or impedes your view of the night sky, is a form of pollution and can be substantially reduced without detriment to the lighting task.

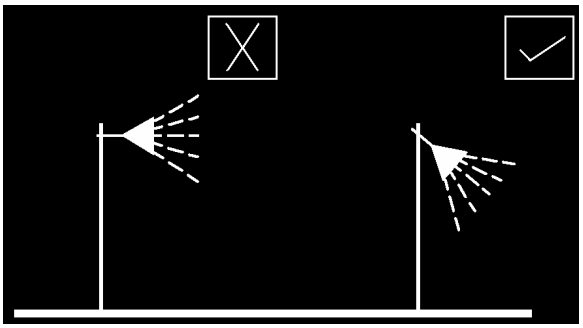
Sky glow, the brightening of the night sky above our towns, cities and countryside, **Glare** the uncomfortable brightness of a light source when viewed against a dark background, and **Light Trespass**, the spilling of light beyond the boundary of the property or area being lit, are all forms of obtrusive light which may cause nuisance to others, waste money and electricity and result in the unnecessary emissions of greenhouse gases. Think before you light. Is it necessary? What effect will it have on others? Will it cause a nuisance? How can I minimise the problem?



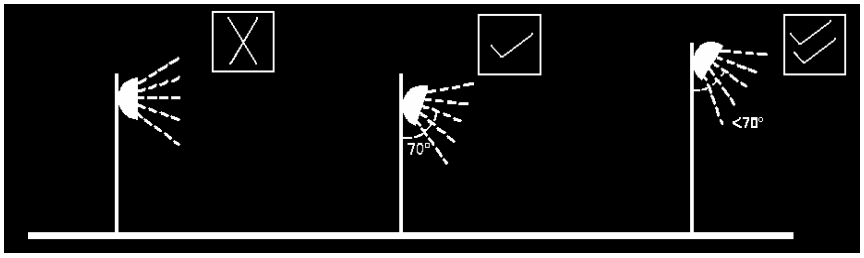
Do not "over" light. This is a major cause of obtrusive light and is a waste of energy. There are published standards for most lighting tasks, adherence to which will help minimise upward reflected light. Organisations from which full details of these standards can be obtained are given on the last page of this leaflet.

Dim or switch off lights when the task is finished. Generally a lower level of lighting will suffice to enhance the night time scene than that required for safety and security.



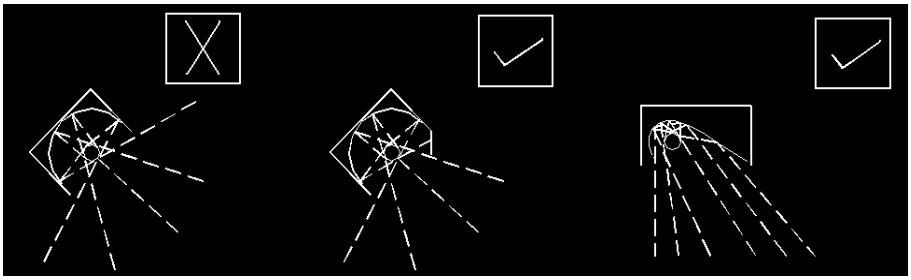


Use specifically designed lighting equipment that minimises the upward spread of light near to and above the horizontal. Care should be taken when selecting luminaires to ensure that appropriate units are chosen and that their location will reduce spill light and glare to a minimum. Remember that lamp light output in LUMENS is not the same as lamp wattage and that it is the former that is important in combating the problems of obtrusive light

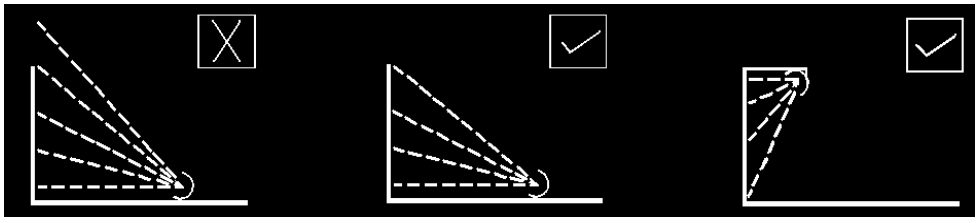


Keep glare to a minimum by ensuring that the main beam angle of all lights directed towards any potential observer is not more than 70°. Higher mounting heights allow lower main beam angles, which can assist in reducing glare. In areas with low ambient lighting levels, glare can be very obtrusive and extra care should be taken when positioning and aiming lighting equipment. With regard to domestic security lighting the ILE produces an information leaflet GN02 that is freely available from its web site.

The UK Government will be providing an annex to PPS23 Planning and Pollution Control, specifically on obtrusive light. However many Local Planning Authorities (LPA's) have already produced, or are producing, policies that within the new planning system will become part of the local development framework. For new developments there is an opportunity for LPA's to impose planning conditions related to external lighting, including curfew hours.



For sports lighting installations (see also design standards listed on Page 4) the use of luminaires with double-asymmetric beams designed so that the front glazing is kept at or near parallel to the surface being lit should, if correctly aimed, ensure minimum obtrusive light. In most cases it will also be beneficial to use as high a mounting height as possible, giving due regard to the daytime appearance of the installation. The requirements to control glare for the safety of road users are given in Table 2.



When lighting vertical structures such as advertising signs direct light downwards, wherever possible. If there is no alternative to up-lighting, as with much decorative lighting of buildings, then the use of shields, baffles and louvres will help reduce spill light around and over the structure to a minimum.

For road and amenity lighting installations, (see also design standards listed on Page 4) light near to and above the horizontal should normally be minimised to reduce glare and sky glow (Note ULRs in Table 1). In sensitive rural areas the use of full horizontal cut off luminaires installed at 0° uplift will, in addition to reducing sky glow, also help to minimise visual intrusion within the open landscape. However in many urban locations, luminaires fitted with a more decorative bowl and good optical control of light should be acceptable and may be more appropriate.

ENVIRONMENTAL ZONES:

It is recommended that Local Planning Authorities specify the following environmental zones for exterior lighting control within their Development Plans.

Category	Examples	
E1:	**Intrinsically dark landscapes**	National Parks, Areas of Outstanding Natural Beauty, etc
E2:	**Low district brightness areas**	Rural, small village, or relatively dark urban locations
E3:	**Medium district brightness areas**	Small town centres or urban locations
E4:	**High district brightness areas**	Town/city centres with high levels of night-time activity

Where an area to be lit lies on the boundary of two zones the obtrusive light limitation values used should be those applicable to the most rigorous zone.

DESIGN GUIDANCE

The following limitations may be supplemented or replaced by a LPA's own planning guidance for exterior lighting installations. As lighting design is not as simple as it may seem, you are advised to consult and/or work with a professional lighting designer before installing any exterior lighting.

Table 1 – Obtrusive Light Limitations for Exterior Lighting Installations

Environmental Zone	Sky Glow ULR [Max %] (1)	Light Trespass (into Windows) Ev [Lux] (2)		Source Intensity I [kcd] (3)		Building Luminance Pre-curfew (4)
		Pre- curfew	Post- curfew	Pre- curfew	Post- curfew	Average, L [cd/m2]
E1	0	2	1*	2.5	0	0
E2	2.5	5	1	7.5	0.5	5
E3	5.0	10	2	10	1.0	10
E4	15.0	25	5	25	2.5	25

ULR = **Upward Light Ratio of the Installation** is the maximum permitted percentage of luminaire flux for the total installation that goes directly into the sky.

Ev = **Vertical Illuminance in Lux** and is measured flat on the glazing at the centre of the window

I = **Light Intensity in Cd**

L = **Luminance in Cd/m2**

Curfew = **The time after which stricter requirements (for the control of obtrusive light) will apply**; often a condition of use of lighting applied by the local planning authority. If not otherwise stated - 23.00hrs is suggested.

***** = From Public road lighting installations only

(1) **Upward Light Ratio** – Some lighting schemes will require the deliberate and careful use of upward light – e.g. ground recessed luminaires, ground mounted floodlights, festive lighting – to which these limits cannot apply. However, care should always be taken to minimise any upward waste light by the proper application of suitably directional luminaires and light controlling attachments.

(2) **Light Trespass (into Windows)** – These values are suggested maxima and need to take account of existing light trespass at the point of measurement. In the case of road lighting on public highways where building facades are adjacent to the lit highway, these levels may not be obtainable. In such cases where a specific complaint has been received, the Highway Authority should endeavour to reduce the light trespass into the window down to the after curfew value by fitting a shield, replacing the luminaire, or by varying the lighting level.

(3) **Source Intensity** – This applies to each source in the potentially obtrusive direction, outside of the area being lit. The figures given are for general guidance only and for some sports lighting applications with limited mounting heights, may be difficult to achieve.

(4) **Building Luminance** – This should be limited to avoid over lighting, and related to the general district brightness. In this reference building luminance is applicable to buildings directly illuminated as a night-time feature as against the illumination of a building caused by spill light from adjacent luminaires or luminaires fixed to the building but used to light an adjacent area.

Table 2 – Maximum Values of Threshold Increment from Non-Road Lighting Installations				
Light Technical Parameter TI	**Road Classification** [5]			
	No road lighting	ME5	ME4/ ME3	ME2 / ME1
	15% based on adaptation luminance of 0.1cd/m^2	15% based on adaptation luminance of 1cd/m^2	15% based on adaptation luminance of 2 cd/m^2	15% based on adaptation luminance of 5 cd/m^2

TI = **Threshold Increment** is a measure of the loss of visibility caused by the disability glare from the obtrusive light installation

(5) **Road Classifications** as given in BS EN 13201 - 2: 2003 Road lighting Performance requirements
Limits apply where users of transport systems are subject to a reduction in the ability to see essential information. Values given are for relevant positions and for viewing directions in path of travel. See CIE Publication 150:2003, Section 5.4 for methods of determination. For a more detailed description and methods for calculating and measuring the above parameters see CIE Publication 150:2003.

RELEVANT PUBLICATIONS AND STANDARDS:

British Standards: www.bsi.org.uk	BS 5489-1: 2003 Code of practice for the design of road lighting – Part 1: Lighting of roads and public amenity areas BS EN 13201-2:2003 Road lighting – Part 2: Performance requirements BS EN 13201-3:2003 Road lighting – Part 3: Calculation of performance BS EN 13201-4:2003 Road lighting – Part 4: Methods of measuring lighting performance. BS EN 12193: 2003 Light and lighting – Sports lighting	
Countryside Commission/DOE www.odpm.gov.uk	Lighting in the Countryside: Towards good practice (1997) *(Out of Print)*	
CIBSE/SLL Publications: www.cibse.org	CoL LG1 LG4 LG6 FF7	Code for Lighting (2002) The Industrial Environment (1989) Sports (1990+Addendum 2000) The Exterior Environment (1992) Environmental Considerations for Exterior Lighting (2003)
CIE Publications: www.cie.co.at	01 83 92 115 126 129 136 150 154	Guide lines for minimizing Urban Sky Glow near Astronomical Observatories (1980) Guide for the lighting of sports events for colour television and film systems (1989) Guide for floodlighting (1992) Recommendations for the lighting of roads for motor and pedestrian traffic (1995) Guidelines for minimizing Sky glow (1997) Guide for lighting exterior work areas (1998) Guide to the lighting of urban areas (2000) Guide on the limitations of the effect of obtrusive light from outdoor lighting installations (2003) The Maintenance of outdoor lighting systems (2003)
Department of Transport www.defra.gov.uk		Road Lighting and the Environment (1993) (Out of Print)
ILE Publications: www.ile.org	TR 5 TR24 GN02	Brightness of Illuminated Advertisements (2001) A Practical Guide to the Development of a Public Lighting Policy for Local Authorities (1999) Domestic Security Lighting, Friend or Foe
ILE/CIBSE Joint Publications ILE/CSS Joint Publications		Lighting the Environment - A guide to good urban lighting (1995) Seasonal Decorations – Code of Practice (2005)
Campaign for Dark Skies (CfDS) www.dark-skies.org		

NB: These notes are intended as guidance only and the application of the values given in Tables 1 & 2 should be given due consideration along with all other factors in the lighting design. Lighting is a complex subject with both objective and subjective criteria to be considered. The notes are therefore no substitute for professionally assessed and designed lighting, where the various and maybe conflicting visual requirements need to be balanced.