

3 Project area agricultural resources and enterprises

The AIS guidelines require identification of the agricultural resources and enterprises in the project area. This chapter presents land characteristics, hydrology, land and soil capability, vegetation, soil type, groundwater resources and current land use/enterprises of the project area.

3.1 Slope and land characteristics

3.1.1 Topography and slope

The project area is situated on the elevated, relatively flat Woronora-Nattai Plateau of the Southern Highlands, approximately 100 km south-west of Sydney and 4.5 km west of Moss Vale town centre. Elevations typically range from approximately 550 to 735 metres (m) above Australian Height Datum (AHD). Most of the central and eastern parts of the project area have very low rolling hills with occasional elevated ridge lines. There are steeper slopes and deep gorges in the west of the project area, in Belanglo State Forest, associated with steeply incised valleys, gorges and drainage lines. Figure 3.1 shows the topography of the project area.

A digital elevation model (DEM) was developed to detail the slope categories across the project area. The topography of the project area and surrounds is diverse with slopes varying from 2 to > 50%. The DEM was split into two categories; slopes greater than (>) and less than (<) 10%.

Figure 3.2 shows that the majority of the project area has slopes of 10% or less. There are steeper slopes above 10%, associated with the deeply incised drainage lines in the west of the project area and the elevated ridge lines through the central and eastern parts of the project area.

3.1.2 Surface hydrology

The drainage lines within the project area (shown in Figure 3.1) generally drain in a north to north-westerly direction and flow into the Wingecarribee River. The Wingecarribee River catchment forms part of the broader Warragamba Drinking Water Dam and Hawkesbury-Nepean catchments.

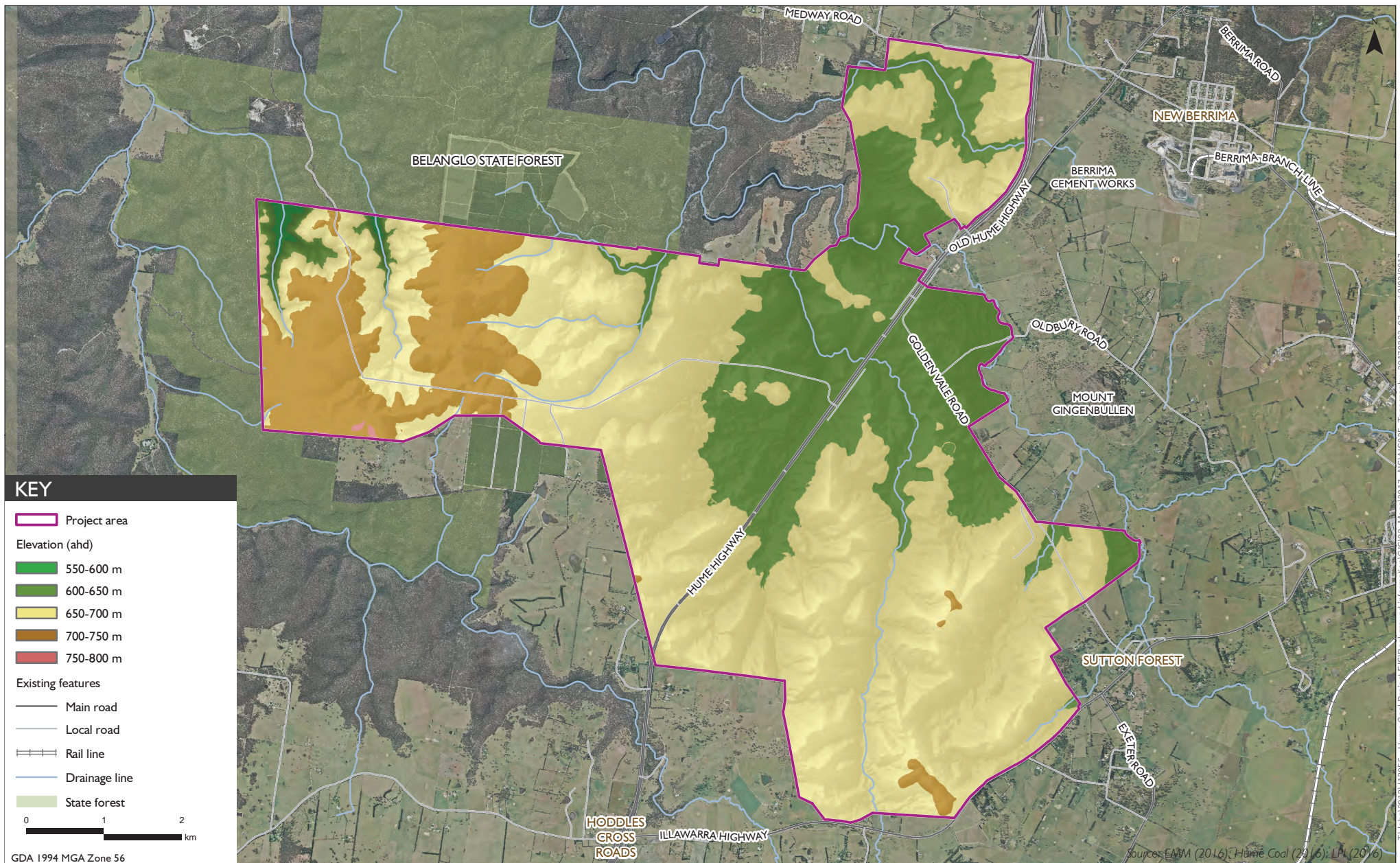
Local sub-catchments of the Wingecarribee River catchment within the project area ultimately discharge into the Wingecarribee River, at least 5 km downstream from the project area. These include:

- Medway Rivulet catchment, incorporating the Oldbury Creek sub-catchment, where a majority of the project area and the surface infrastructure is located; and
- Black Bobs Creek catchment, incorporating Redarm Creek and Longacre Creek catchments.

Medway Rivulet is the predominant drainage line in the project area. Near the project surface infrastructure area, Medway Rivulet is confined by steep gullies. Downstream of the project area, Medway Rivulet has been dammed to create a 1,350 ML reservoir, Medway Dam. The reservoir is part of Wingecarribee Shire Council's water supply system.

Oldbury Creek commences near New Berrima and joins the Medway Rivulet 1.5 km downstream from the reservoir. Similarly to the Medway Rivulet, the creek is characterised by several in-stream storages that impede continuous flow within the upper catchment. A large agricultural in-stream storage dam is located adjacent to the proposed CPP area.

Full details of the surface water in the project area are described in Chapter 5 of the *Water Assessment* (EMM 2017d) which forms Appendix E of the Hume Coal Project EIS.

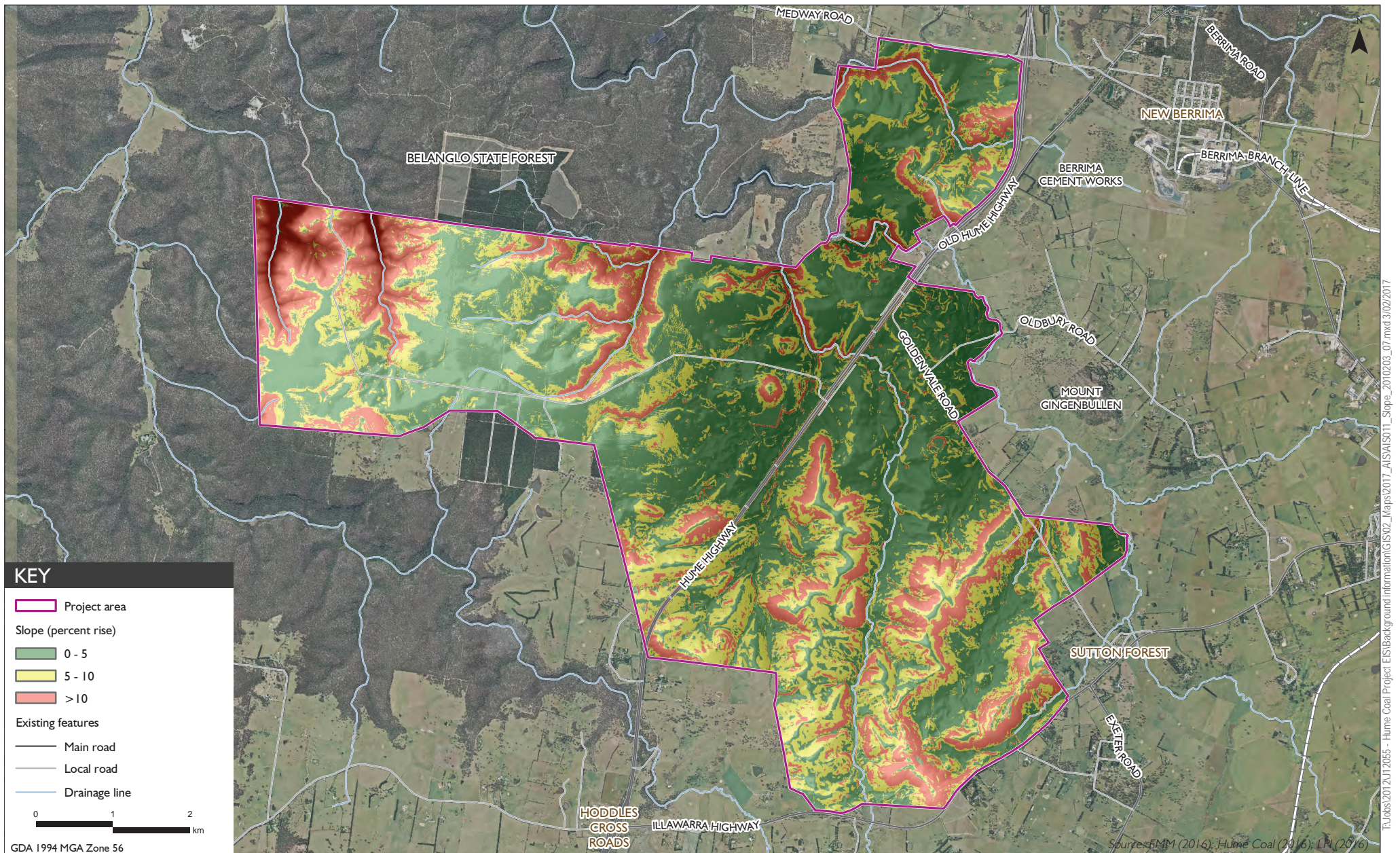


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Topography of the project area

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Figure 3.1



Slope map of the project area

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Figure 3.2

3.1.3 Soil and land resources

i Soil landscapes

The *Soil and Land resources of the Hawkesbury-Nepean Catchment Map* (1:100,000) identifies fourteen soil landscapes within the project area (DECC 2008). The most extensive landscapes in the project area are the Soapy Flat landscape (26% of area), rises and low hills on Hawkesbury Sandstone; and the Moss Vale landscape (24% of area), rises on Wianamatta Group Shale (Table 3.1). The other significant soil landscapes include Lower Mittagong, Kangaloon, and Nattai Tablelands. The soil landscapes are described in Table 3.2 and shown in Figure 3.3. The soil landscapes are classified and grouped based on geological origin and similarity in local relief and slopes. Therefore, each landscape may include a range of soil types.

Table 3.1 Soil landscapes and extent in the project area

| Geological Origin | Soil landscape | Approx. area (ha) | Percentage of total (%) |
|---------------------------------------|-------------------------------|-------------------|-------------------------|
| Hawkesbury Sandstone | Hawkesbury | 140.3 | 2.8 |
| | Soapy Flat | 1317 | 26.1 |
| | Soapy Flat variant A | 87.6 | 1.7 |
| | Nattai Tablelands | 318.4 | 6.3 |
| | Nattai Tablelands variant A | 41.6 | 0.8 |
| Laterite and Ordovician Metasediments | Larkin | 302.4 | 6.0 |
| Quaternary Alluvium | Wingecarribee River | 21.9 | 0.43 |
| | Wingecarribee River variant A | 17.3 | 0.34 |
| | Wollondilly River | 1.2 | 0.02 |
| Tertiary Basalt | Kinnoul Hill | 18 | 0.36 |
| | Avoca | 52.5 | 1.05 |
| Wianamatta Group Shale | Kangaloon | 591.6 | 11.7 |
| | Lower Mittagong | 919.6 | 18.2 |
| | Moss Vale | 1,221.6 | 24.2 |
| Total | | 5,051 | 100% |

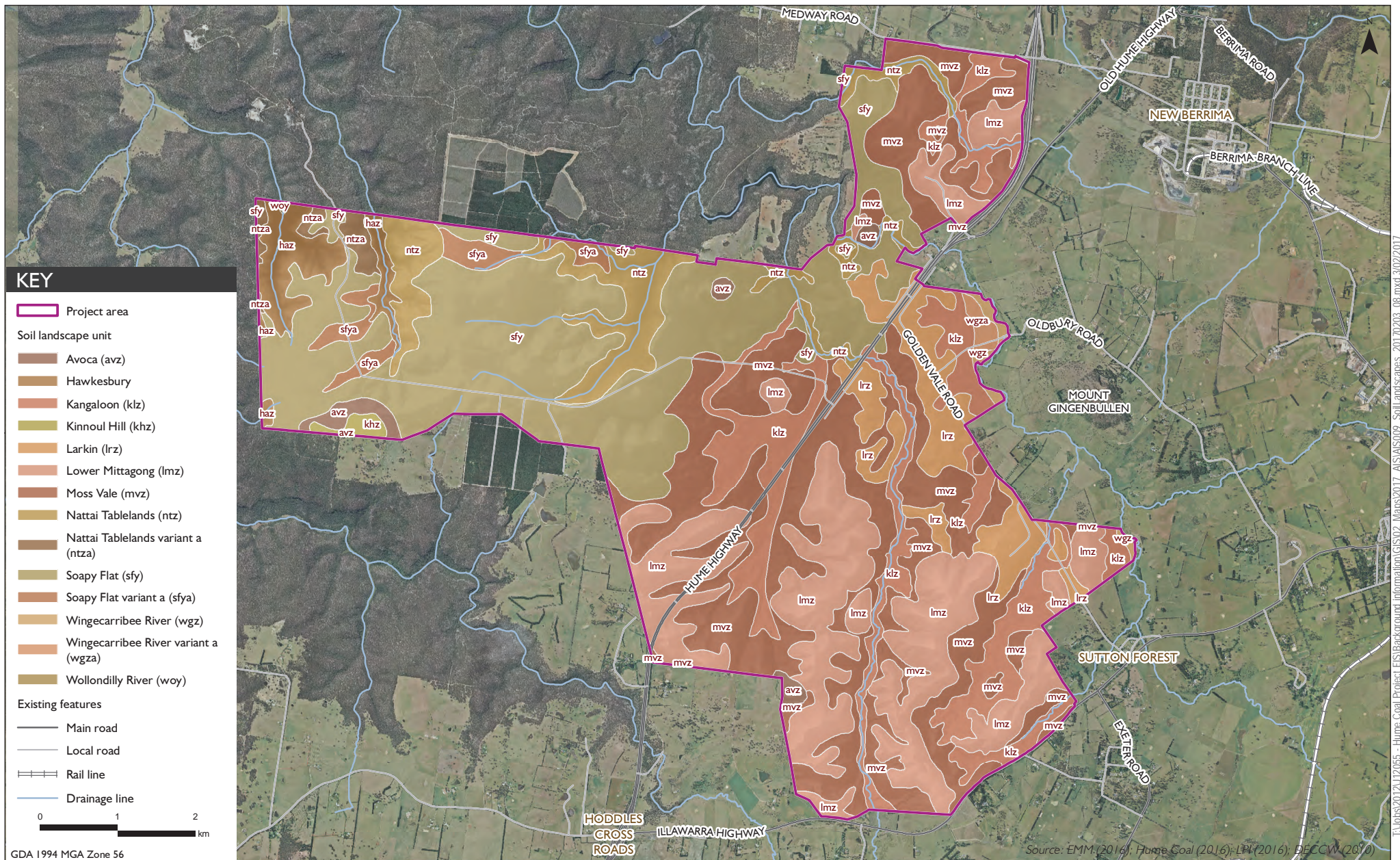
Table 3.2 Description of the soil landscapes in the project area

| Description | General landscape | Land use | Soils and vegetation | Erosion |
|------------------------|--|--|---|---|
| Avoca | Rises and low hills on Tertiary Basalt (basalt). Local relief 10-90 m; altitude 519-1041 m; slopes 3-20%; rock outcrop <2%. | Beef production on improved pastures occurs along with some olive and grape enterprises. | Gravelly Brown and Red Ferrosols and occasional Red Ferrosol. Most of this landscape has been extensively cleared and improved pasture varieties have been sown. Small areas of woodland still remain. | Sheet erosion is common in cultivated paddocks. Localised steeper slopes are prone to mass movement. |
| Hawkesbury | Scarps and benches within hills on Hawkesbury Sandstone. Local relief 40-200m; altitude 1-1016m; slopes 20-70%; rock outcrop >50%. | Belanglo State Forest. | Leptic and Orthic Tenosols and Rudeosols, Yellow Kandosols, and Kurosols. | Severe sheet erosion during storms and after bushfires. |
| Kangaloon | Foot slopes within plain on Wiamatta Group Shale. Local relief 0-9m; altitude 531-745m; slopes 1-3%; rock outcrop nil. | Grazing. | Brown Kurosols and Hydrosols. Extensively cleared open grassland. | Waterlogging as a result of tree clearing. |
| Kinnoul Hill | Hills on Tertiary Basalt (basalt). Local relief 30-100 m; altitude 489-1123 m; slopes 20-50%; rock outcrop nil. | Improved pastures used for grazing. | Rudosols and Red Ferrosols. Most of this landscape has been cleared for cattle grazing. | Clearing of many steep slopes has resulted in a large amount of soil loss. Localised landslips occur. |
| Lower Mittagong | Rises and low hills on Wianamatta Group Shale (shale). Local relief 5-90 m; altitude 534-820 m; slopes 0-25%; rock outcrop nil. | Beef cattle grazing, rural residential development, olive and vineyard development, plus urban development around Mittagong and Moss Vale. | Brown Kurosols, Red Kurosols, Brown Dermosols and Red and Brown Kandosols, with Yellow Natric Kurosols in drainage lines. Generally Mittagong Sandstone Woodland community. | Minor to moderate gully erosion occurs in cleared drainage plains. Minor sheet erosion is common. |
| Larkin | Plain and rises on laterite, shale and sandstone-quartz. Local relief 0-10 m; altitude 576-1012 m; slopes 2-6%; rock outcrop nil. | Cattle grazing plus some minor areas of sheep grazing. | Red Ferrosols and Red Kurosols on shales with Red Kandosols and Ferrosols on sandstones. Due to the moderate fertility of these soils most areas of the original open forest have been cleared for grazing. | Moderate sheet erosion in overgrazed paddocks. |
| Moss Vale | Rises on Wianamatta Group Shale (shale). Local relief 5-30 m; altitude 544-740 m; slopes 0-5%; rock outcrop nil. | Beef cattle grazing and rural residential development. | Yellow Kurosols, Red Kurosols, Brown Kurosols and Yellow Kandosols. Mostly cleared pasture with isolated paddock trees. | Minor to moderate gully erosion occurs in cleared drainage plains. |

Table 3.2 Description of the soil landscapes in the project area

| Description | General landscape | Land use | Soils and vegetation | Erosion |
|--------------------------------------|---|---|--|---|
| Nattai Tablelands | Rises and low hills on Hawkesbury Sandstone. Local relief 10-90m; altitude 87-793m; slopes 2-25%; rock outcrop 10-20%. | Predominantly uncleared native vegetation due to steep slopes and remote location. | Yellow Kandosols, Orthic Tenosols, Rudosols, Yellow Kurosols and Chromosols on shales. Soils are discontinuous, with sandstone benches and small scarps outcropping. | Minor to moderate sheet erosion is common where shrub/understorey has been cleared. |
| Nattai Tablelands variant A | Plateau on Hawkesbury Sandstone. Local relief 10-90m; altitude 412-782m; slopes 2-25%; rock outcrop >50%. | Predominantly native bushland and scrub. | Discontinuous Leptic Tenosols (Earthy Sands) interspersed with significant rock outcrop. Uncleared woodland to open-forest communities. | Minor to moderate sheet erosion is common where shrub/understorey has been cleared. |
| Soapy Flat | Rises and low hills on Hawkesbury Sandstone. Local relief 10-30 m; altitude 477-796 m; slopes 2-10%; rock outcrop <2%. | Crown reserve, including Soapy Flat reserve. | Brown Dermosols, Yellow Kurosols and Chromosols, Orthic Tenosols on ridges and Hydrosols (Acid Peats) in swamps. | Minor sheet erosion occurs where ground cover is cleared. |
| Soapy Flat variant A | Footslopes within rises on Hawkesbury Sandstone. Local relief 10-30 m; altitude 490-716 m; slopes 2-10%; rock outcrop <2%. | Crown reserve, including Soapy Flat reserve as well as pine forestry operations in Belanglo State Forest. | Orthic Tenosols (Deep Earthy Sands). Extensively cleared woodland. | Minor sheet erosion occurs where ground cover is cleared. |
| Wingecarribee River | Plains and stream channels within flood plain on Quaternary Alluvium. Local relief 0-5 m; altitude 629-688 m; slopes 0-1%; rock outcrop nil. | Extensively cleared open woodland, grassland and water communities. Area predominantly used for grazing. | Dermosols (Chocolate Soils and Wiesenbodens). | Localised erosion of stream banks and faecal contamination of waters due to stock. |
| Wingecarribee River variant A | Plains and levees within terrace and flood plain on Quaternary Alluvium. Local relief 0-5 m; altitude 630-667 m; slopes 0-1%; rock outcrop nil. | Extensively cleared open woodland, grassland and water communities. Area predominantly used for grazing. | Hydrosols (Gleyed Podzolic Soils). | Occasional erosion of banks and unformed roads and tracks. |
| Wollondilly River | Alluvial plain and terrace on Quaternary Alluvium. Local relief 0-15m; altitude 110-720m; slopes 1-6%; rock outcrop nil. | Belanglo State Forest. | Rudosols, Brown Dermosols, Yellow Kandosols, Brown Chromosols. Riparian woodland. | Minor sheet and streambank erosion. Common gully along drainage lines. |

Notes: 1. Source: Soil and Land Resources of the Hawkesbury-Nepean Catchment.



Soil landscapes of the project area (OEH mapping)

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Figure 3.3

ii Agricultural land suitability

As described in Section 2.3.2ii, the five class system used by NSW Agriculture classifies land in terms of its suitability for general agricultural use. The 1:50,000 scale *Agricultural Land Classification Map - Moss Vale* (Dept of Agriculture 1986), maps most of the project area as Land Class 3, with smaller areas of Class 4 and 5 (see Table 2.2 for description of categories).

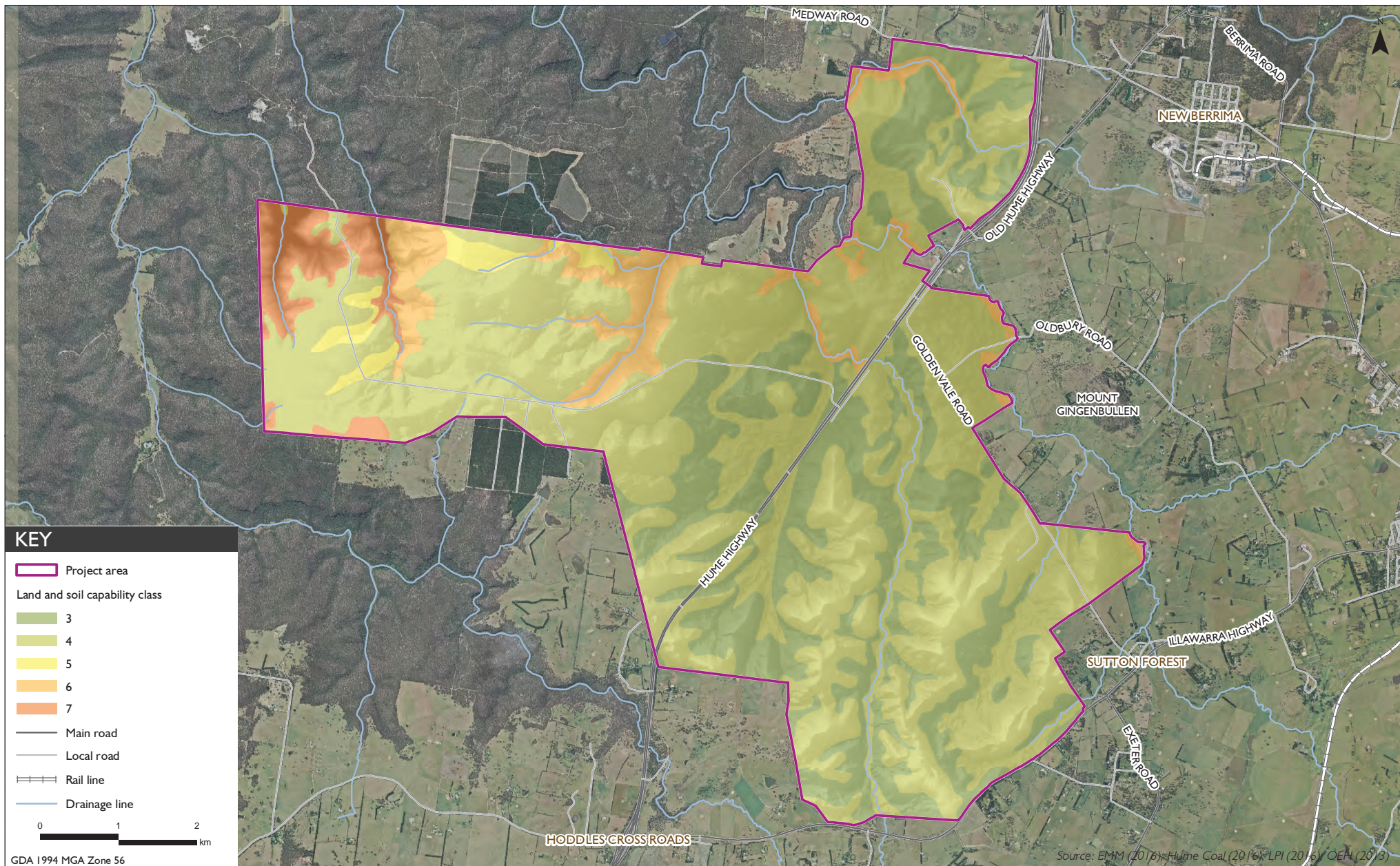
The area of land to have surface disturbance (within the project area) is mostly allocated to Class 3. (Grazing land or land well suited to pasture improvement. It may be cropped in rotation with sown pasture). It should be noted that the maps available were only available as a scanned and printed map which was not suitable for accurate estimation for number of hectares for each class. The assessment of LSC provides more useful information, and has been used instead for the area estimates of before and after the project's development (see Section 3.4 and 4.3.4).

iii LSC classes

The project area is mapped by the *Land and Soil Capability Mapping of NSW* (OEH 2015b) as predominately Class 4 – Moderate capability and Class 3 – High capability, with small areas of Class 6 – Low capability and Class 7 – Very low capability (Table 3.3 and Figure 3.4). The LSC classes in the project area are matched with the relevant soil landscapes. This mapping is not intended to be used for detailed assessment at the property scale which would require more intensive field investigation. A local scale assessment of LSC has been conducted using the soil survey and is presented in Section 3.4.

Table 3.3 Regional LSC classes in the project area

| LSC Class | Soil landscapes | Description | Area (Ha) | % |
|-----------|--|--|-----------|------|
| 3 | Moss Vale | High capability land: Land has moderate limitations and is capable of sustaining high-impact land uses, such as cropping with cultivation. However, careful management of limitations is required for cropping and intensive grazing to avoid land and environmental degradation. | 1,221.6 | 24 |
| 4 | Kangaloon, Larkin, Lower Mittagong, Soapy Flat, Avoca Wingecarribee River varA | Moderate capability land: Moderate to high limitations for high-impact land uses. It will restrict land management options for regular high-impact land uses such as cropping, high-intensity grazing and horticulture; and the limitations can only be managed by specialised management practices with a high level of knowledge, expertise, inputs, investment and technology. | 3,200.4 | 63 |
| 5 | Wollondilly River, Soapy Flat var A | Moderate-low capability land: High limitations for high-impact land uses. Will largely restrict land use to grazing, some horticulture (orchards), forestry and nature conservation. The limitations need to be carefully managed to prevent long-term degradation. | 88.8 | 2 |
| 6 | Nattai Tablelands; Wingecarribee River | Low capability land: Very high limitations for high-impact land uses and is generally suitable for limited land uses such as grazing, forestry and nature conservation. Careful management of limitations is required to prevent severe land and environmental degradation. | 340.3 | 7 |
| 7 | Hawkesbury, Nattai Tablelands var. A, Kinnoul Hill | Very low capability land: Severe limitations that restrict most land uses and generally cannot be overcome. Generally suitable only for selective forestry and nature conservation. | 199.9 | 4 |
| Total | | | 5,051 | 100% |



Soil and land capability (OEH mapping)

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Figure 3.4

3.2 Vegetation

The majority of the project area comprises cleared land dominated by exotic grasses and herbs. A total of 90 introduced plant species were recorded in the project area, comprising 20% of all plant species recorded. To the west, the Belanglo State Forest has mainly been used as a pine plantation containing Radiata Pine (*Pinus radiata*) and Maritime Pine (*P. pinaster*).

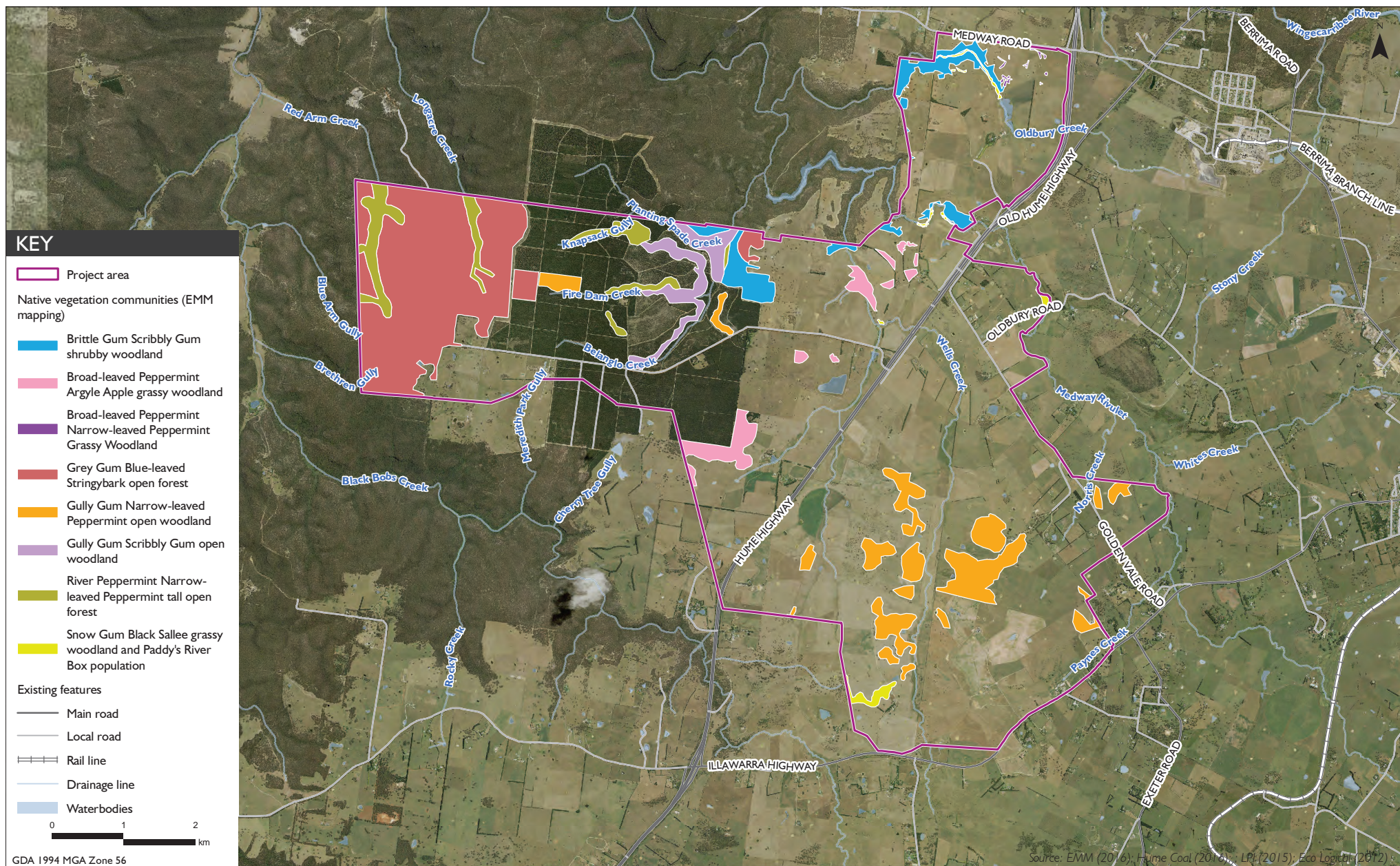
Remnant native vegetation is mainly restricted to the parts of Belanglo State Forest where steep and rocky terrain has made it inaccessible for machinery. This has left most of the scarps and cliff lines protected from historic clearing. Some remnant vegetation occurs in the central northern area, associated with creeks, and there are isolated paddock trees in places. There are also scattered patches of poorer condition native vegetation in agricultural areas in the centre of the project area, generally comprising isolated stands of native trees with an exotic groundcover. Remnant native vegetation covers approximately 1,800 ha (or 20%) of the project area.

Weeds are prevalent in the eastern part of the study area that is cleared, particularly exotic grasses. Some Weeds of National Significance including Blackberry (*Rubus fruticosus* spp. agg), Fireweed (*Senecio madagascariensis*), Serrated Tussock (*Nassella trichotoma*) and Willows (*Salix* spp.) occur in this area. Significant infestations of an invasive weed, Gorse (*Ulex europaeus*), are present in the central southern and central northern parts of the study area.

Eight native vegetation communities have been recorded in the project area (EMM 2017c), generally comprising eucalypt forests and woodlands (Figure 3.5), as follows:

- wet sclerophyll forest:
 - River Peppermint (*E. elata*) Narrow-leaved Peppermint (*E. radiata*) tall open forest;
- dry sclerophyll forests/woodlands:
 - Grey Gum (*E. punctata*) Blue-leaved Stringybark (*E. agglomerata*) open forest;
 - Brittle Gum (*E. mannifera* subsp. *gullickii*) Scribbly Gum shrubby woodland; and
 - Gully Gum (*E. smithii*) Scribbly Gum open woodland.
- grassy woodlands:
 - Gully Gum Narrow-leaved Peppermint open woodland;
 - Broad-leaved Peppermint (*E. dives*) Argyle Apple (*E. cinerea*) grassy woodland;
 - Broad-leaved Peppermint Narrow-leaved Peppermint grassy woodland; and
 - Snow Gum (*E. pauciflora*) Black Sallee (*E. stellulata*) grassy woodland.

Of the 353 native plant species recorded in the project area by the current study, one species, Paddy's River Box (*Eucalyptus macarthurii*), is listed as endangered under the NSW *Threatened Species Conservation Act 1995*.



Vegetation of project area (EMM mapping)

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Figure 3.5

3.3 Soil information

The following soil information is reported from the EMM (2015) *Hume Coal Project - Biophysical Strategic Agricultural Land Verification Assessment*. The soil survey was completed at a 1:25,000 scale with the soil survey considering the soil profile to a maximum depth of 0.75 m, as required by the *Interim protocol for site verification and mapping of biophysical strategic agricultural land* (NSWDPE, 2013).

3.3.1 Summary of soil units identified in site assessment

The soil survey identified five major soil types within the project area (Table 3.4). The soil types identified were: Kandosols, Dermosols, Rudosols, Hydrosols, Tenosols. Figure 3.6 presents the spatial distribution of the soil types within the project area.

Yellow Kandosols are the dominant soil type of the project area (61%). A general description of the soil order is presented in Sections i to v. A full description of the soil type in the project area, including tables showing soil chemistry data, is presented in Sections 3.3.2 to 3.3.6.

Table 3.4 Soil types in the project area

| ASC order (Soil type) | Total area mapped within project area | |
|-----------------------|---------------------------------------|-----|
| | (ha) | (%) |
| Kandosol | 3,076 | 61 |
| Rudosol | 852 | 17 |
| Tenosol | 714 | 14 |
| Hydrosol | 245 | 5 |
| Dermosol | 164 | 3 |
| TOTAL | 5,051 | 100 |

i Kandosols

Kandosols are soils which lack strong texture contrast, have massive or only weakly structured B horizons, and are not calcareous throughout. The B2 horizon is generally well developed and has a maximum clay content in some part of the B2 horizon which exceeds 15%. In the project area Kandosols are associated with predominantly cleared, gently undulating grazing lands. The Kandosol described in the project area is further classified as Dystrophic Yellow Kandosol and is described in detail in Section 3.3.2.

ii Rudosols

Rudosols are usually young soils in the sense that soil forming factors have had little time to pedologically modify parent rocks or sediments. These are soils with negligible (rudimentary) pedologic organisation apart from a minimal development of an A1 horizon or possibly the presence of less than 10% of B horizon material, usually in fissures in the parent rock or saprolite. There are generally no pedological colour changes apart from the darkening of an A1 horizon. The Rudosol described in the project area is further classified as Lithic Leptic Rudosol and is described in detail in Section 3.3.3.