15.0 Landscape and visual amenity

This chapter provides an assessment of the potential impacts of the Project on the landscape character and visual amenity of the Project Site and surrounding area. This assessment is supported by the Landscape and Visual Impact Assessment (LVIA) Methodology and Criteria which is provided in Appendix O.

15.1 Director General's Requirements

The assessment of visual impacts addresses the DGRs as detailed in Table 15.1.

Table 15.1 DGRs for the assessment of landscape and visual amenity

DGRs - Landscape and Visual Amenity
Visual – including: - height, scale, signage and lighting, particularly from: • Nearby public receivers; and • Significant vantage points of the broader public domain.

Construction of the Project has the potential to adversely affect the landscape character and visual amenity of the area. The Project would result in the addition of an industrial complex within the existing rural setting including some elements which would be visually prominent from many locations due to the generally flat landscape.

This assessment includes:

- A review of the existing landscape and visual amenity values
- An assessment of potential impacts the Project may have on landscape and visual amenity
- Recommendations to mitigate potential impacts.

15.2 Methodology

The assessment was based on a desktop assessment of the existing environment and a site visit to the Project Site. Referenced information includes:

- Information provided by Dongmun Greentec
- Digital imagery captured by AECOM staff during the site visit (1 and 2 June 2015).

No surveying or consultation with stakeholders was undertaken to prepare this assessment.

The approach was designed to gather suitable information in order to assess the potential impacts arising from Project activities and, where relevant, provide mitigation measures.

15.2.1 Landscape character and visual amenity

There are currently only limited national or state level guidelines for LVIA in Australia. Therefore, the approach to this LVIA has been developed with reference to:

- The Landscape Institute and the Institute of Environmental Management and Assessment, UK (2002) *Guidelines for Landscape and Visual Impact Assessment, Second Edition* (2002)
- *Guidance Notes for Reduction of Obstructive Lighting* , The Institution of Lighting Engineers UK *Australian (2005)*
- *Australian Standard 4282 – Control of Obtrusive Effects of Outdoor Lighting* (1997)

For the purposes of this assessment, these are considered the most relevant and appropriate guidelines for LVIA, and are collectively referred to as the 'EIA guidelines' in this chapter. The LVIA methodology is applicable to the assessment of likely impacts:

- During the operation of the Project for landscape character assessment and for both construction and operation of the Project for visual impact assessment. Note: an assessment of landscape character effects during construction is not considered to be required as these effects are temporary and more appropriately addressed within the context of visual effects during construction.
- During both day and night time.

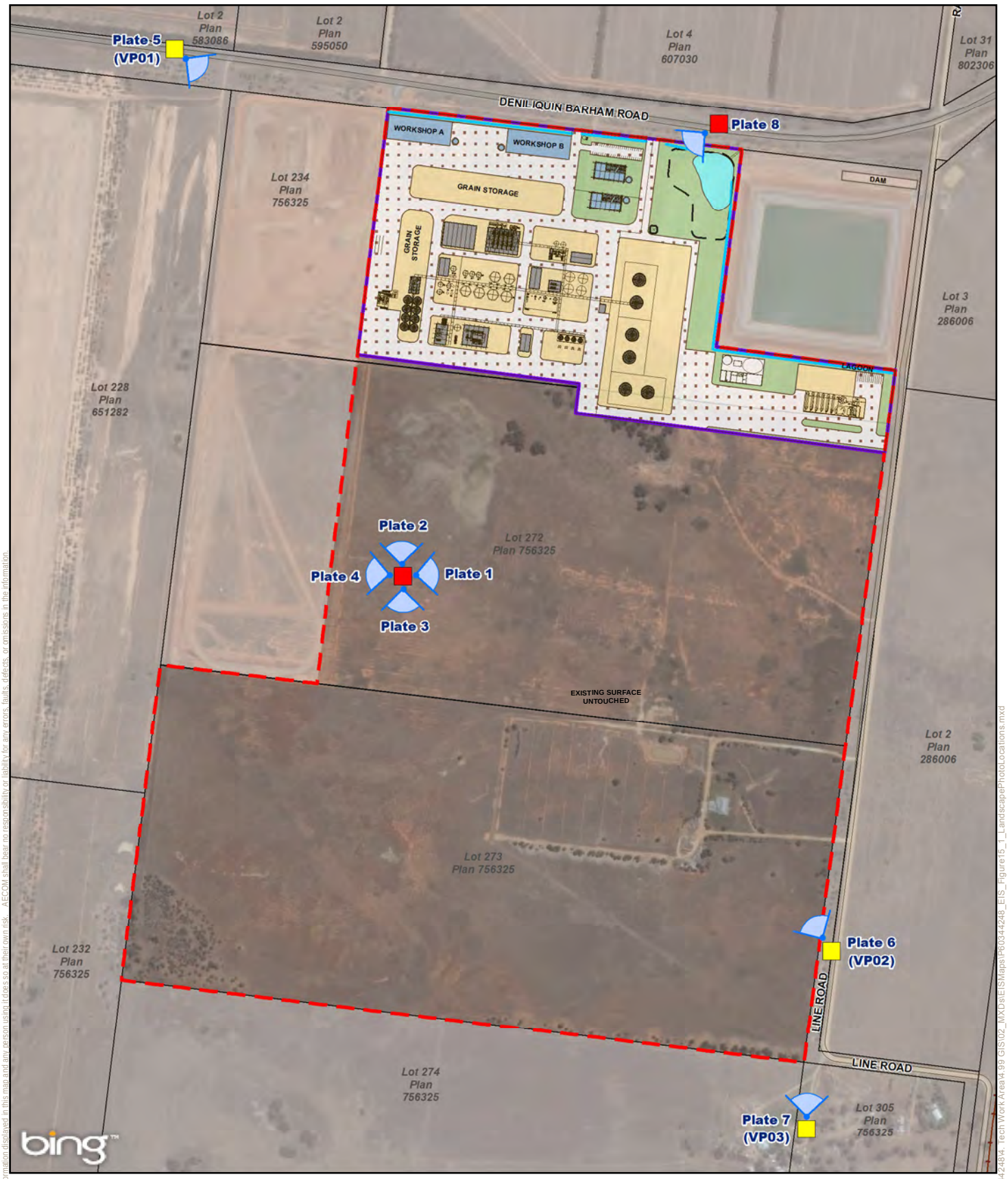
The method used to determine the significance of impact to landscape character and visual amenity is provided in Appendix O.

15.3 Existing environment

The relatively flat topography of the Deniliquin landscape (refer to topography section in Chapter 14 Soils, Land Capability and Land Use for detailed description of topography), in conjunction with historical land clearing and current day pastoral and agricultural land uses, has resulted in a wide, open planar landscape. This landscape is characterised by a mosaic pattern of land cover defined primarily by land use, including low, straw coloured tussock grass grazing land for cattle and sheep, juxtaposed with broad, regularly shaped, seasonally deep green irrigated rice growing areas. A further important defining element of the landscape comprises isolated stands of remnant trees, particularly along watercourses, and perimeter tree planting of primarily endemic species, providing a visually characteristic tree cover element. A native saltbush shrub layer is also regularly in evidence along road edges and other unmanaged areas, comprising grey-green, low, mounding land cover elements.

Plate 15.1 to Plate 15.8 show existing views to and from the Project Site. Figure 15.1 provides information as to the location of the photographed viewpoints. For detailed descriptions of the grassland types present, refer to Chapter 8 Biodiversity.

Location Map of Viewpoints



LEGEND

- Photo Location
- Viewpoint Photo
- Photo and Viewpoint Direction
- Site Layout
- Vegetated Swale
- Cadastral Boundaries
- Pavement Area
- Bio-Retention Basin
- Hardstand Area
- Landscaping
- Roofwater Catchment

Data Sources:
1.Imagery: © 2015 DigitalGlobe © 2015 GeoEye Earthstar Geographics SIO © 2015 Microsoft Corporation
2. Roads, Railway, Drainage, Suburbs, Parks, Localities: @ Street Pro, 2011
3. Key Map Base Layer: ESRI Online
4. Site Layout: based on CAD Drawingd prepared by DONGMUN I.R.S. Co. Ltd.

Disclaimer:
Site Layout is indicative only. To be used for information only. For detailed design reffer to CAD Drawings

AECOM
www.aecom.com

DATUM GDA 1994, PROJECTION MGA ZONE 55

N 0 50 100 150
Metres

FIGURE 15.1

A4

Plate 15.1 Centre of the Project Site facing east

Plate 15.2 Centre of the Project Site facing north

Plate 15.3 Centre of the Project Site facing south

Plate 15.4 Centre of the Project Site facing west

Plate 15.5 View of the Project Site from the north west (Deniliquin Barham Road) facing east

Plate 15.6 View of the Project Site from the south east at Line Road, facing north to north west

Plate 15.7 View of the Project Site from the south (Line Road) facing north

Plate 15.8 View of the Project Site from the east (along Deniliquin Barham Road) facing south west

The Project Site is generally open, with the exception of one substantial stand and a few smaller stands of remnant trees within the centre of the of the Project Footprint, leaving it highly visible from all publically accessible locations. The existing homestead lot on the southern portion of the Project Site has substantial tree planting around it, which appears to provide some level of visual screening to the north. Additionally, this lot contains perimeter tree planting along the eastern boundary and part of the southern boundary, as well as a small regrowth patch of native vegetation within the south west corner of the lot.

South and south-east of the above property, a further two homesteads are located at a distance of about 1.3 kilometres from the Project Site. The western homestead is likely to be relatively well screened from the Project Site by a substantial tree planting along its northern boundary, in conjunction with tree planting in the above noted homestead to the north. The eastern homestead has no immediate screening in front of it, but would be expected to receive a moderate level of visual screening from the Project Site by tree plantings both along Line Road, and within the above mentioned property to the north.

The adjacent property to the west has extensive perimeter tree planting along Deniliquin Barham Road boundary, and its eastern boundary, which is at semi-mature stage of growth, and can be expected to provide longer distance screening to the Project Site for vehicles travelling east along Deniliquin Barham Road. A vegetated

backdrop would also eventually be provided to the Project Site by these plantings for vehicles travelling west along Deniliquin Barham Road. Additionally, the property to the north of the Project Site has substantial perimeter tree planting along the Barham Road boundary at an early stage of maturity, in conjunction with the north-south running lines of trees between rice growing areas.

The Project Site is located approximately 5.5 km from the Deniliquin Township. Due to the lack of any significant topographical features, it is difficult to determine the Project Site from a distance, as it blends into the horizon within the broad landscape setting. There are no distinct features on or close to the Project Site that differentiate it from much of the land around it.

15.4 Assessment of potential impacts

The Project would impact upon the character of the surrounding landscape. Project activities, such as clearing and construction of hardstands, have the potential to change the vegetation character of the local area. The verticality of the Project built components (specifically the silos and production/processing zones) would comprise visually contrasting vertical built elements within the landscape, which is otherwise generally relatively flat and featureless. An indicative view model of the Project is shown below, taken from the location of Plate 8 (refer Figure 15.1).

Figure 15.2 Indicative view model of the Project from Deniliquin Barham Road looking west

However, it must be considered that within the context of a large regional town such as Deniliquin, an industrial complex such as the Project is not necessarily either out of place, or visually unsightly, if it is well presented and maintained e.g. with architectural input into an overall colour scheme and use of materials appropriate to a modern industrial development. This can be seen as a point of visual interest, particularly in conjunction with appropriately designed signage that identifies the function of the development, i.e. the production of ethanol (biofuels) using low grade local grain crops for providing an environmentally improved method of powering cars and other machinery.

The primary sources of potential landscape and visual impact are associated with the following Project components and activities:

- Construction and operation of Project buildings, processing facilities and structures, with the two large workshop buildings set close to along Deniliquin Barham Road boundary of particular note with regard to visual impact
- Installation of security fencing
- Construction and operation of water management infrastructure (bioretention and flood detention basin)
- Removal of vegetation within the Project Site
- Removal and storage of topsoil
- Vehicles (haulage and supply heavy vehicles) during construction and operation.

15.4.1 Potential visual impacts

An assessment has been undertaken to evaluate the Project's potential impacts on one broad landscape character type (LCT) identified surrounding the Project Site namely Rural Plains and Croplands. Potential impacts are detailed in Table 15.2 and the significance of effect on the LCT is discussed in Table 15.3.

Table 15.2 Potential impacts to landscape character and visual amenity

Project component	Potential impact
Construction and operation of Project buildings, processing facilities and structures	The Project would result in the addition of an industrial complex within the existing rural setting, including elements of substantial bulk and scale, such as the rectifier tower, at 35 m, the distillation column at 37 m, elements of substantial bulk and scale such as the milling building (27 m high by 25 m wide), fermentation tanks (23.6 m high), grain storage tanks (24 m high), which would be visually prominent from many locations, and may be visible from relatively distant locations due to the generally flat, rural landscape setting. The two large workshop buildings close to the Deniliquin Barham Road would be particularly visually prominent given their proximity to the road. The vertical elements of the Project would punctuate the horizon when seen from closer locations. The Project would comprise a visually uncharacteristic industrial complex within an otherwise rural landscape. However this should be considered within the context of other large industrial developments within the outskirts of Deniliquin, and most notably the Deniliquin Rice Mill located approximately 4 km east of the Project Site, which is also visually prominent from Deniliquin Barham Road. Within this context, it is not unusual to see large infrastructure within or on the outskirts of large country towns, such as grain silos. Large industrial scale developments are often located on the outskirts of large country towns, such as abattoirs; sewage treatment plants; engineering facilities servicing the broader region, an example being that located on the eastern outskirts of Deniliquin on the Conargo Road; and sales of farm equipment. Within this context the Project can be seen to have visual precedents. It is noted that visitors to the town from the west are given a visual cue that they are entering the Deniliquin township environs, as a large bespoke sign naming the town is located within the road corridor adjoining the Project Site. It is also noted that the area adjoining the Project Site is zoned General Industrial and Infrastructure, and as such, visually complimentary adjoining development is planned by Deniliquin Council.
Construction and operation of water management infrastructure	Water management infrastructure, including swales and a bioretention and flood detention basin, would be constructed to accommodate the Project. These structures are likely to consist of vegetated earthen walls built above the existing ground level; however, their position on the Project Site would typically be at a lower topographical point on the Project Site than other components of the Project.
Removal of vegetation within the Project Site	The existing vegetative character of the Project Site is one of closely grazed, low-growing grassland vegetation, with relatively few trees, many of which are within the Project Footprint, and therefore marked for removal. The proposed Project Site layout proposes a vegetative screen around on the eastern and northern boundary of the site to help minimise the potential impact the Project has on Deniliquin Barham Road.
Removal and storage of topsoil and subsoil	Where possible, topsoil would be used immediately in landscaped areas, and subsoil for construction where proposed. However, during the site preparation and construction it is likely that both subsoil and topsoil would need to be stored in stockpiles for a period of time, until the site construction is at the appropriate phase. As such, stockpiles would be created and would appear as vegetated

Project component	Potential impact
	mounds.
Vehicles (haulage and supply heavy vehicles) during operations	The construction of the Project Site and associated components would result in the presence of construction traffic to and within the Project Site, resulting in short term impacts on visual values. Once operating, the roads may generate longer term adverse impacts on the landscape and visual values, particularly associated with the presence of intermittent vehicular traffic (particularly heavy vehicles).

15.4.2 Landscape character type assessment

The LCT identified in the Project Site is shown in Table 15.3. Further to the identification of the LCT, Table 15.3 details the key sensitivities, magnitude of change, level of visual effect, and significance of effect on the LCT.

Table 15.3 Landscape character type in the Project Area

LCT – Rural plains and croplands	
Landscape Character Sensitivity Assessment	Key sensitivities include: - Remnant trees and vegetation. - Open and rural character, vulnerable to visual intrusion by tall/visually contrasting 'industrial' elements. - Planar, open landscape providing little variation in elevation or screening and, therefore, facilitating extended views and large horizons from publically accessible locations. - Visually accessible to tourists travelling along Deniliquin Barham Road and those living and working on the land. Overall sensitivity of the LCT is considered to be **Medium** with the context that: - No part of the LCT within the Project Site is subject to planning designations for scenic qualities, and the Project Site comprises a very small component of this extensive LCT. - The Project Site is visually connected with a major regional road, which has another large industrial development located adjacent to it (the Deniliquin Rice Mill), albeit 4 km to the east, and visually connected to the outskirts of town. - Both the rice mill and the industrial estate on the eastern fringe of town provide visual precedents for the Project, as do other towns within the region, which typically locate their industrial facilities on the outskirts of town.
Magnitude of Change Assessment	The Project would comprise a significantly contrasting development on a small component of this extensive, commonly occurring LCT, and would be located within a relatively short distance of the Deniliquin Rice Mill, which comprises a development of broadly similar bulk and scale. Within this context, it is considered that the magnitude of change would be **Medium** since the Project would introduce a considerable change to the landscape and intensify the level of impacts.
Level of Visual Effect	**Moderate adverse** based on the assessment ratings of medium sensitivity and medium magnitude of change.
Significance of Effect	The effect of the Project on the LCT is considered to be **Moderate adverse** but **Not Significant** primarily due to the extent of this LCT within the region. Additionally, the contextual relationship to larger industrial scale developments on the periphery of major regional towns, including the Deniliquin Rice Mill, has also resulted in this rating.

15.4.3 Viewpoint assessments

Viewpoint assessments have been undertaken that focus on sensitivity, magnitude of change and overall significance of impact. An assessment of the anticipated impacts was conducted at three publically accessible viewpoints, and the results are provided in Table 15.4. Figure 15.1 illustrates the viewpoint locations relative to the site.

Table 15.4 Impacts to visual amenity from viewpoint locations

VP01 – West (Deniliquin Barham Road) facing east
 Existing view of the Project Site from Deniliquin Barham Road travelling west
 Indicative view model of the Project from Deniliquin Barham Road travelling east
This viewpoint was selected to demonstrate the potential impact of the Project on views from Deniliquin Barham Road as vehicular traffic approaches Deniliquin from the west. It therefore takes into consideration the speed at which drivers and passengers are moving through the landscape, the likely interest of the vehicle occupants in their surroundings, and the proximity of the viewpoint to the Project Site boundary. Sections of Deniliquin Barham Road are 80 kilometres per hour, changing to 100 kilometres per hour near to the Project Site, and therefore vehicles have been assumed to be travelling at or about this higher speed. Drivers travelling from the west would, in many cases, have driven a long distance and the Project would be viewed as a relatively fleeting element of that total journey. However, the Project would be viewed at close range from the road, although the extent of detail available can be expected to be moderately limited by the proposed tree planting on the basis of the growth rates attained by similar perimeter plantings within the local area. Further, most of the visual receivers can be expected to be local to the area, such as farmers travelling to or from town, or long distance transport haulage drivers, i.e. people who are engaged in their daily work. This group of visual receivers is generally considered to be less sensitive to changes in the landscape than, for instance, tourists, who can be expected to make up a relatively small proportion of the visual receivers for the Project. On this basis, the sensitivity of the visual receivers for the Project is considered to be **Low**. The magnitude of change is considered to be **High** within the context that: - The two workshops located close to the boundary would comprise large and visually prominent, contrasting built-form elements within the landscape

VP01 – West (Deniliquin Barham Road) facing east

- The view to the Project would generally be set within a well-considered landscape planting as described above, where planting on adjacent property perimeters have the capacity to provide a significant level of screening (refer to Section15.5). However, planting between the two workshop buildings and the Deniliquin Barham Road boundary may be limited due to a combination of space constraints, and need for solar access to a proposed vegetated swale proposed to run along this boundary.
- Although visual receivers would have generally been travelling a long distance (from the west) through a broadly homogenous landscape as defined by LCT A, and the sight of the Project would therefore comprise a new and substantially contrasting built visual element, the view to the Project also has the potential to be observed within the context of approaching Deniliquin, effectively marking the outer edge of this large regional town.

The above ratings of sensitivity and magnitude provide a visual impact rating of **Moderate adverse**.

Within the context of the above, the visual impact of the Project from this observer location is considered to be **Not Significant**. However, the implementation of the proposed mitigation measures (refer to Section 14.5) have the potential to further reduce the visual impact of the Project.

VP02 – South-east at Line Road, Facing North to North-west

Existing view of the Project Site from Line Road looking north to north-west

Indicative view model of the Project from Line Road looking north to north-west

VP02 – South-east at Line Road, Facing North to North-west

This viewpoint was selected to demonstrate the potential impact of the Project on views from the property in the north east corner of Lot 273. It therefore takes into consideration the impact of the Project on existing property owners and landscape occupants, and the proximity of the viewpoint to the Project Site boundary.
Likely changes to be experienced from this representative viewpoint have been analysed though interpretation of existing topography and the proximity of the viewpoint to the Project. The existing natural features that have been identified have also been considered in the magnitude of change assessment.

This viewpoint is approximately 750 m from the centre of the Project Site and would, therefore, be seen in a significant level of detail. Existing tree planting to the north of the residence provides some limited screen to the Project Site.

Two further residences some 500 m south of this receptor appear to be generally well screened from the Project Site. Additionally, the Project includes screening to the southern boundary, which is demonstrated on nearby perimeter property boundaries to be an effective form of screening, and can be expected over time to reduce the visibility of the Project in a way that comprises a characteristic landscape element within the locality. This would however take a period of years to achieve an effective screening outcome. Notwithstanding the anticipated high level of sensitivity of this receptor (Lot 273), the number of receptors is very low. On this basis a visual sensitivity rating of **Low** would be applied in this regard.

The magnitude of change is **High**.

The above ratings of sensitivity and magnitude provide a visual impact rating of **Moderate adverse**.

Within the context of the above, the visual impact of the development from this observer location is considered to be **Not Significant**. However, the implementation of the proposed mitigation measures (refer to Section 14.5) have the potential to further reduce the visual impact of the Project.

VP03 – South at Line Road Facing North

This viewpoint was selected to demonstrate the potential impact of the Project on views from Line Road as vehicular traffic approaches Deniliquin Barham Road from the south. It therefore takes into consideration the speed at which drivers and passengers are moving through the landscape, the likely interest of the vehicle occupants in their surroundings, and the proximity of the viewpoint to the proposed Project Site boundary.

Line Road is a gravel road used predominantly for access to the private properties to the south of the Project Site. As such, these visual receivers are considered likely to be low in number and travelling at relatively low speed, engaged in their daily work. This group of visual receivers is generally considered to be less sensitive to changes in the landscape than for instance tourists, who would use this road. The Project Site is, however, highly visible along this boundary, although screen planting is proposed along this boundary which would reduce the visual prominence of the development. On this basis, the sensitivity of the visual receivers for the Project is considered to be **Low**.

The magnitude of change is **High**.

The sensitivity of the visual receivers for the Project is considered to be **Moderate adverse**.
Within the context of the above, the visual impact of the development from this observer location is considered to

VP03 – South at Line Road Facing North
be **Not Significant**. However, the implementation of the proposed mitigation measures (refer to Section 14.5) have the potential to further reduce the visual impact of the Project.

15.4.4 Lighting

A qualitative assessment of the impacts of lighting on visual amenity has been undertaken based upon determination of the current level of lighting within the area and any potential changes to lighting levels that may be associated with the Project. As there is no prescribed assessment method for the impacts of lighting on visual amenity, guidance and terminology has been taken from the *Guidance Notes for Reduction of Obtrusive Lighting* (2005), prepared by The Institution of Lighting Engineers UK, and *Australian Standard 4282 – Control of Obtrusive Effects of Outdoor Lighting* (1997). This information has then been combined with the standard method of assessment for impacts on visual amenity.

The magnitude of change is established by comparing existing lighting conditions to the potential lighting conditions that may occur as a result of the Project. An evaluation of significance is then drawn based on sensitivity and the magnitude of change that are likely to be experienced from each viewpoint, which is provided in Table 15.5.

Table 15.5 Lighting impact assessment

VP01 – West (Deniliquin Barham Road) facing east
The sensitivity of the visual receivers to the Project is considered to be **Low** within the context of the relatively fleeting view that receivers would experience at night. The magnitude of change is **Medium** within the context of the receiver approaching Deniliquin as discussed in Table 15.4. The above ratings of sensitivity and magnitude provide a visual impact rating for lighting of **Moderate to Minor adverse**. Within the context of the above, the visual impact of the development from this observer location is considered to be **Not Significant**. However, the implementation of the proposed mitigation measures (refer to Section 14.5) have the potential to further reduce the visual impact of the Project.

VP02 – South east at Line Road, facing north to north west
The sensitivity of the visual receivers for the Project is considered to be **Medium** within the context of the low receiver numbers, proximity of the receptor to the view and the extent and potential moderate visual prominence of the lighting even with screening in place. The magnitude of change is considered to be **Medium**, particularly within the context of the considerable change to the night time view from the residence from an intrinsically dark landscape to a predominantly lit landscape. This rating is made notwithstanding that: - the closest lighting is approximately 500 m away from the residence (it is likely that this residence would be acquired for the Project and if this were the case, the closest lighting would be 850 m from the nearest residence) - screening can be expected to at least moderately reduce the visual extent and prominence of the lighting, although this would take a period of many years for the plantings to achieve - the extent of lighting would be restricted to that necessary for operational and safety requirements, and would incorporate light spill cut-off features. The above ratings of sensitivity and magnitude provide a visual impact rating for lighting of **Moderate adverse**.

VP02 – South east at Line Road, facing north to north west
Within the context of the above, the visual impact of the development from this observer location is considered to be **Minor**. However, the implementation of the proposed mitigation measures (refer to Section 14.5) have the potential to reduce the visual impact of the Project.

VP03 – South at Line Road facing north
The sensitivity of the visual receivers for the Project is considered to be **Low** within the context of the anticipated low receiver numbers, and nature of the receivers being local residents using the road with brief views of the Project Site. The magnitude of change is considered to be **Medium** given that the proposed screening can be expected to moderately reduce the visual prominence of the lighting, but the lighting would still constitute a substantial change to the view. The above ratings of sensitivity and magnitude provide a visual impact rating for lighting of **Moderate to Minor adverse**. Within the context of the above, the visual impact of the development from this observer location is considered to be **Not Significant**. However, the implementation of the proposed mitigation measures (refer to Section 14.5) have the potential to further reduce the visual impact of the Project.

15.5 Mitigation measures

The landscape and visual amenity impact assessment considered a potentially significant impact on residential properties to the south of the Project Footprint, within the Project Site. Dongmun Greentec is currently developing appropriate measures which will be discussed in partnership with owners of the surrounding properties to ensure that potential impacts with regards to visual amenity are managed.

Mitigation measures to reduce and manage the potential impact of the Project on landscape and visual amenity in a local context are provided in Table 15.6.

Table 15.6 Landscape and visual amenity mitigation measures

Element	No.	Mitigation measure	Timing
Landscape character and visual amenity			
Vegetation removal	LV1	Vegetation would remain in-situ for the greatest possible length of time prior to removal to provide screening effects of the Project Site from receptors.	Construction Phase
Stripping of topsoil from the Project Site and storage	LV2	Stripped topsoil would be removed immediately for landscape works where practicable to facilitate regeneration of the existing tussock pasture grass.	Construction Phase
	LV3	Topsoil would be managed in a manner that mitigates deterioration of the topsoil quality during stockpiling (such as the provision of a cover crop, separate stockpiling of topsoil and subsoil).	Construction Phase
	LV4	The height of topsoil stockpiles would be minimised as far as practical, should stockpiling be required	Construction Phase
Lighting associated with construction activities and moving plant	LV5	The number of lights would be kept to the minimum required to perform the tasks in accordance with health and safety legislation/requirements.	Construction Phase
	LV6	Light spill would be contained to the greatest extent possible (e.g. the use of directional lighting where possible, as per AS 4282 – Control of Obtrusive Effects of Outdoor Lighting (1997))	Construction Phase
	LV7	Downlights would be used in preference to up-lighting or spill lights.	Construction Phase
General Site Landscape	LV8	The Project Site would be maintained in good condition during construction, with sound	Construction Phase

Element	No.	Mitigation measure	Timing
		housekeeping practices.	
General Approach	LV9	Provide a landscape planting to the Deniliquin Barham road frontage that provides attractive stands of endemic trees, potentially in conjunction with saltbush plantings, within a tufted, dry grassland setting as is currently in place on the Project Site. Allow for framed views through this vegetation to the Project .	Operation Phase
	LV10	Consider during detail design phase for the two workshops adjacent to Deniliquin Barham Road to be set further back (south) from the boundary to facilitate tree planting between the swale and the workshops, sufficient to meet solar access requirements for the proper functioning of the swale. Further consider moving the western workshop building east to facilitate screen planting between the western edge of the building and the western site boundary, to reduce the visual prominence of this element when seen driving east along Deniliquin Barham Road	Detailed design
	LV11	Consider in conjunction with Council providing informal endemic tree planting within the approximately 30m wide grassy verge between Deniliquin Barham Road and the site boundary	Operation Phase
	LV12	Consider landscape planting as per LV09 along the western and southern boundaries of the Project Site, to provide a vegetated visual backdrop to the development when seen from Deniliquin Barham Road, and reduce potential visual impacts from property homesteads to the south.	Operation Phase
Vegetation	LV13	Vegetation would be selected that is consistent with that found in the neighbouring area to the Project Site, with species selection of mid and over storey species suited to optimising screening qualities.	Operation Phase
Boundary Fencing	LV14	Boundary fencing would be of a type that maximises visual permeability and facilitates views through into the Project Site.	Operation Phase
Lighting associated with permanent facilities and moving plant	LV15	The number of lights would be kept to the minimum required to perform the tasks in accordance with health and safety legislation/requirements. Light spill would be contained to the greatest extent possible (e.g. the use of directional lighting where possible). Use of downlights preferential to the use of up-lighting or spill lights.	Operation Phase
Signage	LV16	All signage with be displayed in accordance with - State Environmental Planning Policy No 64 - Advertising and Signage (2001).	Construction and Operation Phase
General Site Landscape	LV17	The Project Site would be maintained in good condition, with sound housekeeping practices to reduce the visual impact on adjacent neighbouring properties.	Operation Phase

15.6 Summary and conclusions

The impact on landscape character is considered to be acceptable within the context of the location of the Project in relation to the Deniliquin township and the extensive nature of the landscape character within which the Project is located. Visual impacts from representative receiver locations were considered to be 'Moderate' with the implementation of reasonable mitigation measures. Lighting impacts were considered to be not significant at the identified sensitive receptors.

Impacts to visual amenity and landscape character are unavoidable due to the local topography of the area, and the verticality of the Project infrastructure. Although currently proposed mitigation measures are unlikely to entirely mitigate this impact, impacts are generally considered to be not significant. The implementation of the above 'for consideration' mitigation measures (LV10, LV11, LV12) has the potential to provide a significant improvement over time to the currently proposed landscape outcomes for the Project, including reduced visual impacts for all sensitive receivers.

16.0 Air Quality, odour and emissions

This chapter provides an assessment of the potential impacts of the Project on air quality. This assessment is supported by the air quality impact assessment provided in Appendix P.

The air quality impact assessment for the Project:

- Established the existing meteorological and air quality conditions within the region
- Determined the air quality criteria relevant to the Project
- Determined key pollutants of interest
- Established the methodology to predict emissions from the Project
- Predicted emissions from the Project and cumulative impacts from other sources
- Provides an assessment of the predicted air quality impacts against relevant criteria
- Established measures to manage and mitigate predicted impacts as required.

Some project changes have occurred after the air quality impact assessment was conducted. These late project changes have not been found to have a material impact on the outcomes of the assessment. Further details and adjustments to the air quality impact assessment are provided in the assessment of construction and operational impacts sections of this chapter.

16.1 Director General's Requirements

The assessment of air quality addresses the DGRs as detailed in Table 16.1.

Table 16.1 DGRs for the assessment of air quality

DGRs
Air Quality and Odour
- Description of all potential odour sources and predicted odour emissions from the construction and operation of the ethanol plant and its wastewater treatment plant
- A comprehensive air quality assessment of all potential air quality and odour impacts from the development, including details of air quality and odour impacts on private properties, in accordance with relevant Environmental Protection Authority guidelines
- Details of mitigation, management and monitoring measures for preventing and/or minimising both point and fugitive emissions
- An assessment of the effectiveness of the proposed air quality and odour mitigation measures
Greenhouse Gas
- A full GHG assessment (including an assessment of the potential scope 1, 2 and 3 GHG emissions of the project, and an assessment of the potential impacts of these emissions on the environment)
- A detailed description of the measures that would be implemented on site to ensure that the project is energy efficient

16.2 Methodology

16.2.1 Air quality impact assessment

The methodology for the air quality impact assessment included both an initial desktop and detailed technical investigation as follows:

- A desktop review was conducted for other studies in the area, relevant legislation, historical meteorological data and ambient air quality monitoring data. A gap analysis was conducted to assess the applicability of other impact assessments for the Project.
- Specific meteorological data was generated to provide representative meteorological conditions at the Project Site.
- Potential impacts from the Project were assessed using the following approach:
    - Sensitive receptors in the vicinity of the Project Site were identified (locations shown on Figure 16.1).
    - Potential pollutants of interest to sensitive receptors were defined and potential sources of emissions from the Project were identified. Locations where sources of emissions were vented to the air are

based on process flow diagrams provided in Appendix B of Appendix P. This also included preparing an inventory of potential emission sources for the pollutants of interest from the Project.

- Predicted pollutant concentrations were forecast using a recognised atmospheric dispersion model.
- The predicted pollutant concentrations at each sensitive receptor were compared to the appropriate air quality objectives.

Mitigation measures were identified, where appropriate, to manage and minimise potential impacts during construction and operation of the Project.

16.2.2 Pollutants of interest

Key pollutants of interest for sources of air emissions at ethanol plants were identified as part of the air quality impact assessment. Key sources of air pollutants and associated pollutants of interest that were included as emission sources in the modelling for the operations phase of the Project include:

- Particulate matter (Particulates under 10 microns (PM_{10}) and Particulates under 2.5 microns ($PM_{2.5}$)), from boiler combustion sources
- Oxides of nitrogen (NO_x) and carbon monoxide (CO), from boiler combustion sources
- Volatile Organic Compounds (VOCs), including acetaldehyde, acrolein, formaldehyde, ethanol and methanol, from combustion sources
- Odour generation due to the operation of the wastewater management system and ethanol production process.

16.2.3 Guidance and standards

Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales 2005

The NSW OEH Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (Approved Methods) lists the statutory methods for modelling and assessing air emissions from stationary sources in the State. It provides the pollutants of interest and relevant assessment criteria, the approved air dispersion models, the applicable methods for assessing cumulative impacts and the processes should impacts exceed criteria. This Air Quality Impact Assessment was conducted in accordance with the requirements of the Approved Methods.

Odour technical framework and notes

The NSW EPA's Technical Framework, Assessment and Management of Odour from Stationary Sources in NSW, 2006 provides a system to protect amenity of the environment from the impacts of odour emissions. Further detail regarding this guideline is provided in Chapter 5 Statutory Control and Approvals.

NSW Energy from Waste Policy Statement January 2015

The NSW Environment Protection Authority (EPA) has published an Energy from Waste Policy Statement that requires any facility proposing to recover energy from waste to meet current international best practice. The policy sets out eligible waste fuels that may be thermally treated using a range of technologies. Any proposed control technology must represent the most efficient reuse of the resource with no increased risk to human health or the environment. The policy also requires that emissions must, as a minimum, meet current emission limits prescribed by the *Protection of the Environment Operations (Clean Air) Regulation 2002* (POEO (Clean Air)). Further detail regarding this Policy Statement is provided in Appendix P1 Addendum to Air Quality Technical Report.

16.2.4 Construction phase air quality impact assessment

Potential impacts of air emissions during the construction phase of the Project were assessed qualitatively by means of the methodology set out in the UK Institute of Air Quality Management (IAQM) document *Guidance on the assessment of dust from demolition and construction* (IAQM, 2014). The IAQM methodology consists of a four-step process for assessing dust impacts from construction activities. A detailed breakdown of the methodology is provided in Appendix P and summarised below:

Step 1

The Step 1 screening criteria provided by the IAQM guidance suggests screening out the requirement for any assessment of impacts from construction activities where sensitive receptors are located more than:

- 350 m from the boundary of the site.
- 50 m from the route used by construction vehicles on public roads more than 500 m from the site entrance.

Step 2

Step 2a of the assessment procedure provides "emission magnitudes" for four activities; demolition, earthworks, construction, and trackout. "Magnitude" describes the anticipated scale of proposed works and consequently, the potential scale of the predicted environmental change and the likelihood of the impact resulting in a change to existing (baseline) conditions. The magnitudes are: Large; Medium; or Small. Suggested definitions for each category provided in Table A for each activity.

Step 2b of the assessment allows the sensitivity of the area to be defined and addresses different potential effects on the population and property, and human health. The sensitivity of the area takes into account:

- The specific sensitivities of receptors in the area.
- The proximity and number of those receptors.
- Site specific factors, such as whether there are natural shelters, such as trees, to reduce the risk of wind-blown dust.
- In the case of impacts to human health, the local background concentration of PM_{10} is considered.

Receptors may be classified as having High, Medium or Low sensitivity to dust deposition or PM_{10} concentrations. Exposure to dust deposition may lead to nuisance impacts and exposure to PM_{10} has the potential to have impacts on human health.

Step 2c of the assessment combines the dust emission magnitude from Step 2a and the receptor sensitivity from Step 2b to determine the risk category with no mitigation applied.

Risk Category	Scale of Emission Magnitude		
Sensitivity of receptor	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Step 3

Once the risk categories are determined for each of the relevant activities, site-specific mitigation measures are identified based on whether the site is a low, medium or high risk site.

Step 4

The residual impact is determined after mitigation has been considered.

16.2.5 Operations phase air quality impact assessment

The following approach was used for the quantitative dispersion modelling assessment:

- Selection of representative meteorological data
- Selection of an appropriate dispersion model
- Development of the meteorological dataset for dispersion modelling
- Verification of the meteorological dataset
- Emissions estimation
- Dispersion modelling
- Post-processing.

Selection of meteorological data

The year of meteorological data used for the dispersion modelling was selected by reviewing the most recent five years of historical surface observations at the Bureau of Meteorology (BoM) Deniliquin automatic weather station (AWS) (2009 to 2013 inclusive) to determine the most representative year as detailed in Appendix P; 2012 was selected as a suitably representative year of meteorology.

Selection of model

The air quality impact assessment utilised meteorological and air dispersion models as approved under the NSW EPA Approved Methods (NSW OEH 2005) and detailed in Appendix P. The models used are as follows:

- The Air Dispersion Model (TAPM) (with CALTAPM) for meteorological processing of prognostic data;
- CALMET for processing the meteorological data into a format suitable for CALPUFF;
- CALPUFF for predicting the dispersion of emissions; and
- CALPOST for formatting results and creating dispersion pattern contours.

Meteorological model verification

The model predictions were verified against actual 2012 observations at Deniliquin Airport BoM. The model was found to adequately address the conditions under which the worst ground level concentrations will occur. The verification is discussed in detail in the Air Quality Impact Assessment report in Appendix P.

16.2.6 Greenhouse gas emissions

Estimation of the GHG emissions associated with the Project's operations was undertaken using the emission factors and methods outlined in the National greenhouse accounts (NGA) Factors (DOE, 2014). The NGA Factors provide three types of assessment categories:

- **Scope 1**, which covers direct emissions from sources within the boundary of an organisation, such as fuel combustion and manufacturing processes.
- **Scope 2**, which covers indirect emissions from the consumption of purchased electricity, steam or heat produced by another organisation.
- **Scope 3**, which includes all other indirect emissions that are a consequence of an organisation's activities but are not from sources owned or controlled by the organisation; that is, emissions associated with the production of fuels, and emissions associated with the transmission and distribution of purchased electricity.

The main operations likely to generate GHGs at the Project are:

- natural gas consumption (Scope 1)
- process emissions (fermentation) (Scope 1)
- electricity use (Scopes 2 and 3)
- delivery and distribution of feed stock and products via road and rail (Scope 3)
- passenger vehicles transporting staff to and from site (Scope 3)
- combustion of fuel distributed from the Project (Scope 3).

For this assessment, estimation of emissions was undertaken for the activities listed above. Only emissions associated with the operation of the Project were included.

All emissions were estimated using the NGA Factors with the exception of product transport via rail. The NGA Factors only include factors for rail transport based on fuel use (i.e.kg $CO_{2\text{-}e}$/kL), which was impractical to estimate. As such, an emission factor specifically developed for estimating transport emissions of biofuels via rail (Woods et al., 2005) was instead used, which enables the estimation of emissions based on tonne kilometres.

16.2.7 Project specific air quality goals

The ambient air quality objectives and guidelines listed in Table 16.2 were applied as the air quality objectives for the Project. The odour level was selected based on the location of five defined receptors (totalling an estimated 10 people) within approximately 1 km of the Project Site, equating to a criterion of 6 odour units (OU) under the Approved Methods (refer Appendix P for more detail).

Table 16.2 Proposed Project air quality objectives

Pollutant	Averaging Period	Criteria	Units	Source
PM_{10}	24 hours	50	$\mu g/m^3$	NEPC (1998)
	Annual	30	$\mu g/m^3$	EPA (1998)
$PM_{2.5}$	24 hours	25	$\mu g/m^3$	NEPM (2003)
NO_2	1-hour	246	$\mu g/m^3$	NEPC (1998)
	Annual	62	$\mu g/m^3$	NEPC (1998)
CO	15-min	100	mg/m^3	WHO (2000)
	1-hour	30	mg/m^3	WHO (2000)
	8-hour	10	mg/m^3	NEPC (1998)
Acetaldehyde	1-hour	0.042	mg/m^3	VIC EPA (2001)
Acrolein	1-hour	0.00042	mg/m^3	VIC EPA (2001)
Formaldehyde	1-hour	0.02	mg/m^3	VIC EPA (2001)
Ethanol	1-hour	2.1	mg/m^3	VIC EPA (2001)
Methanol	1-hour	3.0	mg/m^3	VIC EPA (2001)
Nuisance Odour	-	6	OU	EPA (2001)

16.3 Existing environment

16.3.1 Wind speed and wind direction

The meteorological data was obtained from the Australian Government BoM AWS located at Deniliquin Airport. On an annual basis, the dominant wind direction is quite scattered between northerly, southerly, south westerly and westerly winds. Annually, 2.9 percent of wind speeds were recorded as calms (≤0.5 m/s).

During summer, winds from the south predominate. By autumn, the southerly winds are less frequent compared with northerly and south westerly winds. Winds in winter are predominantly westerly or northerly, reflecting the frequent passage of cold fronts and general westerly flow, while in spring a transition occurs again with a more uniform wind direction distribution but with westerly to south westerly flow most frequent.

16.3.2 Sensitive receptors

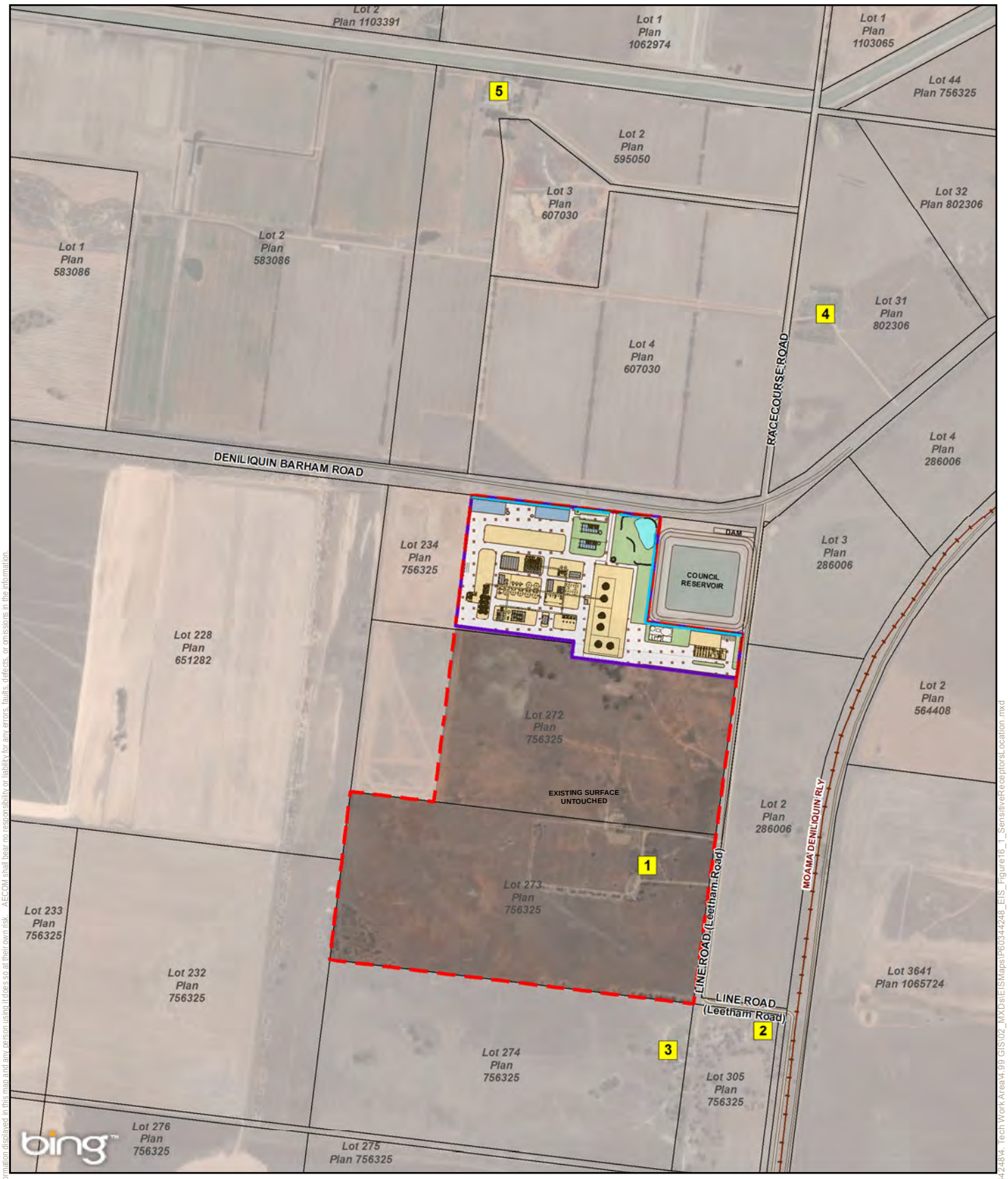
Sensitive receptors are defined by the EPA as locations where people are likely to work or reside, which may include dwellings, schools, hospitals, offices or public recreational areas (DEC, 2005). The nearest and potentially affected sensitive receptors are farmhouses or homesteads. The identified sensitive receptors for this assessment are summarised in Table 16.3 and shown in Figure 16.1.

Table 16.3 List of sensitive receptors

Receptor ID	Easting (m, UTM)	Northing (m, UTM)	Type	Approximate Distance from Site (m) / Direction[1]
R1	310235	6062318	On-site Residential	500 m S
R2	310569	6061841	Rural Residential	850 m SE
R3	310295	6061784	Rural Residential	880 m S
R4	310749	6063912	Rural Residential	550 m N
R5	309806	6064557	Rural Residential	1100 m N

Notes: 1. Measured from Project Footprint to property boundary of the sensitive receptor

Sensitive Receptor Locations



LEGEND

- Sensitive Receptors
- Railway
- Site Layout
- Vegetated Swale
- Cadastral Boundaries
- Project Site
- Project Footprint
- Pavement Area
- Bio-Retention Basin
- Hardstand Area
- Landscaping
- Roofwater Catchment

Data Sources:
1.Imagery: © 2015 DigitalGlobe © 2015 GeoEye Earthstar Geographics SIO © 2015 Microsoft Corporation
2. Roads, Railway, Drainage, Suburbs, Parks, Localities: @ Street Pro, 2011
3. Key Map Base Layer: ESRI Online
4. Site Layout: based on CAD Drawingd prepared by DONGMUN I.R.S. Co. Ltd.

Disclaimer:
Site Layout is indicative only. To be used for information only. For detailed design reffer to CAD Drawings

AECOM
www.aecom.com

DATUM GDA 1994, PROJECTION MGA ZONE 55

N 0 75 150 225 Metres

FIGURE 16.1

A4

All receptors are located more than 50 m from the route used by construction vehicles (refer to Figure 16.1). However, Receptor 1, 2 and 3 are located within 350 m of the Project Site boundary and within 500 m of the Project Site entrance and, in accordance with the IAQM methodology, must be included in the assessment. Given Receptor 4 and Receptor 5 are outside the range of the step 1 screening criteria, they have not been included in the assessment.

16.3.3 Background air quality

Background air quality data for PM_{10}, $PM_{2.5}$, NO_2, and CO were sourced from NSW Government operated monitoring stations at the following air quality monitoring stations (AQMS):

- Albury (PM_{10}): located approximately 190 km to the ESE of the Project Site.
- Wagga Wagga (PM_{10}): located approximately 225 km to the ENE of the Project Site.
- Wagga Wagga North (PM_{10} and $PM_{2.5}$): located approximately 225 km to the ENE of the Project Site.
- Bargo (NO_2): located approximately 540 km to the ENE of the Project Site.
- Liverpool (CO): located approximately 580 km to the ENE of the Project Site.

The first three AQMS measure particulate concentrations; however other pollutants such as CO and NO_2 are not measured. Ambient concentrations of NO_2 have been sourced from Bargo AQMS and CO ambient concentrations from Liverpool.

Meteorological data for the year 2012 were used in this assessment. For reasons of consistency, 2012 data from each of the air monitoring stations were selected as an estimate of existing ambient air quality at the Project Site. The background monitoring data were used in the calculation of cumulative impacts (i.e. the increase over background levels due to the operation of the Project). Albury was selected for PM_{10} concentrations due to similar representative population and hence the emissions from vehicles will be more representative of Deniliquin air quality levels but still conservative.

Table 16.4 Summary of adopted background air quality

Pollutant	Averaging Period	Background Concentration	Units	Source
PM_{10}	24-hour	54.4	$\mu g/m^3$	Albury 2012
	Annual	14.3		
$PM_{2.5}$	24-hour	23.2	$\mu g/m^3$	Wagga Wagga North 2012
NO_2	1-hour	82.7	$\mu g/m^3$	Bargo 2012
	Annual	9.4		
CO	8-hour	2.18	mg/m^3	Liverpool 2012
	1-hour	3.30		
	15-minute	4.35		

Given the lack of significant industry in the local area, it can be assumed that there are no notable background sources of the VOCs (acetaldehyde, acrolein, formaldehyde, ethanol and methanol). In addition, the Approved Methods requires the Project Site incremental impact only (impacts from the Project alone) to be compared against the assessment criteria for VOCs.

In accordance with NSW OEH Odour Framework and Technical Notes, only odour with similar characteristics may be assessed cumulatively, and given the lack of similar processes in the immediate environment, for the purposes of this assessment the background odour is assumed to be negligible.

16.3.4 Greenhouse gases

GHGs are gases found in the atmosphere that absorb outgoing heat reflected from the Earth. Different GHGs have different heat absorbing capacities. The primary GHG is CO_2. In order to achieve a basic unit of measurement, each GHG is compared to the absorptive capacity of CO_2, and measurements and estimates of GHG levels are reported in terms of CO_2 equivalent emissions (CO_2-e).

Australia's National Greenhouse Gas Inventories are designed to provide estimates of Australia's net GHG emissions and track Australia's progress towards its internationally agreed GHG reduction targets. Australia has published annual national GHG inventories for each year from 1990 to 2013 inclusive. In 2013 (the latest available

data at the time of writing the report), Australia's total GHG emissions were estimated to be 549.4 Mt CO_2-e. Of these emissions, approximately 26 percent (141.8 Mt CO_2-e) were attributed to emissions from NSW (DOE, 2013).

The Project has an ethanol production capacity of 115 mega litres (ML) per annum from locally grown wheat, with the ethanol to be used as an additive to produce E10 fuel. Electricity will be supplied by the grid, and natural gas will be supplied by pipeline from a nearby third party supplier. The site will use an estimated 6,600 – 8,200 kW (57.8 – 71.8 GWh) of electricity and 76,703 GJ of natural gas per year.

16.4 Assessment of potential construction impacts

16.4.1 Emission sources

Key potential air quality impacts associated with the Project's activities include:

- Nuisance dust and particulate matter emitted from the Project's activities, particularly during earthworks and site preparatory works.
- The emission of products of combustion, including NOx, CO, CO_2, sulphur dioxide (SO_2), VOCs and particulate matter from construction equipment (i.e. heavy vehicles, excavators, bulldozers, generators, etc.) and worker transport (i.e. light vehicles).
- Fugitive release of VOC emissions from the storage and transfer of diesel and other fuels.
- Emissions of dust and fumes from workshops (e.g. from sanding, welding and the use of solvents for cleaning equipment parts).

16.4.2 Potential impacts to sensitive receptors

A detailed assessment of potential construction impacts to sensitive receptors is provided in Appendix P Air Quality Technical Report, which identifies Receptor 1 as being within the Project Site and therefore exempt from complying with assessment criteria. Although outside the Project Footprint, Receptor 1 is within the Project Site boundary (Figure 16.1) and remains a location where people may work or reside and therefore has been included in this chapter as a sensitive receptor. For the assessment of potential construction impacts, Receptor 1 is categorised the same under IAQM as the other receptors due to it being greater than 20 m from the construction activities. It therefore falls into the same risk categories as the other receptors.

With no mitigation applied during the construction phase works, it is considered that there is an overall **Low** risk of adverse air quality impacts occurring at offsite receptor locations. Table 16.5 provides a summary of these preliminary impacts based on the IAQM methodology presented in Appendix P Air Quality Technical Report.

Table 16.5 Preliminary impacts - construction phase

Construction Phase	Demolition	Earthworks	Construction	Trackout
	Preliminary Risk of Air Quality Impacts			
Potential Impact to Sensitive Receptors	Negligible	Low Risk	Low Risk	Low Risk

16.5 Assessment of potential operations impacts

A detailed assessment of potential operational impacts to sensitive receptors is provided in Appendix P Air Quality Technical Report. The report identifies Receptor 1 as being within the Project Site and therefore exempt from complying with assessment criteria. Although outside the Project Footprint Receptor 1 is within the Project Site boundary (Figure 16.1). Therefore, it has been included in this chapter as a sensitive receptor.

16.5.1 Emission sources

There are multiple sources that release air pollutants into the atmosphere from ethanol production operations. Key potential air quality impacts associated with the operation of the Project include:

- Odour generation due to the operation of the wastewater management system and ethanol production process
- Particulate matter (PM_{10} and $PM_{2.5}$), from combustion sources
- NOX and CO, from combustion sources
- VOCs, including acetaldehyde, acrolein, formaldehyde, ethanol and methanol

- Traffic-related exhaust emissions due to increased vehicle movements (i.e. heavy vehicle transport of stock/product).

The operations which have the potential to cause emissions to air, and the pollutants likely to be emitted are outlined in Table 16.6.

Table 16.6 Air pollutant emission from the ethanol plant

Operation	Type of Emission	Pollutants Emitted	Comments
Ethanol Plant			
Grain intake and processing	Fugitive	Particulate matter	The receiving, storage, pre-cleaning, de-branning and milling of grain is a closed-system therefore no dust emissions will be released to atmosphere from this process.
Fermentation process	Fugitive	Particulate matter	The dust generated from the mixing, liquefaction, saccharification, pre-fermentation and fermentation processes will be filtered by bag filter and returned to the process. There are no significant emissions to atmosphere from this process.
Distillation process	Fugitive	Speciated VOCs, odour	Any emissions generated in the Mash Tower, Rectification, and Distillation processes are exhausted to the vent scrubbers once the ethanol vapour has been recovered. The vapours are returned to the Waste Heat (WH) boiler in a closed system. There are no significant emissions to atmosphere from this process.
Boilers for generation of steam (Steam boiler and WH boiler)	Point	Products of combustion, particulate matter, speciated VOCs, odour	The boilers will ultimately be fuelled by gas. It will operate 24 hours a day.
Ethanol storage	Fugitive	Speciated VOCs	Ethanol vapour generated in the tank during loading will be collected by a vent scrubber and vented to the exhaust system. When loading ethanol, a breather valve in the top of tank will absorb ethanol vapour and direct it to the vent scrubber. There are no significant emissions to atmosphere from this process.
DDGS drying	Point	Speciated VOCs, odour, particulate matter	VOCs and odour generation are likely from the mixing and drying of DDGS, however of odours will be destroyed using the Thermal Oxidation method on the exhaust gas. Dust generated by the drying process will be collected by dust filters located at the rear of the drying equipment.
Wastewater treatment	Fugitive	Odour	The aeration basin contains pre-treated wastewater, is exposed to the air and may generate odorous emissions.
Ancillary Sources			
Traffic exhaust	Fugitive	Products of Combustion	Due to traffic numbers to site, exhaust emissions will be minimal in context of the surrounding environment. It is assumed these emissions are adequately captured in background data.
Wheel-generated dust	Fugitive	Particulate matter	All internal roads on site are sealed, therefore wheel generated dust will be minimal.
Transfer points and loading/unloading	Fugitive	Particulate matter	Minimal dust will be emitted from unloading/ loading of heavy vehicles.

Based on the emission sources identified in Table 16.6 above, emission rates of pollutants of interest were included in the model for the following sources:

- Steam Boiler (point source)
- WH Boiler (point source)
- Aerated Basin (area source).

Emissions inventory

An operations phase emissions inventory for each pollutant of interest was developed based on emission factors listed in the National Pollutant Inventory (NPI 2011) and VOC stack test data from a similar ethanol manufacturing facility in Nebraska, USA (State of Nebraska 2004). The published NPI emissions factors were adopted due to the absence of site-specific data. Stack parameters used in the modelling are presented in Table 16.7.

Table 16.7 Stack source parameters

Stack ID	Coordinates (km UTM)		Height	Diameter	Exit Temp	Volumetric Flow Rate	Exit Velocity	Fuel Burn Rate
	X	Y	m	m	(K)	(m^3/min)	(m/s)	tonnes/hr
Steam Boiler	309.777	6063.002	30	1.5	393	1,484	14	1.62
WH Boiler	309.818	6063.189	30	1.5	423	1,590	15	3.00

Emission rates used in the modelling for pollutants released from the Steam boiler and WH Boiler are presented in Table 16.8. The thermal oxidation efficiency associated with VOC emissions from the WH Boiler was assumed to be 98 percent.

Table 16.8 Emission estimation for the boilers

Emission Parameter and Units	Pollutant	Steam Boiler	WH Boiler
Emission Factor (kg/tonne)	PM_{10}	0.16	0.16
	$PM_{2.5}$	0.16	0.16
	NO_x	5.95	5.95
	CO	1.82	1.82
Emission Rate (mg/min)	Acetaldehyde	78,812	1,576
	Acrolein	1030	21
	Formaldehyde	35,728	715
	Ethanol	18,915	378
	Methanol	1,081	22
Emission Rate (g/s)	PM_{10}	0.07	0.13
	$PM_{2.5}$	0.07	0.13
	NO_x	2.67	4.97
	CO	0.82	1.52
	Acetaldehyde	1.31	0.026
	Acrolein	0.017	0.00034
	Formaldehyde	0.6	0.012
	Ethanol	0.32	0.0063
	Methanol	0.018	0.00036

The VOCs were also assessed for odour impacts given that their odour threshold concentrations are typically higher than concentrations that may have human health impacts. Specific odour detection thresholds for each pollutant, the emission rates in Table 16.8, and the volumetric flow rates in Table 16.7 were used were used to

calculate the total odour concentration of the mix of compounds. The resulting odour emission rates for the steam boiler and waste heat boiler stacks are presented in Table 16.9.

Table 16.9 Odour emission rates

Source and Speciated VOCs	Odour Detection Threshold	Correlated Odour Concentration	Odour Emission Rate (OER)
	g/m^3	OU	$OU.m^3/sec$
Steam Boiler			
Acetaldehyde	0.00009	550.1	14,581
Acrolein	0.0041	0.16	4.2
Formaldehyde	0.0010	22.0	584
Ethanol	0.00026	46.4	1,230
Methanol	0.21	0.0032	0.086
Total OER			**16,399**
Waste Heat Boiler			
Acetaldehyde	0.00009	11.8	292
Acrolein	0.0041	0.0034	0.083
Formaldehyde	0.0010	0.47	11.7
Ethanol	0.00026	0.99	24.6
Methanol	0.21	0.000069	0.0017
Total OER			**328**
Aerated Basin			
Odour			0.05 $OU.m^2/sec$

16.5.2 Potential impacts to sensitive receptors

Predicted ground level pollutant concentrations at nearby sensitive receptors are presented in the following sections. Contour plots for each pollutant and averaging period are presented in the Air Quality Impact Assessment in Appendix P.

Predicted PM_{10} impacts

Predicted annual average ground level concentrations of PM_{10} at nearby sensitive receptors are presented in Table 16.10. Predicted Project contribution to annual average PM_{10} concentrations was very low. There were no predicted exceedances of the criterion when including the uniform background concentration from Albury.

Table 16.10 Predicted annual average PM_{10} concentrations at sensitive receptors

Receptor ID	PM_{10} Annual Average ($\mu g/m^3$)		
	Background	Project Contribution	Total
Criterion	**30**		
1	14.3	0.02	14.32
2	14.3	0.01	14.31
3	14.3	0.01	14.31
4	14.3	0.03	14.33
5	14.3	0.02	14.32

Predicted 24-hour ground level concentrations of PM_{10} at nearby sensitive receptors are presented in Table 16.11. Predicted Project contributions to 24-hour average PM_{10} concentrations were less than 1 percent of the criterion at all sensitive receptors. However, with inclusion of the background concentration there were exceedances of the criterion at each sensitive receptor.

In situations where the maximum 24-hour average ambient PM_{10} concentration exceeds the impact assessment criteria, the Approved Methods allows the licensee to demonstrate that no additional exceedance of the impact assessment criteria will occur as a result of the proposed activity (NSW OEH, 2005).

Table 16.11 presents the total predicted concentration on days with the highest background and the total predicted concentration on days with the highest predicted incremental ground level concentrations. The Approved Methods assessment criterion is provided for assessment against the cumulative (total) concentrations. The single exceedance of the impact criteria on 6 April 2012 shows there is very minor contribution from the Project to the receptors during this 24-hour period. Based on this, it is evident that additional exceedances of the 24-hour average impact assessment criterion are not likely.

Table 16.11 Predicted 24-hour PM_{10} concentrations at sensitive receptors

Receptor ID	PM_{10} Maximum 24-hour Average ($\mu g/m^3$)			
	Date	Background	Project Contribution	Total
Criterion	50			
Assessment of Maximum Cumulative Impact				
1	6/04/2012	54.4	0.038	54.44
2	6/04/2012	54.4	0.016	54.42
3	6/04/2012	54.4	0.018	54.42
4	6/04/2012	54.4	0.023	54.42
5	6/04/2012	54.4	<0.001	54.40
Assessment of Maximum Project Contribution Impact				
1	22/05/2012	20.7	0.26	20.96
2	22/05/2012	20.7	0.14	20.84
3	09/05/2012	16.8	0.13	16.93
4	13/09/2012	10.5	0.31	10.81
5	06/03/2012	11.2	0.17	11.37

Predicted $PM_{2.5}$ impacts

Predicted 24-hour average ground level concentrations of $PM_{2.5}$ at nearby sensitive receptors are presented in Table 16.12. Predicted Project contributions were very minimal and no exceedances of the criterion were predicted inclusive of the background concentration.

Table 16.12 Predicted $PM_{2.5}$ concentrations at sensitive receptors

Receptor ID	$PM_{2.5}$ Maximum 24-hour Average ($\mu g/m^3$)		
	Background	Project Contribution	Total
Criterion	25		
1	23.2	0.02	23.22
2	23.2	0.01	23.21
3	23.2	0.01	23.21
4	23.2	0.03	23.23
5	23.2	0.02	23.22

Predicted NO_2 impacts

Predicted 1-hour and annual average ground level concentrations of NO_2 at nearby sensitive receptors are presented in Table 16.13. As a conservative approach, 100 percent of NO_x emissions from the Project were assumed to be oxidised to NO_2. The measured NO_2 background concentration was used in the assessment. Predicted Project contributions for 1-hour and annual averages were minimal and no exceedances of the criterion were predicted inclusive of the background concentrations.

Table 16.13 Predicted NO_2 concentrations at sensitive receptors

Receptor ID	NO_x as NO_2 Maximum 1-hour Average ($\mu g/m^3$)			NO_x as NO_2 Annual Average ($\mu g/m^3$)		
	Background	Project Contribution	Total	Background	Project Contribution	Total
Criterion	246			62		
1	82.7	31.4	114.1	9.4	0.8	10.2
2	82.7	31.9	114.6	9.4	0.4	9.8
3	82.7	27.5	110.2	9.4	0.5	9.9
4	82.7	30.1	112.8	9.4	1.1	10.5
5	82.7	25.9	108.6	9.4	0.6	10.0

Predicted CO impacts

Predicted 1-hour and 8-hour average ground level concentrations of CO at nearby sensitive receptors are presented in Table 16.14. Predicted Project contributions were minimal and no exceedances of the criterion were predicted inclusive of the background concentrations.

Table 16.14 Predicted 8-hour and 1-hour CO concentrations at sensitive receptors

Receptor ID	CO Maximum 1-hour Average (mg/m^3)			CO Maximum 8-hour Average (mg/m^3)		
	Background	Project Contribution	Total	Background	Project Contribution	Total
Criterion	30			10		
1	3.30	0.010	3.31	2.18	0.006	2.19
2	3.30	0.010	3.31	2.18	0.004	2.18
3	3.30	0.008	3.31	2.18	0.004	2.18
4	3.30	0.009	3.31	2.18	0.007	2.19
5	3.30	0.008	3.31	2.18	0.004	2.18

Predicted 15-minute average ground level concentrations of CO at nearby sensitive receptors are presented in Table 16.15. Predicted Project contributions are minimal with no exceedances of the criterion predicted inclusive of the background concentration.

Table 16.15 Predicted 15-minute CO concentrations at sensitive receptors

Receptor ID	CO Maximum 15-minute Average (mg/m^3)		
	Background	Project Contribution	Total
Criterion	100		
1	4.35	0.013	4.36
2	4.35	0.013	4.36
3	4.35	0.011	4.36
4	4.35	0.012	4.36
5	4.35	0.011	4.36

Predicted VOC impacts

Predicted 15-minute average ground level concentrations of speciated VOCs at nearby sensitive receptors are presented in Table 16.16. No exceedances of the individual VOC criteria were predicted.

According to the Approved Methods, concentrations of acrolein and formaldehyde must be assessed at and beyond the boundary of the Project Site. Predicted concentrations at Receptor 1 (within the site boundary) are

almost 10 times lower than the criteria. Based on this, it is highly unlikely that concentrations of acrolein or formaldehyde will be above criteria at or beyond the site boundary.

Table 16.16 Predicted speciated VOC concentrations at sensitive receptors

Receptor ID	VOCs 99.9th Percentile 1-hour Average (mg/m^3)				
	Acetaldehyde	Acrolein	Formaldehyde	Ethanol	Methanol
Criterion	0.042	0.00042	0.02	2.1	3.0
1	0.005	0.00008	0.0024	0.0013	0.00008
2	0.003	0.00005	0.0016	0.0008	0.00005
3	0.004	0.00006	0.0017	0.0009	0.00006
4	0.004	0.00006	0.0019	0.0010	0.00006
5	0.004	0.00005	0.0016	0.0009	0.00005

Predicted odour impacts

Predicted peak 1-second ground level concentrations of odour at nearby sensitive receptors are presented in Table 16.17. No exceedances of the odour criterion were predicted.

Table 16.17 Predicted peak 1-second average (99.9th percentile) odour concentrations

Receptor ID	Odour Concentration (99th percentile, nose-response time) (OU)
Criterion	6.0
1	0.10
2	0.06
3	0.06
4	0.12
5	0.07

16.5.3 Greenhouse gas emissions estimates

Processing operations

The Project will use an estimate of 232,433 MJ of natural gas per day. For a 330 day work year, the Project would use an estimated 76,703 GJ/year. Based on that consumption rate, the gas consumption would generate around 4,000 $tCO_{2\text{-}e}$ per annum as shown in Table 16.18.

Table 16.18 Greenhouse gas emissions - processing

Greenhouse Gas	Emission Factor (kg CO_2-e/GJ)*	Emissions (t CO_2-e/year)
CO_2	51.2	3,927
CH_4	0.1	8
N_2O	0.03	2
Total		3,937
* Source: Table 2, NGA Factors, December 2014		

In addition to the natural gas used, the waste water treatment plant on site will generate 2,200 m^3 of biogas per day, which will be sent to the Dryer. The GHG emissions associated with the combustion of this gas were estimated using the emission factors specified in Table 16.19.

Table 16.19 Emission factors for the consumption of biogas

Fuel combusted	Energy Content Factor (GJ/m^3)	Emission factor (kg CO_2-e/GJ)		
		CO_2	CH_4	N_2O
A biogas that is captured for combustion, other than landfill and sludge biogas	3.77E-02	0	4.8	0.03
* Source: Table 2, NGA Factors, December 2014				

Based on operating 330 days per year, the equivalent emissions of CO_2 associated with the biogas were estimated to be 132 tonnes per year as shown in Table 16.20.

Table 16.20 GHG emissions - biogas combustion

Greenhouse Gas	Emission Factor (kg CO_2-e/GJ)	Emissions (t CO_2-e/year)
CO_2	0	0
CH_4	4.8	131
N_2O	0.03	1
Total		**132**

The ethanol production process includes pre-fermentation and fermentation stages, which generate emissions of CO_2. The CO_2 generated by the pre-fermentation process, which generates CO_2 from the decomposition of the glucose in the wheat, is passed through a vent scrubber which absorbs the gas, which is then recovered and returned to the process. The slurry generated by the pre-fermentation process is then fermented, a process which produces ethanol and CO_2.

Dongmun Greentec estimates that 30 percent of the wheat flour (300,000 tonnes per year) would be converted to CO_2 emissions through the fermentation process, with an average CO_2 generation rate of 11.51 tonnes per hour. Operations 330 days per year, 24 hours per day would, therefore, generate an estimated 91,159 $tCO_{2\text{-}e}$ per annum. When there is a market, Dongmun Greentec intends to capture and sell the CO_2 gas. Until then, the gas will be released to atmosphere from the vent scrubber post fermentation.

Electricity consumption

Dongmun Greentec estimates the electricity consumption at the site would be between 6,600 kW and 8,200 kW per year, or 52.3 – 64.9 MWh per year (based on 330 operational days per year). Scope 2 (indirect emissions from the consumption of purchased electricity) and Scope 3 emissions (transmission and distribution losses associated with purchased electricity) were estimated using the higher consumption as shown in Table 16.21. As shown, the GHG emissions associated with electricity use would be around 64,000 $tCO_{2\text{-}e}$ per annum.

Table 16.21 GHG emissions - electricity use

Emissions Type	Emission Factor* (kg CO_2-e/kWh)	GHG Emissions (t CO_2-e)
Scope 2	0.86	55,852
Scope 3	0.13	8,443
Full Fuel Cycle (total)	**0.99**	**64,295**
* Latest estimate for consumption of electricity in NSW. Source: Table 41, NGA Factors, December 2014		

Vehicle fuel consumption

The Project's operations involve four sources of vehicle fuel consumption: heavy vehicle deliveries of materials; dispatch of product by heavy vehicle; dispatch of ethanol by rail (approximately 70 percent of ethanol produced); and staff commuting. Estimates of GHG emissions associated with these activities are provided below. While emissions associated with the delivery and dispatch of materials and staff commuting could be argued to be indirect (i.e. Scope 3) as they will not be under the direct control of Dongmun Greentec, these activities were conservatively assessed as Scope 1 emissions.

Material delivery by heavy vehicle

Inbound traffic to the Project will consist of a total of 9,972 heavy vehicle deliveries per year, comprising the following:

- Approximately 6,930 heavy vehicles per year traveling a 7 km round trip from the freight rail station Deniliquin Rice Growers Siding made up of:
  - 70 percent of 30 vehicles per day for grains
- Approximately 3,042 heavy vehicles per year made up of:
  - 30 percent of 30 vehicles per day for grains
  - 1 vehicle per month for Caustic Soda
  - 1 vehicle per month for Ammonium Phosphate
  - 1 vehicle per month for Urea
  - 1 vehicle per month for Antifoam Liquid
  - 1 vehicle per month for Hydrochloric Acid
  - 1 vehicle per month for Sodium Hypochlorite

The heavy vehicles not originating at Deniliquin Rice Growers Siding will likely be delivering product from the Riverina Region. Each heavy vehicle was assumed to travel 168 km each way (the average distance of the main towns of Hay, Griffith, Wagga Wagga, Corowa and Albury from the Project Site) for a roundtrip of 336 km. With a diesel consumption rate of 0.285 L/km (VicRoads, 2006) the estimated annual fuel consumption is 152.6 kL. The estimated emissions associated with these heavy vehicle movements are shown in Table 16.22.

Table 16.22 Scope 1 emissions – delivery of materials by heavy vehicles (diesel-powered)

Greenhouse Gas	Emission Factor (kg CO_2-e/GJ)	Energy Content Factor (Diesel) (GJ/kL)	Emissions (t CO_2-e/year)
CO_2	69.2	38.6	408
CH_4	0.2		1
N_2O	0.5		31
Total			**412**
* Source: Table 4, NGA Factors, December 2014			

Material dispatch by heavy vehicles

Outbound traffic from the Project will consist of a total of 11,225 heavy vehicle dispatches per year, comprising the following:

- Approximately 4,400 heavy vehicles per year for a 7 km round trip to the freight rail station Deniliquin Rice Growers Siding made up of:
  - 70 percent of 9 vehicles per day of ethanol
- Approximately 6,825 heavy vehicles per year made up of:
  - 30 percent of 9 vehicles per day for ethanol
  - 11 vehicles per day for DDGS
  - 1 vehicle per day for liquid fertiliser (sludge).
  - 14 vehicles per day for distiller's syrup

The heavy vehicles not delivering to the Deniliquin Rice Growers Siding was assumed to travel 342 km (the distance from the site to Melbourne). It should be noted that fuel is currently supplied to the Riverina region by B-Double trucks, which return empty to Melbourne and Sydney. Ethanol produced by the Project will be loaded into these trucks for transport to the refinery terminals, meaning that the product transport emissions are essentially negligible. For the sake of this assessment, however, these emissions were conservatively included in the inventory as one-way trips. With a diesel consumption rate of 0.285 L/km (VicRoads, 2006) the estimated annual fuel consumption is 352.4 kL. Estimated emissions associated with material dispatch are shown in Table 16.23.

Table 16.23 Scope 1 emissions – transport of Project outputs by heavy vehicle (diesel-powered)

Greenhouse gas	Emission factor (kg CO_2-e/GJ)	Energy content factor (Diesel) (GJ/kL)	Emissions (t CO_2-e/year)
CO_2	69.2	38.6	941
CH_4	0.2		3
N_2O	0.5		7
Total			951
* Source: Table 4, NGA Factors, December 2014			

Rail transport

The estimated emissions associated with the delivery of ethanol by rail are shown in Table 16.24. Dongmun Greentec advised that 70 percent of the ethanol produced at the Project Site (i.e. 80,500 kL) will be transported to Melbourne by rail. The estimated distance of this trip was assumed to be the same as that for road travel (i.e. 342 km). The emission factor for rail transport of ethanol provided in Woods, Brown and Estrin (2005) was used to calculate emissions based on freight (i.e. moving a payload a certain distance). The weight of the ethanol was calculated assuming a density of 789 kg/m^3 (or kg/kL).

Table 16.24 Scope 1 emissions - delivery of ethanol by rail

Emission factor (kg CO_2-e/t-km)	Total weight of ethanol transported by rail (tonnes)	Transport distance (km)	Emissions (t CO_2-e/year)
0.03	63,515	342	652

Staff movements

Emissions associated with staff commuting to and from the site were estimated as shown in Table 16.25. Chapter 12 Traffic and Transport estimates 44 inbound staff vehicle movements per day. Staff were all assumed to drive gasoline-powered cars with a conservative fuel consumption rate of 0.19 L/km (DOE, 2008), and have a total commuting distance of 10 km (round trip). Staff were assumed to work for 330 days per year for the purpose of this assessment.

Table 16.25 Scope 1 emissions – passenger vehicles for commuting staff

Greenhouse gas	Emission factor (kg CO_2-e/GJ)	Energy content factor (Gasoline) (GJ/kL)	Emissions (t CO_2-e/year)
CO_2	66.7	34.2	125.9
CH_4	0.6		1.1
N_2O	2.3		4.3
Total			131.3
* Source: Table 4, NGA Factors, December 2014			

Consumption of ethanol by end users

Indirect emissions of GHGs will also occur due to the use (combustion) of the ethanol produced by the Project. Estimates of these Scope 3 emissions are shown in Table 16.26. The Project will have an annual throughput of around 115 ML of ethanol (115,000 kL). It should be noted that the NGA Factors do not provide Scope 3 emission factors for ethanol, as emissions are highly dependent on individual plant and project characteristics. As such, the average emission factor of all the fuels for which a Scope 3 emission factor was provided was used.

Table 16.26 Scope 3 emissions - consumption of ethanol produced by the Project

Fuel type	Emission factor* (kg CO_2-e/GJ)	Energy content Factor ^ (GJ/kL)	Throughput (ML)	GHG emissions (t CO_2-e/year)
Ethanol for use as a fuel in an internal combustion engine	5.3	23.4	115	14,262

Fuel type	Emission factor* (kg CO_2-e/GJ)	Energy content Factor ^ (GJ/kL)	Throughput (ML)	GHG emissions (t CO_2-e/year)
* Table 40, NGA Factors, December 2014 ^ Table 3, NGA Factors, December 2014				

Greenhouse gas emissions summary

The total estimated GHG emissions associated with operation of the Project are shown in Table 16.27. The scale of these emissions in the broader context of GHG emissions from NSW and Australia as a whole is not considered significant. As shown, the total emissions of the Project were estimated at 0.17 Mt CO_2-e per year, equating to approximately 0.03 percent of the total Australian emissions (554.57 Mt CO_2-e) and 0.1 percent of the total NSW emissions (154.72 Mt CO_2-e) in Australia in 2012. The greatest contributor to emissions was the generation of CO_2 by the fermentation process (55.8 percent of the Project's estimated emissions).

Table 16.27 Greenhouse gas emissions summary

Activity	Estimated GHG emissions (t CO_2-e/year)
Gas consumption	3,937
Biogas consumption (generated from WWTP)	132
Fermentation	91,159
Electricity consumption	51,749
Fuel consumption – delivery (heavy vehicle)	412
Fuel consumption – dispatch (heavy vehicle)	951
Fuel consumption – dispatch (rail)	652
Fuel consumption – staff commuting	131
Fuel consumption by end users	14,262
Total GHG emissions	**163,386**

16.6 Mitigation measures

Mitigation measures applicable to potential air quality impacts have been highlighted in Table 16.28.

Table 16.28 Air quality mitigation measures

Impact	No.	Environmental management measure	Timing
Air Quality			
Dust	AQ1	Dust mitigation measures that would be implemented include the following: - Removing silt and other material would around erosion and sediment control structures. - Minimising the use of material stockpiles and ensuring sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process. - Minimising drop heights from loading shovels and other loading / unloading equipment and using fine water sprays on such equipment where appropriate. - Ensuring vehicles entering/exiting the Project Site are covered to prevent escape of materials during transport. - Reducing the heavy vehicle speeds on site to reduce wheel generated dust.	Construction Phase Operations Phase

Impact	No.	Environmental management measure	Timing
Construction machinery	AQ2	Control measures relating to plant and machinery that would be implemented include the following: - Ensuring vehicles and machinery are maintained in accordance with manufacturer's specifications. - Minimising heavy vehicle queuing and unnecessary trips through logistical planning of materials delivery and work practices. - Ensure all vehicles switch off engines when stationary so that there are no idling vehicles for long periods of time. - Fixed plant would be located as far from local receptors as practicable.	Construction Phase
General	AQ3	Air emissions associated with all construction activities would also be managed through compliance with a CEMP. A CEMP would be implemented so that: - The works are conducted in a manner that minimise the generation of air emissions. - The effectiveness of the controls being implemented is monitored. - Additional measures are implemented where required.	Construction Phase
	AQ4	Construction contractors would undertake daily environmental inspections of their works and worksite. Inspections would include: - Visual inspection of dust generation - Ensuring roads leaving the site are free of soil, and prevention of soil tracking onto the road network - Inspection of the erosion and sediment controls - Inspection of any rehabilitated or landscaped areas (where relevant) - Ensuring spill kits are appropriately located and stocked. Any remedial or corrective actions should be reported to the Site Manager as soon as is practicable.	Construction Phase
Complaints handling	AQ5	An effective complaints logging system would be maintained to monitor complaints, to effectively manage any requests for information or respond to any public concerns in relation to the project throughout the construction phase, and to ensure identified incidents are dealt with through investigation and implementation of corrective treatments.	Construction Phase

Impact	No.	Environmental management measure	Timing
Greenhouse gas	AQ6	Operational procedures to be implemented on the site to reduce GHG emissions would include: - Ensuring that there are no leakages from the ethanol plant site through appropriate and effective planning and management. - Undertaking regular inspections to identify compromised parts of the plant. - Investigating the use of renewable energy sources, such as wind, solar or biomass, for externally-sourced electricity. - Closely regulating the use of plant lighting. - Installation of solar-powered lighting around the site where practical.	Operations phase

16.6.1 Greenhouse gas abatement/energy efficiency measures

The Energy Savings Scheme was established in 2009 under the *Electricity Supply Act 1995, and is legislated to continue until 2020. The primary objective of the scheme is to reduce electricity consumption through the provision of financial incentives. Energy retailers and large energy users are required to purchase* energy savings certificates (ESC) generated by accredited certificate providers to offset their consumption.

A business implementing certain energy efficiency or renewable energy projects (such as the installation of rooftop photovoltaic cells) would then be entitled to the generation of certificates that would lower the capital expenditure of the Project.

The primary energy reduction strategy proposed for the Project is the use of a Mechanical Vapour Recompression System. The Mechanical Vapour Recompression System would reuse energy, thereby reducing energy consumption. Use of the biogas generated by the wastewater treatment plant in the Dryer would also serve to reduce the energy consumption of the Project.

The fermentation process would generate CO_2 gas. When there is a viable market for this gas, such as for use as a fertiliser in the agricultural sector, Dongmun Greentec would investigate the potential to capture and sell the gas.

16.7 Summary and conclusions

An air quality impact assessment examined the potential for off-site impacts due to air emissions from the Project. Air quality impacts due to emissions from construction activities were assessed qualitatively by means of the UK IAQM guidance document. Operational impacts were assessed quantitatively by means of air dispersion modelling. The following is a summary of key findings of the assessment:

- Offsite impacts from appropriately mitigated construction activities at the Project were found to be negligible at all nearby sensitive receptors.
- No impacts at sensitive receptors due to operational emissions from the Project were predicted for annual average PM_{10}, $PM_{2.5}$, NO_2, CO, and VOC concentrations.
- No additional exceedances of the 24-hour average PM_{10} criterion were likely to occur as a result of operational activities at the Project.

A number of mitigation strategies aimed at avoiding, managing or mitigating off-site air quality impacts by reducing emissions from the Project have been provided.

GHG emissions associated with gas consumption, biogas combustion, the fermentation process, electricity consumption, fuel use (associated with the delivery of materials and dispatch of ethanol and staff movements) and consumption of Dongmun Greentec ethanol by end users were considered. The total emissions of the Project were estimated to be 0.163 Mt CO_2-e per year, which represents approximately 0.03 percent of the total Australian emissions and 0.1 percent of the total NSW emissions in Australia in 2012. The greatest contributor to emissions is expected to be the fermentation process (55.8 percent of Dongmun Greentec's estimated emissions). The estimated emissions of GHG associated with the Project were considered to be minor in the context of emissions for the NSW and Australia as a whole.

In conclusion, this assessment indicates that the Project will not result in significant impacts on air quality.

17.0 Noise and vibration

This section provides an assessment of the potential impacts of the Project from noise and vibration and blasting and proposes mitigation measures to minimise or avoid adverse effects to nearby sensitive receptors where identified.

This assessment is supported by a Noise and Vibration Technical Report which is provided in Appendix Q.

17.1 Director General's Requirements

The assessment addresses the DGRs as detailed in Table 17.1.

Table 17.1 DGRs for the assessment of noise

Noise DGRs
- Description of all potential noise sources such as construction, operational, on and off-site rail noise and traffic noise
- A comprehensive noise impact assessment including a cumulative noise impact assessment in accordance with relevant Environment Protection Authority guidelines
- Details of noise mitigation, management and monitoring measures
- Noise and Vibration assessments are to be in accordance with the following Policies, Guidelines and Plans: • NSW Industrial Noise Policy (EPA, 2000) and Industrial Noise Policy Application Notes • NSW Road Noise Policy (EPA, 2011) • Environmental Noise Control Manual (DECC) • Interim Construction Noise Guideline (DEDCC, 2009) • Assessing Vibration: a Technical Guide (DEC, 2006) • Interim Guidelines: Assessment of Noise from Rail Infrastructure Projects • Rail Infrastructure Noise Guideline draft for Consultation

17.2 Existing environment

17.2.1 Background noise and vibration

Some existing infrastructure in the area has influence on the background noise and vibration environment of the Project Site and surrounds. These include road traffic noise emissions from Deniliquin Barham Road (north of the Project Site), Line Road (east of the Project Site) and the Deniliquin Rail Line (east of the Project Site).

Background noise measurements have not yet been undertaken as part of the Project. As such, the minimum possible background noise level (rating background noise or RBL) of 30 dBA, has been conservatively adopted. It is noted that this approach, which is accepted by the Industrial Noise Policy (INP), would result in the lowest noise limits for assessment purposes.

Detailed background noise measurements should be undertaken at a later stage of the Project to better understand the existing noise environment.

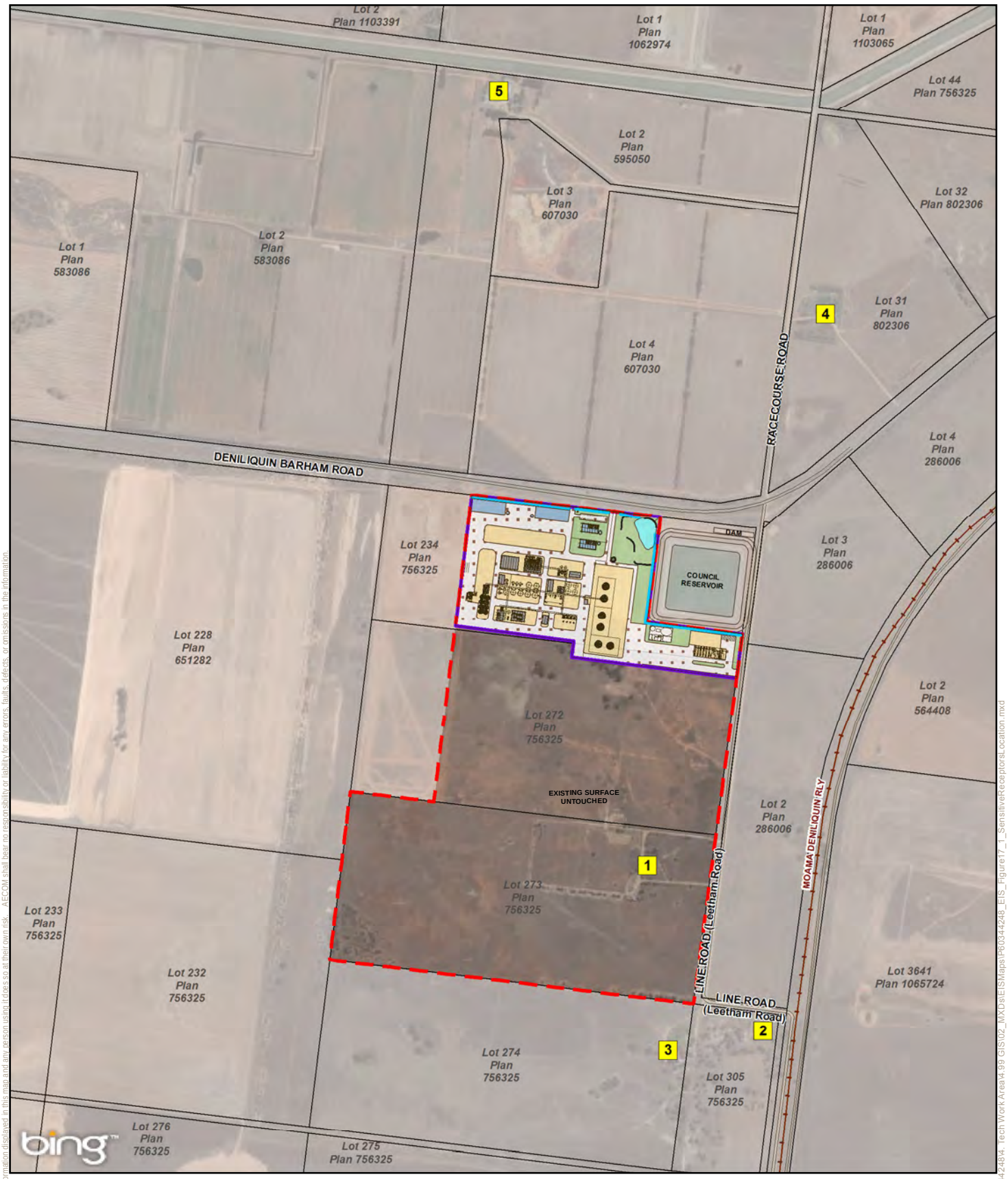
17.2.2 Sensitive receptors

The nearest and potentially most affected sensitive receptors all comprise residential dwellings and are summarised in Table 17.2 and shown in Figure 17.1. It is noted that Receptor 1 is located within the site boundary and may be acquired as part of the Project.

Table 17.2 Summary of noise sensitive receptors

Receptor ID	Easting	Northing	Type	Approximate Distance from Site (m) / Direction (degree true)
R1	310235	6062318	On-site Residential	500 m S
R2	310569	6061841	Rural Residential	850 m SE
R3	310295	6061784	Rural Residential	880 m S
R4	310749	6063912	Rural Residential	550 m N
R5	309806	6064557	Rural Residential	1100 m N

Sensitive Receptor Locations



LEGEND

- Sensitive Receptors
- Railway
- Site Layout
- Vegetated Swale
- Cadastral Boundaries
- Project Site
- Project Footprint
- Pavement Area
- Bio-Retention Basin
- Hardstand Area
- Landscaping
- Roofwater Catchment

Data Sources:
1.Imagery: © 2015 DigitalGlobe © 2015 GeoEye Earthstar Geographics SIO © 2015 Microsoft Corporation
2. Roads, Railway, Drainage, Suburbs, Parks, Localities: @ Street Pro, 2011
3. Key Map Base Layer: ESRI Online
4. Site Layout: based on CAD Drawingd prepared by DONGMUN I.R.S. Co. Ltd.

Disclaimer:
Site Layout is indicative only. To be used for information only. For detailed design reffer to CAD Drawings

AECOM
www.aecom.com

DATUM GDA 1994, PROJECTION MGA ZONE 55

N 0 75 150 225 Metres

FIGURE 17.1

A4

17.3 Relevant criteria

The following section outlines the noise and vibration criteria applicable to the Project. Additional information including the INP project specific criteria is detailed in Appendix Q Noise Technical Report.

17.3.1 Construction noise

The impact from onsite construction works has been assessed in accordance with the DECC's (EPA) document Interim Construction Noise Guideline (ICNG) (DECC July 2009).

Noise management levels for residential receptors and details of how they are to be applied are outlined in the ICNG. Where noise emitted during construction is predicted or measured to exceed the noise management levels, various levels of mitigation are recommended based on the level of exceedance.

Assuming an RBL of 30 dBA (as discussed in Section 17.2.1), the construction noise goals applicable to the Project are outlined in Table 17.3.

Table 17.3 Construction noise goals

Period	Assumed Minimum RBL, dBA	Construction Noise Goal $L_{Aeq\ (15\ min)}$
Day (RBL + 10 dBA)	30	40
Evening (RBL + 5 dBA)	30	35
Night (RBL + 5 dBA)	30	35

17.3.2 Operational noise

Operational noise criteria have been developed based on intrusiveness and amenity in line with the INP policy objectives.

Assessing intrusiveness

The intrusiveness criterion is determined based on the background noise level. The equivalent continuous noise level (L_{Aeq}) of the noise source should not be more than 5 dBA above the measured background noise level (L_{A90}).

Assessing amenity

The amenity criterion is specific to the given land use and associated activities. The cumulative effect of the existing and proposed industry must not produce noise levels that would significantly exceed the criterion.

Summary of operational noise criteria

The Project specific operational noise criteria are outlined in Table 17.4 below.

Table 17.4 Project specific noise criteria

Time of Day	Amenity Criteria, dBA[1]	Intrusiveness Criteria, dBA[2]	Project Specific Criteria, dBA[3]
Day	50	35	35
Evening	45	35	35
Night	40	35	35

Note: 1. Based on the Acceptable Noise Levels for a rural area from Table 3 of the INP, assuming no existing sources of industrial noise.

2. Based on a minimum RBL of 30 dBA + 5 dBA

3. Most stringent of Amenity and Intrusiveness Criteria

17.3.3 Sleep disturbance

An initial screening criterion of background plus 15 dBA (as described in the Application Notes to the INP) is the EPA's current approach to assessing potential sleep disturbance. Where the initial screening criterion cannot be achieved further detailed analysis must be undertaken. The sleep disturbance criterion applies outside the bedroom window of a sensitive receptor.

The sleep disturbance initial screening criterion applicable to the Project is summarised in Table 17.5 below.

Table 17.5 Sleep disturbance – Initial screening criterion

Time of Day	Noise Level (L_{max}, dBA)[1]
Night	45

Note 1: Based on a minimum RBL of 30 dBA + 15 dBA

According to the RNP, in some circumstances higher noise levels may occur without significant sleep disturbance. Based on studies into sleep disturbance, the RNP states:

> *"Maximum internal noise levels below 50 dBA to 55 dBA are unlikely to cause awakening reactions."*
>
> And
>
> *"One or two noise events per night, with maximum internal noise levels of 65 dBA to 70 dBA, are not likely to affect health and wellbeing significantly."*

Based on this worst case minimum attenuation through a bedroom window, of 10 dBA, the first statement above suggests that awakening reactions are unlikely to occur as the result of short term external noises of 60 dBA to 65 dBA.

Therefore, the sleep disturbance noise limit derived through the detailed analysis is summarised in Table 17.6.

Table 17.6 Sleep disturbance – noise limit

Time of Day	Noise Level (L_{max}, dBA)
Night	60

17.3.4 Rail noise

The EPA's approach to the assessment of noise impacts from rail noise is outlined in the document '*Rail Infrastructure Noise Guideline'* (RING) (EPA 2013). The guideline applies to heavy and light rail infrastructure projects including the construction of new rail lines and upgrades to existing lines. It also outlines assessment requirements for rail traffic-generating developments such as the Project. This document has been used as the basis for the assessment of impacts from rail traffic generated by the development.

The rail noise limits drawn from the RING applicable to the Project are presented in Table 17.7.

Table 17.7 Airborne heavy rail noise trigger levels for residential land uses

Type of Development	Noise Trigger Levels dBA (External)[1]	
	Day (7 am – 10 pm)	Night (10 pm – 7 am)
Redevelopment of existing rail line	Development increases existing $L_{Aeq\ (period)}$[2] rail noise levels by 2 dB or more, or existing L_{Amax} rail noise levels by 3 dB or more and predicted rail noise levels exceed:	
	65 $L_{Aeq\ (15hr)}$ OR 85 L_{AFmax}	60 $L_{Aeq\ (9hr)}$ OR 85 L_{AFmax}

Notes: 1. These numbers represent external levels of noise that trigger the need for an assessment of potential noise mitigation measures to reduce noise levels from a rail infrastructure project.

2. $LAeq_{(period)}$ means $LAeq_{(15h)}$ for the day-time period and $LAeq_{(9h)}$ for the night time period.

17.3.5 Road traffic noise

Road traffic criteria are provided in the RNP, which sets out noise criteria applicable to particular types of projects, road category and land use for the purpose of defining traffic noise impacts.

Table 17.8 presents the criteria for residential land uses affected by noise from an arterial road. It is noted that vehicle noise from operations on the Project Site is assessed for compliance in accordance with the criteria outlined in Section 17.3.2.

Table 17.8 Road traffic noise assessment criteria for residential land use

Type of Project and Land Use	Total Traffic Noise Criteria	Relative Increase Criteria
Existing residences affected by additional traffic on existing freeways/arterial/sub arterial road generated by land use development.	Daytime 60 $L_{Aeq\ (15hour)}$	Existing $L_{Aeq\ (15hour)}$ plus 12 dBA
	Night-time 55 $L_{Aeq\ (9hour)}$	Existing $L_{Aeq\ (9hour)}$ plus 12 dBA

17.3.6 Ground vibration criteria

Vibration can affect people in a number of ways:

- Vibration at low frequencies can be perceptible to humans and can result in annoyance or disturbance for building occupants.
- Vibration can also travel into building structures and can be reradiated as audible noise (known as 'regenerated noise').
- Higher levels of vibration can result in the disturbance of building contents.
- Eventually, cosmetic or structural building damage may result.

Vibration limits for the Project have been taken from *Assessing Vibration: a Technical Guide* (DEC, 2006) in accordance with the DGRs. Descriptions of the various vibration types assessed as part of the vibration assessment is defined in Table 17.9.

Table 17.9 Descriptions of vibration types

Types of Vibration	Description
Continuous	Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery).
Impulsive	Infrequent activities that create up to 3 distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading.
Intermittent	Trains, nearby intermittent construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer this would be assessed against impulsive vibration criteria.

The criteria outlined below are applicable to the assessment of both construction and operations phase ground vibration. Table 17.10 summarises the preferred and maximum vibration levels as outlined in *Assessing Vibration: a Technical Guide* (DEC, 2006).

Table 17.10 Vibration limits

Place	Time	Peak Velocity (mm/s)	
		Preferred	Maximum
Continuous Vibration			
Residences	Daytime	0.28	0.56
	Night-time	0.20	0.40
Impulsive Vibration			
Residences	Daytime	8.6	17.0
	Night-time	2.8	5.6
Intermittent Vibration			
Residences	Daytime	0.2	0.4
	Night-time	0.13	0.26

17.4 Methodology

In order to determine the impact of noise emission from the Project, a computer model was prepared using SoundPLAN V7.3 software. SoundPLAN V7.3 allows the use of the CONCAWE algorithm, which is suitable for the assessment of large industrial plants. Where possible, key inputs and assumptions have been adopted as per the modelling in Appendix B of of the Noise Technical Report in Appendix Q for consistency.

Key inputs and assumptions used in developing the computer noise model included the following:

- 1 m terrain data
- A ground absorption factor of 0.5, assuming the land surrounding the site is 'medium soft' ground.
- Any shielding provided by buildings associated with the Project has been conservatively excluded from the assessment
- Octave band sound power levels (SWLs) for significant plant and equipment were derived from a variety of sources, including
    - Project Description Information
    - The SLR technical report (Appendix B of Appendix Q Noise Technical Report)
    - AECOM's database of industrial equipment typical noise levels.
- Plant items have been modelled as a combined point source in the centre of the site. Mobile plant items such as trucks have also been modelled as a point source, as the majority of time would be spent in loading bays.
- Plant has been assumed to operate 100 percent of the time for all periods of the day including the night. This assumption is in line with the INP 15 minute assessment interval. Whilst down time can be expected of some plant at times, there would be other periods where all plant operates concurrently for at least 15 minutes.
- Two weather scenarios have been assessed; one neutral and one that enhances noise propagation. These are input into the model as:
    - Neutral (CONCAWE Category 4) meteorological conditions, wind speed 0 m/s and Pasquill stability class D
    - Enhanced (CONCAWE Category 6) meteorological conditions, wind speed 3 m/s downwind and Pasquill stability class F.

17.5 Assessment of potential impacts

17.5.1 Construction noise

Equipment sound power levels

A typical construction scenario comprising representative plant and equipment has been developed to assess the potential noise and vibration impacts during construction. The equipment used as part of the typical construction scenario are summarised in the Noise Technical Report in Appendix Q. It is understood that all construction works are proposed to be undertaken during standard daytime periods (7.00 am to 6.00 pm Monday to Friday and 8.00 am to 1.00 pm on Saturdays).

Construction noise modelling results

The results of the construction noise modelling are presented in Table 17.11, along with the relevant design goals for daytime construction. The predictions are representative of the worst-case scenario with all equipment operating simultaneously. Noise contour plots for the construction stage are presented in Appendix C of Appendix Q Noise Technical Report.

Table 17.11 Construction noise predictions

Receptor	Noise Level – L_{Aeq}(15minute) (dBA)			
	Predicted	RBL	Design Goal	Exceedance
1	49	30	40	9
2	42	30	40	2
3	42	30	40	2
4	45	30	40	5
5	41	30	40	1

Noise levels are predicted to exceed construction noise goals at Receptor 1 by up to 9 dBA. It is understood however that discussions are being held with the resident of 1 and that this property is likely to be acquired as part of the Project. Therefore, mitigation is unlikely to be required at this receptor.

Noise levels at all other receptors are forecast to be within 5 dBA of the construction noise goal and are categorised as 'noise affected' but not 'highly noise affected' under the INCG. Potential mitigation measures are outlined in Section 17.6.

17.5.2 Operational noise

Equipment sound power levels

Equipment sound power levels adopted in the operational noise assessment have been taken from the SLR technical report located in Appendix B of Appendix Q Noise Technical Report. The equipment used as part of the typical operational scenario are summarised in Appendix Q Noise Technical Report.

Operational noise modelling results

The results of the operational noise model are outlined below in Table 17.12 for both enhanced and neutral propagation weather conditions, along with relevant criteria. Noise contour maps are presented in Appendix C of Appendix Q Noise Technical Report.

Table 17.12 Operational noise assessment

Receptor	Predicted Noise Level, L_{eq}, 15min (dBA)		Criteria (dBA)	Exceedance (dBA)	
	Neutral	Enhanced		Neutral	Enhanced
1	41	45	35	6	10
2	34	39	35	0	4
3	34	39	35	0	4
4	37	42	35	2	7
5	33	38	35	0	3

Noise levels are predicted to exceed operational noise limits at Receptor 1 by up to 10 dBA during enhanced weather conditions. However, as mentioned above, this property is likely to be acquired and therefore mitigation would not be required at this receptor.

Noise levels are forecast to generally comply with criteria at most other receptors under neutral weather conditions, with a minor exceedance of up to 2 dBA forecast at Receptor 4. Noise levels are forecast to exceed criteria at all receptors under 'enhanced propagation' conditions, with the maximum exceedance of 7 dBA at Receptor 4.

Further assessment of noise emissions should be undertaken during the Project's detailed design once inputs and assumptions have been refined. The design should incorporate mitigation measures to reduce noise levels during operations phases to comply with the noise criteria.

17.5.3 Sleep disturbance impacts

Differing from the operational and construction noise assessments, sleep disturbance is measured using the L_{Amax} noise descriptor. Given the continuous nature of the mechanical plant, the variation in peak L_{Amax} noise events

from the modelled operational L_{Aeq} noise levels would likely be minimal. Consistent with the SLR technical report in Appendix B of Appendix Q Noise Technical Report, at most, L_{Amax} noise levels would be 8 dBA higher than L_{Aeq} levels. Therefore the predicted maximum noise levels would be as shown in Table 17.13.

Table 17.13 Sleep disturbance assessment

Receptor	Predicted Noise Level, Lmax, 15min (dBA)		Night Time Noise Limit (dBA)	Exceedance (dBA)	
	Neutral	Enhanced		Neutral	Enhanced
1	49	53	60	0	0
2	42	47	60	0	0
3	42	47	60	0	0
4	45	50	60	0	0
5	41	46	60	0	0

In some instances the L_{Amax} noise levels may be higher than the initial screening criterion of background plus 15 dBA (45 dBA). However, the predicted noise levels are unlikely to result in sleep disturbance as per the noise limit (60 dBA) derived through additional analysis. Night time noise emissions are therefore predicted to comply with the sleep disturbance criteria applicable to the Project.

17.5.4 Rail noise impacts

The Project is forecast to transport 70 percent of the raw materials and output products from ethanol production using the existing rail network. The remaining 30 percent of the raw materials and output would be trucked via the existing road network. The nearest rail siding facility is the Rice Growers Rail Siding approximately 3.5 km to the north east of the Project Site. Product would be trucked to and from this siding.

As discussed in Chapter 12 Traffic and Transport, it is estimated that the average number of train wagons required would be 12 wagons per day inbound and 10 wagons per day outbound from Deniliquin. Rail noise and vibration emissions are not expected to significantly increase from train movements/wagons associated with the operation of the Project. However this would be managed as part of the transport plan once assumptions have been refined.

17.5.5 Road traffic noise impact

The Project will utilise existing road networks to transport 30 percent of raw materials and output products from ethanol production. During the operational stage of the Project it is understood that there would be up to 130 heavy vehicle (HV) movements per day at the site access intersection.

The future change in road traffic noise attributable to the Project has been calculated using the Calculation of Road Traffic Noise (CoRTN) prediction algorithms and taking into consideration:

- the existing traffic movements on Deniliquin Barham Road (based on traffic counts by Dongmun Greentec in January 2014)
- all heavy vehicle movements enter the Project Site via Deniliquin Barham Road and exit via Line Road
- a maximum of 130 additional HV movements on any single day attributed to the Project
- 100 km/h vehicle speeds along Deniliquin Barham Road
- a distance of 300 m to the nearest sensitive receptor

Table 17.14 outlines the traffic flow inputs and forecast noise levels.

Table 17.14 Calculation of proposed road traffic noise level

	Day	Night
Existing total traffic flow	253	152
Existing HV flow	83	50
Existing HV percentage	33%	33%
Future total traffic flow	443	180
Future HV flow	213	50
Future HV percentage	48%	28%
Existing CoRTN predicted noise level at nearest sensitive receptor	41.9 dBA, $L_{10,15h}$	41.9 dBA, $L_{10,\ 9\ h}$
Future CoRTN predicted noise level at nearest sensitive receptor	45.4 dBA, $L_{10,15h}$	42.2 dBA, $L_{10,\ 9\ h}$
Proposed increase in traffic noise level	**45.4 – 41.9 = 3.5 dBA**	**42.2 – 41.9 = 0.3 dBA**
Final L_{eq} noise level	**45.4 – 3 = 42.4 dBA**	**42.2 – 3 = 39.2 dBA**

The predicted levels of road traffic noise at the closest sensitive receptors along Deniliquin Barham Road is $L_{Aeq,15h}$ 42 dBA during the day and $L_{Aeq,9h}$ 39 dBA at night. As such, levels at all residential dwellings in the vicinity of the Project are forecast to be below the NSW RNP criteria of $L_{Aeq,15h}$ 60 dBA and $L_{Aeq,\ 9h}$ 55 dBA.

The predicted change in traffic noise level of 3.5 dBA is also below the 12 dBA increase criterion. On this basis, the noise impact of road traffic generated by the development is not forecast to be significant.

17.5.6 Ground vibration impact

Vibration emission from typical construction sources varies widely depending on ground conditions, size/power of the mobile plant and method of operation. Indicative levels for typical construction equipment operating in a standard operating pattern on normal hard ground are provided in Table 17.15.

Table 17.15 Indicative vibration emission from typical construction sources (in footnote

Activity	Typical Levels of Ground Vibration
Vibratory Rollers[(1)]	1.5 mm/s at 25 m
Hydraulic Rock Breakers (levels typical of a large rock breaker in hard sandstone)	4.5 mm/s at 5 m
	1.3 mm/s at 10 m
	0.4 mm/s at 20 m
	0.1 mm/s at 50 m
Compactor	20 mm/s at 5 m
	2 mm/s at 15 m
	0.3 mm/s at 30 m
Excavators	0.2 mm/s at 40 m
Truck traffic (over maintained road surfaces)	0.2 mm/s at 10 m
Truck traffic (over irregular surfaces)	2 mm/s at 10 m
Bulldozers	2 mm/s at 5 m
	0.2 mm/s at 20 m

Activity	Typical Levels of Ground Vibration
Air track drill	5 mm/s at 5 m
	1.5 mm/s at 10 m
	0.6 mm/s at 25 m
	0.1 mm/s at 50 m
Jackhammer	1 mm/s at 10 m

Notes: 1. Higher levels could occur at closer distances depending on local conditions and the roller operation. For a heavy roller, it is expected that damage would not occur with a minimum 12m buffer to the foundations of a standard residential building. Vibration levels may vary between continuous pass-by and start/stop (changing direction).

2. Significant changes to vibration levels can occur based on soil conditions and driving energy of the hammer.

The majority of the equipment used during construction and operation is likely to produce vibration levels similar to those shown for heavy vehicle traffic (over maintained road surfaces) and Compacters in Table 17.15. The typical levels of ground vibration expected from these activities have therefore been used as part of the vibration assessment.

Given that the closest sensitive receptor is located 500 m from the Project Site, ground vibration levels attributed to construction and operation of the plant are expected to fall well below limits outlined in Section 17.5.6. Should a complaint regarding vibration be raised by a nearby resident, monitoring should be undertaken to confirm that levels comply with these limits.

17.5.7 Impact on fauna

Noise emissions from the Project activities have the potential to have an adverse impact on fauna in the vicinity of the Project. Elevated noise levels near existing habitats could potentially impact behavioural patterns such as feeding and mating for noise sensitive species.

Within Australia there are no specific regulatory instruments that recommend noise and vibration conditions considered suitable for protecting wildlife amenity. It is acknowledged that there is likely to be a wide range of sensitivity to noise from various species, however for the purpose of this assessment, the effect of noise and vibration is assumed to have similar effects to those observed in humans.

Noise and vibration emission from construction and operational equipment are only likely to be disruptive close to vibration sources. As there are no significant changes expected in either rail or road volumes, the Project is unlikely to significantly change the acoustic environment near these transport corridors and therefore is unlikely to impact on local fauna.

The Project Site contains habitat for the protected Plains Wanderer. An impact assessment of the Plains Wanderer was undertaken and the findings of the assessment and corresponding mitigation recommendations are contained in Chapter 8 Biodiversity. Further control measures to reduce the Project's impact on the protected species would be outlined in a Plains Wanderer Species Management Plan as discussed further in Chapter 8 Biodiversity.

17.6 Mitigation measures

17.6.1 Environmental noise management

Table 17.16 outlines the management controls which would be implemented for the construction and operation of the Project to manage noise emissions.

Table 17.16 Noise and vibration mitigation measures

	No.	Environmental Management Measures	Timing
Noise management	NV1	Prepare a construction noise management plan as part of the CEMP.	Detailed design phase
Vehicle and plant generated noise	NV2	Maintain nominated speed limits for vehicles on internal roads.	Construction phase Operation phase
	NV3	Schedule noisy equipment movements, wherever possible, to avoid sensitive times.	Construction phase Operation phase
	NV4	Ensure all vehicle and plant operators are aware of the location of sensitive receptors and the measures required for limiting noise, where possible.	Construction phase Operation phase

	No.	Environmental Management Measures	Timing
	NV5	Enclose equipment to limit noise level including the construction of underground conveyors to transport raw materials, where possible.	Construction phase
	NV6	Consider noise emissions when selecting equipment.	Detailed design phase
	NV7	Ensure all vehicles, plant and machinery are regularly maintained to avoid unnecessary engine, motor or muffler noise.	Construction phase Operation phase
High noise activity scheduling	NV8	Notify key stakeholders when particularly noisy activities are scheduled.	Construction phase Operation phase
	NV9	Limit activities with high noise emissions to daytime hours where possible.	Construction phase Operation phase
Community complaints	NV10	Undertake noise and/or vibration monitoring in response to community complaints in accordance with procedures outlined in the NSW Industrial Noise Policy and Industrial Noise Policy Application Notes. Complaints would be investigated and recorded in the site complaints/incidents register, along with any actions taken in response to the investigation.	Construction phase Operation phase
Noise management	NV11	Carry out further assessment of noise emissions during the Project's detailed design once inputs and assumptions have been refined. The design should incorporate mitigation measures to reduce noise levels during operations phase to comply with the noise criteria. Acoustic treatments such as noise walls or may be required to reduce noise levels to comply with the various criteria.	Detailed design phase

17.7 Summary and conclusions

Assessment of proposed construction activities for the facility show that there are exceedances at some nearby sensitive receptors, indicating that some properties may be 'noise affected' as defined by the policy. A detailed construction noise management plan should be undertaken once the various construction scenarios are better understood.

Operational noise from the Project is predicted to exceed the applicable INP requirements related to amenity and intrusiveness at the sensitive receptors without the provision of noise mitigation. Acoustic treatments (such as noise walls, mounding or similar) will be considered during detailed design to reduce impacts to sensitive receptors. Further assessment of noise emissions would be undertaken during the Project's detailed design once inputs and assumptions have been refined.

Noise emissions from the proposed road and rail movements associated with the Project Site are predicted to comply with the nominated limits.

Vibration levels attributed to plant operations are expected to fall well below the recommended limits.

A number of mitigation and management measures have been recommended for the construction and operation of the Project. The noise controls proposed are forecast to reduce the potential for and impact of noise generated by the Project to the surrounding environment.

In conclusion, this assessment indicates that the Project is unlikely to result in significant, long term noise and vibration impacts on sensitive receptors.

18.0 Cultural heritage

This chapter provides an assessment of the potential impacts of the Project on Aboriginal and historical heritage, and is supported by the following reports (see Appendix R):

- Access Archaeology & Heritage (2014) *Aboriginal Cultural Heritage Assessment Proposed Ethanol Plant, Deniliquin, NSW*
- AECOM (2015) *Deniliquin Ethanol Plant: Aboriginal and Historical Cultural Heritage Assessment*

18.1.1 Director General's Requirements

The Aboriginal and Cultural Heritage assessment addresses the DGRs as detailed in Table 18.1.

Table 18.1 DGRs for the Assessment of Heritage

Aboriginal and Non Aboriginal Cultural Heritage
- No specific requirements were provided

18.2 Methodology

18.2.1 Aboriginal heritage

The key tasks of this assessment have been to:

- Conduct a search of the OEH Aboriginal Heritage Information Management System (AHIMS)
- Review relevant archaeological and ethnohistoric information for the Project Site and environs
- Undertake an inspection of the Project Site
- Provide a detailed assessment of impacts to any identified heritage sites
- Develop appropriate mitigation or management measures for Aboriginal cultural heritage.

18.2.2 Historical heritage

The assessment of historical heritage includes:

- Review of the relevant State and Federal heritage registers and listings to identify any registered heritage sites
- Review of existing historical heritage assessments and documents relevant to the Project Site
- Inspection of the Project Site
- Assessment of the significance of any heritage sites in accordance with the *Burra Charter* (ICOMOS (Australia) 2013) and *Assessing Heritage Significance* (NSW Heritage Office 2001)
- provision of management recommendations.

18.2.3 Impact assessment

The potential impact on heritage values in the Project Site was assessed using standard criteria developed from policy guidelines provided by ICOMOS (2011), and general impact assessment methods.

Cultural heritage places may be of differing levels of significance, ranging from local to international and this significance provides an indication of how sensitive the place would be to impacts (Table 18.2).

Table 18.2 Levels of cultural heritage sensitivity

Sensitivity	Justification	Status
Very High	Exceptional, rare or outstanding place demonstrating important themes in national or international history and heritage.	Fulfils criteria for local, state, national or potentially international listing.
High	Place demonstrating important themes in state history and heritage.	Fulfils criteria for local and state listing.
Moderate	Place demonstrating important themes in local history and heritage.	Fulfils criteria for local listing and may fulfil criteria for state listing.

Sensitivity	Justification	Status
Low	Place demonstrating minor themes in local history and heritage.	May fulfil criteria for local listing and does not fulfil criteria for state listing.
Negligible	Place that has no heritage significance.	Does not fulfil criteria for local or state listing.

Impacts to heritage places and their values can be either direct or indirect. Direct impacts are those where there is a physical connection between the development activities and the heritage place, whereas indirect impacts require some additional pathway for the impact to arise, such as changes to the setting of a heritage place. The degree of impact an activity would have can generally be measured by the magnitude of the change it would create. In the case of heritage places, this impact is assessed in terms of the magnitude of change to the acknowledged heritage values of a place (Table 18.3).

Table 18.3 Determining magnitude of change

Magnitude	Example criteria
Major	Change to all or most significant aspects of the place, such that its heritage values are substantially reduced or destroyed.
Medium	Change to some significant aspects of the place, such that some of its heritage values are partially reduced.
Low	Minor change to significant aspects of the place, such that some of its heritage values are slightly reduced.
Negligible	Changes to insignificant aspects of the places, such that its heritage values are not reduced.
No Change	No change.

The significance of the impact on a heritage place is a factor of the cultural heritage sensitivity of the place, combined with the predicted magnitude of change (Table 18.4). Where a choice of two impact significance descriptors is available, only one is chosen. This allows for professional judgement and a final determination when assessing the risk of impacts on cultural heritage assets.

Table 18.4 Estimating the potential impact and significance

Significance of impact		Magnitude of change				
		Major	Medium	Low	Negligible	No change
Cultural heritage sensitivity	Very High	Very Large	Large/Very Large	Moderate/ Large	Slight	Neutral
	High	Large/Very Large	Moderate/ Large	Slight/ Moderate	Slight	Neutral
	Moderate	Moderate/ Large	Moderate	Slight	Neutral/ Slight	Neutral
	Low	Slight/ Moderate	Slight	Neutral/ Slight	Neutral/ Slight	Neutral
	Negligible	Slight	Neutral/ Slight	Neutral/ Slight	Neutral	Neutral

Note: Shaded boxes indicate a significant effect in terms of EIA

A prediction of impact significance can be made both before and after the implementation of identified mitigation measures, allowing the efficacy of the measures to be assessed and revealing residual impacts that need to be taken into account.

18.3 Existing environment

The nature and distribution of heritage places is invariably connected to the environment in which they occur. Environmental variables such as topography, geology, hydrology, flora and fauna will have played a critical, though by no means determinative, role in influencing how people moved within and utilised a given parcel of land. Accordingly, any attempt to predict or interpret the character and distribution of heritage sites in a given landscape must take environmental factors into account. At the same time, an assessment of historic and current

land uses allows predictions to be made concerning the likely presence or absence of sites and, where appropriate, their archaeological integrity.

The following sections provide summary information on the natural environment and the Aboriginal and historical heritage context of the Project Site. For further detail see Appendix R.

18.3.1 Natural environment

The Project Site is located within the Edward–Wakool alluvial plain, a component of the broader Murray Riverine Plain which is characterised by flat to gently undulating topography. The Project Site itself sits on a gently sloping to flat plain, with its highest point at the southern boundary, and its lowest at the northern boundary. A small depression vegetated with mature black box trees (*Eucalyptus largiflorens*) is located on the boundary between Lot 234 and Lot 272, and a pocket of regrowth river red gum (*E. camaldulensis*) is located in the south western corner of the site. Otherwise the Site has been completely cleared, and subject to significant ground disturbance from over 140 years of mixed agricultural practice. Erosion scalds - tracts of bare, vegetation free soil - speak to the ongoing and extensive movement of water-borne sediment across the site.

The closest permanent watercourse to the Project Site is the Edward River, approximately 6 km northeast. There are no major springs, wetlands or swamps within the Project Site, and the area is located outside of the Edward River 0.5% Annual Exceedance Probabilities (or 1 in 500 year Average Recurrence Interval) flood line (see Chapter 10 Surface Water). However, there is the potential for water to pool in depressions, such as that on the boundary between Lot 234 and Lot 272, following local rain events.

18.4 Aboriginal heritage context

the Project Site lies within the traditional country of the Yorta Yorta Aboriginal language group (also spelt Yola Yola, *Jotijota, Jodajoda, Joti-jota, Yodayod, Yoda-Yoda, Yoorta, Yota, Yota Yota, Yoti Yoti, Yotta-Yotta, Youta),* who occupied the area along the Murray River between Deniliquin, Echuca and Cobram (Horton 1994). Historical sources describe the area as being ‘thinly populated by innumerable small tribes’ (Mereweather 1859) of 100 to 700 people, with camps often constructed in sheltered locations adjacent to waterways (The Bohemian 1882).

A range of local plant and animal foods were exploited by Aboriginal people, and cooking and eating operations were a community event. Food was gathered into a central location and cooked on a single fire where all group members were gathered. Cooking pits (earth ovens) were the typical means of cooking utilised by the Yorta Yorta (Coutts, 1977:6-11). Earth mounds are the remnants of these cooking ovens and have become a particularly prevalent archaeological feature within the Murray valley. Generally found in association with major streams on the riverine plains (Coutts, 1977:6-11), the contemporary mounds are typically characterised by surficial expressions of organic fabric with a matrix of baked clay fragments or peds, charcoal, silty material, often with nearby deposits of animal bone, shell and stone tools.

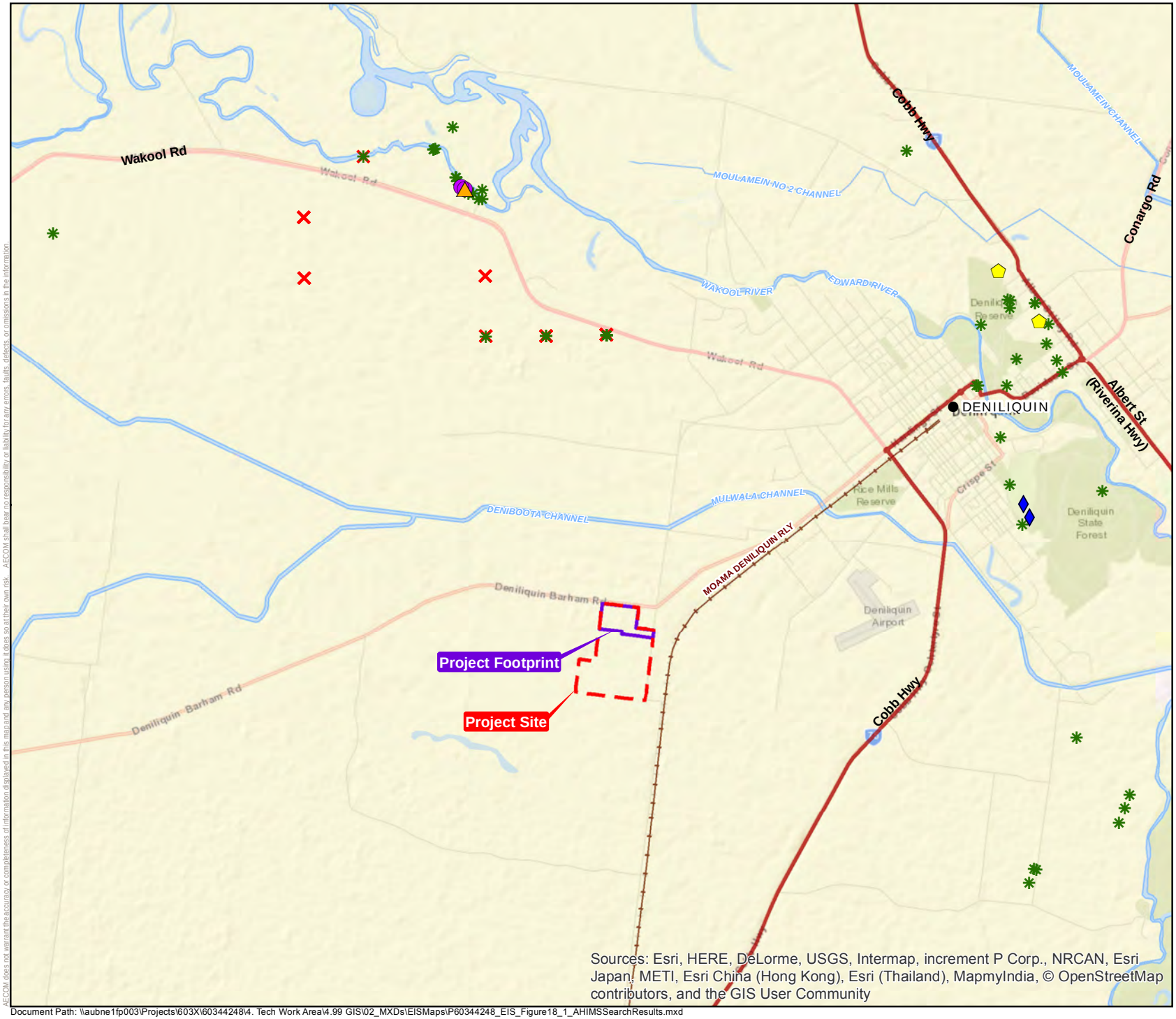
18.4.1 AHIMS search

A search of the AHIMS database on 13 May 2015 identified 100 sites in a 5 x 5 km area surrounding the Project Site (Table 18.5, Figure 18.1). There are no previously recorded Aboriginal archaeological sites within the Project Site with the closest site being recorded 5 km from the northern boundary. The majority of previously identified sites (95 per cent) are scarred trees or earth mounds clustered in the riparian corridor surrounding the Edwards River. The remaining sites are artefact scatters, burials or middens.

It is noted that only two artefact scatters appear in the AHIMS results, representing two per cent of all sites. However, given the regional proliferation of complex site types such as earthen mounds which can include artefact scatters, this is more likely a reflection of recording and naming practices, rather than it is an accurate measure of regional artefact scatter incidence.

Deniliquin Ethanol Plant
Environmental Impact Statement

FIGURE 18.1
AHIMS Search Results



DATUM GDA 1994, PROJECTION MGA ZONE 55

N

0 1 2 3
Kilometres

LEGEND

- Locality

AHIMS Sites

- Burial
- Hearth
- Hearth, Modified Tree
- Isolated Artefact
- Modified Tree
- Non-Human Bone and Organic Material
- Freeway; Highway
- Main Road
- Railway
- Major River / Watercourse
- Minor Watercourse
- Project Site
- Project Footprint

Data Sources:
1. Roads, Railway, Parks, Drainage, Suburbs: @ Street Pro, 2011
2. Base Map Layer: Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community
3. Parks and Reserves: An area of land, the boundaries of which have been determined by the Governor by proclamation in the Government Gazette, which has been reserved for various protection purposes defined in instruments administered by Department of Environment and Climate Change (Parks & Wildlife Division).

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A4 size

Document Path: \\aubne1fp003\Projects\603X\60344248\4. Tech Work Area\4.99 GIS\02_MXDs\EISMaps\P60344248_EIS_Figure18_1_AHIMSSearchResults.mxd

Table 18.5 AHIMS search results by site type

Site Type	Count	% of Count
Culturally Modified Tree	50	49%
Earth Mound / Hearth	47	46%
Burial	2	2%
Artefact Scatters	2	2%
Non-Human Bone and Organic Material	1	1%
Total	**102**	**100%**

18.4.2 Consultation

Notification of the Project and identification of Registered Aboriginal Parties (RAPs) was undertaken by NGH Environmental and Access Archaeology & Heritage during the 2014 heritage assessment, in accordance with the requirements of the OEH Aboriginal Cultural Heritage Consultation Requirements for Proponents (the Consultation Requirements). Three RAP groups were identified during this process:

- Albury Local Aboriginal Land Council
- Deniliquin Local Aboriginal Land Council (DLALC)
- Yarkuwa Indigenous Knowledge Centre Aboriginal Corporation (YIKCAC).

Each of these groups was subsequently invited to:

- provide information about the cultural significance of the Project Area
- comment on the proposed archaeological survey methodology
- participate in the Access Archaeology & Heritage survey
- provide feedback on the Access Archaeology & Heritage report.

As the consultation process already undertaken meets the requirements of the Departmental guidelines, and as the current assessment seeks to confirm and update the Access Archaeology & Heritage report rather than undertake a new study, no further Aboriginal consultation is required at this stage. It is anticipated that the results of this report would form part of the consultation and negotiations subsequently undertaken for the development of a Heritage Management Plan for the Project Site.

18.4.3 Site survey

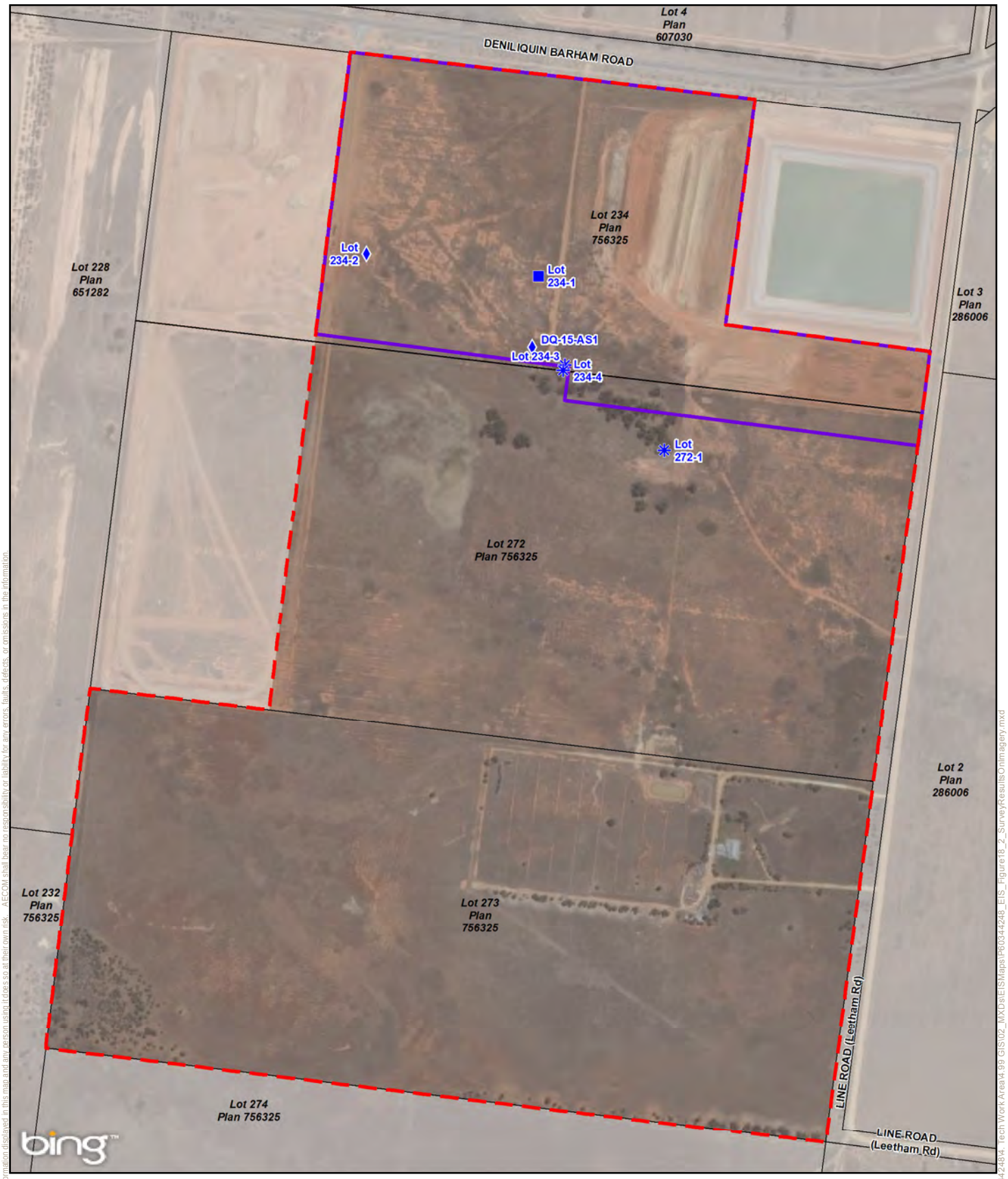
The archaeological survey of the Project Site conducted by Access Archaeology & Heritage (2014) identified five Aboriginal sites across the Project Site (Table 18.6, Figure 18.2):

- a potential hearth (Lot 234-1)
- an artefact scatter (Lot 234-2)
- three scarred trees (Lot 234-3, Lot 234-4, Lot 272-1).

Access Archaeology & Heritage (2014) assessed the potential hearth feature (Lot 234-1) and artefact scatter (Lot 234-2) as being of low scientific significance, and the scarred trees (Lot 234-3, Lot 234-4, Lot 272-1) as being of moderate scientific significance.

As part of the gap analysis and confirmatory work, AECOM relocated four of the five previously identified sites during a site inspection: the potential hearth (Lot 234-1); the artefact scatter (Lot 234-2); and two of the scarred trees (Lot 234-3, Lot 272-1) (2015). AECOM also identified an additional site during the survey – artefact scatter DQ-15-AS1 – which has been assessed as being of moderate significance (AECOM Australia Pty Ltd 2015) (Figure 18.2).

Survey Results



LEGEND

- Artefact Scatter
- Potential Hearth
- Scarred Tree
- Cadastral Boundaries
- Project Site
- Project Footprint

Data Sources:
1.Imagery: © 2015 DigitalGlobe © 2015 GeoEye Earthstar Geographics SIO © 2015 Microsoft Corporation
2. Roads, Railway, Drainage, Suburbs, Parks, Localities: @ Street Pro, 2011
3. Key Map Base Layer: ESRI Online
4. Site Layout: based on CAD Drawingd prepared by DONGMUN I.R.S. Co. Ltd.

Disclaimer:
Site Layout is indicative only. To be used for information only. For detailed design reffer to CAD Drawings

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DATUM GDA 1994, PROJECTION MGA ZONE 55

0 50 100 150
Metres

FIGURE 18.2

A4

Table 18.6 Sites identified on the Project Site (Access Archaeology & Heritage 2014)

Site Name	Easting	Northing	Site Type	Scientific Significance	Details
Lot 234-1	310084	6063276	Potential Hearth	Low	Dispersed hearth with a single stone artefact (fragment of edge ground axe) and one mussel shell fragment
Lot 234-2	309856	6063309	Artefact Scatter	Low	Ten flaked stone artefacts
Lot 234-3	310214	6063154	Scarred Tree	Moderate	Single vertical, asymmetric scar on trunk mature *Eucalyptus largiflorens*
Lot 234-4	310119	6063149	Scarred Tree	Moderate	Single completely healed scar on mature *Eucalyptus largiflorens*
Lot 272-1	310255	6063044	Scarred Tree	Moderate	Single symmetrical scar on horizontal bough of mature *Eucalyptus largiflorens*
DQ-15-AS1	309973	6062992	Artefact scatter	Moderate	Two fine-grained siliceous flaked pieces

18.4.4 Native title context

A search of the National Native Title Tribunal (NNTT) on 16 June 2015 indicates that there are no current Native Title applications over the Project Site.

18.5 Historical heritage context

18.5.1 Historical background

In 1842, banker and entrepreneur Benjamin Boyd dispatched Augustus Morris to investigate the pastoral potential of the area to the north of the Murray River. The land that Morris subsequently claimed for his employer constituted some 700,000 acres (259,000 ha) of land in the present-day Deniliquin area. the Project Site is located on the far western border of what was the largest of Boyd's selections, the 100,000 acre (40,470 ha) Deniliquin run. Adjacent to the Deniliquin Run, and the Project Site, was the slightly smaller 60,000 acre (24,282 ha) Warbreccan Run. Although Boyd was integral to the initial settlement of the Deniliquin district, he had little role in its subsequent development. By the end of the 1840s his finances were failing, and he departed Australia to try his luck on the Californian goldfields (Walsh 2015). Anxious to recoup some of their investments, his backers broke up his brief pastoral empire, and offered all for sale in 1855.

Both Deniliquin and the neighbouring Warbreccan Run were purchased by the Tyson Brothers, who made multiple improvements to their properties, adding fences and dams and investigating the potential for irrigation (Denholm 2015). In 1862 the Deniliquin Run was sold to by Robert and Alexander Landale, who proceeded to split the property into several smaller holdings, including North Deniliquin, Lower Deniliquin and South Deniliquin, on which the Project Site is now located (Bartlett n.d.) (Figure 18.3). The neighbouring Warbreccan was purchased by Sir P.A. Jennings, a noted colonial politician and pastoralist (Cahill 2015).

Like other large pastoral runs, both South Deniliquin and Warbreccan were broken into smaller, freehold parcels in the second half of the 19th century (Shaw 1953). The lots on which the Project Site is located, 234, 272 and 273 were purchased by Sir P.A. Jennings, the owner of the former Warbreccan (Figure 18.4). At this time, much of the land around Deniliquin was used to produce fine Marino wool, although there were also some experiments with the cultivation of wheat at Warbreccan, and potentially on the land that now constitutes the Project Site (Bartlett n.d.; Shaw 1953).

In the 1890s, the Riverina Frozen Meat Company sought to take advantage of Deniliquin's proximity to good sheep country and railway lines to establish a new abattoir and freezing works. The land selected for this endeavour was the former town common and racecourse reserve to the east of the Project Site, with construction commencing in 1894. Although the Project Site was not part of the allotments owned by the meatworks, it is thought that this site may have been used for the abattoir's sheep holding pens (Jeff Shand pers. comm. 2015).

Figure 18.3 Detail of an 1879 pastoral map showing the South Deniliquin run (green) and the approximate Project Site (red) (NLA MAP RM 3062)

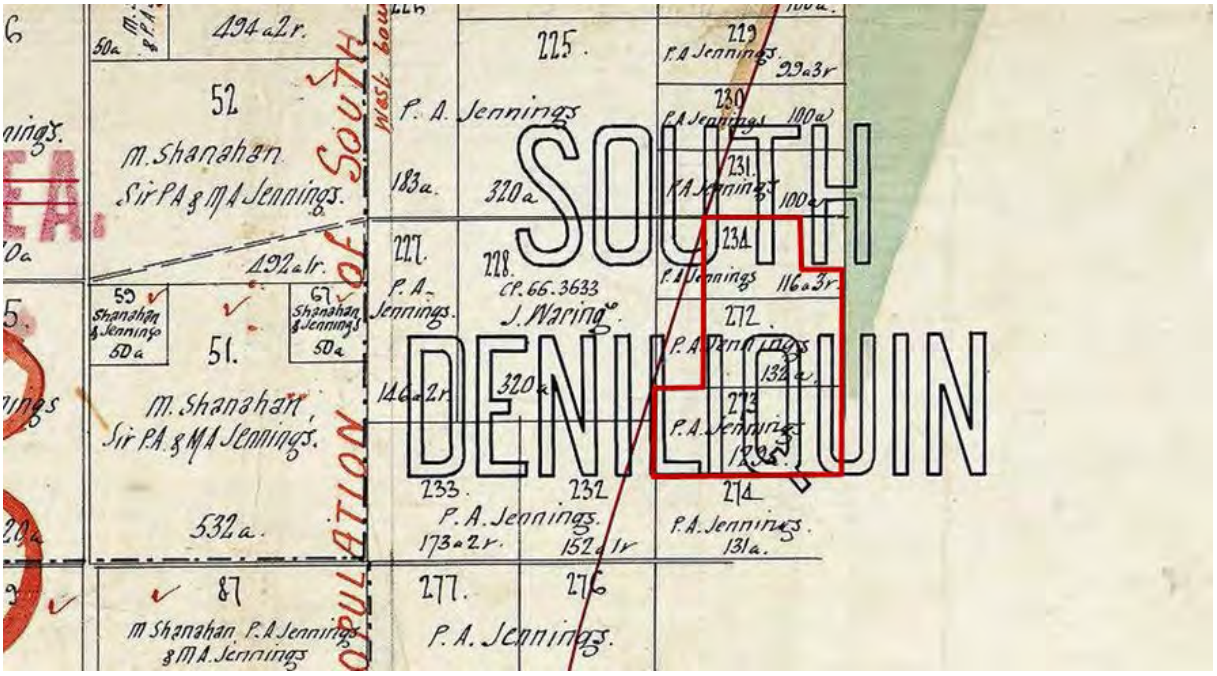


Figure 18.4 Detail of a c1883 map of Warbreccan showing the Project Site (HLRV 573640).

Aerial photographs of the Project Site from the mid-20th century do not show holding pens or any other structures on the site, although the dams and animal trails shown on the 1961 image suggest that the allotments were being used for grazing at this point. The 1961 image also shows a grid pattern in the ground cover in the north east corner of Lot 272, suggesting that yards may once have stood in this location.

Land use around Deniliquin was transformed in the 1930s, with the commencement of several irrigation schemes (Shaw 1953). Focus shifted from wool production to fat lamb production, as well as dairying and cereal cultivation. The area south west of Deniliquin was used mostly for a mixture of wool and cereal production (Shaw 1953), and it seems likely that the Project Site was used for both grazing and cultivation in the 20th century.

18.5.2 Register searches

A search of Commonwealth, State and local heritage registers was conducted on 5 June 2015, and found no recorded historical heritage places in or adjacent to the Project Site.

18.5.3 Historical archaeological potential

The Project Site is located on the border of two original pastoral runs in the Deniliquin region – Deniliquin (subsequently Deniliquin South) and Warbreccan. These runs are not only two of the earliest in the district, but are associated with notable pastoralists and entrepreneurs Benjamin Boyd, Sir P.A. Jennings and James Tyson. As such, the Project Site is a part of the early colonial history of the Deniliquin region, and of NSW more broadly.

Early pastoral history can be archaeologically represented by a number of site types, including:

- building remains (fireplaces, posts, post holes) related to homesteads, outstations, or ancillary buildings
- rubbish dumps (discarded bottles, crockery, metal and bone)
- yards and fencing (posts or post holes)
- water infrastructure (bores, windmills, tanks, dams, wool scours and irrigation channels).

However, there seems little potential that any such archaeological remains are preserved in the Project Site.

Standing on the far western boundary of the Deniliquin run, some 5 km from any permanent water source, the Project Site is not a likely location for any early homesteads, outstations or shepherds huts, all of which tended to be built in more central locations, and with access to water. The absence of any such features in the Project Site is borne out by the 1945 aerial photographs, which show no standing or ruined structures on the site.

Early maps show that the original boundary between Warbreccan and Deniliquin ran across what is now allotment 234 and 272 (Figure 18.4), but it appears to have been located just outside the Project Site. Even if this were not the case, however, it seems unlikely that any remnants of a boundary fence would have survived over 130 years of grazing and cultivation.

There is some potential for remnants of later, 20th century activities to remain in the Project Site. Aerial photographs from the 1960s and local oral history suggest that sheep holding pens for the nearby abattoir may have been located in the north eastern corner of the Project Site. Physical evidence of any such yards is likely to have been disturbed or destroyed by subsequent ploughing in the area, but there is some potential that posts or postholes remnants are preserved subsurface.

18.5.4 Site inspection

No historical heritage places were identified during the site inspection. This is consistent with the known history of the Project Site which suggests that, although part of early pastoral runs, the area was never intensively used and there is no evidence of early structures on the site. No evidence was found of the 20th century sheep yards that may have stood in the north eastern corner of the Project Site.

18.6 Assessment of potential impacts

18.6.1 Project activity

The Project is centred on Lot 234, with some construction works in the far north east corner of Lot 272. Clearing, grubbing and grading would occur over the Project Footprint during the pre-construction phase causing extensive ground surface disturbance to a depth of at least 20 cm.

18.6.2 Significance assessment

As discussed in Section 18.2.3, cultural heritage places may be of differing levels of significance, ranging from local to international and this significance provides an indication of how sensitive the place would be to impacts. In Australia, the primary guide to the assessment of cultural significance is the *Australian ICOMOS Charter for the Conservation of Places of Cultural Significance* (2013), informally known as the *Burra Charter*, which defines it as the '*aesthetic, historic, scientific, social or spiritual value for past, present or future generations*' of a site or place (Chapter 5).

With respect to Aboriginal sites and places, it is possible to identify two major streams in the overall significance assessment process: the assessment of scientific significance by archaeologists and the assessment of cultural or social significance to Aboriginal people. Scientific significance refers to the capacity of an archaeological site to make a meaningful contribution to current understanding of Aboriginal culture (i.e. their research potential) and is commonly assessed on the basis of four key criteria: rarity, representativeness, integrity and potential for archaeological deposit. It is this type of significance that is assessed here. Cultural significance and impacts to this significance can only be identified by Aboriginal people.

Table 18.7 summarises AECOM's significance assessment of each of the heritage places identified on the Project Site (see also Appendix R).

Table 18.7 Significance assessment

Site name	Site Type	Rarity	Representativeness	Integrity	Potential for Archaeological Deposits	Scientific Significance
Lot 234-1	*Potential Hearth*	*Common*	*Low*	*Low*	*Low*	*Low*
Rationale - Lot 234-1 is a poor example of a locally and regionally common site type (hearths and earth mounds make up 45% of AHIMS sites in the area (see section 18.4.1). - The interpreted contents of the site were generally consistent with those found on a local scale, noting however that no charcoal, ash, bone or significant lithic materials were observed which are typical of these sites. - The site is highly disturbed by historical agricultural practises and is considered to have low subsurface archaeological potential. - The site has little capacity to contribute a meaningful understanding of Aboriginal culture in the local area.						
Lot 234-2	*Artefact Scatter*	*Uncommon*	*Low*	*Low*	*Low*	*Moderate*
Rationale - Lot 234-2 is an uncommon site type in the local area as reflected in the AHIMS search, although it is noted that lack of recorded open artefact sites likely reflects the priority of other associated Aboriginal sites (such as hearths/earth mounds). - The recorded contents of the site demonstrate the raw materials and manufacturing techniques utilised by Aboriginal people. - The site is highly disturbed by historical agricultural practises and is considered to have low subsurface archaeological potential. - The site has a moderate capacity to contribute a meaningful understanding of Aboriginal culture in the local area.						
Lot 234-3	*Scarred tree*	*Common*	*Low*	*Low*	*Low*	*Low*
Rationale - Lot 234-3 possesses no clearly visible diagnostic features, which would indicate that the scar is definitively of Aboriginal origin. - The visible scar is a poor example of a locally and regionally common site type. Better examples of this type of site exist locally and regionally which are characteristic of Aboriginal-derived scars. - The site is highly disturbed by historical agricultural practises and is considered to have low subsurface archaeological potential.						
Lot 234-4	*Scarred tree*	*Common*	*Low*	*Low*	*Low*	*Low*
Rationale - Lot 234-4 possesses no clearly visible diagnostic features, which would indicate that the scar is definitively of Aboriginal origin. - The visible scar is a poor example of a locally and regionally common site type. Better examples of this type of site exist locally and regionally which are characteristic of Aboriginal-derived scars. - The site is highly disturbed by historical agricultural practises and is considered to have low subsurface archaeological potential.						
Lot 272-1	*Scarred tree*	*Common*	*Low*	*Low*	*Low*	*Low*
Rationale - Lot 272-1 possesses no clearly visible diagnostic features, which would indicate that the scar is definitively of Aboriginal origin. - The visible scar is a poor example of a locally and regionally common site type. Better examples of this type of site exist locally and regionally which are characteristic of Aboriginal-derived scars. - The site is highly disturbed by historical agricultural practises and is considered to have low subsurface archaeological potential.						

Site name	Site Type	Rarity	Representativeness	Integrity	Potential for Archaeological Deposits	Scientific Significance
DQ-15 AS-1	*Artefact Scatter*	*Uncommon*	*Low*	*Low*	*Low*	*Moderate*
Rationale - DQ-15-AS1 is an uncommon site type in the local area as reflected in the AHIMS search, although it is noted that lack of recorded open artefact sites likely reflects the priority of other associated Aboriginal sites (such as hearths/earth mounds). - The site is highly disturbed by historical agricultural practises and is considered to have low subsurface archaeological potential. - The site has a moderate capacity to contribute a meaningful understanding of Aboriginal culture in the local area.						
Sheep Yards	*PAD (Historical)*	*Common*	*Low*	*Low*	*Low*	*Low/None*
Rationale - The sheep yards that potentially stood in the north corner of the Site date to 20th century abattoir activities, and are not considered rare. - If any remnants of these yards remain *in situ*, they are likely to be highly disturbed, and thus they are neither representative or intact. - Given the degree of ground disturbance and the wooden construction of the yards, archaeological potential is low.						

18.6.3 Construction phase impacts to known heritage

There are six known Aboriginal heritage places on the Project Site; one potential hearth, two artefact scatters and two modified trees on Lot 234, and one modified tree on Lot 272. The artefact scatters have been assessed as being of moderate significance, and the potential hearth as being of low scientific significance. The modified trees on Lots 234 and 272 were assessed as being of moderate significance by Access Archaeology and Heritage (2014), but AECOM notes that the identified 'scars' are similar to other stock damage related scars on trees nearby in the same grove.

It is anticipated that without mitigation measures, sites Lot 234-2, Lot 234-1, DQ-15-AS1 and Lot 234-3 would be destroyed during the pre-construction works for the Project (Figure 18.5). Site Lot 234-4 and Lot 272-1 are outside the construction footprint, and should not be directly impacted by the works (Figure 18.5). It is noted, however, that Lot 234-4 is only 5 m from the site boundary, and so there is some potential for accidental or indirect impact. The final site, Lot 272-1 (scarred tree) is some 60 m from the Project Footprint, and so would not be impacted. A summary of impacts for each of these sites is found in Table 18.8.

Table 18.8 Summary of impacted sites

Site ID	Site Type	Scientific Significance	Magnitude of Impact	Significance of Impact
Lot 234-1	Potential Hearth	Low	Major	Slight/Moderate
Lot 234-2	Artefact Scatter	Moderate	Major	Moderate/Large
Lot 234-3	Scarred Tree	Originally moderate. To be reassessed	Major	To be determined
Lot 234-4	Scarred Tree	Originally moderate. To be reassessed	No change	Neutral
Lot 272-1	Scarred Tree	Originally moderate. To be reassessed	No change	Neutral
DQ-15-AS1	Artefact Scatter	Moderate	Major	Moderate/Large

Alternatives to avoid impact

As currently designed, the Project covers the entirety of Lot 234 and the north east corner of Lot 272. The current layout has been specifically developed to use as little space as possible, and there is no obvious scope to alter this layout without impacting the functionality of the plant (Figure 18.5). The feasibility of redesign is also limited by the nature of the Aboriginal archaeological record on the Project Site. As discussed in Access Archaeology & Heritage (2014:22), the artefact scatters identified on the Project Site are diffuse in nature, lacking clear

boundaries. These scatters may continue across the Site, only becoming evident as vegetation is cleared or sediment disturbed, making it difficult to design a plant layout that would avoid all archaeological sites.

18.6.4 Construction phase impacts to unknown heritage

The known natural and colonial history of the Project Site, suggests that it has never been intensively occupied. Likewise the absence of reliable water suggests that the area would not have been an attractive permanent occupation site for Aboriginal people. However, the Project Site may have been used by Aboriginal people for temporary camps or resource extraction, particularly during peak flood events, and there is also the chance that huts or other minor buildings associated with pastoral operations may have been constructed. There is also some potential for archaeological remnants of 20th century sheep holding pens in the north eastern corner of the Project Site. However, as these pens relate to relatively recent abattoir activities rather than the early pastoral ventures, they are considered to be of negligible heritage significance.

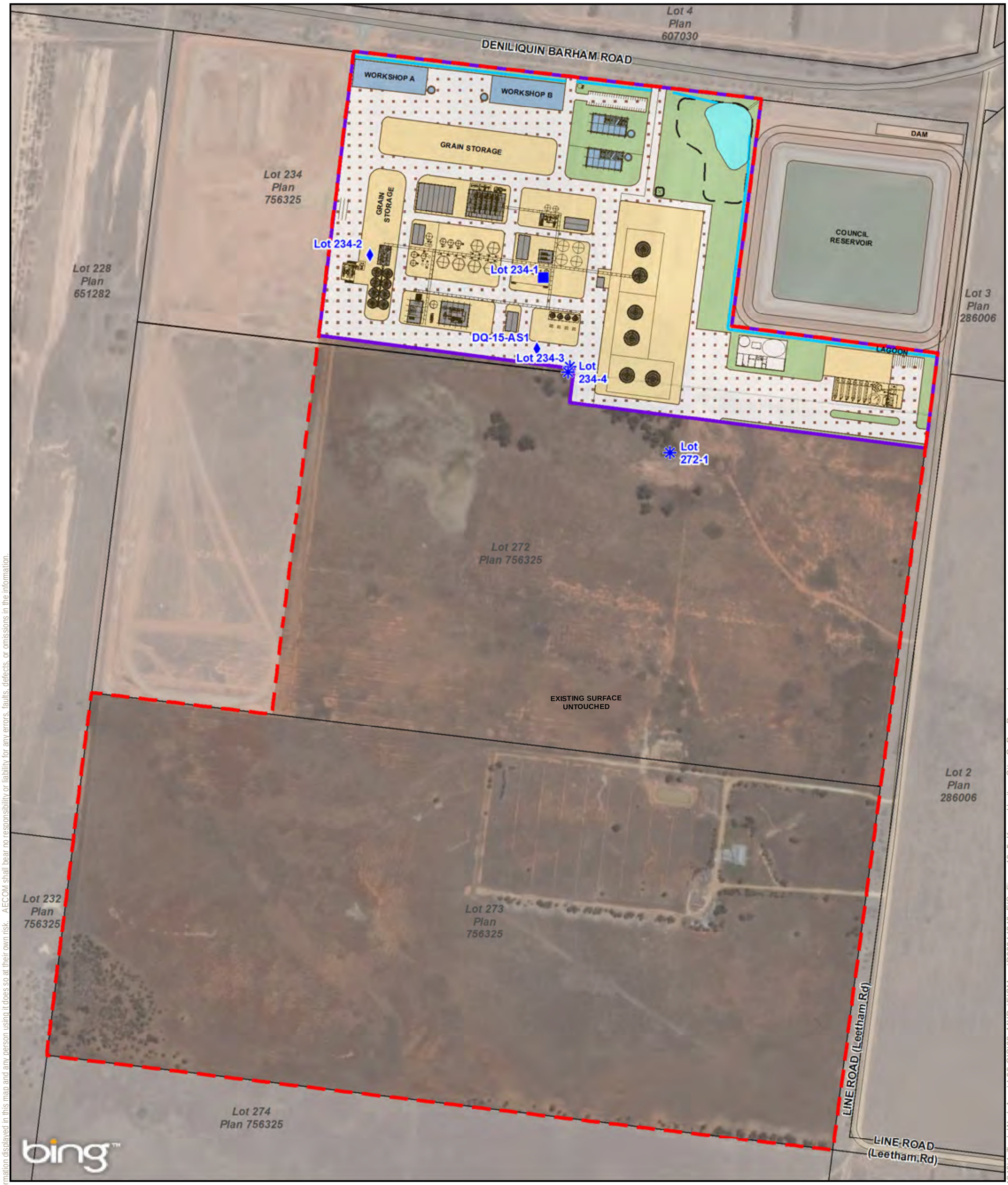
There is thus some potential, albeit low, for both Aboriginal and historical, colonial era archaeological sites across the Project Site. Given the known historical and archaeological background of the Project Site, any additional archaeological sites are likely to be of low or moderate significance, and their destruction would result in a slight/moderate to moderate/large significance of impact.

18.6.5 Operations phase impacts to heritage

Impact to Aboriginal heritage sites or historical archaeological sites is predominately associated with ground disturbing activities. It is therefore likely that heritage impacts associated with the Project would be limited to the clearing and grubbing work completed during the construction phase (Sections 18.6.3, 18.6.4).

However, any subsequent ground disturbing work outside of the current footprint does have the potential to cause further impacts to heritage values, particularly around identified sites (Figure 18.5).

Known Heritage Sites on Project Site



LEGEND

- Artefact Scatter
- Potential Hearth
- Scarred Tree
- Site Layout
- Vegetated Swale
- Cadastral Boundaries
- Project Site
- Project Footprint
- Pavement Area
- Bio-Retention Basin
- Hardstand Area
- Landscaping
- Roofwater Catchment

Data Sources:
1.Imagery: © 2015 DigitalGlobe © 2015 GeoEye Earthstar Geographics SIO © 2015 Microsoft Corporation
2. Roads, Railway, Drainage, Suburbs, Parks, Localities: @ Street Pro, 2011
3. Key Map Base Layer: ESRI Online
4. Site Layout: based on CAD Drawingd prepared by DONGMUN I.R.S. Co. Ltd.

Disclaimer:
Site Layout is indicative only. To be used for information only. For detailed design reffer to CAD Drawings

AECOM
www.aecom.com

DATUM GDA 1994, PROJECTION MGA ZONE 55

N 0 50 100 150 Metres

FIGURE 18.5

A4

18.7 Mitigation measures

A management strategy to address the potential impacts of the Project on the known and potential heritage places of the Project Site is summarised in Table 18.9. The details of this strategy would be specified in a Heritage Management Plan (HMP) for the Project, which would be prepared in consultation with RAPs, OEH and DP&E. Subject to Division 4.1 Development Consent and HMP approval by DP&E, this document would guide the management of Aboriginal cultural heritage within the Project Site (see also Appendix R).

Table 18.9 Cultural heritage mitigation measures

Impact	No.	Environmental management measures	Timing
HMP	CH1	Preparation of a HMP in consultation with RAPs, to include the provisions below	Detailed design phase Construction phase
Impacts to unidentified sites	CH2	Archaeological salvage program including: - Surface collection - Test excavation - Salvage excavation (if warranted by results of test excavation)	Detailed design phase
Scarred trees	CH3	Scarred tree management, including - Reassessment of scarred trees by a qualified arborist - Recording and removal of trees (if warranted by reassessment)	Detailed design phase
Protection of non-impacted sites	CH4	Management of non-impacted sites, including; - Protective fencing - Annual monitoring	Construction phase Operations phase
Management of staff and Contractor's activities	CH5	Aboriginal and historical heritage induction and cultural awareness training, including - Information on likely site types - Procedures for accidental discoveries	Construction phase Operations phase
	CH6	Chance finds procedures for: - Aboriginal archaeological sites/materials - Human remains - Historical cultural heritage	Construction phase Operations phase
	CH7	Site reporting and registration requirements for: - Aboriginal heritage sites - Historical heritage sites	Construction phase Operations phase

18.8 Summary and conclusions

As currently proposed, the Project would destroy four of the six known heritage sites on the Project Site (Lot 234-2, Lot 234-1, DQ-15-AS1 and Lot 234-3), and has the potential to disturb or destroy any currently unknown heritage places within the Project Footprint, constituting a moderate/large significance of impact to the heritage values of the Project Site.

AECOM has recommended a series of management measures to mitigate this impact, including an archaeological salvage program, reassessment and management of the scarred trees, development of cultural heritage inductions, protection measures for sites remaining *in situ*, and chance finds procedures. With these measures in place, it is anticipated that Project's overall significance of impact to the site's heritage values would be reduced to minor.

19.0 Socio-economic

19.1 Introduction

This chapter describes the social and economic environment within the area surrounding the Project Site in both a local and regional context. The assessment then discusses the Project's potential impact on existing socio-economic values and, where applicable, proposes mitigation and management measures.

19.2 Methodology

A desktop assessment was carried out of the potential impacts to the existing social and economic environment in Deniliquin and the wider Murray region as follows:

- Definition of the relevant study area (Table 19.1) for the Project, taking into account the extent or scale of the potential impacts of the Project, including both direct and indirect impacts.
- Creation of a profile of the existing socio-economic environment for the immediate Project area as well the regional area. This was achieved through the review of data sourced from the ABS census data (ABS, 2011), regional councils and local council including economic development strategies.
- Assessment of the potential impacts of the Project on local businesses.
- Assessment of the potential impacts of the Project with regard to property impacts, business impacts, community infrastructure, traffic and transport, as well as access and connectivity.
- A cumulative assessment of the socio-economic impacts of all phases of the Project, combined with the impacts of other planned and anticipated Projects.
- Identification of measures to mitigate or manage potential socio-economic impacts as a result of the Project.

19.3 Existing environment

19.3.1 Study area

The study area for the socio-economic assessment has been identified as the geographical statistical areas (as defined by the ABS) that encompass the Project. Two levels of geographical statistical area have been identified as being potentially influenced by the socio-economic effects of the Project, based on the scale of the Project. The two levels identified are:

- Local (Primary Study Area – PSA)
- Regional (Secondary Study Area – SSA).

Statistics for these areas will also be compared to state and / or national averages for context.

Table 19.1 provides the ABS statistical area level and statistical area reference codes that have been used to define the study area.

Table 19.1 Study area statistical areas

Level	Name	Statistical Area Level	Statistical Area Reference Code
Local (PSA)	Deniliquin	Statistical Local Area (SLA)	155152500
Regional (SSA)	Murray Region	Statistical Area Level 4 (SA4)	109

19.3.2 Socio-demographic profile

The following key population and demographic characteristics of the two levels of study area identified (based on the 2011 Census (ABS, 2011)) are summarised as follows:

- The estimated resident population with the PSA was 7,121 and within the SSA the population was 110,317. Over the period 2006 to 2011 the population of the PSA declined by 4 percent and the population of the SSA declined marginally by 0.2 percent. This trend of population decline is in opposition to the population change across NSW which increased by 9 percent in the same period. The population projection for the two decades between 2011 and 2031 is 12.8 percent growth in the SSA (Regional Development Australia, 2014)
- The median age within the PSA was 44 years old and in the SSA was 41 years old. The median age across NSW was 38.

- The percentage of individuals in the study are that identified as Aboriginal and/or Torres Strait Islander is 3.5 percent approximately; 1 percent higher than the NSW average of 2.5 percent
- 4 percent of residents in the PSA and 5 percent of residents in the SSA spoke a language other than English at home. This is significantly lower than the NSW average of 22 percent.

19.3.3 Families and housing

In 2011, dwellings in the PSA comprised predominantly separate houses (88.1 percent). The majority of households within the PSA are family households (64.2 percent) with a median of three occupants. Houses in the PSA are primarily owned outright (37.8 percent) followed by housing owned with a mortgage (30.2 percent) and then rental housing (27.2 percent). Housing in the region is affordable with median mortgage repayments and median rent lower in the PSA ($1,083 per month and $150 per week respectively) and SSA ($1,300 per month and $165 per week respectively) than in NSW as a State ($1,993 per month and $300 per week respectively). A summary of these statistics for the PSA, SSA and comparable statistics from NSW are presented in Table 19.2.

Table 19.2 Family and housing statistics for PSA, SSA and NSW (ABS, 2011)

Area	Primary Dwelling Structure	Primary Household Composition	Primary Tenure	Median Mortgage Repayments (per month)	Median Rent (per week)
PSA	Separate house (88.1 %)	Family households (64.2 %)	Owned outright (37.8 %)	$1,083	$150
SSA	Separate house (84.8 %)	Family households (67.7 %)	Owned outright (36.4 %)	$1,300	$165
NSW	Separate house (69.5%)	Family households (71.9 %)	Owned outright (33.2%)	$1,993	$300

19.3.4 Socio-economic status

An estimate of the socio-economic advantage / disadvantages has been based on the Index of Relative Socio-Economic Advantage/Disadvantage (IRSAD). IRSAD summarises information about the economic and social conditions of people and households within an area. A higher score on the Index indicates an area has attributes of “higher advantage” such as a relatively high proportion of people with high incomes or a skilled labour force. It also means an area has a low proportion of people with low incomes and relatively few unskilled people in the labour force. ISRAD scores are not available for regional areas and hence the SSA has not been considered in this section.

In 2011, the PSA recorded an IRSAD score of 926 and decile rank within NSW of 3. The scores recorded for the PSA are relatively low by State and Australian standards. This highlights that Deniliquin is a relatively disadvantaged socio-economic area compared with other regions across the State and Australia. These statistics are summarised in Table 19.3.

Table 19.3 ISRAD scores and ranking within NSW for PSA (ABS, 2011)

Area	ISRAD score	Ranking within state		
		Rank	Decile	Percentile
PSA	926	40	3	21

19.3.5 Labour force income and employment

The median household income within the PSA in 2011 was $853 per week and within the SSA was $921. The median household income for NSW was $1,237 per week.

The rate of unemployment in the PSA in 2011 was 4.6 percent and in the SSA was 5.0 percent. This was lower than the State unemployment rate of 5.9 percent and the national rate of 5.6 percent. Median household income and unemployment rate for the PSA, SSA, NSW and Australia are summarised in Table 19.4

Table 19.4 Labour force statistics for PSA, SSA, NSW and Australia (ABS, 2011)

Area	Median household income (per week)	Unemployment rate
PSA	$853	4.6 %
SSA	$921	5.0 %
NSW	$1,237	5.9 %
Australia	$1,234	5.6%

19.3.6 Community facilities

The immediate area surrounding the Project Site is predominantly agricultural use with accompanying homesteads on these properties. The Deniliquin township is located approximately 4 km north east, where there are a diversity of community facilities. These facilities include the Deniliquin Multi Arts Centre, Deniliquin Community Health Centre, Deniliquin Hospital, several educational institutions including primary and secondary schools and a TAFE college, as well as sporting facilities and clubs including a swimming centre.

The SSA, which encompasses thirteen LGAs, is also home to a significant amount of community infrastructure. Each LGA contains facilities that are essential to meeting the needs of the local population. The SSA also provides facilities to service the wider community including several private hospitals, a university and aged care facilities.

The PSA is within close proximity to the Murray Valley National Park which provides recreational opportunities for bushwalkers, mountain bikers and nature enthusiasts. The Edward River also provides opportunities for anglers and water skiers. Other recreational facilities in the area include the Deniliquin Golf Club and the Deniliquin Bowling Club (Deniliquin Council, 2015).

19.3.7 Economic / business environment

Within the SSA, the clear strengths of the region are the agricultural and manufacturing industries (DoP, 2009), jointly contributing approximately 30 percent of total Industry Gross Value Add (GVA) between 2011-2012 (Regional Development Australia, 2014). There are obvious distinctions between the economic activities of the PSA and the SSA, with the predominant contributors to GVA in the PSA being financial and insurance services and health care and social assistance.

The estimated value of the SSA's gross regional product (GRP) in 2011-2012 was estimated at $18.2 billion, with an annual growth of 4.2 percent over the previous five years (Regional Development Australia, 2014). The growth rate within the region has remained below the average for both NSW and Victoria over this period. The GRP for the PSA between 2011-2012 was $518 million (Regional Development Australia, 2014).

Within the PSA, the highest employment industries in 2011 were health care and social assistance, retail trade, manufacturing, and agriculture, forestry and fishing (Regional Development Australia, 2014). The SSA has a similar distribution of industries of employment with the highest employment industry being health care and social assistance, followed by agriculture, forestry and fishing, retail trade and manufacturing. Further, both the PSA and SSA have a diversified economy with a wide range of industries providing significant employment.

There are strategic and economic advantages for business within the study areas. The location of Deniliquin and the greater Murray region provides good connectivity to major centres. Deniliquin is only 3.5 hours (by road) to Melbourne and has established transport links to Canberra, Sydney and other major regional centres allowing for efficient distribution of goods. Low labour costs in the region also provide an opportunity for business. Weekly wages in the region were significantly below that of the NSW average (17.8 percent) in 2011 with the disparity in wage levels evident across all industries. This equates to affordable labour for business allowing businesses in the area to reduce cost base compared to the rest of the State.

19.4 Assessment of potential impacts

Social and economic impacts have the potential to occur during the construction and operation phases of the Project. The positive and negative impacts from the Project would include:

- Economic and business impacts
- Property impacts
- Amenity impacts

- Impacts on community infrastructure, services and cohesion
- Traffic and access related impacts
- Cumulative impacts with other construction projects.

19.4.1 Economic and business impacts

The Project would generate significant economic benefits for the local and regional area. Potential beneficial impacts arising from the Project include increases in GRP, employment and incomes in the area over the Project life through both direct and indirect impacts.

Potential direct impacts that would be generated by the Project include:

- Employment of up to 350 workers during the construction phase (14 to 16 months)
- Continued employment during the operation phase of 50 workers (majority of workforce during construction and operation would be sourced from the local area where a good supply of skilled workforce is available)
- Direct construction expenditure to benefit local suppliers
- Increase in GRP
- Central to the major agricultural market for the sale of DDG and DDGS, distiller's syrup and liquid fertiliser (co-products of ethanol production)
- The purchase of grain input will inject a further $50 million annually into the local economy and provide a stable local market for growers.

The construction expenditure of the Project would be of significant benefit to the local and regional economies. Local and regional businesses would principally benefit from this expenditure through purchases made by construction businesses and associated workers to build and support the development of the Project. The Project also creates an end user market for grain growers in the region.

There are also potential indirect benefits for other aspects of the local economy. These include:

- Increased profitability for local business, particularly food and beverage retailers, accommodation providers and retail outlets
- Contribution to the local skills base through development and training programs as part of the Project.

Potential negative impacts for the community on economy and business include:

- Draw of labour for the Project may create competition with other local and regional business. This could result in upward pressure on labour prices.
- If labour costs increase, this could put pressure on pre-existing businesses to remain viable.
- Local supply chains may not have developed the capacity to provide appropriate supplies for the construction and operation of the Project. This would lead to non-local suppliers being utilised and reducing potential economic benefits to local business.

Although these impacts could be considered negative by some groups, they can also be seen as opportunities for increased salary for local residents and opportunities to create greater wealth for local business.

19.4.2 Property impacts

The Project Site spans across three properties (Lots 234, 272 and 273 of DP 756325), two of which are owned by Deniliquin Council and one that is privately owned. Deniliquin Council has been consulted during the design development for the Project and has shown significant support for the project as it envisages the project would contribute significantly to the local economy. It is likely that the privately owned property would be acquired for the Project.

Large projects in rural communities have the potential to directly or indirectly increase demand for residential or commercial property and thereby inflate prices. However, as the Project only requires a small workforce and the majority of this workforce would be local residents, property price inflation is unlikely.

19.4.3 Amenity impacts

Amenity impacts include any factors that affect the ability of a resident, visitor or business owner to enjoy their home and daily activities, for example, noise, vibration, changes to views or changes to air quality.

Detailed discussion on amenity impacts can be found in the following chapters:

- Chapter 15 Landscape character and visual amenity
- Chapter 16 Air Quality, odour and emissions
- Chapter 17 Noise and Vibration.

19.4.4 Community infrastructure, services and cohesion

There would be no significant changes to access to community infrastructure or facilities such as schools, child care centres, community centres, health care and places of worship throughout the construction or operation phases of the Project.

Access to public transport would be maintained throughout the duration of the Project. A shuttle bus would also be used to transport the workforce living in Deniliquin, which would reduce the congestion on the roads and around community facilities at peak times.

As the majority of the workforce would be sourced locally, it is unlikely that there would be reduced access and amenity to essential services for local residents.

Some local residents may experience uncertainty about the Project. To manage this concern, a continued consultation program would be implemented.

19.4.5 Traffic

The Project would result in increases in vehicular traffic, primarily along regional and State roads including the Cobb and Riverina Highways and Deniliquin Barham Road and local road networks. However, the number of vehicle trips generated throughout the construction and operation phase is considered to be relatively low and as such no significant impact on the operation of the surrounding road network is anticipated. In addition, heavy vehicles would travel on designated routes only and the majority of product would be transported by rail.

Based on the limited changes to vehicle use in the immediate vicinity of the Project, it is anticipated that access to properties, community facilities or businesses would not be affected throughout the Project's lifecycle. Therefore, it is unlikely that people would be deterred from shopping at local businesses or visiting community facilities due to the Project.

A detailed discussion on the impacts of traffic during the Project can be found in Chapter 12 Traffic and Transport.

19.5 Mitigation measures

Economic impacts from the Project would be predominantly beneficial and impacts to property, community infrastructure and services as well as traffic would be negligible. Therefore, the implementation of mitigation measures for these values is largely not required. However, some negative social and economic impacts are associated with changes to amenity (such as noise, air quality and visual). Mitigation measures for these values have been considered in each of the respective chapters and are relevant to managing potential social and economic impacts.

Additional mitigation measures applicable to social and economic impacts are shown in Table 19.5.

Table 19.5 Socio-economic mitigation measures

Impact	No.	Environmental management measure	Timing
Social and Economic			
Economy and Business	SE1	Keep local business informed of goods and services required for the Project.	Pre-commencement
Community Cohesion	SE2	A community consultation program would be developed and implemented to ensure suitable information is available to local residents. Information may include but is not limited to, details of the construction program, any changes to access or traffic conditions, any potential environmental or health and safety impacts.	Pre-commencement, Construction Phase, Operation Phase, Decommissioning
Employment	SE3	Employ local skilled and unskilled workers as relevant. Encourage where possible the use of local contractors/ subcontractors..	Pre-commencement, Construction Phase, Operation Phase

19.6 Summary and conclusion

This chapter has outlined the existing social and economic environment within the immediate Project area and within a regional context. Potential impacts have then been identified and mitigation measures provided to avoid, minimise and manage negative impacts where appropriate.

The Project would provide significant positive economic benefits within the local, area, which is currently considered a low socio-economic area at a State and national level. These include increased employment, increased profitability for local business including the creation of an end user market for local grain growers, upskilling of the local labour force and an increase in GRP. Although, some potentially negative impacts to the economic environment were identified, these were minor issues which, if managed correctly, could provide positive economic outcomes.

Some impacts to amenity, related to landscape character and visual amenity, air quality and noise, were identified earlier in this EIS. Appropriate mitigation would where feasible minimise impacts. This assessment did not determine that there would be any major impacts on access to community infrastructure or services or traffic and public transport.

Overall, the Project would provide beneficial social and economic outcomes making it desirable for the local and regional area.

20.0 Health and safety

This chapter considers the potential human health and safety issues relevant to the development of the Project. Health and safety issues are considered for the construction and operational workforce, site visitors and the public. There are no DGRs that require addressing in this section.

20.1 Existing values

20.1.1 Existing environment and receptors

A demographic profile of the local population, compiled with data from the most recent Australian Government Census (2011), is provided in Chapter 19 Socio-economic.

20.1.2 Health, safety and emergency services

Deniliquin has a public hospital, which provides care to local residents. With 61 beds (2011) it provided 1,526 overnight care and 1,021 day admissions during 2010-2011 year. It provides a range of emergency, medical, surgical and allied health services; which are provided by a team of over 180 local people.

Within Deniliquin there are four doctors' clinics and one surgical (general) practice.

The health, safety and emergency services in the vicinity of the Project have been summarised in Table 20.1. These services would help provide procedures for responding to incidents, which would ultimately be adopted into the Project's health and safety management planning.

Table 20.1 Health, safety and emergency services

Service	Location
Police	7 Hardinge Street, Deniliquin, NSW, 2710
Rural Fire Service	360 Whitelock Street, Deniliquin, NSW, 2710
Search and Rescue	Charlotte Street, Charlotte St, Deniliquin, NSW, 2710
Hospital and Ambulance Service	Charlotte Street, Charlotte St, Deniliquin, NSW, 2710
Medical Centre	Deniliquin, NSW, 2710
Medical Centre	409 George St, Deniliquin, NSW, 2710
Medical Centre	Deniliquin, NSW, 2710
Medical Centre	Level 2 - 4, 34 Lowe St, Deniliquin, NSW, 2710
Community Health Centre	24 Macauley St, Deniliquin, NSW, 2710

20.1.3 Community values

There are a number of existing community values that relate to public health and safety that may be affected by the Project. Health and safety values within the community are important aspects that need to be protected through management, monitoring and auditing. Community health and safety values are considered to be:

- a safe and healthy living environment
- community health and wellbeing
- quality of life.

Further information on meeting these community values is provided in Chapter 13 Hazard and Risk which details the potential hazards and risks associated with the Project. Chapter 16 Air Quality and Emissions details the potential impacts of air emissions at sensitive receptors that may be caused by the Project's construction and operations. Chapter 17 Noise details the potential impacts of noise and vibration emissions that may be caused by the Project's construction at identified sensitive receivers. Chapter 12 Traffic and Transport describes the likely safety impacts during construction and operation of the Project.

20.2 Potential impacts and mitigation

20.2.1 Project workforce

Construction is expected to take 14 to 16 months and employ approximately 350 workers. The operational workforce is expected to be approximately 50 full time equivalents. Workers would be sourced from the local community and surrounding area, where possible. Further details on workforce can be found in Chapter 3 Project Description.

20.2.2 Potential impacts

Large infrastructure projects have the potential to impact upon community health and safety in both the short and long term throughout their construction and operations phases. Key potential impacts (relative to health and safety) have been identified as the following:

- work force accidents
- dust, air emissions and odour
- noise and vibration
- confined spaces
- vehicle and equipment accidents
- contaminant release
- disease vectors
- natural hazards and emergencies.

The following sections describe the potential impacts and the mitigation measures that would be applied to control impacts. Workforce accidents

Slips, trips and falls are a common source of workplace injury. Construction and operation workforce could be subject to this risk. Higher risk areas include wet or oily floors, uneven ground, sloping surfaces and cluttered areas. The risk of slips, trips and falls during construction would be reduced through effective site housekeeping, appropriate work wear and work process planning.

Working on the Project Site may require entry to confined spaces. Examples of confined spaces include tanks, pits, pipes, containers, shafts and trenches. The risks associated with working in confined spaces include lack of oxygen resulting in suffocation or loss of consciousness due to airborne contaminants. Risk assessment, training and work procedures would effectively manage the risks associated with entry to confined spaces.

20.2.3 Construction and operational dust, emissions and odour

An air quality impact assessment was undertaken to examine the potential for off-site impacts due to air emissions from the Project. Air quality impacts due to emissions from construction activities were assessed. Operational impacts were assessed quantitatively by means of air dispersion modelling. The following is a summary of key findings of the assessment:

- Offsite impacts from appropriately mitigated construction activities at the Project were found to be negligible at all nearby sensitive receptors.
- No impacts at sensitive receptors due to operational emissions from the Project were predicted for annual average PM_{10}, $PM_{2.5}$, NO_2, CO, and VOC concentrations.
- No additional exceedances of the 24-hour average PM_{10} criterion were likely to occur as a result of operational activities at the Project.

A number of mitigation strategies aimed at avoiding, managing or mitigating off-site air quality impacts by reducing construction emissions from the Project have been provided in Chapter 16 Air Quality.

20.2.4 Construction and operational noise

Assessment of proposed construction activities for the Project show that there is a minor noise exceedance at one location, indicating that the property may be 'noise affected' as defined by the NSW Industrial Noise Policy (EPA, 2000). A detailed construction noise management plan would be undertaken once the various construction scenarios are better understood.

Operational noise from the plant is predicted to comply with applicable Industrial Noise Policy requirements (including sleep disturbance) at the closest residential premises under neutral conditions. As such, no

additional mitigation measures are required. Further assessment of noise emissions would be undertaken during the Project's detailed design once inputs and assumptions have been refined.

Noise emissions from the proposed road and rail movements associated with the Project are predicted to comply with the nominated limits. Vibration levels attributed to Project operations are expected to fall well below the recommended limits.

A number of mitigation and management measures would be employed during the construction and operation of the Project. The noise controls would reduce the potential for and impact of noise generated by the Project. Implementation of a detailed construction noise management plan, a noise monitoring programme and a complaints management system to control noise emission would likely result in a negligible impact on the surrounding environment. The Noise Technical Report in Appendix Q concluded indicates that the Project would not result in significant, long term impacts on sensitive receptors.

20.2.5 Vehicle and equipment accident

The assessment provided in Chapter 12 Traffic and Transport, identifies the likely potential impacts of Project generated traffic upon the existing transport infrastructure. The impact assessment investigates the infrastructure's capability to operate safely and efficiently considering the projected road usage associated with the Project. The assessment indicated that traffic volumes generated by the Project are within the capacity of the existing road infrastructure. This indicates a low likelihood of major consequence events, such as incidents resulting in death or injury to individuals and damage to private property (vehicles). These issues are further discussed in Chapter 13 Hazard and Risk and Chapter 12 Traffic and Transport.

Increased heavy traffic movements are predicted to occur throughout the construction phase of the Project. Once the Project reaches the operations phase, heavy traffic movements would decrease.

The risks associated with workforce driver fatigue and public road usage are reduced due to sourcing the workforce from the nearby Deniliquin township, where possible.

Injury arising from machinery or equipment (e.g. trapped or crushed limbs, lacerations) is common in a construction setting and can have minor or major consequences. However, these risks would be mitigated through worker training, job safety analysis, appropriate PPE and the use of appropriate tools for the job.

20.2.6 Hazardous substances

A hazardous material is one that poses a hazard to human health when improperly handled, stored or disposed of. The hazard may arise from acute or chronic toxicity or carcinogenicity of the substance or its corrosive or flammable nature.

Dangerous goods and waste would be stored in accordance with relevant Australian Standards and regulations, utilising guiding policies and systems noted in the standards to minimise the risk of exposure to sensitive receptors such as the workforce, environment and community. A list of hazardous goods and chemicals that would be stored or used on site, the quantities in which they are anticipated to be used and stored and the relevant classifications and precautions to be taken in using and storing the goods has been compiled as part of Chapter 13 Hazard and Risk.

In order to mitigate the risk of health and safety effects resulting from the use of dangerous goods and waste associated with the Project, the following strategies would be adopted as a minimum and would be continually updated and monitored:

- Material Safety Data Sheets for all dangerous goods used or stored on the Project Site would be maintained in a register accessible to Project personnel.
- Storage facilities housing dangerous goods or waste would be constructed and operated according to AS1940- 2004 for flammable and combustible liquids such as fuels, or other specific standards for other dangerous goods or wastes.
- Waste streams, including waste lubricating oil, would be stored in a bulk tank or bins for disposal through the Project's licenced waste contractor. The contractor's health and safety management plan would be adequately revised for use on the Project Site, and would require approval from the appropriate site supervisor indicating that the plan meets the Project Site's requirements as a minimum.
- To mitigate potential impacts on hydrology, flooding and water quality associated with the Project, a water management strategy would be developed for the site.

The storage and transport of dangerous goods and waste would be further addressed during the detailed design and commissioning phases of the Project. With the abovementioned controls and mitigation strategies in place,

the residual impact on health and safety values from dangerous goods storage and use is not considered to be significant.

20.2.7 Fire

Construction activities that pose a fire risk include welding works, grinding or heat generating machinery. Fire risk may be exacerbated in the presence of flammable substances such as fuels and oils that are likely to be used in small quantities during construction. Appropriate management measures for fire risk during construction include appropriate storage of flammable substances and worker training for 'hot works'. The likelihood of a bushfire occurring is considered to be highly unlikely due to the lack of bush land or vegetated areas in proximity to the site. The Project Site is not located within an area of bushfire prone land.

20.2.8 Natural hazards

Extreme meteorological events, flood, or failure of storages can potentially affect the environmental values of the surrounding area, presenting a public health risk. The risk of these events occurring would be adequately mitigated through the detailed design of the Project's infrastructure to meet requirements held in relevant standards and guidelines. The development of a strategy to notify relevant stakeholders in the event of natural hazards and emergencies is integral to mitigating potential impacts due to Project activities or infrastructure to the lowest possible level. The Project would have an Emergency Contact Register in place to notify relevant stakeholders in the event of an extreme meteorological event, flood or catastrophic failure.

20.2.9 Disease

Disease risks during construction are largely linked to disease vectors such as mosquitoes. Deniliquin's climate is not overly conducive to the proliferation of mosquito outbreaks, however it is possible. Exposure of workers to biting insects would be managed through the use of repellents, PPE and worksite management to reduce areas of standing water that can serve as mosquito breeding areas. The identification of bacteria growth or insect breeding, as well as other disease vectors suspected of propagating from the Project Site, would be investigated by site environmental staff in accordance with directives from relevant authorities and legislative requirements. The risk of disease vectors affecting the health and safety of the community and workforce is not considered to be significant with the controls in place.

20.2.10 Security

Unauthorised visitors, including children, may not be familiar with the dangers on the Project Site and have no understanding of the risks that they may be exposed to once they have entered the site. These risks can include serious injury from falls from buildings and equipment, vehicle interactions, collapsing material causing suffocation or crushing; coming into contact with hazardous substances and plant. The construction contractor would be responsible for ensuring the Project Site is secure during the construction phase and would include measures such as perimeter fencing, appropriate signage, adequate site lighting and appropriate storage containers for hazardous materials/wastes. Once operational, the Project Site would be staffed 24 hours a day, seven days a week. Visitors would be required to access the site through the security gate and would be required to adhere to site procedures.

20.2.11 Health and safety management system

Health and safety risks associated with the Project would be managed under an IMS. The IMS hierarchy consists of policies, standards, procedures, plans, manuals, guidelines, forms, checklists and registers. The IMS sets the foundation for the risk-based approach to management and mitigation of potential health and safety impacts through design, construction and operation of the Project.

Dongmun Greentec is committed to the health and safety of its workers (employees, contractors, labour hire workers, outworkers, apprentices, students or volunteers) while at work, and that the health and safety of other persons (e.g. visitors) is not put at risk from the Project's operations. This would be achieved by:

- Providing and maintaining a healthy and safe work environment through the implementation of safe work practices, safe systems of work and the provision of safe plant and equipment
- Ensuring that workplaces under the control of Dongmun Greentec are safe, without risk to health, and have safe means of access and egress
- Routinely consulting in order to maintain effective and co-operative relationships between Dongmun Greentec and its workers, and with other duty holders, on health and safety matters in the workplace
- Reviewing, through appropriate mechanisms, the effectiveness of the safety measures taken.

Dongmun Greentec commitment to providing safe and healthy working environments for its workers includes:

- Providing relevant, up to date workplace health and safety information to all workers on matters such as workplace safety and their responsibilities
- Providing expert assistance in workplace health and safety matters where necessary
- Providing instruction and/or training in work processes where appropriate
- Developing and implementing strategies which include workplace assessment, hazard identification, and appropriate remedial action to eliminate or control hazards
- Implementing and maintaining appropriate information, reporting and statistical systems.

Dongmun Greentec would prepare a site specific Health and Safety Management Plan that would include as a minimum:

- Responsible personnel and their nominated responsibilities during operation of the Project
- Consultation and communication arrangements
- Training that would be provided on a continual basis to new and existing employees
- A workplace health and safety risk assessment to ensure that, for any identified hazards, appropriate control measures are implemented in order to protect workers, contractors and visitors from risks to their health, safety and welfare
- Emergency response procedures
- Hazard/Injury/Incident reporting
- First aid procedures.

The Health and Safety Management Plan would be reviewed regularly to ensure that it remains up to date with relevant legislation, polices and guidance documents.

20.3 Summary and conclusion

The Project has the potential to impact upon human health and safety in both the short and long term throughout the construction and operations phases. Potential impacts (relative to health and safety) have been identified as work force accidents; dust, air emissions and odour; noise and vibration; confined spaces; vehicle and equipment accident; contaminant release; disease vectors; and natural hazards and emergencies.

With the implementation of standards, management systems, plans and policies, the impacts upon the community health and safety as a result of the Project are anticipated to be manageable and can be adequately mitigated. Ongoing consultation with relevant stakeholders and the continual reviews and monitoring of the effectiveness of strategies, would allow the health and safety plans to continually influence the safe operation of the Project within the community.

21.0 Cumulative impacts

This chapter provides the findings of the cumulative impact assessment in relation to the key environmental issues for the Project.

21.1 Introduction

Cumulative impacts are the successive, incremental and combined impacts (both positive and negative) of an activity on society, the economy and the environment. They can arise from the compounding activities of a single Project or multiple Projects, as well as the interaction of the Project impacts with other past, current and future activities that may not be related to the Project. Cumulative impacts are most often raised in the context of multiple Projects in areas where numerous developments are proposed. However, cumulative impacts may also arise through the interaction of any one Project with other existing and proposed activities and industries, such as grazing and broad scale agriculture.

An assessment regarding the potential cumulative impact of the Project and its interaction with proposed projects and existing uses and activities in the Deniliquin region has been undertaken. The findings of the cumulative impact assessment in relation to the key environmental issues for the Project are provided below.

21.2 Proposed projects

In order to determine other proposed projects in the vicinity of the Project Site, a search of Current Development Applications was conducted on the Deniliquin Council website open resource. The search produced no current open Development Applications.

A search of the DP&E Major Project Register (1 August 2015) revealed that an EIS is currently being developed for the Deniliquin Abattoir, approximately 3 km north east of the Project Site. No details regarding this development are publically available and as such the cumulative impact of the Project in conjunction with the proposed Abattoir project, could not be assessed.

Beyond this, there are no major developments proposed in the Deniliquin region which would be constructed or operational in the near future.

21.3 Assessment of potential cumulative impacts

21.3.1 Biodiversity

Based on the assessment of impacts of the Project to biodiversity values, the main potential impact resulting from the Project relates to the removal of grassland habitat for the plains wanderer. The local Deniliquin area is a highly cleared and disturbed agricultural landscape, and as such any remaining primary or secondary grassland areas will be important to local breeding pairs of the plains wanderer. Agricultural practices in the area would be the greatest impact to habitat through modification of habitat condition and structure.

The proposed expansion of Deniliquin Abattoir, could result in cumulative impacts to the plains wanderer habitat, if suitable grassland areas occur within this projects footprint.

21.3.2 Groundwater

The Project is not expected to have an impact on groundwater. As a result the cumulative effect of the Project with regards to groundwater is considered to be extremely unlikely and insignificant.

21.3.3 Surface water

Cumulative impacts of the Project on surface water were considered relative to surrounding land use, current and proposed. Assessment indicates that surface water in the local area is used for a number of purposes, with agriculture and grazing the dominant use. The construction and operation of the proposed abattoir expansion may result in an increase in hardstand area in the immediate area with a potential for increased runoff and sedimentation of local waterways. The additional area is likely to be small and is unlikely to cause a significant effect on the local area.

21.3.4 Co-products and waste

Wastes exported from the Project Site would mainly comprise municipal, recyclable and regulated wastes. As described in Chapter 11 Co-products and Waste the construction and operation of the Project would produce a relatively small amount of waste that would need to be disposed of to landfill, with the remainder of the waste recycled or re-used on-site or re-used by the local agriculture industry (liquid fertiliser/compost). In addition co-products from the process would be sold to the local agricultural market (DDGS and distiller's syrup).

Deniliquin Waste Depot has advised that this landfill currently accepts 20,000 tonnes of general solid waste (putrescible) and 20,000 tonnes of general solid waste (non-putrescible) per annum and would be able to accommodate the projected residual waste quantities associated with the Project. It is not expected that the additional waste generated by the Project would have a cumulative impact.

21.3.5 Traffic and transport

The construction program for the Project is between 14 and 16 months to be commenced following the approval of the Project. It is unlikely that the works for the Project would occur at the same time as construction stages of the proposed Abattoir expansion. Based on this and the findings that operational traffic generated by the Project would be insignificant, any potential cumulative impacts are anticipated to be negligible.

21.3.6 Hazard and risk

No existing projects or proposals in the Deniliquin region are considered likely to have an adverse cumulative effect on the potential hazard and risks for the Project Site or any other developments in the vicinity of the Project Site.

21.3.7 Soils, land capability and land use

Cumulative impacts of the Project on land values have been considered relative to the surrounding land use, current and proposed. Assessment indicated that land use values in the local area are predominantly related to agriculture and grazing.

It is considered that cumulative impacts relating to land based environmental values would largely relate to loss of agricultural land. In spite of the lack of information relating to the proposed abattoir expansion, it is considered likely that cumulative impacts relating to land based environmental values would largely relate to loss of agricultural land. In this instance, the Project would result in an in-combination impact for the region. However, the level of similar, suitable agricultural land is relatively common in the immediate area, and more broadly in the Riverina region. Therefore the Project is not considered to represent a significant adverse impact to this land type at the local or regional scale.

21.3.8 Landscape and visual amenity

The Project would impact upon the character of the surrounding landscape. Project activities, such as clearing and construction of hardstands have the potential to change the vegetation character of the Project area. The verticality of the Project built components would result in visually contrasting vertical built elements within the landscape, which is otherwise relatively flat and featureless.

Impacts to visual amenity and landscape character are unavoidable due to the local topography of the area, and the verticality of the Project infrastructure. Although mitigation measures are unlikely to significantly mitigate this impact, impacts are generally considered to be not significant. Although detail regarding the proposed Abattoir development is unavailable, it is considered that the cumulative effect of its development coupled with the Project would result in a minor impact to the existing visual amenity of Deniliquin Barham Road.

21.3.9 Air quality and greenhouse gas

The Project is relatively isolated in terms of other existing or planned major projects. The nearest project of significance to the Project Site is the Deniliquin Abattoir. The distance to the Abattoir is such that no cumulative impact on sensitive receptors surrounding the Project Site is considered likely.

No other cumulative impact on sensitive receptors surrounding the Project Site is considered likely.

The relationship between GHG concentrations and climate change is very complex and nonlinear. The Project represents a relatively minor source of GHG emissions, both in terms of the emissions in NSW and in Australia as a whole. As such, the cumulative GHG emissions associated with the Project with other existing development in the local area, are not considered to significantly affect the environment.

21.3.10 Noise

As noted above, the Project Site is not located in close proximity to any other existing or planned major projects. The nearest project of significance is the proposed Deniliquin Abattoir, however the distance to the Abattoir is such that it is unlikely to significantly contribute to ambient noise levels at sensitive receptors surrounding the Project Site. There are no other major sources of industrial noise in the area. As such, no cumulative noise impacts are expected at sensitive receptors surrounding the Project Site.

21.3.11 Cultural heritage

No existing projects or proposals in the Deniliquin region are considered likely to have an adverse cumulative effect on the identified historical cultural heritage sites within or in the vicinity of the Project Site.

21.4 Summary and conclusion

Overall, the potential for significant cumulative impacts as a result of the construction and operation of the Project is considered to be unlikely and insignificant.

22.0 Residual environmental consequences

This chapter considers the residual risks to environmental values as a result of the Project.

22.1 Residual impacts

Residual impacts are those that are associated with the broad impacts of the Project that remain following the application of mitigation and management measures. This chapter identifies the potential residual impacts that are associated with the Project.

22.2 Assessment of residual impacts

22.2.1 Biodiversity

The only significant residual impact on biodiversity values that was identified after the 'avoid' and 'mitigate' principles were applied would be on the local Deniliquin population of the plains wanderer (*Pedionomus torquatus*) resulting from the removal of potential secondary habitat for the species within the Project Site. For this reason, offsets have been identified as a requirement to counterbalance this potential residual impact, and as part of this EIS an offset strategy has been prepared to outline the path forward to achieve a neutral to positive environmental outcome for the plains wanderer.

22.2.2 Groundwater

It is consider highly unlikely that the Project would have an impact on groundwater. Therefore it is not anticipated that there would be any residual impact as a result of the construction and operation of the Project.

22.2.3 Surface water

Residual water quantity impacts

The Project requires 2,640 kL/day of clean water, of which 1,368.2 kL/day would be recycled wastewater and 1271.8 kL/day would be supplied by Deniliquin Council. Deniliquin Council has indicated a commitment to develop a mains extension to the Project Site to provide water for the plant. Deniliquin Council has sufficient water capacity for future growth in town, as well as growth in industrial usage Overall, the Project is considered to have an insignificant impact on local water supply sources.

Stormwater Quality

Changes to the Project Site layout, including increasing the impermeable area, could increase stormwater runoff from the Project Site. This would be addressed through stormwater harvesting, and the establishment of vegetated drainage swales and on-site flood detention. With these measures in place the Project is considered to have a negligible residual impact on stormwater quantity discharging from the Project Site.

Following the application of proposed mitigation measures there is a low likelihood that contaminants from hardstand areas or stored materials would be present in runoff from the Project Site. Additionally, Project design includes pavement of active operational areas, and landscaping of other areas, which would reduce the potential for erosion and sediment transport from the Project Site. The Project is considered to have an insignificant impact on stormwater quality from the Project Site.

22.2.4 Co-products and waste

Relatively small amounts of residual waste would be generated by the construction and operation of the Project, with most of the co-products being commercialised or reused. It is not anticipated that there would be any residual impact as a result of the construction and operation of the Project.

22.2.5 Traffic and transport

While the Project is anticipated to have some impact on the road transport network as a result of an increase in Project construction related traffic, the level of impact will be dependent upon the final construction schedule and product and co-product distribution. The preparation of a Traffic Management Plan (TMP) will seek to minimise any potential impacts during construction. A transport plan for operations traffic and consultation with Deniliquin Council will ensure road traffic generated by the Project will not have a significant residual impact on the existing road transport network.

22.2.6 Hazard and risk

Residual hazardous impacts are those that consider the risk to land uses following the application of mitigation and preventative safeguards. Given the size of the Project, distances to site boundaries and surrounding

receivers, a Preliminary Hazard Analysis has appropriately detailed the hazards associated with the Project and demonstrated through risk assessment that the hazards do not pose a significant risk to surrounding land uses.

22.2.7 Soils, land capability and land use

Land Use

The land use of the Project Site will permanently change while the Project is in operation. The impact to the change in land use cannot be mitigated and is considered a residual impact. However, the Project Site is not situated adjacent to incompatible land uses, with the surrounding Deniliquin area generally designated as RU1 Primary Production, with the exception of the Deniliquin Township (5 km away). To this extent, the likelihood of encountering incompatible land uses is low, considering that most ancillary infrastructure required for the Project, such as powerlines and water supply, already exists close to the Project Site. Therefore, the overall impact on land use is considered to be low and not significant.

Land Disturbance

Although disturbance of land cannot be avoided, residual impacts are considered to be minor and not significant where all mitigation measures are implemented effectively.

Land Degradation

Impacts as a result of contamination incidents causing land degradation are considered to be unlikely with the application of mitigation and control measures. The residual impact to land based environmental values as a result of land degradation is therefore considered to be minor and not significant.

Erosion and Stability

Following the application of mitigation, the residual risk to land based values as a result of erosion and sedimentation is considered to be low and not significant in terms.

22.2.8 Landscape and visual amenity

The impact on landscape character is considered to be acceptable within the context of the location of the Project in relation to the Deniliquin Township and the extensive nature of the landscape character within which the Project is located. Visual impacts from representative receiver locations were considered to be moderate to minor with the implementation of reasonable mitigation measures. Lighting impacts were considered to be not significant at the identified sensitive receptors.

Impacts to visual amenity and landscape character are unavoidable due to the local topography of the area, and the verticality of the Project infrastructure. Although mitigation measures are unlikely to significantly mitigate this impact, residual impacts are generally considered to be not significant.

22.2.9 Air quality and greenhouse gas

Residual construction phase air quality impacts from mitigated air emissions were assessed as part of the air quality impact assessment. Overall, the risk of residual construction phase air quality impacts on surrounding sensitive receptors is considered to be negligible.

The quantitative assessment addressed the impacts to air quality of emissions from the operation of the Project, including NO_2, CO, PM_{10}, $PM_{2.5}$, speciated VOCs and odour. The predicted ground level concentrations of the pollutants assessed met their respective guidelines for the appropriate averaging periods. The predicted maximum 24-hour average PM_{10} ground level concentrations did not comply with the respective guideline when background air quality concentrations from Albury were included. However, further analysis of the contemporaneous impact and background concentrations showed that no additional exceedances of the 24-hour average impact assessment criterion are likely. Provided the Project is well managed and proposed mitigation measures are implemented, minimal adverse residual impacts would be anticipated.

22.2.10 Noise

The Project is forecast to comply with nominated criteria under neutral weather conditions and have minor exceedances under worst case weather conditions. The residual impact is therefore considered to be negligible and not significant.

22.2.11 Cultural heritage

Following the implementation of the proposed mitigation measures, the residual impact on known heritage places in the Project Site is likely to be minor.

It is more difficult to assess residual impacts on currently unknown heritage places. Any additional archaeological places in the Project Site are likely to be of similar significance to the known sites; low or moderate. It is

anticipated that the recommended mitigation measures would reduce the magnitude of change to low at any discovered site. Depending on the significance of the find, the significance of impact might then range from neutral to minor.

22.3 Summary and conclusion

Overall, the potential for significant residual impacts as a result of the construction and operation of the Project is considered to be unlikely and insignificant.

23.0 Environmental management and monitoring

This chapter provides an overview of the Integrated Health, Safety and Environmental Management System (IMS) that would be implemented for the Project.

23.1 Overview

An IMS would be developed following approval of the Project. The purpose of the IMS would be to set out measurable commitments, objectives, targets, and management mechanisms for managing HSE at the Project in accordance with NSW State and Commonwealth legislation, applicable Australian and international standards, and in compliance with ISO 14001, ISO 18001, and ISO 9001. The IMS would provide a platform for preparing and implementing site-specific management plans, programs, monitoring, standard operating procedures, and standards that safeguard the health and safety of all employees, contractors and visitors to the plant, and the environment. The IMS would demonstrate a commitment to HSE, as well as a commitment to continually improving the system through inspections, audits, and reviews.

This chapter provides an overview of the IMS that would be implemented for the Project. The IMS would contain the Project specific management and mitigation measures, monitoring programs and reporting mechanisms for all potential impacts identified in this EIS. The IMS would be established to prevent environmental harm and/or contravention of the legislative and regulatory framework during the construction and operation phases. The system would evolve as new information becomes available, taking into account changes in construction techniques and statutory requirements.

The IMS is a framework document for the Project and provides Dongmun Greentec with a strategic framework for environmental management, consistent with the commitments and recommendations put forward in the EIS.

23.2 Legislation and compliance

The IMS framework would be prepared in context with the applicable legislation relevant to the Project. The legislation, standards, policies and guidelines that are relevant to specific elements of the Project are listed as part of the safeguards and mitigation measures proposed to be undertaken. Legislation of relevance to the Project is described in Chapter 5 Statutory Controls and Approvals. Dongmun Greentec would ensure that it holds all licenses, permits and approvals relevant to the Project and that these are kept up to date. To ensure this occurs, a register of all licenses, permits and approvals for the Project would be maintained. Dongmun Greentec would also ensure compliance of the Project with the conditions placed on these licences, permits and approvals.

23.3 Communication

The IMS would be communicated to all construction and operational personnel. The nominated construction contractor and Dongmun Greentec would ensure that the general intent, scope and relevance of these documents are understood. Environmental issues for the Project would be communicated by the following methods:

- Induction programs and training
- Regular toolbox meetings
- Risk workshops
- Management meetings
- Environmental reports.

Third party environmental audits would be conducted to determine the effectiveness of the communication. Effectiveness would be measured through awareness of staff and subcontractors and compliance with day to day site environmental management requirements.

A procedure for complaints and a complaints investigation reporting form would be developed by Dongmun Greentec. The construction contractor would establish a complaints register and all legitimate and verifiable complaints received would be logged into the register. The construction contractor would advise Dongmun Greentec of any complaints received. If a complaint is received, the person receiving the complaint would record details on a complaints reporting form. Complaints would be investigated immediately and corrective actions implemented as soon as they are identified. Complaints would be resolved as quickly as possible, in a consultative manner with the complainant. Dongmun Greentec and the construction contractor would respond to the complainant in writing and/or by telephone within 24 hours of receipt of the complaint to inform them of the status of the investigation and the timeframe for resolution. A similar complaints procedure would be developed by Dongmun Greentec for the operation of the Project.

23.4 Document control

An adequate document control system would be implemented to ensure that only current documentation is in use. Records collected would be retained by the construction contractor and Dongmun Greentec for the legally required period of time. Environmental records include but would not be limited to:

- Site inspection checklists
- Environmental audit reports
- Training records
- Monitoring data
- Complaints and associated records of communication
- Meeting minutes.

During construction, the contractor would make these records available to Dongmun Greentec or any relevant authorities and their representatives on request. During the operations phase, Dongmun Greentec would similarly make these records available to any relevant authorities and their representatives on request and where justified and in accordance with applicable legislation.

23.5 Training

The construction contractor and Dongmun Greentec would ensure that all employees and subcontractors involved with the Project receive environmental training appropriate to their role. The provision of training would be in accordance with the management measures developed for the Project. An environmental awareness induction would be provided when personnel commence on the Project. Environmental topics would also be included in toolbox talks during construction and other ongoing environmental training would be provided as appropriate and throughout operation.

23.6 Internal environmental reporting

During construction, a monthly report would be prepared by the construction contractor and supplied to Dongmun Greentec. The report would include site inspection records, monitoring results, training undertaken, initiatives, incident records and details of any corrective and preventive actions taken where non-conformances had been identified and all non-conformances that have not been closed-out.

During operation, environmental reports would be prepared in accordance with reporting obligations in the conditions of approval. This would include site inspection records, monitoring results, training undertaken, initiatives, incident records and details of any corrective and preventive actions taken where non-conformances had been identified and all non-conformances that have not been closed-out. All staff and contractors would be required to report any environmental incidents (including complaints) or breaches of the conditions of approval immediately to their supervisors who would then involve the Environmental Manager to facilitate further action.

23.7 External environmental reporting

External reporting would be undertaken in accordance with legal obligations and compliance requirements set out for the Project. Dongmun Greentec would provide timely, relevant and appropriately presented information to government authorities, the local community and the general public on the environmental performance of the Project. Reporting commitments would include monitoring results as required by authorities and progress reports as required in the conditions of approval. Any significant environmental incidents or serious breaches of the conditions of approval would be reported to the relevant authorities in a timely manner and in accordance with legislative requirements.

23.8 Environmental audits

Regular audits would be undertaken to verify compliance with all applicable environmental requirements and would cover all aspects of the IMS. Audits would be conducted by qualified auditors and would be independent of the construction or operational activities being audited. The audit results, conclusions and any corrective actions required would be communicated to the responsible persons for implementing the corrective actions. An audit report would be prepared to summarise the findings of the audits and any corrective and preventive actions. The environmental audit reports would be made available to relevant authorities as required by the conditions of approval.

23.9 Continuous improvement

Dongmun Greentec would regularly review and, where relevant, update the final IMS. The review would take into account:

- Changes in legislative requirements
- Changes in conditions of approval
- Environmental performance, outcomes from environmental audits and inspections
- Outcomes of regulatory agency consultation
- Outcomes of consultation with communities and resolution of any complaints
- Any changes in external and internal policies, standards and guidelines.

The review would provide the opportunity to allow continuing suitability, adequacy and effectiveness of the IMS, as well as including opportunities for improvement.

23.10 Environmental management plans

Environmental aspects and their impacts have been identified throughout this EIS and in the accompanying technical reports in the appendix. Mitigation measures to be implemented for the Project are provided in Chapter 24 of this EIS.

Environmental Management Plans (EMPs) would be provided for the construction and operation of the Project to effectively administer the mitigation and management controls to avoid or minimise the likelihood of adverse impacts on environmental values.

23.10.1 Construction environmental management plan

A CEMP would be prepared by the construction contractor and would include mitigation and controls for the following environmental topics:

- Biodiversity (terrestrial flora and fauna)
- Surface water quality and flows
- Soil
- Waste management
- Transport and road network
- Noise and vibration
- Air quality
- Non-Aboriginal heritage
- Hazardous materials and risk management.

The CEMP would also provide an emergency response plan to cover natural disaster events.

Other relevant management plans prepared to support the EIS include:

- Environmental Management Plan
- Species Management Plan
- Traffic Management Plan
- Offsets Strategy
- Emergency Management Plan
- Waste Management Plan
- Heritage Management Plan (to manage the impacts on Aboriginal heritage)

23.10.2 Operational environmental management plan

The operational EMP would be prepared by Dongmun Greentec and would include mitigation and controls for the following environmental topics

- Biodiversity Surface water quality and flows
- Waste management
- Transport and road network
- Noise and vibration
- Air quality
- Greenhouse gas emissions
- Cultural heritage
- Social environment
- Hazardous materials and risk management.

The operational EMP would also provide an emergency response plan to cover natural disaster events.

It is not expected that the Project would impact on Aboriginal cultural heritage during operations. HMPs developed and approved for the Project apply and would address potential impacts that may arise.

24.0 Summary of commitments

This chapter collates the environmental management measures for the Project that were identified through the impact assessment process in Chapter 8 through to Chapter 20. All measures identified would be incorporated into management plans and the operational framework for the Project. A framework for managing the potential impacts is provided with reference to environmental management plans.

24.1 Environmental management plans (or systems)

A number of safeguards and management measures have been identified in order to minimise adverse environmental impacts, including social impacts, which could potentially arise as a result of the Project. These management measures would be incorporated into the detailed design and applied during the construction and operation of the Project.

A contractor's CEMP would be prepared to describe safeguards and management measures identified. The plan would provide a framework for establishing how these measures would be implemented and who would be responsible for their implementation.

The plan would be prepared prior to construction of the Project and must be reviewed and certified prior to the commencement of any on-site works. The CEMP would be a working document, subject to ongoing change and updated as necessary to respond to specific requirements.

Other relevant management plans prepared to support the EIS include:

- Environmental Management Plan
- Species Management Plan
- Traffic Management Plan
- Offsets Strategy
- Emergency Management Plan
- Waste Management Plan

These plans would be read alongside this commitment register.

24.2 Summary of mitigation and management measures

Environmental safeguards outlined in Chapter 8 through to Chapter 20 of this EIS would be incorporated into the detailed design phase of the Project and during construction and operation. These mitigation measures would minimise any potential adverse impacts arising from the Project on the surrounding environment. All mitigation measures described in this EIS would be incorporated into the Approval of the Project. Mitigation and management measures applicable to the Project are summarised in Table 24.1.

Table 24.1 Summary of safeguards and management measures

Impact	Ref #	Environmental management measure	Timing
Biodiversity			
Potential impacts to threatened flora	FF1	Pre-clearance surveys would be undertaken in spring for threatened flora species within the Project Site prior to any clearing activities.	Pre-commencement
Potential impacts to plains wanderer habitat. Potential disturbance too, or mortality of plains wanderer individuals or breeding pairs.	FF2	Pre-clearance surveys would be undertaken for plains wanderer and plains wanderer breeding places prior to any clearing activities.	Pre-commencement
Removal of native vegetation	FF3	A vegetation management plan would be prepared and include: - Clear delineation of clearing extent - How clearing is to be undertaken, e.g. timing, staging - How topsoil is to be handled and stored	Pre-commencement
Spread of weeds	FF4	A weed management plan would be prepared including: - Weed control and hygiene measures - Methods to remove African boxthorn and Bathurst burr would be removed from the Project Footprint pre-construction, and disposal protocols. - Weed hygiene procedures to be followed during the construction phase, with particular emphasis on limiting the spread or movement of the noxious weed species African boxthorn and Bathurst Burr. - Continued weed hygiene and monitoring procedures to be followed throughout the life of the Project.	Pre-commencement
Habitat loss Fauna disturbance Fauna mortality	FF5	A fauna management plan would be prepared addressing: - Supervision of the felling of hollow bearing trees and translocating permitted animals to approved sites by an experienced and licensed ecologist. - Staging of native vegetation clearance. - Felling of trees outside the main bird-nesting season i.e. winter months. - Implementation of appropriate speed limits and fencing. - Measures to reduce impacts from noise, light and vibration pollution.	Pre-commencement

Impact	Ref #	Environmental management measure	Timing
Potential impacts to plains wanderer habitat. Potential disturbance too, or mortality of plains wanderer individuals or breeding pairs.	FF6	A plains wanderer species management plan would be prepared. The requirements within the plan would include but not be limited to: - Clearing extents within plains wanderer habitat would be clearly delineated to ensure no over-clearing occurs - Permanent lighting would be directed away from adjacent plains wanderer habitat - Efforts to minimise noise would be undertaken where possible (e.g. mufflers on machinery) - Staff training toolboxes would be delivered to all staff associated with the clearing and management of plains wanderer habitat	Pre-commencement
Removal of native vegetation. Habitat loss.	FF7	Landscaping would use native species where possible.	Construction Phase
Groundwater			
Fuel spills and sedimentation	GW1	Preparation of a site specific CEMP by the contractor prior to construction would detail control measures for fuel spills and sedimentation.	Pre-construction phase
Water management	GW2	Implementation of a site wide IMS including an EMS system as well as specific water management plans.	Operations phase
Water storage	GW3	Constructing the water storages with concrete, and if required a cut-off trench, to reduce any leakage.	Construction phase
	GW4	Constructing the water storages with outer bunds to capture any leakages caused by a wall breach.	Construction phase
Water management	GW5	Implementation of a site wide IMS including an EMS system as well as specific water management plans.	Operations phase
Fuel leaks and spills	GW6	Providing bunding and spill kits around fuel depots and stockpile areas. Response plans would be developed to address fuel leaks and spills at machinery compounds or during refuelling including a spill emergency procedure.	Operation phase
	GW7	Emergency response and management plans would be developed to address fuel leaks and spills at machinery compounds or during refuelling including a spill emergency procedure.	Operation phase

Impact	Ref #	Environmental management measure	Timing
Surface water			
Water usage efficiency	SW1	Water usage efficiency would be increased by minimising the water loss in the system. One of the major losses is in the cooling tower. The Project would collect blow-down water for reuse on-site which improves the efficiency of the system. Mitigation measures may include: - to install all valves properly to make sure that there is no leakage and to monitor water consumption - to replace the current open loop cooling tower system with a closed loop system. This would significantly reduce water loss in the cooling tower - to monitor the quality of the feed water and blow-down water conductivity to maintain higher average conductivity, thus reducing total bow-down.	Detailed design phase
	SW2	Rainwater tanks would be used for potable water supply	Operation phase
Water requirements	SW3	A double waste water treatment system would be installed and the volume supplied by each system would be larger than the required volume.	Construction phase Operation phase
Storage	SW4	No organic waste would be pumped or released. Water, waste water and by-products would be stored on-site within sealed or concrete lined areas.	Operation phase
	SW5	Waste water and by-product storage should be constructed in accordance with Australian codes (such as Fertiliser Australia – Fertiliser Handling Code of Practice (December 2014) and Australian Fertiliser Services Association Code of Practice (August 2008)), standards and legislative requirements and follow the storage and handling procedures outlined in the CEMP. The construction management plan would document the nature of these dangerous goods in detail.	Construction phase
	SW6	All storage and containers would be labelled clearly and correctly so the contents are easily identifiable.	Operation phase
Accidental spills	SW7	Spill management equipment would be available in all areas where materials or goods are stored. All materials and goods would be stored in appropriate containers in designated areas, with bunding provided to contain any accidental spills and designed in accordance with the Australian Standards (such as AS1940 - 1993 for the Storage of Flammable and combustible liquids and AS 4452 - 1997 for the Storage and Handling of Toxic Substances).	Operation phase
	SW8	Spill kits would be provided on site and staff would be trained on the handling of chemicals and materials particularly spillage management	Operation phase

Impact	Ref #	Environmental management measure	Timing
Sewerage	SW9	Sewage generated by on site facilities (i.e. toilets and kitchen) would be disposed to Deniliquin Council's sewerage system via an extension provided by Deniliquin Council. Should a sewer connection not be available, An off-line septic system if required would be designed to comply with AS/NZA 1546.1:2008 On-site Domestic Wastewater Treatment Units – Septic Tanks standard.	Detailed design phase Operation phase
Anaerobic and aerobic digesters	SW10	Real-time monitoring would be carried out of various parameters in the anaerobic and aerobic digesters such as methane, oxygen and temperature	Operation phase
Effluents	SW11	Online monitoring would be carried out of various effluent parameters, including (but not limited to) DO, TSS, ORP, ammonia, nitrate/nitrite analysers. Real time monitoring of these parameters at key process units (i.e. in the intermediate basin) would ensure that all effluent directed towards the aerated lagoon would be of sufficient quality. In the event of an exceedance of any parameter, the effluent can be recycled back in the wastewater treatment system for additional treatment.	Operation phase
Potential fouling	SW12	Regular cleaning of the Membrane bioreactor membranes to prevent fouling. This may include membrane backwashing or chemical cleaning. The frequency of these backwashing events would be determined during operation.	Operation phase
Hazardous materials and accidental incidents	SW13	A Materials Storage and Handling Plan would be implemented during construction for the on-site storage of potential pollutants, such as oil, to avoid accidental spillage into the receiving environment.	Operation phase
Stormwater impacts due to vegetation stripping and/or earthworks and site development	SW14	Temporary stormwater management measures will be installed during construction, to avoid stormwater impacts to the Project Site, or receiving environment as a result of vegetation stripping and/or earthworks. The contractor would be required to prepare and implement a detailed construction Stormwater Management Plan, as part of the CEMP. Civil works would be staged to minimise disruption to the local drainage regime. At the detailed design stage, an updated MUSIC model would be developed to demonstrate water quality compliance with required targets. In addition to currently proposed water treatment features (e.g. vegetated swales and bioretention and flood detention basin) structural treatment devices, such as oil separators, may also be required. These will be confirmed during detailed design stage.	Detailed design phase Construction phase

Impact	Ref #	Environmental management measure	Timing
Drainage	SW15	If stormwater drainage system not maintained properly, there is a residual flood risk associated with blocked or damaged stormwater infrastructure such as culverts and drains. A routine drainage inspection and maintenance program would be established as part of the overall site asset management plan	Construction phase
Erosion and sediment	SW16	The permanent vegetated swales would be established first, which would also fulfil a sediment and erosion control function during construction.	Construction phase
	SW17	Any exposed areas of the Project Site would be covered as soon as possible, to prevent erosion and sediment mobilisation. An Erosion and Sediment Control Plan would be developed and implemented by the Contractor as part of the CEMP.	Pre-construction phase Construction phase
Waste and Co-products			
Waste management	CW1	A waste management plan would be incorporated into the CEMP and operational EMP for the Project.	Construction phase and operations phase
	CW2	Waste generated during construction would be managed and disposed of in accordance with Table 11.4 in Chapter 11 Waste and co-products	Construction phase
	CW3	Waste generated during operations would be managed and disposed of in accordance with Table 11.4 in Chapter 11 Waste and co-products	Operations phase
	CW4	A database inventory would be used to record and report all waste streams, quantities and management measures for all waste streams arising through the construction and operations phase of the Project.	Construction phase and operations phase
	CW5	A designated, secure waste storage area would be provided to enable waste separation into general waste and recycling	Construction phase and operations phase
	CW6	Bins and skips would be covered to prevent rubbish from blowing away or rainwater entering the waste receptacles	Construction phase and operations phase
	CW7	Temporarily stored construction waste would be located in a suitably stabilised area, e.g. construction compound or designated stockpile areas	Construction phase and operations phase
	CW8	Suitable containment would be provided for the temporary storage of wastes, which would be collected frequently	Construction phase and operations phase
	CW9	Temporarily stored putrescible waste, or other wastes that may attract vermin, would be stored in secure containers and be disposed of regularly	Construction phase and operations phase
	CW10	Waste and other potential polluting materials would be removed from the site and the site left in a clean and tidy state	Construction phase and operations phase

Impact	Ref #	Environmental management measure	Timing
	CW11	Waste would be disposed of in accordance with statutory and local authority requirements by an appropriately licensed contractor	Construction phase and operations phase
	CW12	Waste would be disposed of in accordance with statutory and local authority requirements by an appropriately licensed contractor	Construction phase and operations phase
	CW13	The Project Site would be kept in a neat and tidy condition through good house-keeping practices, including regularly removing waste bins (including recycling bins) to prevent bins overfilling, promptly cleaning up after spills, and regularly tidying up the site.	Construction phase and operations phase
	CW14	Inspections of the waste management areas would be conducted on a weekly basis to ensure that correct waste management procedures are being followed	Construction phase and operations phase
Traffic and transport			
General	TT1	For any works on road corridors during construction, a detailed Road Use Management Plan (RMP) (to include details on the number, type and duration of the vehicle movements, traffic management and controls, fatigue management, and consideration of public transport) would be prepared by the construction contractor for the Project further to discussions with RMS and Deniliquin Council including any detailed traffic control plans.	Detailed design phase
	TT2	A Transport Management Plan (TMP) for the operations phase would be provided to RMS and Deniliquin Council for review prior to project works or project related works occurring. Where appropriate, the TMP would also provide details on the number, type and duration of the vehicle movements, description of intended access locations, consideration of public transport, fatigue management, and transportation of hazardous materials.	Detailed design phase
Road safety during construction	TT3	For safety reasons, the Deniliquin Barham Road entry and exit should have traffic management in place during the construction phase. Adequate signage should be displayed to inform motorists of the approach to the intersection for construction traffic turning. This should form part of the RMP (and governed by Australian Standard AS 1742.3 – 2009) for the construction phase of works.	Construction phase
	TT4	Once more detail is known around the exact construction vehicles and routing, then more detailed vehicle swept path analysis should be undertaken along the heavy vehicle route (if required). The outcomes would be included within the RMP. Large oversize materials (if required) should be transported outside of peak traffic times to reduce impacts on road network (subject to RMS approval) and the police should be contacted for any of these movements.	Detailed design phase

Impact	Ref #	Environmental management measure	Timing
Impacts on existing road surfaces and junctions (including safety)	TT5	The condition of the public roads to be used for the delivery of raw and fabricated materials should be established prior to commencement of works and then regularly monitored during the period of the works. The road and intersection conditions should be established by the use of field surveys and regular site inspections. When required, rehabilitation of the pavement and/or edges of seal, shoulders and verges would be carried out. At the completion of the construction works, the access roads should be in the same or be of superior condition than at the commencement of the works. The measures required to ensure safety and structural integrity of the section of Deniliquin Barham Road between the development site and the end of Deniliquin Council's upgrade (during construction and operations phases) would be the subject of further discussions with Deniliquin Council.	Detailed design phase
	TT6	Intersections to enter and exit the site during operations phase be designed during the detailed design phase to meet the Road Design Guide (RTA) and Austroads Guide to Road Design, including provision of acceleration and deceleration lanes where required. To be discussed with Deniliquin Council.	Detailed design phase
Transporting hazardous materials	TT7	Transportation of hazardous materials would be carried out in consultation with the consent authorities and in accordance with NSW Government's *Hazardous Industry Planning Advisory Paper No 11 on Route Selection, January 2011*. The TMP would include the following: - Hours of operation. - Routes to be used through the affected local government area(s). - The quantity of hazardous goods (i.e. ethanol product) to be transported. - Safety controls including fatigue management	Operations phase
Hazard and Risk			
Safety in design	HR1	Locate product storage tanks at separation distances with specific reference to the applicable Australian Standards AS 1940:2004 *The storage and handling of flammable and combustible liquids.*	Design phase
Safety in design	HR2	Conduct a fire safety study for the Project to determine appropriate fixed and portable fire protection systems for the Project Site to ensure the consequences of major fire incidents are adequately mitigated.	Design phase

Impact	Ref #	Environmental management measure	Timing
Safety in design	HR3	Conduct a Hazard and Operability (HAZOP) study for the processes and plant items within the Project Site to identify potential hazards and operational problems in terms of plant design and human error. HAZOPs seek to minimise the effect of an atypical situation in the operation/process by ensuring that control and other safety systems such as functional safety (e.g. emergency safe shutdown) are in place and operate with a high level of reliability to achieve a safe outcomes.	Design phase
Explosive atmospheres and ignition sources	HR4	Conduct a Hazardous Area Classification Study in accordance with *AS/NZS 60079* series which considers explosive dust atmospheres and explosive gas atmospheres and develop comprehensive ignition source control measures for the Project Site.	Design phase
Emergency response plan	HR5	Develop an emergency response plan in accordance with *HIPAP No.1 – Industry Emergency Planning Guideline* for the site including scenario based emergency response plans developed for the range of incident scenarios that have been identified as having significant consequences.	Design phase
Dangerous goods transport	HR6	Develop a Traffic Risk Assessment and a detailed route selection study in line with *HIPAP No. 11 –Route Selection* and *Australian Dangerous Goods Code* for the dangerous goods transport activities particularly for the transport of ethanol from the Project Site.	Design phase
Health and safety management	HR7	Develop a detailed Safety Management System prior to the commencement of operation in accordance with the requirements of the *NSW Work Health and Safety Regulation 2011 and DP&I's HIPAP No. 9 – Safety Management*	Design phase, prior to commencement of operations
Hazard analysis	HR8	The results of the preliminary hazard analysis (PHA), would be used as inputs into other safety studies required to be developed as a part of the design, construction / commissioning and operations phase of the Project	Design phase and other subsequent phases
Safety Instrumented Systems	HR9	Identification and implementation of Safety Instrumented Systems in line with AS IEC 61511.1 -2004, *Functional safety – Safety instrumented systems for the process industry sector*	Design phase
Safety in design	HR10	Conduct safety in design reviews in accordance with *WHS Regulations and Code of Practice – Safe Design of Structures*.	Design phase and other subsequent phases
Safety for construction activities	HR11	Develop and implement an appropriate Safety Management Plan in line with *HIPAP No. 7 – Construction Safety Study Guidelines*. This should include access by workers to a risk register for all construction activities.	Construction phase
Emergency response	HR12	Develop an Emergency Response Plan in accordance with DP&I's *HIPAP No.1 – Industry Emergency Planning Guideline*, including actions to be taken in the event of an emergency.	Construction phase

Impact	Ref #	Environmental management measure	Timing
High risk activities	HR13	Ensure a permit to work system is implemented, in particular where workers may be exposed to high risk activities.	Construction phase
Appropriately managed and audited construction activities	HR14	Undertake audits on construction activities, and address and communicate any findings to relevant workers	Construction phase
Staff training and competency	HR15	Ensure workers have appropriate training and the necessary competencies.	Construction phase
High risk activities	HR16	Implement actions / risk reduction strategies as identified through Safety in Design reviews	Construction phase
Safety Management Plan	HR17	Develop an appropriate Safety Management Plan. This should include access by workers to a risk register for all operational activities.	Operation phase
Hazard scenarios	HR18	Development of Emergency Response Plan to ensure a co-ordinated response to hazard scenarios	Operation phase
Operational environmental health	HR19	Develop an Operations Environmental Management Plan	Operation phase
Appropriately managed and audited operational activities	HR20	Undertake audits on operational activities, and address and communicate any findings to the relevant workers	Operation phase
Staff training and competency	HR21	Ensure all workers have appropriate training and necessary competencies.	Operation phase
Preventative maintenance programs	HR22	Implementation of appropriate preventive maintenance programs.	Operation phase
Exceedance of Schedule 15 chemicals threshold	HR23	Notify Work Cover NSW that the quantity of ethanol in relation to the Schedule 15 chemicals is likely to be exceeds 10% of the threshold quantity	Operation phase
Decommissioning plan	HR24	Develop a decommissioning plan. This should include a Project risk register that is available to all workers, including any risk items added during the construction and operations phases	Post closure phase
Appropriate records for future audits	HR25	Keep records of all workplace health and safety related information relating to the Project post closure phase	Decommissioning phase
Soil, Land Capability and Land Use			
General	SL1	Prepare and implement a CEMP.	Pre-commencement, Construction Phase
	SL2	Prepare and implement an EMP.	Pre-commencement, Operations Phase
	SL3	Prepare an EMS to measure and manage environmental performance at the Project Site.	Pre-commencement, Operations Phase

Impact	Ref #	Environmental management measure	Timing
	SL4	All storage areas for chemicals, oils, fuels, solvents and other potentially hazardous materials would have adequate signage and comply with Australian Standards.	Operations Phase
	SL5	All storage and handling areas would be sufficiently bunded.	Construction Phase, Operations Phase
	SL6	The storage, handling and use of chemicals would adhere to the provisions outlined in the relevant Materials Safety Data Sheet (MSDS).	Operations Phase
	SL7	Monitoring of environmental practices would be undertaken across the Project Site through regular site inspections.	Operations Phase
	SL8	Where applicable, site workers would be trained in visually identifying gross contamination.	Operation Phase
Erosion and Stability	SL9	Carry out progressive clearing, restricting clearing to areas of imminent development.	Construction Phase
	SL10	Minimise length of time bare ground is exposed should stockpiling of topsoil be undertaken.	Construction Phase
	SL11	Undertake clearing outside the wet season, where possible.	Construction Phase
	SL12	Prevent run-off from undisturbed areas flowing over cleared land.	Construction Phase, Operations Phase
	SL13	Direct run-off from cleared land to appropriate sediment-controlling structures or facilities.	Construction Phase, Operations Phase
Building / Plant Sites	SL14	Follow suggested methods of land clearance and topsoil handling prior to and throughout construction, including temporary diversion and drainage construction.	Construction Phase
	SL15	Stabilise disturbed areas as quickly as practical to limit erosion, with progressive revegetation undertaken.	Construction Phase
Landscape character and visual amenity			
Vegetation removal	LV1	Vegetation would remain in-situ for the greatest possible length of time prior to removal to provide screening effects of the Project Site from receptors.	Construction Phase
Stripping of topsoil from the Project Site and storage	LV2	Stripped topsoil would be removed immediately for landscape works where practicable to facilitate regeneration of the existing tussock pasture grass.	Construction Phase
	LV3	Topsoil would be managed in a manner that mitigates deterioration of the topsoil quality during stockpiling (such as the provision of a cover crop, separate stockpiling of topsoil and subsoil).	Construction Phase
	LV4	The height of topsoil stockpiles would be minimised as far as practical, should stockpiling be required	Construction Phase

Impact	Ref #	Environmental management measure	Timing
Lighting associated with construction activities and moving plant	LV5	The number of lights would be kept to the minimum required to perform the tasks in accordance with health and safety legislation/requirements.	Construction Phase
	LV6	Light spill would be contained to the greatest extent possible (e.g. the use of directional lighting where possible, as per AS 4282 – Control of Obtrusive Effects of Outdoor Lighting (1997))	Construction Phase
	LV7	Downlights would be used in preference to up-lighting or spill lights.	Construction Phase
General Site Landscape	LV8	The Project Site would be maintained in good condition during construction, with sound housekeeping practices.	Construction Phase
General Approach	LV9	Provide a landscape planting to the Deniliquin Barham road frontage that provides attractive stands of endemic trees, potentially in conjunction with saltbush plantings, within a tufted, dry grassland setting as is currently in place on the Project Site. Allow for framed views through this vegetation to the Project .	Operation Phase
General Approach	LV10	Consider during detail design phase for the two workshops adjacent to Deniliquin Barham Road to be set further back (south) from the boundary to facilitate tree planting between the swale and the workshops, sufficient to meet solar access requirements for the proper functioning of the swale. Further consider moving the western workshop building east to facilitate screen planting between the western edge of the building and the western site boundary, to reduce the visual prominence of this element when seen driving east along Deniliquin Barham Road	Detailed design
General Approach	LV11	Consider in conjunction with Council providing informal endemic tree planting within the approximately 30m wide grassy verge between Deniliquin Barham Road and the site boundary	Operation Phase
General Approach	LV12	Consider landscape planting as per LV09 along the western and southern boundaries of the Project Site, to provide a vegetated visual backdrop to the development when seen from Deniliquin Barham Road, and reduce potential visual impacts from property homesteads to the south.	Operation Phase
Vegetation	LV13	Vegetation would be selected that is consistent with that found in the neighbouring area to the Project Site, with species selection of mid and over storey species suited to optimising screening qualities.	Operation Phase
Boundary Fencing	LV14	Boundary fencing would be of a type that maximises visual permeability and facilitates views through into the Project Site.	Operation Phase
Lighting associated with permanent facilities and moving plant	LV15	The number of lights would be kept to the minimum required to perform the tasks in accordance with health and safety legislation/requirements. Light spill would be contained to the greatest extent possible (e.g. the use of directional lighting where possible). Use of downlights preferential to the use of up-lighting or spill lights.	Operation Phase

Impact	Ref #	Environmental management measure	Timing
Signage	LV16	All signage with be displayed in accordance with -State Environmental Planning Policy No 64 - Advertising and Signage (2001).	Construction and Operation Phase
General Site Landscape	LV17	The Project Site would be maintained in good condition, with sound housekeeping practices to reduce the visual impact on adjacent neighbouring properties.	Operation Phase
Air Quality			
Dust	AQ1	Dust mitigation measures that would be implemented include the following: - Removing silt and other material would around erosion and sediment control structures. - Minimising the use of material stockpiles and ensuring sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process. - Minimising drop heights from loading shovels and other loading / unloading equipment and using fine water sprays on such equipment where appropriate. - Ensuring vehicles entering/exiting the Project Site are covered to prevent escape of materials during transport. - Reducing the heavy vehicle speeds on site to reduce wheel generated dust.	Construction Phase Operations Phase
Construction machinery	AQ2	Control measures relating to plant and machinery that would be implemented include the following: - Ensuring vehicles and machinery are maintained in accordance with manufacturer's specifications. - Minimising heavy vehicle queuing and unnecessary trips through logistical planning of materials delivery and work practices. - Ensure all vehicles switch off engines when stationary so that there are no idling vehicles for long periods of time. - Fixed plant would be located as far from local receptors as practicable.	Construction Phase
General	AQ3	Air emissions associated with all construction activities would also be managed through compliance with a CEMP. A CEMP would be implemented so that: - The works are conducted in a manner that minimise the generation of air emissions. - The effectiveness of the controls being implemented is monitored. - Additional measures are implemented where required.	Construction Phase

Impact	Ref #	Environmental management measure	Timing
	AQ4	Construction contractors would undertake daily environmental inspections of their works and worksite. Inspections would include: - Visual inspection of dust generation - Ensuring roads leaving the site are free of soil, and prevention of soil tracking onto the road network - Inspection of the erosion and sediment controls - Inspection of any rehabilitated or landscaped areas (where relevant) - Ensuring spill kits are appropriately located and stocked. Any remedial or corrective actions should be reported to the Site Manager as soon as is practicable.	Construction Phase
Complaints handling	AQ5	An effective complaints logging system would be maintained to monitor complaints, to effectively manage any requests for information or respond to any public concerns in relation to the Project throughout the construction phase, and to ensure identified incidents are dealt with through investigation and implementation of corrective treatments.	Construction Phase
Greenhouse gas	AQ6	Operational procedures to be implemented on the site to reduce GHG emissions would include: - Ensuring that there are no leakages from the ethanol plant site through appropriate and effective planning and management. - Undertaking regular inspections to identify compromised parts of the plant. - Investigating the use of renewable energy sources, such as wind, solar or biomass, for externally-sourced electricity. - Closely regulating the use of plant lighting. - Installation of solar-powered lighting around the site where practical.	Operations Phase
Noise and vibration			
Noise management	NV1	A detailed construction noise management plan would be developed as part of detailed design.	Detailed design phase
Vehicle and plant generated noise	NV2	Maintain nominated speed limits for vehicles on internal roads.	Construction phase Operation phase
	NV3	Schedule noisy equipment movements, wherever possible, to avoid sensitive times.	Construction phase Operation phase
	NV4	Ensure all vehicle and plant operators are aware of the location of sensitive receptors and the measures required for limiting noise, where possible.	Construction phase Operation phase

Impact	Ref #	Environmental management measure	Timing
	NV5	Enclose equipment to limit noise level including the construction of underground conveyors to transport raw materials, where possible.	Construction phase
	NV6	Noise emissions would be a factor considered when selecting equipment.	Detailed design phase
	NV7	Ensure all vehicles, plant and machinery are regularly maintained to avoid unnecessary engine, motor or muffler noise.	Construction phase Operation phase
High noise activity scheduling	NV8	Notify key stakeholders when particularly noisy activities are scheduled.	Construction phase Operation phase
	NV9	Activities with high noise emissions should be limited to daytime hours where possible.	Construction phase Operation phase
Community complaints	NV10	Noise and/or vibration monitoring would be undertaken in response to community complaints in accordance with procedures outlined in the NSW Industrial Noise Policy and Industrial Noise Policy Application Notes. Complaints would be investigated and recorded in the site complaints/incidents register, along with any actions taken in response to the investigation.	Construction phase Operation phase
Noise management	NV11	Further assessment of noise emissions should be undertaken during the Project's detailed design once inputs and assumptions have been refined. The design should incorporate mitigation measures to reduce noise levels during operations phase to comply with the noise criteria. Noise walls in the direction of the sensitive receptors (~3m, based off current inputs and assumptions) may be required to reduce noise levels to comply with the various criteria.	Detailed design phase
Cultural Heritage			
Heritage Management Plan (HMP)	CH1	Preparation of HMP in consultation with Registered Aboriginal Parties, to include the provisions below.	Detailed design phase Construction phase
Impacts to unidentified sites	CH2	Archaeological salvage program including: - Surface collection - Test excavation - Salvage excavation (if warranted by results of test excavation)	Pre-construction phase
Scarred trees	CH3	Scarred tree management, including - Reassessment of scarred trees by a qualified arborist - Recording and removal of trees (if warranted by reassessment)	Pre-construction phase

Impact	Ref #	Environmental management measure	Timing
Protection of non-impacted sites	CH4	Management of non-impacted sites, including; - Protective fencing - Annual monitoring	Construction phase Operation phase
Management of staff and Contractor's activities	CH5	Aboriginal and historical heritage induction & cultural awareness training, including - Information on likely site types - Procedures for accidental discoveries	Construction phase Operation phase
	CH6	Chance finds procedures for: - Aboriginal archaeological sites/materials - Human remains - Historical cultural heritage	Construction phase Operation phase
	CH7	Site reporting and registration requirements for: - Aboriginal heritage sites - Historical heritage sites	Construction phase Operation phase
Social and economic			
Economy and Business	SE1	Keep local business informed of goods and services required for the Project.	Pre-commencement
Community Cohesion	SE2	A community consultation program would be developed and implemented to ensure suitable information is available to local residents. Information may include but is not limited to, details of the construction program, any changes to access or traffic conditions, any potential environmental or health and safety impacts.	Pre-commencement, Construction Phase, Operation Phase, Decommissioning
Employment	SE3	Employ local skilled and unskilled workers as relevant. Encourage where possible the use of local contractors/ subcontractors.	Pre-commencement, Construction Phase, Operation Phase
Health and Safety			
Slips, trips or falls	HS1	Application of safety in design principles Adherence to the IMS Implement a Health and Safety Policy Implement Health and Safety Management Plans Staff training and supervision Use of Personal Protective Equipment (PPE) such as hard hats, safety glasses, vests, etc.	Construction phase Operation phase
Working in confined spaces	HS2	Training for working in confined spaces Adherence to the IMS and work procedures Use of licenced operators Emergency procedures and training.	Construction phase Operation phase

Impact	Ref #	Environmental management measure	Timing
Vehicle accident or contact by moving vehicle or equipment	HS3	Application of safety in design Principles Adherence to the IMS and work procedures Implement a Health and Safety Policy Implement Health and Safety Management Plans Implement Traffic Management Plans Exclusion zones around areas of operation Use of Personal Protective Equipment (PPE) such as hard hats, safety glasses, vests, etc. Traffic control and signage Speed restrictions.	Construction phase Operation phase
Spill and subsequent inhalation or contact with hazardous substances	HS4	HAZOP studies MSDS sheets at site Health and Safety Management Plan Staff and contractor training.	Construction phase Operation phase
Fire originating from welding works, heat generating machinery, spark originating from welding and grinding, refuelling operations, pipeline/storage incident	HS5	Application of safety in design principles Adherence to the IMS and work procedures Implement a Health and Safety Policy Implement Health and Safety Management Plans Implement an Emergency Management Plan Obtain hot works permits. Staff/crew training.	Construction phase Operation phase
Workers caught in moving machinery	HS6	Application of safety in design principles Adherence to the IMS and work procedures Implement a Health and Safety Policy Implement Health and Safety Management Plans Staff training and supervision Use of PPE and on-board safety equipment Implement a Drug and Alcohol policy	Construction phase Operation phase
Exposure to natural hazards	HS7	Application of safety in design principles Adherence to the IMS and work procedures Implement a Health and Safety Policy Implement Health and Safety Management Plans Use of PPE Implement an Emergency Management Plan, including evacuation procedures, Implement monitoring and early warning of hazardous events.	Construction phase Operation phase

Impact	Ref #	Environmental management measure	Timing
Introduction of disease, including human, other animal and plant disease	HS8	Implement a Security Management Plan Use of PPE Minimise creation of stagnant or ponding water	Construction phase Operation phase
Electrical hazards	HS9	Contractor Site Safety Management Plan and Safe Work Method Statements Tag and testing all equipment as part of Site Safety Management Plan and Safe Work Method statements Use of dial before you dig for locating underground services Safe Work Method statements. Contractor Site Safety Management Plan.	Construction phase Operation phase
Refuelling of plant	HS10	Implement Contractor Site Safety Management Implement Plan and Safe Work Method Statements Use of licenced operators.	Operation phase
Working at heights	HS11	Implement Contractor Site Safety Management Plan and Safe Work Method Statements	Construction phase Operation phase
Security	HS12	Implement Site Security Management Plan Implement Induction and training for staff, contractors and visitors Erect site fencing and boom gate access points	Construction phase Operation phase

25.0 Justification for approval

Schedule 2 of the EP&A regulation requires that justification be provided for the development or activity to be carried out. The justification should have regard to biophysical, economic and social considerations and the principles of Ecologically Sustainable Development (ESD).

25.1 Project justification

The following positive influential factors justify the Project's development:

- Site suitability including the availability of agricultural land and established grain industry within the region
- Established ethanol mandates and contribution to their achievement
- Demand for co-products within the agricultural sector.

25.1.1 Suitability of the site

The selected Project Site offers the following merits:

- Central to major agricultural area for the efficient supply of input grain.
- Central to the major agricultural market for the sale of DDG, DDGS, distiller's syrup and the liquid fertiliser.
- The area surrounding the Project Site is sparsely populated and is located in a highly disturbed area being within close proximity to a railway line, major roadways and an existing industrial area.
- Established transport links with direct road frontage to Deniliquin Barham Road and convenient access to the Cobb Highway.
- Future logistics advantages with close proximity to a rail spur from the Sydney to Melbourne line.
- Good supply of a skilled workforce.

25.1.2 Ethanol mandates and demand

Established ethanol mandates across a number of states within Australia support the development of the Project. Ethanol mandates are designed to encourage broader use of ethanol and other biofuels and to minimise our reliance on fossil fuels based energy sources. In Australia, government mandated demand for ethanol is projected to grow to over 1.9 GL per annum by 2019 (Department of Industry: Resources & Energy, 2015). However, organic growth in domestic ethanol production is estimated to grow by only 6.5 percent to 408 ML, by 2019 (OECD-FAO, 2011). There is a significant shortfall between expected demand and supply. Mandates and the development of ethanol production facilities are critical to drive market demand for ethanol and achieve mandate targets. Between NSW and QLD, a move to reinstate 6 percent and 5 percent mandate targets respectively will require 835 ML of production per year (Biofuels Association of Australia, 2014). The Project directly helps support the achievement of these targets.

25.1.3 Demand for co-products

DDG and DDGS

DDG and DDGS are excellent, lower cost alternative feed ingredient that can be supplied to the domestic and international agriculture market. DDG and DDGS can be used as partial replacements for some of the more expensive, traditional agriculture products. DDG and DDGS have been found to be higher in protein and when added to standard stock feeds; it results in excellent animal health, performance and food product quality. These attributes have seen the import export market grow significantly in the past few years.

The Project provides a significant opportunity for the development of a DDG and DDGS market (for both domestic and international export) in the Deniliquin region.

Liquid Fertiliser

The production of enhanced liquid fertiliser presents a number of positive benefits including the enhancement of soil viability and yield rates. Given that the Deniliquin area and surrounding region is dominated by agricultural based industries, the delivery of such a product is likely to further increase the viability and profitability of the agricultural sector.

25.2 Project benefits

The local region is well placed to provide the full range of construction and operational expertise required to build and operate the Project. It is estimated the Project will inject significant revenue into the local region's economy annually. The Project will benefit the Deniliquin area, and the State of NSW. Key benefits of the Project include:

- Jobs: The Project will generate approximately 350 jobs during construction, 50 permanent jobs for operation and ongoing management, contributing an additional $5 million into the local employment market.
- Trades: Ongoing plant maintenance will contribute a further $1 million per annum to local trades.
- Sourcing inputs: The purchase of grain input will inject a further $50 million annually into the local economy and provide a stable local market for growers.
- Ethanol mandates: Assist NSW in meeting is ethanol mandate of six percent
- Co-product production: domestic supply of protein rich livestock feed and a centre of excellence for efficient fuel production and agricultural nutritional improvement, over the longer term.

25.3 Biophysical, economic and social considerations

Pursuant to Schedule 2, Clause 7(f) of the EP&A Regulation, the Project is justified in terms of biophysical, economic and social considerations as described below.

25.3.1 Biophysical

An assessment of the potential biophysical impacts of the Project has been undertaken as provided in Chapter 8 Biodiversity. Assessment of potential biodiversity impact has demonstrated that following the implementation of proposed mitigation and management measure the Project is unlikely to result in significant impacts to any listed species populations or communities once offset measures are implemented. Assessment of potential surface and groundwater impacts identified that potential impacts would be minor and easily managed in accordance with current industry practices and the proposed mitigation measures. Although construction and operational activities may have the potential to impact on land based environmental values, the application of mitigation and control measures where appropriate, as well as adherence to proposed plans and procedures, reduces the residual risks to a minor level.

25.3.2 Economic

An assessment was undertaken of the potential impact, both positive and negative that the Project may have on the local, regional, State and national scale. This assessment concluded that the economic benefits out way any potential negative economic benefits. The Project would support the ongoing employment of approximately 355 full time positions during construction and 50 full time positions during operation. Additionally, the Project would inject a further $50 million annually into the local economy and provide a stable local market for growers in the Murray region as well as contributing a further $1million per annum to local trades.

25.3.3 Social

The socio-economic assessment undertaken for the Project has shown that the Project would have negligible impact on social aspects such as employment opportunities, housing, the provision of social services or impacts to social infrastructure. In fact the Project would support the community through the provision of additional jobs as well as training and skill development opportunities. Some impacts to amenity, related to landscape character and visual amenity, air quality and noise, were identified earlier in this EIS. Appropriate mitigation would where feasible minimise impacts. This assessment did not determine that there would be any major impacts on access to community infrastructure or services or traffic and public transport. For these reasons, the Project is justified from a social perspective.

25.4 Ecologically sustainable development

25.4.1 Objects of the EP&A Act

The objects of the EP&A Act provide a framework within which the justification of the Project has been considered. Pursuant to Schedule 2, Clause 7(f) of the EP&A Regulation, the Project is justified in terms of biophysical, economic and social considerations.

25.4.2 Precautionary Principal

The Precautionary Principle, in summary, holds that where there are threats of serious or irreversible environmental damage, the lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

The Project has been subject to a precautionary and conservative assessment, considering worst case and representative scenarios to ensure that environmental impacts and risks are appropriately identified and mitigation measures determined to avoid and minimise impacts consistent with best practice standards. Detailed assessment led to a:

- reduction of the Project Footprint as far as reasonably practicable to minimise any potential impacts
- confining the Project's construction to standard operating hours
- offsets proposed to minimise any potential impact to the plains wanderer
- determination of transport routes based on minimising impacts to local residential streets and to peak traffic periods.

A detailed understanding of the issues and potential impacts associated with the Project has been obtained through consultation and assessment to a level commensurate with the scale of the Project, industry standards, the level of environmental risk and the legislative framework under which the Project is permitted. Specialist assessments, including the use of engineering and scientific modelling, have been undertaken to aid the design of the Project and for impacts relating to surface water and groundwater, hazard and risk, biodiversity, Aboriginal and non-aboriginal heritage, traffic and transport, waste, noise, air quality (including GHG), visual amenity and land capability and land use considerations to be understood. Assessment has also been undertaken for other issues, including socio-economic and health and safety. To this end, there has been careful and thorough evaluation undertaken in order to recognise the potential for and then avoid where possible, serious or irreversible damage to the environment.

25.4.3 Intergenerational Equity

Intergenerational Equity is centred on the concept that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations. There is a moral obligation to ensure that today's economic progress, which will benefit both current and future generations, is not offset by environmental deterioration.

In supporting the construction of the Project and facilitating the production of ethanol as an alternative energy to fossil fuels, the Project would help facilitate the delivery of sustainable energy options and reduce Australia's GHG emissions as a result of energy production for current and future generations. Additionally, the production of liquid fertiliser will assist in the enhancement of soil productivity within the region, benefit future generations by enabling landowners to improve soil quality and agricultural yield and output rates.

25.4.4 Biological Diversity and Ecological Integrity

The principle of Conservation of Biological Diversity and Ecological Integrity holds that the conservation of biological diversity and ecological integrity should be a fundamental consideration for development proposals. The potential environmental impacts of the Project, including upon ecological communities and habitat values, and measures to ameliorate these potential impacts are described within this EIS.

The Project has initially aimed to avoid and minimise potential impacts on ecological values during the planning stage. A detailed ecological assessment has been undertaken for the Project. The potential impacts on ecology within the Project Site have been assessed in detail with mitigation measures proposed to avoid and minimise impacts as far as possible. Additionally, the Project Footprint has been reduced as far as possible to avoid ecology impacts. Offsets have been proposed to further mitigate Project impacts. It is concluded that the Project is unlikely to have a significant impact on any listed species, population or ecological community.

25.4.5 Improved Valuation and Pricing of Environmental Resources

The principle of Improved Valuation and Pricing of Environmental Resources is based on environmental factors being included in the valuation of assets and services. The cost associated with using or impacting upon an environmental resource is seen as a cost incurred to utilise that resource.

Appropriate mitigation costs for residual and unavoidable impacts have been accounted for in the Project development phase, with mitigation measures developed, including an offset strategy, for the Project based on best practice standards.

25.4.6 Climate change and greenhouse effect

The EIS has undertaken a review of the Project in the context of the greenhouse gases that will be generated directly by Project activities. With mitigation measures in place, the Project would be operated in a manner that reduces GHG production to the extent possible.

25.5 Summary and conclusions

Based on the positive benefits provided by the construction and operation of the Project, it is considered that the Project is in the public interest and will contribute significantly to the local region and NSW more generally.

26.0 Conclusion

The Project has been designed to meet the following objectives:

- To supply the domestic fuel grade ethanol market with approximately 115 ML of ethanol per year
- To provide sellable co-products (DDG, DDGS, syrup and liquid fertiliser) to the agricultural sector
- To generate employment opportunities for local residents during construction and operation phases
- To utilise local grain supplies in the production of ethanol
- To minimise impacts on the natural and built environment through sensitive design and appropriate environmental management practices
- To comply with the requirements of law and company policy
- To provide economic stimulus to local and regional economies.

The need and justification for the Project has been assessed against strategic planning objectives and with consideration to feasible alternatives. The Project would help meet the established State ethanol markets as well as provide the agriculture sector with beneficial feed products and land based fertilisers.

The Project will benefit the Deniliquin area, the state of NSW and Australia more broadly. Key benefits of the Project include:

- Jobs: the Project will generate approximately 350 jobs during construction, 50 permanent jobs for operation and ongoing management, contributing an additional $5 million into the local employment market.
- Trades: ongoing plant maintenance will contribute a further $1 million per annum to local trades.
- Sourcing inputs: the purchase of grain input will inject a further $50 million annually into the local economy and provide a stable local market for growers.
- Ethanol mandates: assist NSW in meeting is ethanol mandate of six percent
- Co-product production: domestic supply of protein rich livestock feed and a centre of excellence for efficient fuel production and agricultural nutritional improvement, over the longer term.

Based on the positive benefits provided by the construction and operation of the Project, it is considered that the Project is in the public interest and will contribute significantly to the local region, NSW and Australia more generally.

The Project's environmental impacts have been assessed as part of the EIS process. The residual and cumulative effects of the Project are considered to be unlikely and insignificant.

Based on the above, the Project is considered to be site suitable, justified and in the public's interest.

27.0 References

ABS. 2011. Census Community Profiles 2011. Australian Bureau of Statistics, (online) http://www.abs.gov.au/websitedbs/censushome.nsf/home/quickstats?opendocument&navpos=220, (online) accessed 16 August 2015.

ABS, 2013. Deniliquin Local Government Area – Statistical Summary. Australian Bureau of Statistics (online): http://stat.abs.gov.au/itt/r.jsp?RegionSummary&region=12500&dataset=ABS_NRP9_LGA&geoconcept=REGION&datasetASGS=ABS_NRP9_ASGS&datasetLGA=ABS_NRP9_LGA&regionLGA=REGION&regionASGS=REGION, accessed 7 July 2015.

Access Archaeology & Heritage, 2014. Aboriginal Cultural Heritage Assessment Proposed Ethanol Plant, Deniliquin, NSW. Moryua, NSW.

AECOM. 2015a. Deniliquin Ethanol Plant: Aboriginal and Historical Cultural Heritage Assessment. AECOM Australia PTY LTD, Brisbane.

AECOM, 2015b. Deniliquin Ethanol Plant: Gap Analysis of Draft EIS. AECOM Australia PTY LTD, Brisbane.

Aines, G., Klopfenstein, T., and R. Stock, 1987. Distillers Grains. MP51, Nebraska Agric. Res. Div., Lincoln.

ALA, 2015. Atlas of Living Australia, (online) http://www.ala.org.au, accessed 10 July 2015.

ANZECC, 2000a. Guidelines for Fresh and Marine Water Quality and Guidelines for Water Quality Monitoring and Reporting. Australia and New Zealand Environment and Conservation Council, Canberra.

ANZECC, 2000b. National Water Quality Management Strategy: Australian Guidelines for Fresh and Marine Water Quality. Australia and New Zealand Environment and Conservation Council, Canberra.

Australian National Botanic Gardens, 2015. Australian National Botanic Gardens, (online) http://www.anbg.gov.au, accessed 4 June 2015.

Austroads, Various. Guide to Road Design. Austroads.

Bartlett, R. (n.d.). *History of Canargo Shire.*

Bates, K. and J. Bates. 2009. Advanced Soil Mapping, Electromagnetic Survey for Soil Investigation Barham Road Deniliquin, May 2009. ASM, Deniliquin.

Biofuels Association of Australia, 2014. State Biofuels Policy, available (online) http://biofuelsassociation.com.au/policy/state-biofuel-policy/, accessed 7 July 2015.

BoM, 2015. Climate Database, Bureau of Meteorology, (online) http://www.bom.gov.au/climate/data/, accessed 22 May 2015.

BoM, 2015. Climate Statistics for Australian locations, Bureau of Meteorology, (online) http://www.bom.gov.au/climate/averages/tables/cw_074128.shtml, accessed 22 July 2015.

Braid, A.L., 2012. Chapter 25 – Land use in Australia for biofuels and bio-energy: opportunities and challenges for livestock industries. SCIRO Ecosystem Sciences, ACT.

Brodie, R., and A. Tucker, 1993. Estimation of Leakage Rates Through the Shepparton Formation Aquifer, Deniliquin, New South Wales. Record 1993/88, Australian Geological Survey Organisation, Canberra.

Brown, C. S., 1991. Geology of the Murray Basin Southeastern Australia.

Burke, Heather and Claire Smith, 2004. The Archaeologist's Field Handbook. Allen & Unwin, Sydney.

Bushman's: Saving Australia's Tanks, 2015. Available (online), http://www.bushmantanks.com.au/productlist/water-tanks, accessed 28 September 2015.

Cahill, A. E., 2015. Jennings, Sir Patrick Alfred (1831–1897). Australian Dictionary of Biography.

CHAH, 2015. Council of Heads of Australasian Herbaria, (online), http://www.chah.gov.au/index.html, accessed June 2015.

CNES, Astrium, and Google, 2015. Deniliquin Aerial Imagery and Map Data, (online) www.maps.google.com.au, accessed 21 November 2009.

Coutts, P. J. F., 1977. Aboriginal Prehistory in North Western Victoria. Victorian Archaeological Survey.

Coutts, P. J. F., Henderson, P., and Richard Fullagar, 1979. A Preliminary Investigation of Aboriginal Mounds in North-Western Victoria. Fisheries & Wildlife Division, Ministry for Conservation, Melbourne.

CSIRO, 2015. Mapping. Australian Soil Resource Information System. Commonwealth Scientific and Industrial Research Organisation (CSIRO) Land and Water Division. Sourced 10 June 2015.

DIR&E, 2015. Biofuels Legislation. Department of Industry, Resources and Energy, (online) http://www.resourcesandenergy.nsw.gov.au/energy-consumers/sustainable-energy/office-of-biofuels/biofuels-legislation, accessed 7 July 2015.

DEC, 2000. Assessing Vibration: a Technical Guideline. Department of Environment and Conservation, Sydney.

DEC, 2005a. Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales. Department of Environment and Conservation, South Sydney.

DEC, 2005b. Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation. Department of Environment and Conservation, South Sydney.

DEC, 2006. Manual for the Identification of Aboriginal Remains. Department of Environment and Conservation, South Sydney.

DEC, 2006. Using the ANZECC Guideline and Water Quality Objectives in NSW. Department of Environment and Conservation, South Sydney.

DECC, 1997. Managing Urban Stormwater, Treatment Techniques. The Department of Environment and Climate Change, Sydney.

DECC, 1998. Managing Urban Stormwater. Department of Environment and Climate Change, Sydney.

DECC, 2007. Managing Urban Stormwater: Environmental Targets (consultation draft). Department of Environment and Climate Change, Sydney.

DECC, 2007. Threatened Species Assessment Guidelines: assessment of significance. The Department of Environment and Climate Change, Sydney.

DECCW, 2011.Guidelines on Resource Recovery Exemptions (Land Application of Waste Materials as Fertiliser or Soil Amendment). NSW Department of Environment, Climate Change and Water, Sydney.

DEH, 2006. White box - Yellow box - Blakely's red gum grassy woodlands and derived native grasslands: Policy Statement. Department of the Environment and Heritage, Canberra.

Denholm, Zita. 2015. Tyson, James (1819-1898). Australian Dictionary of Biography.

Deniliquin Council, Deniliquin Council Water and Sewer Limits Policy. Deniliquin Council, Deniliquin.

Deniliquin Council, 2012. Deniliquin Council Stormwater Drainage Asset Management Plan. Deniliquin Council, Deniliquin.

Deniliquin Council,. 2013. Section 64 Report – Draft Local Environmental Plan 2013 (including Annexures A to I). Deniliquin Council, Deniliquin.

Deniliquin Council, 2015a. Economic Development and Tourism, (online) http://www.deniliquin.nsw.gov.au/planning-development-deniliquin/economic-development-deniliquin, accessed 16 August 2015.

Deniliquin Council, 2015b. Economic Development. Deniliquin Council, (online) www.deniliquin.nsw.gov.au/, accessed 5 June 2015.

Deniliquin Council, 2015c. Traffic Volumes – Deniliquin Barham Road. Deniliquin Council, Deniliquin.

DEWHA, 2010. Survey guidelines for Australia's threatened birds. Department of the Environment, Water, Heritage and the Arts, Canberra.

DIN, 2009. German Standard DIN4150-3 – Structural Vibration – Part 3: Effects of Vibration on Structures. DIN Publications, Germany.

DIRD, 2014. The Australian Code for the Transport of Dangerous Goods by Road and Rail (known as the Australian Dangerous Goods Code or ADG), Edition 7.3. Federal Office of Road Safety, Department of Infrastructure and Regional Development, Canberra.

DoE, 2007. Chapter 4 – Groundwater in the Murray Geological Basin. Department of Environment, Canberra.

DoE, 2008. Fuel Consumption Guide Database 1986 - 2003. Department of the Environment, Canberra.

DoE, 2011. National Pollutant Inventory (NPI), 2011. Emission Estimation Manual for Combustion in Boilers, Version 3.6. Department of the Environment, Canberra.

DoE, 2013. National Inventory by Economic Sector. Department of the Environment . National Inventory by Economic Sector, (online) http://ageis.climatechange.gov.au/ANZSIC.aspx; accessed 16 June 2015.

DoE, 2013. Significant Impact Guidelines 1.1 - Matters of National Environmental Significance. Department of the Environment, Canberra.

DoE, 2014. National Greenhouse Accounts Factors - Australian National Greenhouse Accounts. December 2014 Update. Department of the Environment, Canberra.

DoE, 2015. Protected Matters Search Tool, (online) http://www.environment.gov.au/epbc/pmst/index.html, accessed 17 June 2015.

Dongmun Greentec Pty Ltd, 2013. Traffic Impact Assessment.

DoP, 2009. Draft Murray Regional Strategy. NSW Department of Planning, Dubbo, (online) 2015. http://www.planning.nsw.gov.au/Portals/0/PlansForAction/pdf/draft_murray_regional_strategy_.pdf, accessed 17 August 2015.

DP&E, 2011. Planning, Hazardous Industry Planning Advisory Paper (HIPAP) No. 4, Risk Criteria for Land Use Safety Planning. Department of Planning and Environment, Sydney.

DP&E, 2011. Planning, Hazardous Industry Planning Advisory Paper (HIPAP) No. 6, “Hazard Analysis”. Department of Planning and Environment, Sydney.

DP&E, 2015. Major Projects Register. Department of Planning and Environment, Sydney, (online) http://majorprojects.planning.nsw.gov.au/, accessed 15 August 2015.

DP&I, 1994. Applying SEPP 33, Hazardous and Offensive Industry Development Application Guidelines.

DT&I, 2015. Resources and Energy Division. NSW Titles. Department of Trade and Investment, (online) www.resources.nsw.gov.au/titles, accessed 9 June 2015.

DUAP, 2001. State Environmental Planning Policy No 64 - Advertising and Signage. NSW Government Department of Urban Affairs and Planning, Sydney.

Eardley, K., 1999. A foundation for conservation in the Riverina Bioregion. Hurtsville, NPWS.

Cedric Roberts, 2004. Ecoaccess Guideline for the Assessment of Low Frequency Noise. *Proceedings of Acoustics,* Gold Coast.

Engineers Australia (EA), 2006. WSUD Engineering Procedures Stormwater.

Environmental Planning and Assessment Act 1979.

Environmental Planning and Assessment Regulation 2000.

Environmental Protection Act, 1994. Environmental Protection (Noise) Policy 2008.

Environment Protection and Biodiversity Conservation Act 1999.

EPA, 2000. NSW Industrial Noise Policy. Environmental Protection Authority, Sydney.

EPA, 2004a. Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact in Western Australia, No. 51. Perth: Environmental Protection Authority.

EPA, 2004b. Guidance for the Assessment of Environmental Factors: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 52. Perth: Environmental Protection Authority.

EPA, 2009. Interim Construction Noise Guideline. Environmental Protection Authority as part of the Department of Environment, Climate Change and Water, Sydney.

EPA, 2011. NSW Road Noise Policy. Environmental Protection Authority as part of the Department of Environment, Climate Change and Water, Sydney.

EPA, 2013a. Environmental Noise Control Manual, (online) www.epa.nsw.gov.au, accessed 21 August 2015.

EPA, 2013b. Noise Guide for Local Government. Environmental Protection Authority as part of the Department of Environment, Change and Water, Sydney, (online) http://www.epa.nsw.gov.au/resources/noise/nglg07030.pdf, accessed 8 July 2015.

EPA, 2013. Rail Infrastructure Noise Guideline. Environmental Protection Authority, Sydney.

EPA, 2014. EPA Public Registers. Environmental Protection Authority as part of the Department of Environment, Change and Water, Sydney, (online) http://www.epa.nsw.gov.au/publicregister/, accessed 5 June 2015.

ESSS, 2000. Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions. Australian Govenrment Department of the Environment, Canberra.

Eyre, T., Ferguson, D., Hourigan, C., Smith, G., Mathieson, M., Kelly, A., et al., 2012. Terrestrial Vertebrate Fauna Survey Guidelines for Queensland. Brisbane: Queensland Herbarium. Queensland Government Department of Science, Information Technology, Innovation and the Arts.

Geoscience Australia, 2015. MapConnect, (online) www.mapconnect.ga.gov.au, 9 June 2015.

Heritage Office, 1998. Skeletal Remains: Guidelines for the Management of Human Skeletal Remains under the Heritage Act 1977. NSW Heritage Office, Parramatta.

Heritage Office and Department of Urban Affairs and Planning, 1996. NSW Heritage Manual. Heritage Office & Department of Urban Affairs & Planning, Parramatta, (online) http://www.heritage.nsw.gov.au/03_index.htm#M-O, accessed June 2015.

Horton, David., 1994. Encyclopedia of Aboriginal Australia: Aboriginal and Torres Strait Islander History, Society and Culture. edited by D. Horton. Aboriginal Studies Press.

IAQM, 2014. Guidance on the assessment of dust from demolition and construction (February 2014), Institute of Air Quality Management.

ICOMOS, 1999. The Burra Charter. ICOMOS, Burwood, Victoria: Australia, (online) http://australia.icomos.org/wp-content/uploads/BURRA_CHARTER.pdf, accessed June 2015.

ICOMOS, 2011. Guidance on Heritage Impact Assessments for Cultural World Heritage Places. Paris.

ILE, 2005. Guidance Notes for Reduction of Obtrusive Light. The Institution of Lighting Engineers, UK

IPART, 2015. Ethanol supply and demand in NSW: Other Industries – Final Report, available (online) http://www.ipart.nsw.gov.au/Home/Industries/Other/Reviews/Ethanol/Review_of_Ethanol_Supply_and_Demand_in_NSW/23_May_2012_-_Released_Final_Report/Final_Report_-_Ethanol_supply_and_demand_in_NSW_-_March_2012, accessed 7 July 2015.

Keith, D., 2004. Ocean Shores to Desert Dunes: the native vegetation of New South Wales. NSW National Parks and Wildlife Services, Sydney.

Ken & Jenni Bates Pty Ltd 2009; Advanced Soil Mapping, Electromagnetic Survey for Soil Investigation Barham Road Deniliquin, May 2009. ASM, Deniliquin.

Klopfenstein, T.J., G.E. Erickson, and V.R. Bremer. 2008 Board-Invited Review: Use of distillers by-products in the beef cattle feeding industry. *J. Anim. Sci.* 86:1223-1231.

Laity, T., 1998. Department of the Environment, (online), from Directory of Important Wetlands in Australia - Millewa Forest - NSW053, http://www.environment.gov.au/cgi-bin/wetlands/report.pl, accessed June 2015.

Landcom, 2004. Managing Urban Stormwater: Soils and Construction. Landcom, Parramatta.

Long, Andrew., 2003. Scarred Trees: An Identification and Recording Manual. Prepared for Aboriginal Affairs Victoria.

Mavromihalis, J., 2010. National Recovery Plan for the Chariot Wheels Maireana cheelii. Department of Sustainability and Environment, Melbourne.

Melbourne Water (MW), 2005. WSUD Engineering Procedures Stormwater.

Mereweather, J. D., 1859. Diary of a Working Clergyman in Australia and Tasmania, Kept during the Years 1850-53.

Murray-Darling Basin Authority, 2015. Murray-Darling Basin Authority Website, Australian Government, (online) http://www.mdba.gov.au/, accessed 26 May 2015.

Murray-Darling Basin Authority, 2012. Murray-Darling Basin Plan. Australian Government, Canberra.

Neldner, V., Wilson, B., Thompson, E., & Dillewaard, H., 2012. Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland. . Queensland Herbarium, Department of Science, Information Technology, Innovation and the Arts, Brisbane.

NGH Environmental, 2015. Environmental Impact Statement: Proposed Ethanol Plant Deniliquin, South West NSW. Unpublished report for Dongman Greentec Pty Ltd. Wagga Wagga.

NSW Biodiversity Offsets Policy for Major Projects.

NSW Government, 2013. Deniliquin Local Environmental Plan 2013. NSW.

NSW Government, 2015. Six Maps NSW, (online) www.maps.six.nsw.gov.au, accessed 9 June 2015.

NSW Government, 2015. State Environmental Planning Policy (State and Regional Development) 2011.

NSW National Parks and Wildlife Service, 1997. Aboriginal Cultural Heritage Standards and Guidelines Kit. First. NSW National Parks and Wildlife Service, Sydney.

NSW Rural Fire Service, 2006. Planning For Bush Fire Protection. NSW Rural Fire Service with Department of Planning.

OECD-FOA, 2011. OECD-FAO Agricultural outlook 2011-2020, (online) www.agri-outlook.org/48178823.pdf, accessed 7 July 2015.

OEH, 2005a. Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales: Prepared by the NSW EPA, which is part of the Office of Environment and Heritage, Sydney.

OEH, 2005b. NSW Flood Prone Land Policy. Office of Environment and Heritage, Sydney.

OEH, 2015a. BioNet. Department of Environment and Heritage, Sydney. (online) http://www.bionet.nsw.gov.au/, accessed June 2015.

OEH, 2015b. eSPADE NSW Soil and Land Information. Office of Environment and Heritage, Sydney, (online), www.environment.nsw.gov.au, 18 June 2015.

OEH, 2015c. Murray Darling Depression Bioregion – Landform, (online) www.environment.nsw.gov.au, 10 June 2015.

OEH, 2015d. Threatened Species Profiles. Office of Envrionment and Heritage, Sydney, (online) http://www.environment.nsw.gov.au/threatenedspeciesapp/, accessed June 2015.

OEH, 2015h. Vegetation Information System: Classification. Office of Environment and Heritage, Sydney, (online) http://www.environment.nsw.gov.au/research/Visclassification.htm, accessed June 2015.

Protection of the Environment Operations Act 1997.

RDA, 2014a. Murray Regional Plan 2013-2016. Regional Development Australia, (online) http://www.rdamurray.org.au/assets/pdfs/RDA%20Murray%20Regional%20Plan%202013_2016.pdf, accessed 15 August 2015.

RDA, 2014b. Riverina Regional Profile 2014. Regional Development Australia, (online) http://www.rdariverina.org.au/f.ashx/EventsInfo/RDA-Riverina-Regional-Profile-2014.pdf, accessed 7 July 2015.

Rendleman. C and H. Shapuri, 2007. New Technologies in Ethanol Production: USDA Agricultural Economic Report Number 842, (online) www.nass.usda.gov, accessed 12 June 2015.

Richardson, E. I., 2011. Australian groundwater dependent ecosystems toolbox part 1: assessment framework. National Water Commission, Canberra.

RTA, 2002. Guide to Traffic Generating Developments. Roads and Traffic Authority, NSW.

RTA, Various. Road Design Guide. Roads and Traffic Authority, NSW.

Shaw, J., 1953. Land use in the Deniliquin region. *Australian Geographer, 6*(2), 31-37.

Simon, B., & Y. Alfonso, 2011. *AusGrass2*, (online) http://ausgrass2.myspecies.info/, accessed June 2015.

SNARL, 2009-2015. Incidents, (online) http://www.snarl.com.au/rss/suburb/nsw/deniliquin/, accessed 1 August 2015.

Standards Australia, 1990. AS2670 - Evaluation of human exposure to whole-body vibration – Part 2: continuous and shock-induced vibration in buildings (1 to 80 Hz).

Standards Australia, 1997. AS4282 – Control of Obtrusive Effects of Outdoor Lighting.

Standards Australia, 2004a. AS1940 - The storage and handling of flammable and combustible liquids, Standards Association of Australia, Sydney.

Standards Australia, 2004b. AS60079.10 - Electrical Apparatus for Explosive Gas Atmospheres – Classification of Hazardous Areas, Standards Association of Australia, Sydney.

Standards Australia, 2005. AS2419.1 - Fire Hydrant Installations Part 1: System Design, Installation and Commissioning, Standards Association of Australia, Sydney.

Standards Australia, 2008. AS/NZS 1546.1- On-Site Domestic Wastewater Treatment Units, Standards Association of Australia, Sydney.

State Environmental Planning Policy (Rural Lands) 2008

State Environmental Planning Policy (State and Regional Development) 2011.

State Environmental Planning Policy No.33 – Hazardous and Offensive Development.

State Environmental Planning Policy No. 44 – Koala habitat Protection.

State Environmental Planning Policy No. 55 – Remediation of Land.

Sydney Metropolitan Catchment Management Authority (CMA), 2010. Draft NSW MUSIC Modelling Guidelines.

State of Nebraska (2004) "Prevention of Significant Deterioration (PSD) construction permit for Abengoa Bioenergy Corporation Ethanol Manufacturing Facility at 1414 Road O, York, York County, Nebraska"

The Bohemian. 1882. Settlement and the Aboriginals. The Pastoral Times, October 14.

The Landscape Institute and the Institute of Environmental Management and Assessment, UK. 2002. Guidelines for Landscape and Visual Impact Assessment, Second Edition.

Todd, J., 2000. Recovery Plan for twelve threatened spider-orchid Caladenia taxa (Orchidaceae: Caladeniinae) of Victoria and South Australia 2000 - 2004. Department of Environment and Heritage, South Austrlia.

TSSC, 2006. White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland Listing and Conservation Advice. Department of Sustainability, Environment, Water, Population and Communities, Canberra.

TSSC, 2008a. Approved Conservation Advice on *Austrostipa metatoris*. Department of the Environment, Canberra

TSSC, 2008b. Approved Conservation Advice for *Brachyscome papillosa (*Mossgiel Daisy). Department of the Environment, Canberra

TSSC, 2008c. Aproved Conservation Advice for *Swainsona marrayana* (Slender Darling Pea). Department of the Environment, Canberra.

TSSC, 2008d. Weeping Myall Woodlands Listing Advice. Department of the Environment, Canberra.

TSSC, 2010. Grey Box *(Eucalyptus microcarpa)* Grassy Woodlands and Derived Native Grassland of south-eastern Australia. Department of the Environment, Canberra.

TSSC, 2012a. Natural Grasslands of the Murray Valley Plains Listing Advice. Department of the Environment, Canberra.

TSSC, 2012b. Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland *Plains.* Department of the Environment, Canberra.

TSSC, 2014. Approved conservation advice for *Austrostipa wakoolica.* Department of the Environment, Canberra.

United States Environmental Protection Agency (USEPA) (1995). General Information on Clean Air Technology Center Products, Section 6, Chapter 1 Baghouses and Filters.

United States Environmental Protection Agency (USEPA) (1998). AP-42, Compilation of Air Pollutant Emission Factors, Fifth Edition, Volume I, Chapter 1.4:Natural Gas Combustion.

US Grains Council, 2015. A Guide to Distiller's Dried Grains with Solubles (DDGS) Third Edition, (online) http://www.ethanolrfa.org/page/-/rfa-association-site/studies/2012_DDGS_Handbook.pdf?nocdn=1, accessed 7 July 2015.

VicRoads, 2006. GHG Calculator Spreadsheet; references Australian Greenhouse Office Factors and Methods Workbook.

Vicsig, 2015. Deniliquin Line, (online) http://vicsig.net/infrastructure/line/Deniliquin, accessed 1 August 2015.

Water by Design (WD), 2010. MUSIC Modelling Guidelines. SEQ Healthy Waterways Partnership, Brisbane Queensland, ISBN 978-0-9806278-4-8.

Walsh, G. P., 2015. Boyd, Benjamin (Ben) (1801–1851). Australian Dictionary of Biography

Water Management Act 2000.

Wellings, H., 1951. Benjamin Boyd in Australia. Sydney: Ford, D.S.

Whitehouse, J., 2009. Mineral systems of the Murray Basin, New South Wales. Quarterly Notes, Geological Survey of New South Wales.

Whitehouse, J., Roy, P.S., and G. Oakes, 1999. Mineral sand resource potential of the Murray Basin, New South Wales. Report GS1999/038, Geological Survey of New South Wales.

WHO, 1999. Guidelines for Community Noise. World Health Organisation, Switzerland.

WHO, 2009. Night Noise Guidelines for Europe. World Health Organisation, Switzerland.

Wilson, A.D. 1990. The effect of grazing on Australian ecosystems. Proceedings of the Ecological Society of Australia 16: 235-244.

WMA Water, 2014. Edward River at Deniliquin Flood Study – Final Draft for Public Exhibition, August 2014, WMA Water, 2014.

Woods, J., Brown, G and A. Estrin, 2005. Bioethanol Greenhouse Gas Calculator User's Guide. Biomass Energy Group, Centre for Environmental Policy. London, UK.