EMGA Mitchell McLennan

Compliance Lighting Audit

Prepared for Liddell Coal Operations Pty Ltd | 10 June 2015

Planning + Environment + Acoustics

Compliance Lighting Audit

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Compliance Lighting Audit

Final

Report J15042RP1 | Prepared for Liddell Coal Operations Pty Ltd | 10 June 2015

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1 Introduction

1.1 Background

Liddell Coal Operations Pty Ltd (Liddell Coal) is an existing open-cut coal mine in the Hunter coalfield in the upper Hunter Valley of NSW.

Liddell Coal is approximately 25 kilometres (km) north-west of Singleton in the Upper Hunter Valley of New South Wales. The site is within the Singleton local government area (LGA). The area surrounding the mine is dominated by mining and power generating infrastructure and activities (see Figure 1.1). This includes Ravensworth Operations to the south, Ravensworth Underground Mine and the Ravensworth Central Coal Processing (RCCP) facility to the south-west, and the Mt Owen Complex (incorporating Mt Owen, Ravensworth East and Glendell mining operations) to the east. Other mines in the wider surrounding area include Ashton Coal, Integra and Hunter Valley Operations. Bayswater and Liddell Power Stations are west and north-west of the mine respectively.

1.2 Purpose of this report

This Compliance Lighting Audit (CLA) has been commissioned by Liddell Coal for the purpose of reviewing compliance with Condition 34 Schedule 2 of its development consent (DA 305-11-01), which states:

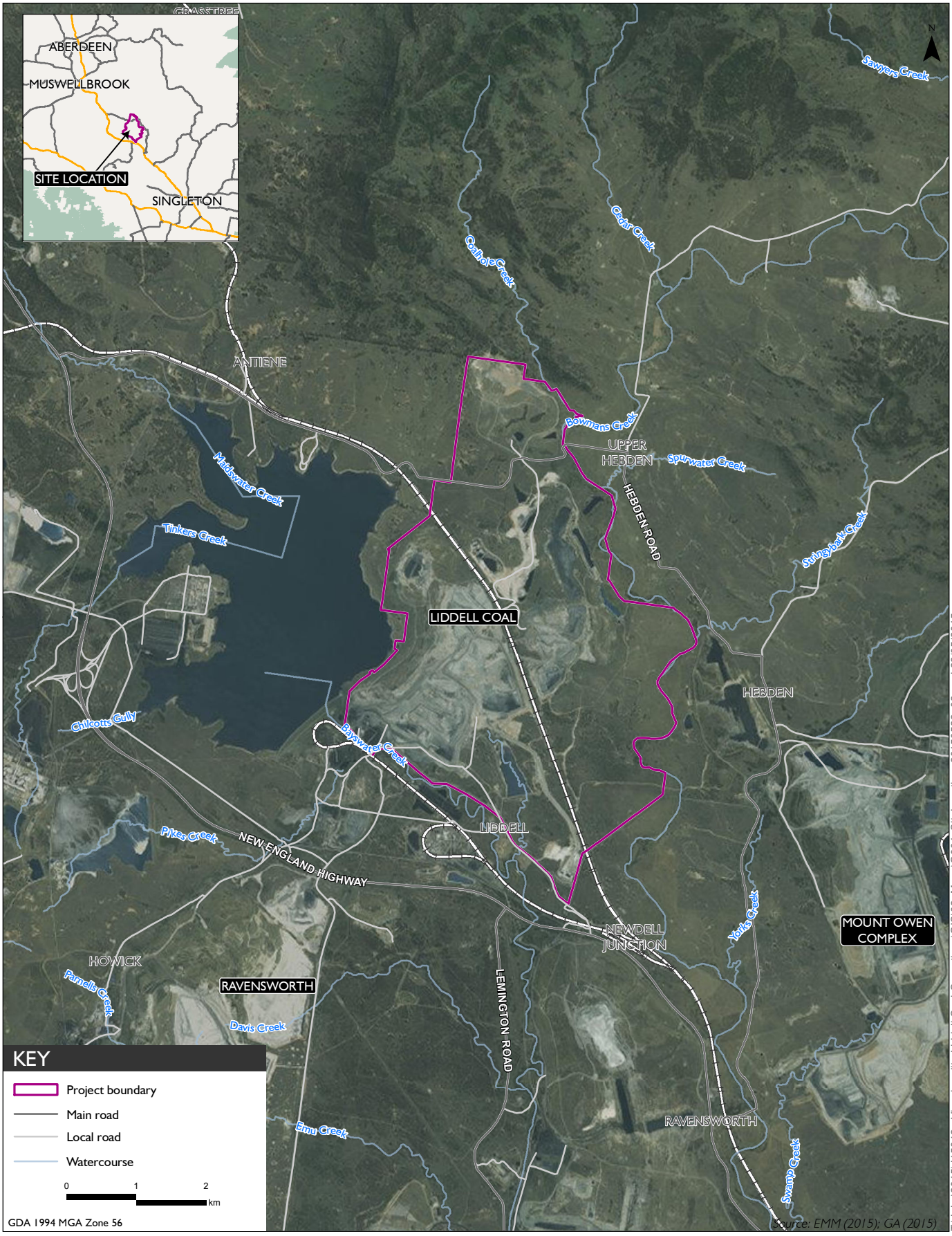
> Visual Amenity and Lighting
>
> 34. The Applicant shall:
>
> (a) implement all reasonable and feasible measures to mitigate visual and off-site lighting impacts from the development;
>
> (b) ensure no outdoor lights shine above the horizontal;
>
> (c) undertake screen plantings along the western boundary of the proposed office and workshop area to further minimise potential visual impacts on the New England Highway; and
>
> (d) ensure that all external lighting associated with the development complies with Australian Standard AS4282 (INT) 1995 – Control of Obtrusive Effects of Outdoor Lighting, to the satisfaction of the Secretary.

It should be noted that Condition 34(c) was not investigated whilst on site and is not addressed in this CLA. During this CLA, Liddell Coal has demonstrated an interest to improve on-site lighting wherever safe to do so with an overall objective to reduce possible lighting effects of its operation on surrounding private landowners and users of surrounding public roads.

1.3 Report structure

The CLA has been prepared by EMGA Mitchell McLennan Pty Limited (EMM) to ensure that all internal lighting associated with the development complies with AS4282. The components of the CLA are:

- Chapter 2 provides a summary of the scope of the audit and the methodology used in the assessment;
- Chapter 3 describes the current lighting sources associated with the operations and the potential lighting impacts to external sensitive receptors;
- Chapter 4 provides a qualitative and quantitative assessment of the visual impacts of existing lighting structures at Liddell Coal on external sensitive receptors and provides recommendations for improvements to lighting where considered appropriate and practical;
- Chapter 5 summarises the audit findings; and
- Appendix A provides a photolog taken during the CLA.



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Local setting
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Figure 1.1

2 Scope of audit

2.1 Development consent conditions

This CLA has been prepared to assist in ensuring Liddell Coal's compliance with Schedule 3, Condition 34 of the development consent. The relevant conditions are detailed in Section 1.2.

2.2 AS 4282 (1997) – Control of Obtrusive Effects of Outdoor Lighting

Australian Standard 4282 (1997) Control of Obtrusive Effects of Outdoor Lighting (AS 4282), which replaced AS 4282 (INT) 1995, is used to provide a basis for assessment of the impacts of proposed and existing lighting on neighbouring land uses. AS 4282 seeks to limit the impact of proposed or existing lighting on occupants of surrounding dwellings and transport users in the vicinity of the relevant lighting installations. In particular, potential lighting impacts include:

(2) Changes to the amenity of an area due to the intrusion of light spill into otherwise dark areas, both outdoors and indoors, and to the direct view of bright luminaires;

(3) A reduction in the ability of transport system users to see essential details of the route ahead, including signalling systems, due to glare from bright luminaires; and

(4) Changes to night sky viewing conditions due to general luminous glow, i.e. skyglow, caused by the scattering of light in the atmosphere.

Table 2.1 outlines the technical parameters which light from a particular source should meet to ensure effects of lighting is kept within acceptable limits.

Table 2.1 Recommended maximum values of light technical parameters for the control of obtrusive light

Light technical parameter	Application or calculation conditions	Recommended maximum values		
		In commercial areas or at boundary of commercial and residential areas[1]	Residential Areas	
			Light surrounds[2]	Dark surrounds[3]
Illuminance in the vertical plane (E_v)	Pre curfew[4]: Limits apply at relevant boundaries of nearby residential properties, in a vertical plane parallel to the relevant boundary, to a height commensurate with the height of the potentially affected dwellings. Values given are for the direct component of illuminance.	25 lx	10 lx	10 lx

Table 2.1 Recommended maximum values of light technical parameters for the control of obtrusive light

Light technical parameter	Application or calculation conditions	Recommended maximum values		
		In commercial areas or at boundary of commercial and residential areas[1]	Residential Areas	
			Light surrounds[2]	Dark surrounds[3]
	Curfewed hours[4]: Limits apply in the plane of the windows of habitable rooms of dwelling on nearby residential properties. In the absence of development (i.e. vacant allotment), the limits apply on the potentially affected property, in a vertical plane parallel to the relevant boundary, at the minimum setback permitted for a dwelling, to a height commensurate with land use zoning provisions. Values given are for the direct component of the illuminance.	4 lx	2 lx	1 lx

Notes: *1.Applies to residential accommodation in commercial areas or at the boundary between commercial and residential areas.*

2. Where the affected property abuts roads that are lit to Category V5 or higher in accordance with AS/NZS 1158.1.

3. Where the affected property abuts roads that are lit to Category B1 or lowers in accordance with AS 1158.1, or where there is no lighting.

4. AS 4282 recognises 'pre curfew' as being between the hours of 6am and 11pm and 'curfewed hours' as being 11pm to 6am.

Table 2.2 outlines recommended maximum lux values for light illuminating from a given source to a receiving location. Lux is a metric unit for measuring the amount of light that falls on an object. Table 2.2 illustrates a rough threshold for common lighting conditions, and is provided only to give context to the requirements of AS4282.

Table 2.2 Illustration of lux levels under various lighting conditions

Lighting condition	From (lux)	To (lux)	Mean value (lux)
Pitch black	0	10	5
Very dark	11	50	30
Dark indoors	51	200	125
Dim indoors	201	400	300
Normal indoors	401	1,000	700
Bright indoors	1001	5,000	3,000
Dim outdoors	5,001	10,000	7,500
Cloudy outdoors	10,001	30,000	20,000
Direct sunlight	30,001	100,000	65,000

Source: *Windows Development Centre: Understanding and interpreting lux values (2012).*

The applicable criteria at sensitive receptors relevant to lighting at the mine as stated in Table 2.1 requires that illuminance should be limited to 10 lx before 11:00 pm and 1 lx between the hours of 11:00 pm and 6:00 am.

2.3 Compliance assessment methodology

i Field measurements

In order to assess the impacts of existing lighting on neighbouring land uses, EMM conducted field measurements at various viewpoints surrounding the mine to gain representative lighting samples from sensitive receptors.

The field measurements were conducted during hours of darkness on 14 May 2015 between 7:30 pm and 9:30 pm to represent periods of darkness where light spill could create disturbance to occupants of surrounding dwellings or user of public roads. The field measurements were undertaken on nights with clear skies and no visible moonlight.

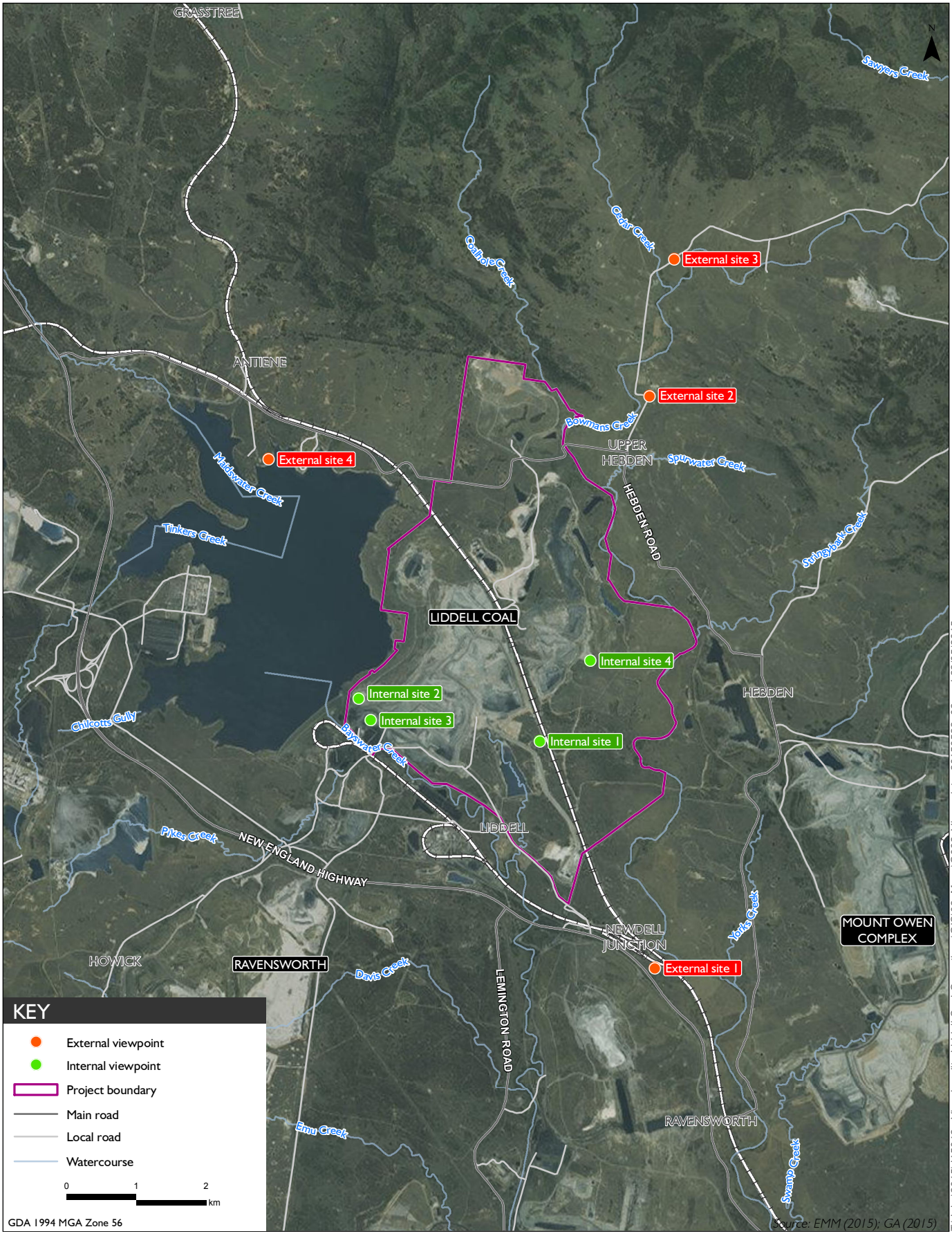
Field measurements were conducted using a Testo 545 Lux meter which was calibrated by a NATA accredited laboratory. Three separate readings were taken at each location to ensure accuracy of measurement.

In addition to the lux readings, a qualitative 'line of sight' assessment was undertaken to analyse the potential obtrusive effects of lighting associated with Liddell Coal's operations. This assessment considered both the impacts of individual lighting structures visible from each viewpoint, as well as the cumulative effects of all lighting structures visible from a given viewpoint.

ii Viewpoints

A visual assessment was prepared in 2013 by SLR as part of a recently approved application from Liddell Coal to modify its development consent for a small extension of mining. The assessment analysed impacts from five viewpoints which were considered significant due to potential impacts to that specific receptor or were considered representative of views to the mine activities from a particular area. Selection of the viewpoints had regard for landscape, sensitivity of viewer location and the nature of mine activities visible from a given point.

To ensure consistency and ease of comparison against the visual assessment, this CLA has utilised three of the five visual receptor locations. The two unused locations are relevant for the (now approved) extension area yet to commence extraction. For this reason the two viewpoints where deemed unnecessary for this CLA. The locations of the viewpoints used for this assessment are shown in Figure 2.1.



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Assessment viewpoints

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Figure 2.1

3 Lighting sources and potential impacts

There are a number of different lighting sources that form part of the mine. The general location of these light sources is illustrated in Figure 3.1. Table 3.1 provides a description of lighting sources, the type of lighting structures associated with different areas, and the potential impacts from these sources.

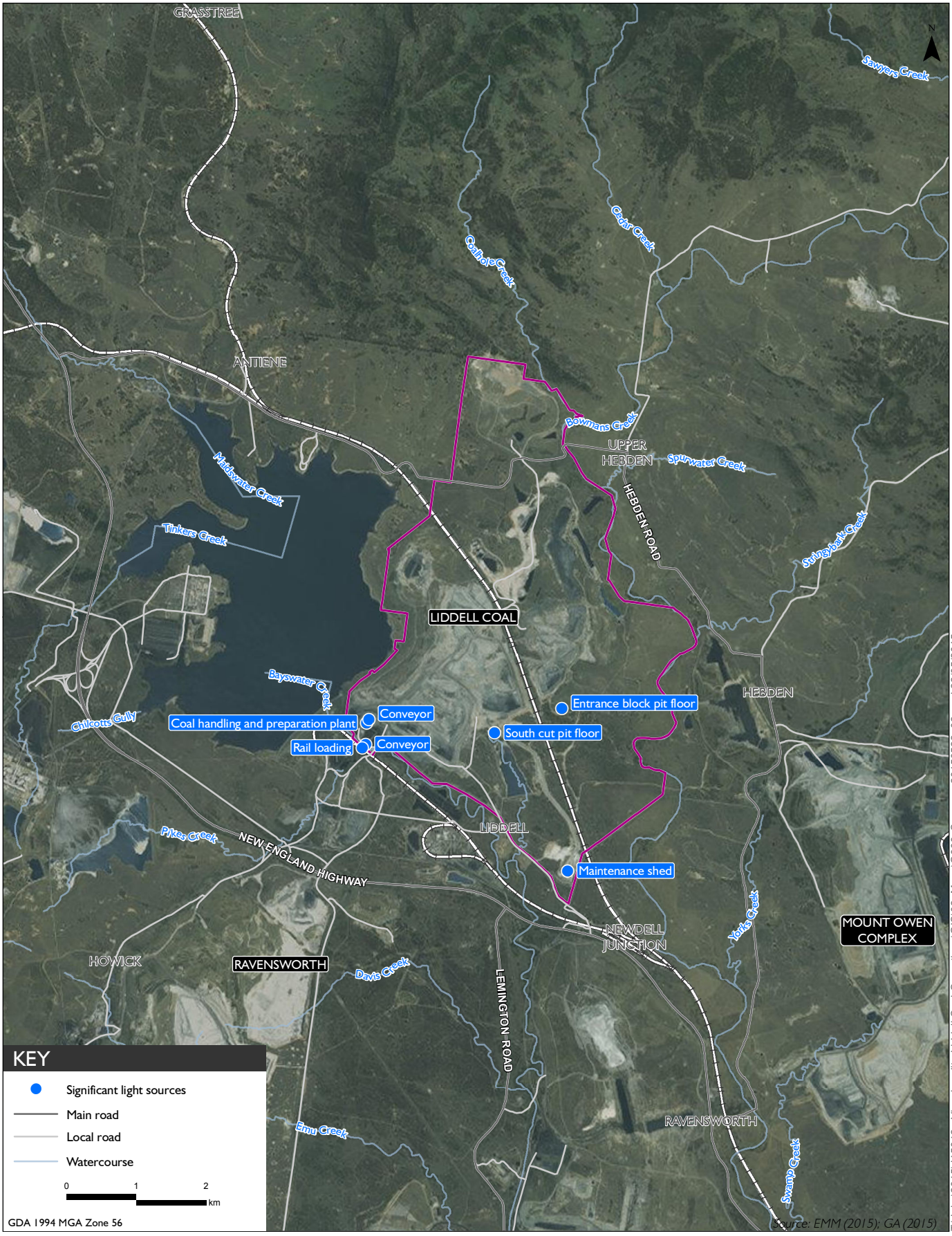
Table 3.1 Lighting sources and potential impacts

Lighting source	Lighting type	Potential impact
Mine pit	Temporary lighting plant	Contribution to sky glow
	Fixed lights to excavators	
	Headlights to haul truck	
Overburden emplacement areas	Temporary lighting plant	Indirect light spill to external areas
	Headlights to haul trucks	Contribution to sky glow
CHPP and ROM stockpile	Temporary lighting plant	Indirect light spill to external areas
	Headlights to haul trucks and loaders	Contribution to sky glow
	Permanent light structures	
	Fixed lighting to CHPP buildings	
Product stockpile	Permanent lighting structures to stockpiles	Direct light spill to external receptors
		Indirect light spill to external receptors
		Contribution to sky glow
Maintenance area and sheds	Fixed lighting to workshop	Direct light spill to external receptors
	Permanent lighting structures surrounding workshop	Indirect light spill to external receptors
Conveyors	Fixed lighting on conveyors	Direct light spill to external receptors
		Indirect light spill to external receptors
		Contribution to sky glow
Rail loader	Fixed lighting to loading bin	Indirect light spill to external receptors
Rail movements	Lighting to locomotives	Direct light spill to external receptors
		Indirect light spill to external receptors

3.1 Lighting types

Two types of light fittings are utilised at the mine; metal halide and high pressure sodium (HPS) lamps.

Metal halide lamps emit a strong white light and provide good colour rendering and are used in areas of high machinery activity, such as within the open pits, overburden emplacement facilities ROM stockpile and product stockpiles. Metal halide lamps which are used in these areas for operational safety reasons, have the potential to emit more light spill and nuisance to external viewers due to the intense white light they create. Metal halide lighting sources on site are either in the form of free-standing light pole structures or portable lighting plant.



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Lighting sources
Liddell Coal Operations
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Figure 3.1

HPS lamps emit a softer orange light than the intense white light of the metal halide. HPS lighting is used at the mine where mobile machinery activity is not as significant and therefore lighting intensity is not as much as a safety requirement. HPS lighting is generally free-standing lighting structures around the workshops and infrastructure areas or attached buildings, such as the CHPP, maintenance area and sheds. HPS lighting is extensively used along the conveyor system and rail loader.

Lighting types at the mine can be divided into four broad categories. These categories are:

- free-standing lighting structures;
- light fitting attached to infrastructure and buildings;
- temporary lighting plant; and
- lighting attached to mobile mine machinery such as haul trucks, excavators and loaders.

3.1.1 Free-standing lighting structures

Free-standing light structures are common in operational areas such as the ROM and product stockpile areas, as the height of towers allows significant areas to be illuminated with minimal fittings. These types of structures, however, if not positioned correctly can result in significant light spill. Examples of the light towers are shown around the product stockpile in Photograph 3.1.

Photograph 3.1 Large free-standing lighting structures to product stockpiles

3.1.2 Fixed lighting

Fixed lighting structures are common around the workshops and infrastructure areas and provide lighting for safe movement of vehicles and personnel. Fittings of this type are for the most part shrouded similarly to the fitting seen attached to the workshop in Photograph 3.2, to ensure the beam is directed downward to light only the area below.

Photograph 3.2 Fixed lighting structures

3.1.3 Temporary mobile lighting plant

Temporary lighting plants are used around the mine to provide targeted light to operational areas with the benefit that they can be relocated and repositioned according to need. Temporary lighting plants, such as the type shown in Photograph 3.3 can, if positioned correctly, offer effective light without unwanted light spill to external receptors.

Photograph 3.3 **Temporary lighting plant used to illuminate work area in the pit and overburden dumps**

3.1.4 Machinery lighting

Lighting incorporated in to machinery such as excavators, haul trucks and loaders provided direct lighting on the workspace and reduce the need for additional lighting. LED lighting, such as the type fitted to the haul truck shown in Photograph 3.4, provide targeted lighting that eliminates light spill from the work area. Light to haul trucks further reduces the need for lighting along haul road which would create the potential for further contributions to skyglow.

Photograph 3.4 **Lighting on excavators and haul trucks reduce need for additional lighting**

4 Assessment of lighting impacts

4.1 Viewpoint lighting assessment

A visual inspection of each viewpoint was carried out on 14 May 2015 for a quantitative and qualitative assessment of impacts of existing lighting structures at the mine. In undertaking this assessment, a lux reading was taken at external viewpoints to determine compliance with the requirements of AS 4282 and qualitative analysis of the light spill (both direct and indirect), as well as the contribution to skyglow.

Field measurement results are illustrated in Table 4.1.

Table 4.1 Measured lighting values taken at viewpoint assessment locations

External viewpoint	Distance to nearest lighting source	Nearest light source	Direction to light source	Time of reading	Allowable criteria (lx)	Value (lx)
Ex VP1	1.8 km	Maintenance area and sheds	North-west	9:25pm	1	0
Ex VP2	4.6 km	Entrance Block pit	South-west	9:05pm	1	0
Ex VP3	6.5 km	Entrance Block pit	South-west	9:15pm	1	0
Ex VP4	4.1 km	Railing loading, CHPP and South cut pit	South-east	8:55pm	1	0

Results for the field measurement showed no exceedances of criteria from lighting associated with the mine. Illuminance at all locations was of a level that meant a positive reading was not possible and therefore well within the acceptable levels for both pre-curfew and curfewed hours.

4.2 Qualitative assessment of lighting impacts from external viewpoints

4.2.1 External viewpoint 1 – New England Highway

At a distance of approximately 1.8 km from the maintenance area and sheds, VP1 is a representative receptor for the New England Highway. From this location, lighting associated with the maintenance area and sheds is evident but unobtrusive. The light fittings associated with these are predominantly of the HPS type that emits a soft light. The number of light fittings associated with the mine infrastructure area and workshops, results in a large soft band of orange illumination in the viewscape from VP1 at night.

The most prominent lighting evident from this viewpoint is skyglow. It is noted that the inspection was undertaken on a night with clear skies. Skyglow is more prevalent when cloud cover is present.

During times when maintenance is not occurring or the workshop is shutdown, Liddell Coal could review the necessary lighting in order to reduce the amount of light spill from this area.

Photograph 4.1 **View taken from external viewpoint 1 facing north-west towards the maintenance area and sheds**

4.2.2 External viewpoint 2 – Residential receptor 1

At a distance of approximately 4.6 km to the nearest lighting source, any direct views of lighting structures are obscured by the presence of a ridge which sits between the mine and this viewpoint. This viewpoint represents the closest residential receptor to the mine.

A negligible level of skyglow was present at this location at the time of inspection. No improvements are currently required to address lighting impacts from the viewpoint.

Photograph 4.2 **View taken from external viewpoint 2 facing south-west towards the Entrance Block pit**

4.2.3 External viewpoint 3 – Residential receptor 8

At a distance of approximately 6.5 km, this viewpoint represents the highest residential receptor in Hebden and to the north-east of the mine. As can be seen in Photograph 4.3, no lighting structures are visible from the mine and skyglow is negligible.

No improvements are currently required to address lighting impacts from the viewpoint.

Photograph 4.3 **View taken from external viewpoint 3 facing south-west towards the Entrance Block pit**

4.2.4 External viewpoint 4 – Lake Liddell recreational area

At a distance of approximately 4.1 km the nearest lighting source to the Lake Liddell recreational area is the CHPP and South Cut pit. Photograph 4.4 shows HPS skyglow emitted from lighting at the CHPP and metal halide skyglow from operations in the Entrance and South Cut pits.

It is noted that the inspection was undertaken on a night with clear skies and skyglow is more prevalent when cloud cover is present however the reflection from Lake Liddell also contributes to the overall affect. Nevertheless, results for this location from the Lux meter show compliance with the relevant criteria.

No improvements are currently required to address lighting impacts from the viewpoint.

Photograph 4.4 **View taken from external viewpoint 4 facing south-east towards the Entrance Block pit**

4.3 Review of lighting from internal viewpoints

An internal viewpoint review was completed whilst on site to determine areas that emit the most light and identify areas that have potential to reduce their lighting impacts. These areas are discussed below.

4.3.1 Internal viewpoint 1 – South Cut pit

Internal viewpoint 1 is adjacent a haul road overlooking the South Cut pit. From this location, the South Cut pit, CHPP, maintenance area and sheds and other mining operations in the Hunter Valley are visible.

It is evident from this location that portable lighting towers and lighting on haul trucks is deep within the pit and unlikely to significantly contribute to light spill. The portable lighting was illuminating active mining areas only and haul roads were not lit. No lighting was evident on top of stockpiles or ridges.

The most significant light contributor identified from this location was the maintenance area and sheds. It was also evident from this location that other mining operations and the Bayswater and Liddell Power Stations contribute to skyglow in the immediate area.

Given Liddell Coal is complying with relevant criteria, no recommendations are proposed for this area.

Photograph 4.5 South Cut pit from internal viewpoint 1

4.3.2 Internal viewpoint 2 – CHPP

Internal viewpoint 2 overlooks the CHPP from the north. Generally, CHPP on mine sites are well lit areas so therefore, the CHPP was a focus of the CLA.

Although well lit with lighting on buildings, conveyors, light towers and the rail loading facility; the mine's CHPP is at a low reduced level with large ridges to the north and west. For this reason the CHPP is not directly visible from the closest sensitive receptors to the north and north-west. The CHPP may only be directly visible to infrequent transient receptors on the Old Hume Highway.

Lighting at the CHPP was appropriate and installed at the correct angles. To verify this, a lux reading was taken and returned a result of 0. Therefore, no recommendations are necessary for this area. It should be noted however, similar to internal viewpoint 1, the maintenance area and sheds look to be the most significant contributor of lighting at the mine.

Photograph 4.6 CHPP from internal viewpoint 2

4.3.3 Internal viewpoint 3 – CHPP

Internal viewpoint 3 was taken from within the CHPP to closer inspect the lighting within the area. Lighting was installed at the correct angles and appropriate. No recommendations are suggested for this area.

Photograph 4.7 CHPP from internal viewpoint 3

4.3.4 Internal viewpoint 4 – Entrance Block pit

Internal viewpoint 4 was taken overlooking the Entrance Block pit from the north. This viewpoint was the most indicative of the residential receptors to the north at Hebden.

No in pit activities were visible from this viewpoint given the depth of operations. The ridge from where this viewpoint is located provides screening from direct light to all external receptors.

No recommendations are required for this area.

Photograph 4.8 Entrance Block pit from internal viewpoint 4

4.3.5 Internal viewpoint 5 – Maintenance area and sheds

From a variety of vantage points on the mine it was evident that the maintenance area and sheds produce the most light and contribute to skyglow. This was amplified by it being topographically prominent at the mine.

Given the high traffic volumes in the area, lighting around the maintenance area and sheds is required for safety. No external viewpoints were quantifiably impacted from the maintenance area and sheds nor is the area directly visible.

Although the maintenance area and sheds emit the most light from the mine, the current operations are complying with relevant criteria and there have been no recorded complaints regarding lighting. Therefore, no recommendations are proposed for this area.

Photograph 4.9 Maintenance area and sheds

5 Conclusion

The field measurements and assessment undertaken found that illuminance at all viewpoints were well within the allowable criteria set out under Condition 34 Schedule 2 of development consent (DA 305-11-01).

The qualitative assessment undertaken from each external viewpoint supported the field measurements with little direct lighting visible and only unobtrusive skyglow from the CHPP and maintenance area and sheds.

The CLA found that operations at the mine are meeting the requirements of their approval which includes the requirements of Condition 34 Schedule 2 of development consent (DA 305-11-01). Given Liddell Coal is complying with relevant criteria and there have been no recorded complaints regarding lighting, no recommendations are currently proposed for the mine.

Appendix A

Photo log

Table A.1 Photolog

	Internal site 1 (day) facing south over the South Cut pit
	Internal site 1 (day) facing south-east over the South Cut pit
	Internal site 1 (night) facing south over South Cut pit

Table A.1 Photolog

	Internal site 1 (night) facing south-east over the South Cut pit towards the maintenance area and sheds
	Internal site 2 (day) facing south-west over CHPP
	Internal site 2 (day) facing south-west over CHPP

Table A.1 Photolog

	Internal site 2 (night) facing south-east over CHPP
	Internal site 2 (night) facing south-east over ROM stockpiles
	Internal site 2 (night) facing south-east over CHPP

Table A.1 Photolog

	Internal site 3 (day) facing south towards CHPP
	Internal site 3 (day) lighting on conveyor

Table A.1 Photolog

	Internal site 3 (day) light tower at CHPP

Table A.1 Photolog

	Internal site 3 (day) building lighting below horizontal
	Internal site 3 (night) facing south towards CHPP
	Internal site 3 (night) facing south-east towards CHPP

Table A.1 Photolog

	Internal site 4 (day) facing south-west
	Internal site 4 (day) facing west south-west
	Internal site 4 (day) facing west north towards external viewpoints 2 and 3

Table A.1 Photolog

	Maintenance area and shed (day)
	Maintenance area and shed (night)
	Maintenance area and shed (night)

Table A.1 Photolog

	Internal site 4 (night) facing south-west
	External viewpoint 1 (day) facing north-west towards the mine
	External viewpoint 1 (night) facing north-west

Table A.1 Photolog

	External viewpoint 2 (day) facing south
	External viewpoint 2 (day) facing south-west
	External viewpoint 2 (night) facing south-west

Table A.1 Photolog

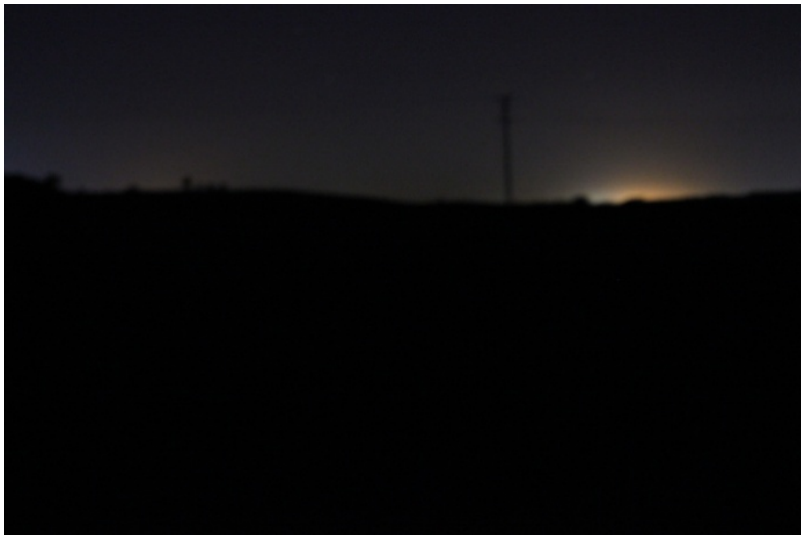
	External viewpoint 3 (day) facing south-west
	External viewpoint 3 (night) facing south-west
	External viewpoint 4 (day) facing south-east

Table A.1 Photolog

	External viewpoint 4 (night) facing south south-east

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