5. Land Systems and Environmental Effects

This chapter describes the existing environment that will be potentially impacted by the proposed transmission line. Detailed impact assessments and mitigation strategies are also described.

5.1 Topography, Geology and Soils

5.1.1 Topography

The proposed transmission line from Wellington traverses flat to gently undulating land until south west of Goolma, where it becomes hilly to steep along the Uamby Creek and Mollys Creek. The terrain is again flat to gently undulating until it reaches just east of Beryl, where the proposed transmission line will skirt around the "Blue Biddy Mountain". As shown on **Figure 4** of Volume 3, the transmission line will be sited on flat to gently sloping land for the remainder of its length, despite passing through hilly areas around Ulan, and passes by steep cliffs along the Wilpinjong Creek adjacent to the southern boundary of the Goulburn River National Park.

The local topography of the northern corridor was taken into consideration when selecting the proposed transmission line route to avoid steep and rugged terrain for both environmental and technical considerations.

5.1.2 Regional Geology

Geological information of the region was obtained from the Dubbo 1:250 000 Soil Landscape sheet published by the Department of Land and Water Conservation. The soil landscape concept allows the integration of geological, topographic and soil information in one unit so that an area can be viewed in terms of limitations to development or agriculture.

There are distinct geologies along the route of the proposed 330 kV Wollar to Wellington transmission line, as shown in **Figure 5** (Refer to Volume 3).

The eastern most section of the line near Wollar is located on the western edge of the Sydney Basin, the geology consisting of marine and freshwater sediments containing large volumes of sandy material. The strata include quartz and lithic sandstones, conglomerates, shales and siltstones with some coal. The transmission line is located in the undulating footslopes and valley floors of the undulating plateau with cliff margins.

There are two main sections of the line that cross large areas of siliceous granites – the Gulgong Granite, between the section to the north of Gulgong and the Sydney Basin and the Wuuluman Granite, north east of Wellington. These rocks are acidic and have high sodium levels. The terrain is variable, ranging from steep to undulating low rises. The maximum elevation is some 650 m in the vicinity of Gulgong.

The remaining portion of the line between Gulgong and the road to Spicers Creek crosses the Hill End Trough. This is a complex physiographic area including large areas of marine sediments and smaller areas of acid volcanics. The main rock types are sedimentary including slates, siltstones, greywacke and conglomerates. The terrain is characterised by a mixture of steep rolling hills and undulating low hills. The low hills occur at elevations of up to 1,000 m and form an undulating plateau with deeply dissected margins.

The geology along the transmission line route is summarised in Table 5.1.

Table 5.1 – Geological Units Along the Proposed Transmission Line

Unit	Structural Setting	Geological Groups	Characteristic Rock Types
1 (Wollar)	Gunnedah Basin	Permian/Triassic: - Illawarra Coal Measures - Narrabeen Group - Shoalhaven Group	Sandstone, shales, conglomerates, siltstones, chert, mudstones and coal.
2	Lachlan Fold Belt	Carboniferous: - Ulan Granite	Granite, ademellite and granodiorite.
3	Lachlan Fold Belt	Silurian/Devonian/Ordovician/Permian : - Tucklan Formation - Dunnedoo Formation - Biraganbil Formation - Piambong Formation - Turondale Formation	Quartz rich greywacke, slates, siltstones, sandstones, basalts, schists.
4	Lachlan Fold Belt	Carboniferous: - Wuuluman Granite	Monzodiorite
5 (Welling-ton)	Lachlan Fold Belt	Silurian/Devonian: - Mumbil Formation - Gleneski Formation - Cuga Burga Volcanics Minor Ordovician: - Oakdale Formation	Volcanics, tuffaceous sandstone, siltstone, limestone.

Source: Parsons Brinckerhoff – Geotechnical investigation Wollar-Wellington 330kV Transmission Line, 2004

5.1.3 Soils

The Dubbo 1:250 000 Soil Landscape sheet published by the Department of Land and Water Conservation was used to provide a general description of the soil units present along the proposed transmission line, as described in the following sections and shown on **Figure 5** of Volume 3.

The soil distribution observed in the area is predominantly a result of the geomorphology, geology and geological structures. Clear relationships exist between the lithology and structure of the underlying bedrock, slope form and process, and the characteristics of the soil materials.

Soil distribution in the region is largely based on the geology of the bedrock materials. There are no extensive areas of Quaternary alluvium or Aeolian materials, however the colluvial materials from bedrock materials can extend away from the bedrock areas. Each of the soil types is described briefly in the following sections.

Section 1 - Sydney Basin Soils (Wollar to Ulan)

The eastern section of the transmission line will be constructed on sediments on the northwestern edge of the Sydney Basin. These soils are found between Wollar and Ulan.

Weathering of the sedimentary rocks of the Sydney Basin yields soils of low to very low fertility. Surface soils tend to be coarse in texture and may be loose sand or more rarely, massive and hardsetting. Subsoils range from sandy loams to more clayey soils. Sandy colluvial materials make a major contribution to the surface soils in the valley areas such as those through which the line crosses.

The majority of these soils are yellow podzolics, found in the valleys within which the transmission line is located. Within this eastern section of the line, some very small sections of the transmission line are also located on shallow soils.

Yellow and Red Podzolics - Podzolic soils dominate the eastern 34 km of the transmission line, being formed on the sedimentary materials of the Sydney Basin. Red podzolics are found higher up the landscape on sideslopes and hill crests while yellow podzolics are found in lower slopes and flats that are not as well drained.

The podzolic soils occur on intermediate parent materials in areas of moderate leaching and are associated with areas that are less than well drained, ie. the valleys in the area. Parent materials include shale, andesite, sandstone, granite, conglomerate and alluvium. These soils are not as leached as the some Podzolic Soils and so have neutral to alkaline reaction trends. Isolated areas of salting may occur.

Surface soils are mainly hardsetting, the textures being sandy loam to clay loam with a weak structure. A_2 horizons are common. There is a clear boundary to a yellowish or reddish brown sandy clay to heavy clay, with moderate to strong blocky or prismatic structure. Lower subsoils may be mottled yellowish-grey in the less well drained areas.

These soils have moderate to low fertility and are often used for improved pasture and cropping although the specific land use depends on the fertility of the soils in the better drained mid-slopes.

The soil landscapes found along the proposed transmission line route that are dominated by red and yellow podzolic soils, interspersed with sandstone benches include:

- Barigan Creek Soil Landscape - located at the Wollar end of the transmission line from the end of the transmission line to the Sandy Hollow-Maryvale Railway

- Ulan Soil Landscape – located from the area where the transmission line crosses the Sandy Hollow-Maryvale Railway to the edge of the Ulan Colliery holdings, just to the west of the Ulan village.

They have a moderate to high erosion hazard under cropping, particularly if they are in a cultivated state or the surface cover is low. The Ulan soils may be susceptible to tunnelling in many drainage lines and depressions as these subsoils are dispersible.

Shallow Soils - Where the transmission line crosses steeper country in the vicinity of Wollar and Ulan areas of shallow soils dominate, with minor areas of yellow earths, yellow podzolics and yellow solidic soils occurring. This occurs about 1 km to the south of Wollar Road and just to the west of Ulan.

Shallow soils occur on steep slopes in excess of 20%, and are usually less than 50 cm deep. They are very stony and patchy in distribution due to the outcrop of rocks. They include soils with no subsoil development and shallow versions of other Great Soil Groups. Rock outcrop is common and the soils are often very stony. They are used mainly for unimproved pastures on cleared land or left as uncleared native bushland. The shallow soils may have sandy, loamy or rarely clayey textures.

Soil Landscapes found in the vicinity of the Wollar and Ulan areas of the transmission line route include:

- Lees Pinch Soil Landscape – located south of Wollar Road.
- Dexter Soil Landscape – found immediately to the west of Ulan on the steeper country that has generally not been cleared.

These soils have erosion hazards that are moderate to very high. In the Ulan area, subsoils on the lower slopes may be dispersible and very susceptible to gully erosion. Sheet and gully erosion are noted in these areas.

Section 2 - Granite Soils (Ulan to Castlereagh Highway)

Sections of the transmission line between an area about 3 km west of Ulan and the Castlereagh Highway soils are formed on granitic parent materials.

The siliceous granites in the vicinity of Gulgong weather to form coarse sands and kaolinitic clays which develop soils of low to very low fertility that are often high in sodium. Severe gully erosion and areas of salinity are common in these areas. The major soils are siliceous sands with small areas of yellow podzolic and solodic soils being found in isolated areas.

Siliceous Sands - Siliceous Sands occur on the acidic parent material including granites, rhyolites, coarse-grained sandstones and on colluvium-alluvium derived from sandstone or granite. There are often granitic tors and sandstone outcrops present in the landscape, and may often be found in association on the sandstones but are usually hardsetting on the granites. The topsoil has a loamy sand to light sandy clay loam texture and is apedal. Subsoils are similar but may show some colour development depending on the rock type and slope position.

The soils are well drained with a low waterholding capacity. Soil reaction trends are neutral to acidic. Topsoils are often acidic and may require treatment with lime prior to development. Land is frequently undeveloped but native pastures may be grazed with some fertiliser input.

Soil landscapes that dominate the section of transmission line between 3 km west of Ulan and the Castlereagh Highway just west of Gulgong are the:

- Rouse Soil Landscape – found north east of Gulgong near Ulan; and
- Home Rule Soil Landscape – located to the east and north of Gulgong.

Section 3 - Hill End Trough Soils (Castlereagh Highway to Spicers Creek Road)

A large section of the line crosses the Hill End Trough, located west of Gulgong and east of Spicers Creek Road. The weathering of the parent materials along this section of the line results in soils with high amounts of fine sand and silt. Bedrock may be exposed and slopes are susceptible to sheet, rill and gully erosion. The soils have relatively low fertility and frequently have high sodium levels, particularly in the lower parts of the landscape. The most common soils along the line in this area are Soloths, occurring on footslopes and drainage lines. Shallow soils occur on upper slopes and in steep terrain. Alluvium along major drainage lines is discontinuous.

Yellow Soloths and Yellow Solidic Soils - Soloth soils tend to occur in higher rainfall areas and are hence more leached and acidic. The Soloths group can be divided into Red Soloths and Yellow Soloths.

Red Soloths have been found on better drained upper to mid-slope positions over rhyolite and shale. Surface horizons are hardsetting. The topsoil has a loam or sandy clay loam texture and may be massive or have a weakly developed structure. There is an A_2 horizon that is bleached, has a loam or clay loam texture and is massive. There is a clear or sharp boundary to the B horizon. The B horizon has a reddish-brown colour, a clay loam to sandy clay or medium clay texture, with weakly to strongly developed, coarse columnar or prismatic structure. The deeper subsoil may be mottled.

Yellow Soloths are most common in areas where drainage is impeded. Leaching of bases results in acid soil reaction trends. Surface horizons are mainly hardsetting, with loamy sand to light sandy clay loam topsoils that are massive or single-grained. A few may have weakly to moderately developed structure. There are massive, bleached loamy sand to sandy clay loam A_2 horizons with a sharp or clear boundary to the B horizon. The B horizons have dull, yellowish-brown to bright, yellowish-brown colours, sandy clay to heavy clay textures and moderately to strongly developed columnar or prismatic structure, although some may appear to be structureless. Mottling is common.

The Soloths have low fertility and are used mainly for unimproved pastures and occasional cropping. They are highly erodible when disturbed and can be

susceptible to severe gully erosion. Tunnelling of earthworks is a potential problem in these soils.

The majority of these sections of the line have soil landscapes with yellow soloths dominating (and associated with podzolic soils) including:

- Mullion Creek Soil Landscape; and
- Mookerawa Soil Landscape.

Interspersed with these soil landscapes are small areas of shallow soils found in the Burrendong Soil Landscape, found in the higher crest areas of the landscape.

Section 4 - Granite Soils (Spicers Creek Road to Structure 257)

The western section of the transmission line is formed on granitic soils between Spicers Creek Road and Wellington sub station.

The siliceous granites to the east of Wellington weather to form coarse sands and kaolinitic clays which develop soils of low to very low fertility that are often high in sodium. Severe gully erosion and areas of salinity are common in these areas. The major soils are siliceous sands with small areas of yellow podzolic and solodic soils being found in isolated areas.

Siliceous Sands - Siliceous Sands occur on the acidic parent material including granites, rhyolites, coarse-grained sandstones and on colluvium-alluvium derived from sandstone or granite. There are often granitic tors and sandstone outcrops present in the landscape, and may often be found in association on the sandstones but are usually hardsetting on the granites. The topsoil has a loamy sand to light sandy clay loam texture and is apedal. Subsoils are similar but may show some colour development depending on the rock type and slope position.

The soils are well drained with a low waterholding capacity. Soil reaction trends are neutral to acidic. Topsoils are often acidic and may require treatment with lime prior to development. Land is frequently undeveloped but native pastures may be grazed with some fertiliser input.

The far western section of transmission line is dominated by siliceous sands of the Wuuluman Soil Landscape. In addition small areas of the Glen Oak Soil Landscape are crossed in the vicinity of Spicers Creek Road.

Section 5 - Molong Geanticline Soils (Structure 257 to Wellington Substation)

The far western 10 km of the line is located in the Molong Geanticline. Soils in this section of the line include Euchrozems.

Euchrozems - These soils occur mainly on basic to intermediate parent materials including the large areas of andesitic parent material and the basalts. Surface horizons are friable and loose or hardsetting. The topsoil has a loam to fine sandy clay loam texture and a moderately to strongly developed structure. There is a gradual boundary to a reddish-brown B horizon which has a clay loam to light

medium clay texture and a strongly developed polyhedral, angular or sub-angular blocky structure.

The soils are well drained and have a neutral or alkaline soil reaction trend often with carbonate segregations and nodules at depth. They are mostly used for cereal crops but also support native and improved pastures. They are moderately fertile but need superphosphate, molybdenum and possibly lime if they become acidic. The shrink-swell potential is frequently high, which is a severe limitation to their use as building foundations. Dams built on these soils often leak because of their strongly aggregated, red clay subsoils.

Soil landscapes with Euchrozems dominating along the proposed transmission line route include:

- Nanima Soil Landscape
- Bald Hill Soil Landscape
- Bodangora Soil Landscape

5.1.4 Potential Impacts on Soils

There are numerous characteristics relating to the potential usefulness or otherwise of soil types, including fertility, water holding capacity, structure, depth, and the chemical composition. However, the characteristics of the soil landscapes only become of relevance for the proposed transmission line where disturbance to the soil surface will occur. This will be the case at each structure location and where access tracks need to be formed.

Of particular relevance to the project are the erosion hazard and the foundation suitability of the soil landscapes found along the length of the line. These are summarised in Table 5.2.

In the siting of transmission line structures the structure degradation hazard will be taken into consideration in the techniques employed to ensure that a stable platform is provided for all poles and structures. A Geotechnical investigation was prepared by Parsons Brinckerhoff to provide comments and recommendations on the suitability of standard footing designs along the alignment. Where standard designs were not considered applicable, alternative footing designs were suggested.

Table 5.2 – Soil Characteristics along the Proposed Transmission Line

Soil Landscape	Erosion Hazard				Structure Degradation Hazard			
	Low	Moder-ate	High	Very High	Low	Moder-ate	High	Very High
Barigan Creek								
Lees Pinch								
Ulan								
Home Rule								
Dexter								
Rouse								
Nanima								
Mullion Creek								
Mookerawa								
Burrendong								
Bald Hill								
Wuuluman								
Glen Oak								

5.1.5 Mitigation Measures

Soil protection measures are part of the project and erosion control measures and rehabilitation techniques are described in Section 4.10.

Particular care will be taken at sites where highly erodible soils are present.

5.2 Geotechnical Issues and Assessment

A geotechnical investigation was carried out by Parsons Brinckerhoff Australia Pty Limited for the proposed 330 kV transmission line from Wollar to Wellington, to assess the suitability of standard footing designs for tower structures along the alignment. The report is summarised in the following sections.

The geotechnical investigation included a desktop review of available geological and soil landscape maps, and borehole logs obtained from Ulan Coal and the Department of Mineral Resources (DPI). A total of 29 boreholes were drilled along the alignment.

5.2.1 Laboratory Testing

Laboratory testing was completed on rock and soil samples recovered from the boreholes. Soil classification tests were used to aid in the selection of footing design parameters. The corrosion assessment tests can be used to assess the aggressivity of the soil to buried structures. Laboratory test results are summarised in Tables 5.3 – 5.5.

Table 5.3 – Laboratory Test Results – Soil Classification

Borehole	Depth (m)	Gravel (%)	Sand (%)	Silt/Clay (%)	Liquid Limit (%)	Plasticity Index (%)
BH2	05-0.95				40	16
BH5	0.6-1.05	42	57	1		
BH6	1.5-1.9	15	81	4		
BH6	2.4-2.6				34	15
BH9	1.45-1.95	6	91	3		
BH9	2.2-2.4				24	13
BH15	3.0-3.45	2	77	21		
BH16	0.55-1.0				28	15
BH19	1.5-1.95				43	19
BH24	3.1-3.5				57	36
BH25	1.5-1.95				33	17

Table 5.4 – Laboratory Test Results – soil Chemical Analysis

Borehole	Depth (m)	pH	Sulfate (mg/kg)	Chloride (mg/kg)
BH4	0.2-0.4	6.7	37	16
BH5	1.2-1.4	7.1	<2.0	1.9
BH6	0.6-1.05	7.2	21	31
BH6	1.5-1.95	7.4	8.0	31
BH7	2.5-2.7	7.5	29	110
BH8	0.55-1.0	7.9	50	44
BH9	0.6-1.05	6.6	150	280
BH12	0.6-1.05	6.3	4.0	5.2
BH13	2.9-3.35	8.9	4.1	13
BH14	1.2-1.3	8.1	<2.0	2.2
BH15	1.5-1.95	8.8	5.4	19
BH16	1.4-1.85	9.1	6.7	14
BH19	0.7-1.15	8.8	190	690
BH20	1.5-1.95	10.2	140	520
BH24	1.45-1.9	9.1	34	190
BH26	0.6-1.05	8.5	14	12

Table 5.5 – Unconfined Compressive Strengths

Borehole	Depth (m)	UCS (Mpa)	Rock Strength Classification
BH4	1.85-2.0	17.9	Medium
BH16	7.1-7.25	23.3	High
BH18	28-2.95	150.1	Very High
BH21	3.1-3.25	21.1	Medium-High
BH22	2.45-2.65	11	Medium
BH23	2.2-2.3	6.8	Low-Medium
BH23	5.5-5.65	7.9	Low-Medium
BH28	1.44-1.7	45.4	High
BH29	4.48-4.64	6.8	Low-Medium

5.2.2 Subsurface Conditions

The Wollar – Wellington alignment can be divided into 5 units, based on subsurface geology, summarised in Table 5.6.

Table 5.6 – Summary of Geological Environment

Units	Structural Setting	Geological Groups	Characteristic Rocktypes
1 (Wollar)	Gunnedah Basin	Permian/Triassic: - Illawarra Coal Measures; - Narrabeen Group; and - Shoalhaven Group.	Sandstone, shales, conglomerates, siltstones, chert, mudstones and coal.
2	Lachlan Fold Belt	Carboniferous: - Ulan Granite	Granite, ademellite and grandodiorite.
3	Lachlan Fold Belt	Silurian/Devonian/Ordovician/Permian: - Tucklan Formation; - Dunnedoo Formation; - Biraganbil Formation; - Piambong Formation; - Turondale Formation.	Quartz rich greywacke, slates, siltstones, sandstones, basalts, schists.
4	Lachlan Fold Belt	Carboniferous: - Wuuluman Granite	Monzodiorite
5 (Wellington)	Lachlan Fold Belt	Silurian/Devonian: - Mumbil Formation; - Gleneski Formation; - Cuga Burga Volcanics; Minor Ordovician Oakdale Formation	Volcanics, tuffaceous sandstone, siltstone, limestone.

5.2.3 Tower Footings

The standard footing types to support the tower loads were assessed by Parsons Brinckerhoff to be applicable along the majority of the proposed alignment, as described in Table 5.7. It was considered that the designs may not be applicable within Geotechnical Units 1b, 1d, 1e, 1f and at 2 tower locations within unit 4a.

In areas where the standard footing types are not applicable, special footings will be developed to suite the local conditions.

5.2.4 Assessment of Geotechnical Issues

A summary of the subsurface conditions anticipated along the alignment is provided in Table 5.7. This data shows that there are some sites which will need special footings. These usually occur around alluvial material, however none require additional environmental controls.

No acid sulphate soils were encountered and no special treatments will be necessary prior to, during or after construction activities.

Table 5.7 – Summary of Subsurface Conditions

Geotechnical Unit	Boreholes	Towers	Typical Subsurface Profile	Suitable for Standard Tower Design
1a	BH1 to BH4	Ang1B, Ang2, Ang3, Ang4, Ang5a, Ang6a, Ang7a, Ang8a	Residual low to medium plasticity silty clays to 0.1 m to 1 m (Stiff to hard) then siltstone/sandstone bedrock. *No groundwater encountered.*	Yes
1b	BH5 to BH6	Ang9, Ang10, Ang11, Ang14, Ang15, Ang16	Alluvial sands (loose-medium dense) and medium plasticity silty and sandy clays (stiff-very stiff) to 5 m to 6 m then siltstone/sandstone bedrock. *Groundwater at 1.9 m (BH5) and 3.2 m (BH6)*	No. Possibility of collapsible sandy soils.
1c	No PB boreholes	No Towers	Sandstone generally outcropping. In outcrop rock strength estimated as medium.	Yes
1d	No PB boreholes	A17	Possible deep alluvial sands and clays within paleochannel.	Unknown.
1e	No PB boreholes	A18, A19	Possible 1 m to 3 m alluvial soil over bedrock. Towers are expected to be close to paleochannel, therefore depths to bedrock may increase.	Unknown.
1f	BH8, Ulan and DMR boreholes	A20, A21	Possible deep alluvial sands and clays within paleochannel.	Unknown
2a	BH9	A22	Alluvial sands (medium dense-dense) and low plasticity sandy clay (stiff) overlying residual medium plasticity silty clay (very stiff to hard) to greater than 9 m. *Groundwater at 5.2 m.*	Yes, assuming groundwater level below final excavation depth.
2b	BH10, BH11, BH12	A23, Ang24, Ang25, Ang26, Ang27, Ang28, Ang29, Ang30	Residual sands (loose-medium dense) and low to medium plasticity silty and sandy clays (stiff) to 0.65 m to 1.65 m then granite bedrock. *No groundwater encountered.*	Yes
2c	BH13	Ang31, Ang32	Residual sand (medium dense-dense) to 1.6 m then granite bedrock. *No groundwater encountered.*	Yes
3a	BH14	Ang33A	Residual low to high plasticity silty clays (hard) to about 1.6 m then schist bedrock. *No groundwater encountered.*	Yes
3b	BH15	Ang33B	Alluvial sands (loose-medium dense) and low to medium plasticity silty and sandy clays (stiff) to greater than 7.8 m.	Yes, assuming groundwater level below final excavation depth.

			Groundwater at 4.5 m.	
3c	No borehole	None	No outcrop observed. Expect residual clays to about 1 m to 3 m over sandstone bedrock.	Yes
3d	BH16, BH17	Ang34, Ang35, A36, Ang37	Alluvial and residual low to medium plasticity silty clays (very stiff-hard) to about 0.5 m to 1 m overlying slate bedrock on hillsides and ridge tops. Bedrock depths increase to about 3 m to 4 m in flatter valley areas. *No groundwater encountered.*	Yes
3e	BH18, BH19, BH20, BH21, BH22	Ang38, Ang39B, Ang40B	As 3d, though bedrock comprises slate and basalt. *No groundwater encountered.*	Yes
4a	BH23, BH26	41A, 42A, 42C	Residual sands (medium dense-very dense) to about 1.1 m to 1.2 m then Granite bedrock. *No groundwater encountered.*	Yes 41A. Not know 42A and 42C.
4b	BH24, BH25	None	Residual sands (medium dense-very dense) and low to high plasticity silty and sandy clays (stiff-hard) to about 4.5 m to greater than 7.95 m overlying granite bedrock. *No groundwater in BH24. Groundwater at about 6 m in BH25.*	Yes, assuming groundwater level below final excavation depth.
5	BH27, BH28, BH29, BH30	Ang6AC, Ang5AC, Ang4AC, Ang3AC, Ang2AC, Ang399	Residual high plasticity silty clays (stiff-very stiff) to about 0.1 m to 0.4 m overlying sandstone, limestone and basalt bedrock. *No groundwater encountered.*	Yes

5.3 Hydrology and Water Quality

5.3.1 Existing Hydrological Regime

There are a number of river systems in the area that will be traversed by the proposed transmission line, each flowing to different destinations, described below:

- At the Wellington end of the line the main rivers are the Cudgegong River, which flows into Lake Burrendong, a water supply reserve for the area. Overflow from Lake Burrendong enters the Macquarie River, which flows in a north-west direction into the Barwon River, then into the Darling River system.

- At the Wollar end of the proposed line the main river system is the Goulburn River, fed by many smaller creeks and tributaries along its course before flowing into the Hunter River and out to the ocean near Newcastle.

Along the route of the proposed transmission line are numerous smaller creeks and tributaries, many of which will be crossed by the line. Some of these creeks would contain flowing water, however at the headwaters and upper tributaries would likely only flow during wet weather. These include:

- Mitchell Creek;
- Sandy Creek;
- Jocks Creek;
- Uamby Creek;
- Goodiman Creek;
- Slapdash Creek;
- Stubbo Creek;
- Gum Creek;
- Copes Creek;
- Sportsman Hollow Creek;
- Moolarben Creek;
- Wilpinjong Creek;
- Gumbo Creek; and
- Spring Flat Creek.

In addition, other creeks that will not be crossed by the proposed line, but will receive runoff from the area include:

- Dickton Creek;
- Poggy Creek;
- Talbragar River;
- Wialdra Creek; and
- Wollar Creek.

5.3.2 Hydrology and Water Quality Safeguards

Hydrology

Navigational and amenity uses on the local waterways can be affected by the transmission line, particularly in light of the higher technology taller masts of modern vessels. The Waterways Authority requires a minimum safe clearance height of 12 m above Mean High Water Mark at each water crossing. Each crossing needs to be licensed and marked with approved signage.

The proposed Wollar to Wellington transmission line will not alter local drainage patterns or flood regimes. It is important that the transmission line be designed to ensure that this essential service is reliable during significant flood events.

Water Quality

Appropriate protocols for the management of wastes and other possible contaminants arising from construction activities will be implemented along the proposed alignment to limit the potential for adverse impacts on receiving water quality. These measures will be implemented as part of the Environmental Management Plan (EMP) for the project.

Protocols are required to prevent the discharge of oils, paints and concrete and other possible contaminants from vehicles and construction sites. Similarly, any stockpile sites or construction camps will be appropriately located, bunded and managed to avoid the potential for discharge of contaminants, including human waste and rubbish, into the surrounding environment.

Water quality can be affected by soil erosion. Soil erosion occurs as a result of land disturbance during construction, vegetation clearing within the easement or construction of access tracks.

To ensure that the stability of drainage lines and minimise potential erosion at construction sites, standard erosion mitigation measures will be employed. These have been described in **Section 4.10** in detail, and will include:

- constructing access tracks with crossfall drainage where required;

- crossing creeks via fords which minimise the disturbance of soil and vegetation. Where vegetation is disturbed the area will be reseeded and stabilised to minimise soil movement;

- revegetating and fertilising disturbed areas to minimise soil erosion; and

- stabilising any drains required during the construction of access roads. This will minimise the potential for scouring and sedimentation of local streams.

Under Section 21D of the Soil Conservation Act, 1938, any 'prescribed streams' require approval to be gained through the Department of Infrastructure, Planning and Natural Resources (formerly Department of Land and Water Conservation) prior to the removal of any trees or shrubs within 20 m of the stream.

In the event that significant amounts of Protected Lands (i.e. land mapped as such by the Department of Land and Water Conservation and generally within 20 m of prescribed streams or with slopes $>18^0$) need to be cleared, approval is required under Section 21B of the Soil Conservation Act, 1938. The impact of clearing the vegetation along the route is included in the SIS assessment. TransGrid will seek approvals as required under the Soil Conservation Act prior to construction commencing.

Provided that the erosion control measures outlined above are put in place during the construction of the transmission line, water quality of the local streams and rivers should be unaffected as a result of the works.

No impact on ground water quality is anticipated as a result of the proposed development.

In addition, local water quality may also be affected in the event of spillage of machinery fuels and lubricants. An emergency spill response plan will be implemented which will ensure that any spillage of liquids are contained and minimised, thus avoiding significant water quality impacts. This plan will be developed as part of the final Construction Environmental Management Plan (CEMP).

5.4 Flora and Fauna

The proposed development area is situated predominantly in the NSW South Western Slopes (NWS) bioregion, with the far eastern edges located on the boundaries of the Sydney Basin (SB) bioregion, and, to a lesser degree, the Brigalow Belt South (BBS) bioregion (NSW National Parks and Wildlife Service 2003, Thackway and Cresswell 1995). This area has had a long history of usage for farming and is the most extensively cleared bioregion in New South Wales with only 16% of the original native vegetation remaining (NSW National Parks and Wildlife Service 2003). However, within the locality surrounding the proposed easement, approximately 25% of the landscape retains native woodland vegetation.

The proposed route for the transmission line has been selected to avoid impacts to high conservation vegetation and to minimise impacts upon threatened species. The majority of the route is through cleared agricultural land. However, the construction of the transmission line will entail some clearance of native vegetation and within the transmission line easement there are occurrences of woodland communities that have been listed as Endangered Ecological Communities (EECs) under both the State *Threatened Species Conservation Act 1995* (TSC Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Some woodland areas also form habitat for threatened and regionally significant flora and fauna species.

To assess the nature and extent of impacts of the transmission line upon threatened species, Cumberland Ecology was commissioned to prepared several formal assessments, including:

- Threatened species assessments under Section 5 A of the *EPA Act 1979* (the so-called eight part test;
- A Referral to the Department of Environment and Heritage (DEH) to fulfil the requirements of the EPBC Act; and
- a Species Impact Statement (SIS) to fulfil the requirements of Section 110 of the TSC Act and the requirements of the Director General of the Department of Environment and Conservation (DEC).

TransGrid determined that an SIS would be necessary based on the specific circumstances of this project and the need to more fully address the issues surrounding the occurrence of EEC's within the study area. The SIS is provided in Volume 2 of the EIS.

The following sections of the EIS provides a summary of the flora and fauna of the study area and of the impacts of the proposed transmission line. It includes:

- a description of the existing flora and fauna of the study area;
- an evaluation of the significance of the flora and fauna in a local, regional and state context;
- assessment of the likelihood that threatened species, populations or communities listed in the Threatened Species Conservation Act 1995 (TSC Act) and/or the Environmental Planning and Biodiversity Conservation Act 1999 (EPBC Act), occur within the study areas;
- recommendations necessary to mitigate impacts of the proposed Transmission Line.

5.4.1 Survey Methodology

5.4.1.1 Flora Investigation

Literature Review and Database Search

Relevant literature covering flora of the landscape surrounding the subject site was reviewed for information that was relevant to the subject site. The landscape in which the subject site occurs includes a few sites that have been subject to flora surveys. There is consequently a small amount of data available on plant species occurring in the area and habitats present. Information from these previous studies from the Western Slopes area was used extensively in this report.

Threatened species records held in databases of the Department of Environment and Conservation and Department of the Environment and Heritage were obtained and reviewed for relevance to the habitats of the study area. The database analysis entailed analysis of threatened flora species records from:

- The NSW National Parks & Wildlife Services Atlas of NSW Wildlife database within the locality of the proposed route; and
- The Department of the Environment and Heritage interactive map database within a polygon that incorporated the proposed route and surrounding landscapes (referred to as a Protected Matters Report).

Further details are provided within the SIS in Volume 2 of the EIS.

Aerial Photograph and Map Interpretation

Aerial photographs (1:4000) were utilised to define the extent of the flora and fauna habitats on the subject site and surrounding land. The analysis of aerial photography was also used to prepare preliminary maps of plant community boundaries and to plan field surveys. The map interpretation was very robust due to the involvement of ecologists who had participated in previous inspections of the route options during the corridor selection process. The air photos are provided in Volume 3 of the EIS as part of the Project Route Plans 1 to 42.

Flora Field Surveys

Flora field surveys were conducted between the 6th to 8th of December 2004 and 26th to 27th of April 2005 in selected areas of the proposed route in order to identify flora species, survey plant communities and to survey potentially sensitive sites for significant species and communities in the subject site. The flora survey included surveys within quadrats to help characterise the vegetation at various locations on the site, target searches for threatened species, and random meanders to maximise detection of plant species.

Extensive Vegetation Impact Assessment and Weeds Survey

In a separate extensive survey, an ecologist from OzArk accompanied the archaeological team visiting the whole line route and access track routes over a

total of fourteen (14) days. The ecologist ground-truthed the vegetation types and habitats present, recorded vegetation details for all structure sites and the weeds status of all areas likely to be affected by the activity. Over most of the route the team was accompanied by an ecologist from International Environmental Consultants who was able to ensure that information from the various contributors was appropriately coordinated and integrated into this EIS.

The field team also included an environmental expert from TransGrid who was able to advise on the practicality of design changes to reduce impacts and to define those sections of the easement where vegetation clearing would not be required due to the height of conductors.

One particular observation made in this extensive field survey was the recording of the presence of a small patch of *Goodenia macbarronii* at one location confirming the rarity of this species also found in a targeted search result by Cumberland Ecology. TransGrid was able to adjust the transmission line design to avoid impacting on this species.

The results of the weed survey and the management strategies for weeds are discussed in Section 7.2.3 of this EIS, Appendix B of the SIS in Volume 2 and in Chapter 6 of the Project Environmental Management Plan contained at the end of this volume.

Vegetation Plots

In order to help characterise the vegetation communities in the path of the proposed alignment, plants were sampled in forty-two (42) 20 x 20 metre square quadrats located within each proposed structure location in the selected areas of the alignment. A total area of 1.68 hectares was surveyed in the vegetation plots. Fifteen plant communities were identified for the subject site, of which 13 represent natural plant communities. The survey effort for each of the plant communities is indicated in Table 5.8. Within each quadrat, all vascular plants present were recorded and estimations were made of the relative abundance of species. Plant specimens that were not easily identified in the field were collected and identified using Harden (1991 -1993) or sent to the Royal Botanic Gardens for identification.

Table 5.8 – Intensive Vegetation Survey

Plant Community	Number of Quadrats
Black Cypress Pine - Broad-leaved Ironbark	3
Black Cypress Pine	0
Black Cypress Pine – White Box	1
Black Cypress Pine - Red Box	4
Black Cypress Pine - Tumbledown Red Gum	8
Yellow Box - Blakely's Red Gum	1
Yellow Box - White Box	6
White Box - Inland Grey Box	3
White Box	5
White Box - Red Stringybark	1
Blakely's Red Gum	1
Riparian woodland	0
Cleared/Partially Cleared	2

Table 5.8 – Intensive Vegetation Survey

Plant Community	Number of Quadrats
Exotic Pasture and Cropland	6
TOTAL	**42**

Plant communities are described according to structure and dominant canopy species following structural definitions by Specht (1970). Where applicable, the plant community names follow standardised names provided in the literature including *Forest Types in NSW* (Forestry Commission of NSW 1989).

Random Meander

Random meander searches were employed to search for plant species and to create lists of plants in selected areas or degraded habitats. Such searches were only conducted within selected areas, particularly those likely to have significant flora and/or those at greatest risk of impact from the proposed construction of the transmission line. Random meander searches were also conducted in areas with degraded habitat where detailed quadrat surveys were not necessary. A total of 1 km was traversed using the random meander search. All plant species detected on the random meander were recorded in the total plant species list.

Threatened Flora Species Surveys

Based upon the results of the literature review and database analysis, a list of potential threatened plant species were compiled for the proposed route.

The likelihood of occurrence of threatened species occurring in the subject area was determined and targeted searches were conducted for threatened species, populations and/or communities that could potentially be at significant risk from the proposal.

Targeted searches were conducted within potential habitat areas for individual plants or populations of the species considered likely to occur. Searches were undertaken for these species during all quadrat and transect surveys.

A list of targeted species and an analysis of their likelihood of occurrence is provided within the SIS in Volume 2 of the EIS.

5.4.1.2 Fauna Investigation

Literature Review and Database Search

The DEC National Parks and Wildlife Service *Atlas of NSW Wildlife* database was used to identify threatened and regionally significant invertebrate, frog, reptile, bird and mammal species that could occur within the locality. This database was also used to identify the occurrence of threatened fauna species in the area and those likely to occur on the proposed route. Likelihood of occurrence was determined by confirming the recorded sightings of the threatened species on the *Atlas of NSW Wildlife* within 50 km of the proposed corridor in combination with an estimate of habitat suitability on the study site for each species.

Habitat Analysis

A habitat assessment was conducted to identify potential areas where threatened and regionally significant fauna species could reside or forage. Habitat assessment and sampling occurred over several survey periods from early summer to mid autumn (6th to 8th December, 21st to 23rd March, 26th to 27th March and 10th to 11th May). In particular potential habitats where threatened species could be present were assessed for important indicators of habitat suitability, including known species of feeding trees and shrubs and occurrence of such features as wetlands, creeks, tree hollows and fallen logs. Descriptions were also made of the structural complexity of vegetation, the age composition of the forest and the nature and extent of human disturbance in various parts of the site.

Areas that are likely to act as corridors or habitat links between the study area and adjacent areas of likely habitat for subject species were also identified and described.

Extensive Fauna Habitat Impact Assessment

In conjunction with the 14 day, Extensive Vegetation Impact Assessment and Weeds Survey, the ecologist made observations of fauna present and assessed impacts on fauna habitats.

Targeted fauna habitat searches

The study area was assessed for potential and actual activity by Koalas, using following set of procedures:

- A search of Atlas of NSW Wildlife database;
- An analysis of the composition of each woodland and open forest type was conducted in order to determine whether or not each woodland and open forest type supported potential Koala habitat (by determining the percentage of feed trees listed in SEPP 44 – Koala Habitat Protection); and
- Koalas were searched for during spotlighting and call playback surveys

Further details are provided within the SIS in Volume 2 of the EIS.

Tree Hollow Analysis

Due to their importance for the life cycles of many vertebrate fauna, specific tree hollow surveys were undertaken in 10 major habitats of the proposed route that could be at risk from the proposal. The tree hollow analysis was conducted in 20 m x 100 m plots. A total area of 2 ha was surveyed. Tree species and diameter at breast height was recorded as well as number and size of hollows.

Fauna Field Survey

A general fauna survey was conducted on the subject sites with emphasis on targeted searches for threatened species that were considered likely to occur in the

habitats in the study area. The list of threatened species that were targeted and the methods used for analysis of likelihood of occurrence are included in the table below. Further details are provided within the SIS in Volume 2 of the EIS.

Table 5.9 – Fauna Survey Effort

Survey Method	Unit	Total Effort	Other details
Spotlighting	1hour / 10 sites / 2 persons	20 hours	Towers 15-17, 83, 88-90, 113, 162, 164, 175, 176, 195-198, 204-207, 208-211, 224-229, 268
Call playback	45 minutes / 6 nights	4.5 hours	Towers 89, 164, 197, 207, 211, 227 Cumbo Rd, Blue Springs Rd, Gum Gully Rd
Hair tube traps	340 traps / 7 nights	2380 trap nights	Towers 15, 83, 86, 88, 89, 175, 176, 197, 198, 206, 207, 209, 211, 225, 227, 268,
Anabat ZCAIM bat detectors	2 detectors / 12 hours / 4 nights 1 detector / 12 hours/ 3 nights	132 hours	Towers 15, 89, 113, 162, 175, 197, 207, 211, 225, 268 Gum Gully Rd
Ornithology survey	25 minutes / 41 diurnal surveys	9 ½ hours	Towers 15-17, 56-58, 83-91, 113, 162, 164, 175, 176, 193-198, 204-211, 224-228, 267, 268
Reptile survey	Diurnal searches		Towers 15, 113, 175, 176, 195-198, 162, 164, 204-211, 224-228, 267,268

5.4.2 Vegetation Communities

Fifteen plant communities occur in the study area as shown in **Figures 6a-o** in Volume 3 of this EIS.

The areas of each plant community are summarised in the following information:

1. The total area of each vegetation community mapped within the study area;

2. The total area of each vegetation community mapped within the subject site (transmission line easement);

3. The total number of towers affecting each community; and

4. An extrapolated figure from the raw mapping data relating to actual likely impact.

The plant communities are described according to structure and dominant canopy species following structural definitions by Specht (Specht 1970). The plant

communities can be grouped into four broad categories based upon topography, species composition and other habitat conditions: Open Forest, Woodland, Grassland and Exotic Vegetation. Where applicable, the plant community names follow standardised names provided in Forest Types in New South Wales (Forestry Commission of NSW 1989).

The open forest group consists of Black Cypress Pine – Broad-leaved Ironbark Open Forest Community (Community 1) in the eastern portion of the route. This community was limited to a sandstone ridgetop in the Ulan Coal property and borders to the north with Goulburn River National Park.

The woodland group consists of several types of woodland communities on a variety of hillside locations and soils. This includes four communities from the Black Cypress Pine League [Black Cypress Pine Woodland (Community 2), Black Cypress Pine – White Box Woodland (Community 3), Black Cypress Pine – Red Box Woodland (Community 4) and Black Cypress Pine – Tumble-down Red Gum Woodland (Community 5)] and six communities from the Yellow Box – White Box - Red Gum League [Yellow Box – Blakely's Red Gum Woodland (Community 6), Yellow Box – White Box Woodland (Community 7), White Box – Inland Grey Box Woodland (Community 8), White Box Woodland (Community 9), White Box – Red Stringybark Woodland (Community 10) and Blakely's Red Gums (Community 11)] and River Red Gum Riparian Woodland (Community 12) along the creeklines.

The Black Cypress Pine community complex tends to occur on poorer soils with the result that they are often in more natural condition than the Yellow Box-White Box-Red Gum League communities. They generally comprise a dense cover of *Callitris endlicheri* (Black Cypress Pine) with scattered eucalypts and a shrub stratum above a generally sparse ground cover.

The Yellow Box – White Box - Red Gum League serves as indicators of good pastoral and agricultural land as members of this league mostly occurs on fairly deep soil of moderate to high fertility (Forestry Commission of NSW 1989). Therefore undisturbed examples of this league are now extremely rare (Forestry Commission of NSW 1989). Owing to the relatively fertile soils on which these communities occur, most sites have had been highly modified by clearing, with varying subsequent regeneration and weed invasion. Most comprise grassland with an open to scattered cover of trees. Some of the sites where this community remain are on poorer or stony soils that were less desirable for farming and therefore less cleared.

River Red Gum Riparian Forest occurred at several locations along the transmission line route along riparian areas. This was in various stages of condition due to previous clearing impacts.

At two locations at the eastern end of the Transmission line, tower numbers 28.2 and 42, a small number of scattered Fuzzy Box trees occur surrounding Wilpinjong Creek and near the Sandy Hollow-Maryvale Railway with an understorey dominated by exotic grasses, which have been heavily grazed. This community has been assessed as remnant Fuzzy Box Woodland (Community 13).

Cleared/Partially Cleared Grassland has been created by the clearance of woodland although it has retained most of the native understorey. It therefore occurs on a variety of soils and has a range of different species mixtures.

Improved Pasture and Cropland has also been created by the clearance of woodland, with most of the native understorey replaced by improved pasture. This community also occurs on a variety of soils although usually on more fertile soil and also supports a range of different species mixtures.

The subject sites and associated study areas are located in vegetation patches. These patches have been numbered as shown in **Figures 6a-o**. The vegetation communities within these patches are also shown in **Figures 6a-o**. Each of the vegetation communities found in the study area is described below. The table following the descriptions provides a summary of the areas of vegetation that will be cleared as a result of the activity (as shown in **Figures 6a-o**), and from other activities associated with the total project.

5.4.2.1 Black Cypress Pine –Broad-leaved Ironbark Open Forest

Status:

This plant community is not currently listed as an endangered ecological community by either the Commonwealth EPBC Act or the State TSC Act.

Description:

This type is found mostly in the drier parts of the Western Slopes districts and at lower altitudes on the western part of the Tablelands, with Black Cypress Pine being associated with one or other of the western Ironbarks (Forestry Commission of NSW 1989). It occurs on areas with shallow, skeletal soils (Forestry Commission of NSW 1989).

Three tower sites (56, 57 and 58) contained undisturbed open forest dominated by *Callitris endlicheri* and *Eucalyptus fibrosa*. Other canopy trees occurred locally, including *Eucalyptus rossii* (Inland Scribbly Gum), *Eucalyptus dwyeri* (Dwyer's Red Gum), *Eucalyptus agglomerata* (Bluetop Stringybark) and *Eucalyptus crebra* (Narrow-leaved Ironbark).

The community had a well-developed shrub stratum with *Allocasuarina gymnanthera*, *Epacris muticus*, *Persoonia linearis* (Narrow-leaved Geebung), *Styphelia triflora* and *Hakea dactyloides* being typical. *Lomandra glauca*, *Lomandra multiflora*, *Pomax umbellata* and various grasses formed the typical ground cover.

Photograph Black Cypress Pine – Broad-leaved Ironbark Open Forest on a sandstone ridge top in the eastern portion of the route

5.4.2.2 Black Cypress Pine

Status:

This plant community is not currently listed as an endangered ecological community by either the Commonwealth EPBC Act or the State TSC Act.

Description:

This community is clearly dominated by Black Cypress pine alone, though other tree species may be associated, including Ironbarks, Red Box, White Box and Stringybarks (Forestry Commission of NSW 1989). It is found through the Slopes and tablelands districts on steep slopes with skeletal soils (Forestry Commission of NSW 1989).

Adjacent to tower 16 an individual stand of early Black Cypress Pine regrowth occurred next to a cleared area.

Photograph Black Cypress Pine Woodland regrowth

5.4.2.3 Black Cypress Pine – White Box Woodland

Status:

This plant community is not currently listed as an endangered ecological community by either the Commonwealth EPBC Act or the State TSC Act.

Description:

In this community Black Cypress Pine is associated with White Box, other species occurring in this community including Ironbarks, Smooth-barked Apple and Red Gum (Forestry Commission of NSW 1989). This community generally occurs in more easterly location than the Black Cypress Pine – Ironbark Communities (Forestry Commission of NSW 1989).

Black Cypress Pine-White Box community was recorded in three sites: 195 and adjacent to 194 and 224, mostly on granite-derived soil in the Chesleigh Group.

Other canopy species included Tumble-down Red Gum. A low, open shrub stratum of *Hibbertia obtusifolia, Cassinia* sp. was typical.

The sparse ground cover varied between the sites but included native grasses and daisies such as *Aristida jerichoensis* var. *spinulifera*, *Bothriochloa decipiens* and *Vittadinia pterochaeta.* Exotic species were estimated to be less than 5% of the ground cover.

Photograph Black Cypress Pine – White Box Woodland in the western portion of the route.

5.4.2.4 Black Cypress Pine – Red Box Woodland

Status:

This plant community is not currently listed as an endangered ecological community by either the Commonwealth EPBC Act or the State TSC Act.

Description:

In this community Black Cypress Pine is associated with Red Box, other species occurring in this community include Ironbarks, Smooth-barked Apple and Red Gum (Forestry Commission of NSW 1989). This community generally occurs in more easterly locations than the Black Cypress Pine – Ironbark Communities (Forestry Commission of NSW 1989).

Black Cypress Pine-Box community was recorded in four sites: 162, 164, 175 and 176 on granite-derived soil in the Chesleigh Group.

Other canopy species included *Eucalyptus macrorhyncha* (Red Stringybark), *Allocasuarina luemannii* (Bull Oak) at Site 175 and *Angophora floribunda* occurred at site 162 and 164. A low, open shrub stratum of *Hibbertia obtusifolia*, *Cassinia* sp. was typical. Other species occurred variably, especially *Lissanthe strigosa* (Peach Heath) and *Melichrus urceolata*.

The sparse ground cover varied significantly between the sites but included: *Danthonia* spp., *Goodenia hederacea, Wahlenbergia* spp. and *Aristida* spp. Exotic species were estimated to be less than 5% of the ground cover.

Photograph Black Cypress Pine – Red Box Woodland

5.4.2.5 Black Cypress Pine – Tumble-down Red Gum Woodland

Status**:**

This plant community is not currently listed as an endangered ecological community by either the Commonwealth EPBC Act or the State TSC Act.

Description:

This community was the most common form of Black Cypress Pine woodland/open forest, being recorded in ten proposed tower sites (84, 85, 86, 87 88, 90, 204, 205). These tended to be rocky hilltops with extensive granite (84-88, 90) or metamorphic outcropping (204, 205).

In addition to the two main canopy species, *Allocasuarina verticillata* (Drooping She-oak) was common in most sites.

Common shrub species included: *Hibbertia obtusifolia, Astroloma humifusum* (Cranberry Heath), *Cassinia arcuata*, and *Melichrus urceolata*. *Bursaria spinosa*

(Blackthorn), *Persoonia linearis* and *Dillwynia juniperina* (Prickly Parrot Pea) were some of the more variably distributed species.

The ground covers varied according to the geology. However *Aristida* spp. and *Austrostipa scabra* were the most common throughout all sites. *Gonocarpus elatus*, *Podolepis neglecta* and *Plantago hispida* were common in or near Sites 84-88 and 90. *Dichondra repens* (Kidney Weed) and *Goodenia hederacea* were fairly common in Sites 204 and 205.

Photograph Black Cypress Pine – Tumble-down Red Gum Woodland

5.4.2.6 Yellow Box – Blakely's Red Gum Woodland

Status:

This plant community is part of a currently listed endangered ecological community by both Commonwealth EPBC Act and State TSC Act. Under the EPBC Act it is under nomination as Yellow Box/Red Gum Grassy Woodland and under the TSC Act it is listed as part of the White Box – Yellow Box – Blakely's Red Gum Woodland.

Description:

The Yellow Box – Blakely's Red Gum community occurs as either tall or savanna woodland on undulating topography with fairly well-drained, deep soils of moderate fertility along the western side of the Tablelands and into the adjoining

Western Slopes (Forestry Commission of NSW 1989). The community is dominated by Yellow Box and Blakely's Red Gum and associated species include Apple Box, Red Box, White Box, Rough-barked Apple, Red Stringybark and various other northern Stringybarks (Forestry Commission of NSW 1989).

This community was recorded at proposed Tower 89 only. It was located in a shallow dip at the change of geology from granite to sandstone.

The canopy appears to have been thinned to promote grass for grazing purposes. Most of the tree cover occurred outside the proposed tower location. *Eucalyptus melliodora* and *Angophora floribunda* (Rough-barked Apple) were the main canopy trees. A couple of small trees (*Acacia implexa* [Hickory Wattle] and *Callitris endlicheri* [Black Cypress Pine] were present.

The shrub stratum was absent although shrubs were scattered through the site. Common species were: *Melichrus urceolata*, *Astroloma humifusum* (Cranberry Heath), *Cassinia arcuata* (Sifton Bush) and *Hibbertia obtusifolia*.

A grassy ground cover was dominated by *Aristida* spp. and other native grasses with exotic Asteraceae being common.

Photograph Yellow Box – Blakely's Red Gum Woodland

5.4.2.7 Yellow Box – White Box Woodland

Status:

This plant community is part of a currently listed endangered ecological community by both Commonwealth EPBC Act and State TSC Act. Under the EPBC Act it is listed as White Box Grassy Woodland and under nomination as Yellow Box/Red Gum Grassy Woodland and under the TSC Act it is listed as part of the White Box – Yellow Box – Blakely's Red Gum Woodland.

Description:

The Yellow Box – White Box community occurs as either tall or savannah woodland on undulating topography with well-drained, deep soils of moderate fertility along the western side of the Tablelands and into the adjoining Western Slopes (Forestry Commission of NSW 1989). The community is dominated by Yellow Box and White Box and associated species include Blakely's Red Gum, Rough-barked Apple and various other northern Stringybarks (Forestry Commission of NSW 1989).

Yellow Box-White Box community was recorded at tower sites: 197, 198, 207, 227 and 228. The first three of these occurred on soils derived from Devonian – Crudine Group – Turondale Formation bedrock. Site 227 was on a Carboniferous intrusion of Wuuluman Granite. All sites appear to be marginal for this community. They were either on poorer granite-derived soils or contained a high proportion of rock. Sites 197, 198 and 207 contained significant weed populations, while 227 and 228 contained an estimated 10% cover of exotic species in the ground cover.

Eucalyptus albens, *Eucalyptus melliodora* and *Angophora floribunda* were the main canopy trees, although the canopy was more open than in most natural community owing to previous clearing for grazing. *Eucalyptus dealbata* (Tumble-down Red Gum) and *Eucalyptus macrorhyncha* (Red Stringybark) were present in or near the sites, indicating marginal growing conditions for the community.

Shrubs were uncommon and the ground cover mainly comprised grasses, especially *Aristida* spp., *Austrostipa scabra* and *Danthonia eriantha* (a Wallaby Grass). *Microlaena stipoides* (Weeping Meadow-grass) was very common at Towers 197 and 198, as were the introduced *Nassella neesiana* (Chilean Needle-grass) and *Avena fatua* (Wild Oats).

Photograph Yellow Box – White Box Woodland

5.4.2.8 White Box – Inland Grey Box Woodland

Status:

This plant community is part of a currently listed endangered ecological community by both Commonwealth EPBC Act and State TSC Act. Under the EPBC Act it is listed as part of the White Box Grassy Woodland and under the TSC Act it is listed as part of the White Box – Yellow Box – Blakely's Red Gum Woodland.

Description:

This community provides a link between the Yellow Box – White Box – Red Gum league and the Western Box- Ironbark league, occurring towards the western limits of the former league's occurrence (Forestry Commission of NSW 1989). It forms savannah woodland in which White Box is associated with one or more species of other Boxes, including Fuzzy, Pilliga, Narrowleaved and Western Grey Box as dominants (Forestry Commission of NSW 1989). Other associates may include various Ironbarks, Red Gum, Yellow Box, Kurrajongs and Bull Oak (Forestry Commission of NSW 1989).

Three sites (Towers 17, 113 and 193) contained White Box-Inland Grey Box woodland.

Eucalyptus microcarpa (Inland Grey Box) was the main canopy tree in both sites. *Eucalyptus albens*, *Eucalyptus blakelyi* and *Angophora floribunda* occurred nearby and were considered to have been a natural part of the original community.

The three sites had mainly grassy understoreys and a shrub cover of less than 5%. *Themeda australis* dominated the ground cover at Tower 17. *Danthonia* sp. (a Wallaby Grass), *Juncus usitatus*, *Aristida vagans* and *Carex appressa* were the principal herb species at Tower 113. Exotic species were rare in all three sites.

Photograph White Box – Inland Grey Box Woodland

5.4.2.9 White Box Woodland

Status:

This plant community is part of currently listed endangered ecological communities by both Commonwealth EPBC Act and State TSC Act. Under the EPBC Act it is listed as the White Box Grassy Woodland and under the TSC Act it is listed as part of the White Box – Yellow Box – Blakely's Red Gum Woodland.

Description:

In this community White Box clearly dominates the stand, with such species as Blakely's Red Gum, Yellow Box and Kurrajong occurring as relatively occasional associates (Forestry Commission of NSW, 1989). The community tends to be

found in sites that are either climatically or topographically drier than sites required by the Yellow Box – Blakely's Red Gum woodland (Forestry Commission of NSW 1989). This woodland is wide spread in the Western Slopes (Forestry Commission of NSW 1989).

White Box woodland was recorded at five tower sites: 15, 208, 209, 211, and 268. The communities at two other sites (83 and 206) were considered to be ecotones between White Box and Black Cypress Pine communities. Site 15 possibly represented an ecotone between White box and a sandstone community.

Within the study area this community typically comprised native pasture with high proportions of exotic herbs (40-60%), with scattered trees including *Eucalyptus albens*. Shrubs were generally absent. Ground covers were variable although *Austrostipa scabra, Danthonia* spp. were representative.

There were variations in the characteristics of these two ecotones– the community occurring at Site 83 was on deep granite-derived soil (much of which had been quarried) while that occurring at Site 206 occurred on a quartz vein in metamorphic bedrock, upslope of better grazing land. Both had low concentrations of exotic species.

Photograph White Box Woodland

5.4.2.10 White Box – Red Stringybark Woodland

Status:

This plant community forms part of currently listed endangered ecological communities by both Commonwealth EPBC Act and State TSC Act. Under the EPBC Act it is listed as part of White Box Grassy Woodland and under the TSC Act as part of White Box – Yellow Box – Blakely's Red Gum Woodland.

Description:

White Box and a Stringybark dominate this community, which occur on more skeletal soils in area where more favourable site carry the White Box woodland community (Forestry Commission of NSW 1989). Other associated species include Silverleaved and Red Ironbarks, Red Gum, Western New England Blackbutt and Black Cypress Pine (Forestry Commission of NSW 1989).

In the study area this community occurs at one tower site (225) in the western portion of the route and is dominated by White Box (*Eucalyptus albens*) and Red Stringybark (*Eucalyptus macrohyncha*) in association with Roughbarked Apple (*Angophora floribunda*) and Black Cypress Pine (*Callitris endlicheri*).

The shrub layer is dense with *Acacia vestita* and the groundcover contains mainly native Weeping Meadow-grass (*Microlaena stipoides)* and exotics such as Chilean Needle Grass (*Nassella neesiana)* and Patterson's Curse (*Echium plantagineum).*

Photograph White Box – Red Stringybark Woodland

5.4.2.11 Blakely's Red Gum Woodland

Status:

This plant community is part of a currently listed endangered ecological community by both Commonwealth EPBC Act and State TSC Act. Under the EPBC Act it is under nomination as Yellow Box/Red Gum Grassy Woodland and under the TSC Act it is listed as part of the White Box – Yellow Box – Blakely's Red Gum Woodland.

Description:

This community is dominated by one of the inland species of Red Gum (Forestry Commission of NSW 1989). The species involved may be Blakely's Red Gum, Baradine Red Gum or Tumbledown Gum (Forestry Commission of NSW 1989). Stands of this community with the first two species dominant are usually on lower lying sandy sites where they may be associated with Roughbarked Apple, while Tumbledown Gum stands usually favour more upland sites (Forestry Commission of NSW 1989).

The western half of one site (91) was dominated by *Eucalyptus blakelyi* (Blakely's Red Gum) and *Angophora floribunda*. *Eucalyptus albens* was observed nearby. A small intermittent creek passed through the western edge of the quadrat and weedy native pasture occurred in the eastern section. The western section of the site contained an estimated 10% exotic species.

Shrubs were fairly common along the creek edge: *Leptomeria* sp., *Cassinia arcuata, Melaleuca thymifolia* and *Acacia ausfieldii*. The threatened *Goodenia macbarronii* occurred in the dry creek bed amongst low ground covers.

Echinopogon caespitosus (a Hedgehog Grass), *Arundinella nepalensis* (Reedgrass), *Microlaena stipoides* and *Juncus* sp. were the main ground covers in the wooded section of the site. *Panicum effusum, Eragrostis cilianensis* (Stinkgrass) and *Hypochaeris radicata* (Flatweed) were the most common pasture species.

5.4.2.12 River Red Gum Riparian Woodland

Status:

This plant community is not currently listed as an endangered ecological community by either the Commonwealth EPBC Act or the State TSC Act.

Description:

Some areas of riparian forest occur on the subject site. Most of the riparian zones lack any canopy cover, and are dominated by invasive weed species. However, degraded River Red Gum Riparian Forest does occur at several locations in the study area.

5.4.2.13 Fuzzy Box Woodland

Status:

This plant community is listed as an endangered ecological community by the State TSC Act.

Description:

Fuzzy Box Woodland is known to occur in two locations within the study area. This is associated with Wilpinjong Creek and near the Sandy Hollow-Maryvale Railway at the eastern extremity of the Transmission line route. The example of Fuzzy Box Woodland is highly disturbed and consists of mainly a small number of remnant trees. The understorey is not representative of the natural structure of this community. Heavy grazing in the area has lead to low species diversity and the creek zone, particularly on the moist southern side has been completely invaded by weeds.

5.4.2.14 Cleared/Partially Cleared

Status:

This plant community is not listed as an endangered ecological community by either the Commonwealth EPBC Act or the State TSC Act.

Description:

This community covers land which was originally forested and which is now maintained in an open condition by grazing and periodic burning (Forestry Commission of NSW 1989). The land often carries remnant trees and clumps of trees and the grazing land is unimproved (Forestry Commission of NSW 1989). Left without grazing and burning, these sites will usually start to revert towards forest vegetation (Forestry Commission of NSW 1989).

This community occurs in patches across the study area and would originally have contained plant communities from the Yellow Box – White Box – Red Gum League.

Photograph Partially cleared woodland showing native grasses and regenerating shrubs in the foreground.

5.4.2.15 Improved Pasture and Cropland

Status:

This plant community is not listed as an endangered ecological community by either the Commonwealth EPBC Act or the State TSC Act.

Description:

This community includes areas which are used for annual agricultural crops or which have clearly been converted to permanent and improved pasture (Forestry Commission of NSW 1989).

In the study area this community occurs mostly in the western portion of the study area.

Photograph Exotic Pasture with broad leaved weeds including Fieldcress, Horehound and Saffron Thistle.

5.4.3 Fauna and Fauna Habitats

5.4.3.1 Fauna Habitats

Fauna habitats in the study area include woodland dominated by a variety of eucalypts and also Black Cyprus Pine. Woodland and forest together comprise approximately 25% of the landscape, with the balance comprising cleared agricultural land. Within and adjacent to the transmission line easement, terrestrial habitats include:

- Eucalypt woodland on gently undulating land with moderately fertile and deep soils, with species including White Box, Yellow Box, Blakely's Red Gum, Rough Barked Apple and Inland Grey Box;

- Eucalypt woodland/forest on steep slopes and escarpments derived from sandstones that give rise to shallow, infertile soil. The dominant species include Narrow-leaved Ironbark, White Box and Stringybarks;

- Black Cyprus Pine-dominated woodlands on steeper drier slopes, with co-dominant or emergent eucalypts including Tumbledown Red Gum, White Box and Red Box; and

- Cleared and partially cleared agricultural land, with some scattered remnant and regrowth trees, which are predominantly eucalypts including White Box, Yellow Box, Blakely's Red Gum, Rough Barked Apple and Inland Grey Box. The resultant grasslands in these habitats range from semi-natural pastures dominated by hard native grasses to improved pastures dominated by exotic species.

The woodland across the study area is dominated by trees that have regenerated from previous clearing for agriculture, timber harvesting and firewood collections. As a result, relatively young trees predominate across the easement, with large old trees being scarce. Trees with hollows are present at most of the woodland locations but they are sparse and trees with large hollows are rare.

5.4.3.2 Corridors and Habitat Links

Corridor and habitat links may be described on various scales and which achieve different purposes. Corridors may consist of discontinuous areas or patches of habitat acting as stepping stones across the landscape, continuous lineal strips of vegetation, or connected areas of known habitat of importance to local fauna. For the purpose of linking areas of habitat in the immediate locality and provide for species movement, local or minor corridors aid connectivity. At a much larger scale, regional corridors are primary landscape connections between larger, regionally significant areas of habitat (Scotts 2003).

Both types of corridors have been identified in the study area. Individual patches, which form stepping stones and discreet areas of habitat, have also been identified.

There are several types of local corridors that pass through the study area and which may be affected by the proposal. These include:

- Woodland patches of various sizes;
- Riparian corridors; and
- Roadside verges.

The corridors provide linkages between other corridors, including riparian corridors, and woodland patches of various quality and size. Some of the corridors will be affected by a reduction in connectivity, a reduction in the proximity of habitat areas and fragmentation of linkages. For example, the connectivity of the riparian corridor and proximate lightly wooded patches near towers 218-221 will be reduced.

Where local corridors are to be crossed by the transmission line corridor, native shrubs and grasses will be planted or retained beneath the transmission line where possible. Hollow-bearing trees within the easement will be retained, although the trees will be killed and the crown removed. This will maintain a vegetated movement/sheltered corridor within which species can travel to interconnected and proximate areas of habitat.

Two regional corridors have been identified in the study area. For the purposes of the SIS, these regional corridors have been described as the Eastern Corridor and Central Corridor.

Corridors are limited in the locality due to clearance of native vegetation for agricultural purposes. A major continuous regional corridor exists between the two large parks/reserves in the locality; Goulburn River National Park and the Munghorn Gap Nature Reserve, east of the south-eastern end of the proposed transmission line. The proposed transmission line will not sever this movement corridor.

The eastern corridor is the largest/widest movement corridor which is made up of large patches which will be intersected by the proposed transmission line, generally occurring between tower numbers 15 and 91. A narrower central corridor exists between tower numbers 162 and 176 further to the west along the proposed transmission line, which will be intersected.

Approximately 42 ha of woodland in the eastern corridor and 7.8 ha in the central corridor will be impacted by the transmission line. However, the removal of areas of vegetation within this relatively narrow easement, will not significantly impact on regional connectivity.

5.4.3.3 Fauna Species

The table below provides a summary of the numbers of species detected during the surveys for the EIS/SIS. Considering that the surveys only provided a snapshot of fauna that occurred along the easement, the numbers of species found was considerable and, based upon the available data from DEC database records, and from the recent surveys conducted for the Wilpinjong Coal Project EIS, many more species occur within the study area. A composite fauna species list (derived from survey, literature review and database analysis) is provided within the SIS, in Volume 2.

Table 5.10 – Fauna Species Recorded in Study Area

Fauna Class	Number of Species Identified
Amphibians	6
Reptiles	14
Birds	85
Mammals	30
Total	135

Source: SIS in Volume 2

The most abundant vertebrates were birds, particularly birds of woodland and more open grassland habitats. This was followed by mammal species and reptiles. Frogs showed low species diversity, due largely to the dryness of the landscape through which the proposed easement passes.

Six species of frogs were detected including Bibron's Toadlet, *Pseudophryne bibroni,* Striped Marsh Frog, *Limnodynastes peronii,* Common Eastern Froglet *Crinia signifera,* Peron's Tree Frog, *Litoria peronii,* Rocket Frog, *L. nasuta,* and Broad-palmed Frog *L. latopalmata.* Of these species, Bibron's Toadlet was

detected under a rock on a dry hillside in the east of the proposed transmission line corridor. The other species were detected in association with farm dams and soaks on the easement.

Reptiles were more abundant than amphibians with 14 species recorded during the surveys. Based upon database records for the region and the nature of habitats found more species are expected. The species found during the surveys are typical of dry woodland environments and rocky hillsides. Species were dominated by skinks including Robust Ctenotus *Ctenotus robustus* (found at 13 sites), Cunningham's Spiny-tailed Skink *Egernia cunninghami* (1 site), Tree Crevice-skink *Egernia striolata* (5 sites), White's Rock-skink *Egernia whitii* (2 sites), South-eastern Morethia Skink *Morethia boulengeri* (7 sites). The burrowing skink Two-clawed Worm-skink *Anomalopus leuckartii* was also found at 2 sites. Four species of geckos were also found including Eastern Stone Gecko *Diplodactylus vittatus* (1 site), Variegated Dtella *Gehyra variegata* (8 sites), Lesueur's Velvet Gecko *Oedura lesueurii* (1 site) and Thick-tailed Gecko *Underwoodisaurus milii* (1 site). Only one species of snake, the Red-naped Snake. *Furina diadema* was detected during the surveys and this species was only found at one site.

A total of just over 80 bird species was detected during the surveys, which was relatively low compared with high quality habitats in the region such as occur at Munghorn Gap Nature Reserve. The low diversity of birds is attributable to several factors including:

- The disturbed nature of many of the survey sites, which have been heavily grazed by livestock and which are dominated by relatively young trees;
- The fact that habitats were predominantly dry woodland and did not include any creek or wetland areas;
- The timing of some surveys, which were conducted in April, after most migrant birds would have left the area.

Several Vulnerable bird species were detected in larger woodland patches along the transmission line and these included:

- Glossy Black-cockatoo *Climacteris picumnus* Site S56, between S84 and S85
- Brown Treecreeper *Climacteris picumnus* Sites S15, S164, S198 & S209
- Speckled Warbler *Chthonicola sagittata* Sites S84, between S84 and S85, S85, S164, S194 & S195
- Diamond Firetail *Stagonopleura guttata* Sites S15 & S209

Several other declining woodland bird species were also recorded. These species are not yet listed as endangered or vulnerable, but may be listed in the near future. The declining woodland bird species detected were:

- Southern Whiteface *Aphelocephala leucopsis*
- Jacky Winter *Microeca fascinans*
- Restless Flycatcher *Myiagra inquieta*

The following species, protected under the Bonn Convention for Migratory Animals, were also detected during surveys:

- Rainbow Bee-eater *Merops ornatus*
- Dollarbird *Eurystomus orientalis*

Many of the sites contained mature White Box forest and this is an important foraging habitat for the threatened Regent Honeyeater *Xanthomyza phrygia* and the Swift Parrot *Lathamus discolor* during the winter. The eastern portions of the study area are close to areas where both species are regularly recorded and it is possible that these two species would have been detected had the surveys been undertaken in winter. It is likely that species diversity would have been greater had all surveys been conducted in late winter to mid spring.

Twenty-seven mammal species were detected across the study area and, based upon literature review and database analysis more species are expected to occur (see SIS in Volume 2). Kangaroos and wallabies included Eastern Grey Kangaroo *Macropus giganteus,* Red Necked Wallaby *Macropus rufogriseus,* Wallaroo *Macropus robustus,* and Swamp Wallaby *Wallabia bicolor.* Of these, Eastern Grey Kangaroos were the most abundant and widespread. Other native ground mammals included Short-beaked Echidna *Tachyglossus aculeatus,* Wombat *Vombatus ursinus,* Brown Antechinus *Antechinus stuartii* and Common Dunnart *Sminthopsis murina.*

Tree dwelling marsupials that were detected included three species: Sugar Glider *Petaurus breviceps,* Brush-tail Possum *Trichosurus vulpecula* and Ring-tail Possum *Pseudocheirus peregrinus.*

At least 11 bat species were positively identified and these include:

- Large-eared Pied Bat *Chalinolobus dwyeri*
- Gould's wattled bat *Chalinolobus gouldii*
- Gould's Wattled Bat *Chalinolobus gouldii*
- Common bentwing bat *Miniopterus schreibersii*
- Common Bentwing Bat *Miniopterus schreibersii*
- Eastern Horseshoe Bat *Rhinolophus megaphyllus*
- Yellow-bellied Sheathtail Bat *Saccolaimus flaviventris*
- White-striped Freetail bat *Tadarida australis*

- Large Forest Bat *Vespadelus darlingtoni*
- Southern Forest Bat *Vespadelus regulus*
- Little forest bat *V. vulturnus*

Three other species were also tentatively identified from their calls and these included:

- Eastern Freetail Bat *Mormopterus norfolkensis*
- Eastern Cave Bat *Vespadelus troughtoni?*
- Chocolate Wattled Bat *Chalinolobus morio?*

Introduced vertebrates were abundant at many places in the study area, as is typical of the bioregion. One exotic bird was found: Common Starling *Sturnus vulgaris*. Exotic mammals found include Red Fox *Vulpes vulpes*, Feral Cat *Felis cattus*, Rabbit *Oryctolagus cunitulus*, Brown Hare *Lepus capensis*, House Mouse *Mus musculus* and Black Rat *Rattus rattus*.

5.4.4 Significant Flora and Fauna

Detailed descriptions and conservation attributes of al threatened flora and fauna species found in the locality is provided in the SIS contained in Volume 2 of the EIS. Table 5.11 lists these species and communities with the legal conservation status of each.

Table 5.11 – Major Threatened Species and Communities Found within the Study Area

Common Name	Species / Community Name	TSC Act	EPBC Act
Endangered Ecological Communities			
	White Box Yellow Box Blakely's Red Gum Woodland	E	
	Fuzzy Box Woodland	E	
	Yellow Box/Red Gum Grassy Woodland		E
	Grassy White Box Woodland		E
Flora			
	Goodenia macbarronii	V	V
Fauna			
Black-chinned Honeyeater	*Melithreps gularis gularis*	V	

Table 5.11 – Major Threatened Species and Communities Found within the Study Area

Common Name	Species / Community Name	TSC Act	EPBC Act
Painted Honeyeater	*Grantiella picta*	V	
Brown Treecreeper	*Climacteris picumnus victoriae*	V	
Diamond Firetail	*Stagonopleura guttatata*	V	
Glossy Black-cockatoo	*Calyptorhynchus lathami*	V	
Hooded Robin	*Melanodryas cucullata cucullata*	V	
Speckled Warbler	*Pyrrholaemus sagittatus*	V	
Square-tailed Kite	*Lophoictinia isura*	V	
Masked Owl	*Tyto novaehollandiae*	V	
Turquoise Parrot	*Neophema pulchella*	V	
Squirrel Glider	*Petaurus norfolcensis*	V	
Large-eared Pied Bat	*Chalinolobus dwyeri*	V	V
Common Bentwing Bat	*Miniopterus schreibersii*	V	
East-coast Freetail Bat	*Mormopterus norfolkensis*	V	
Yellow-bellied Sheathtail bat	*Saccolaimus flaviventris*	V	
Eastern Cave Bat	*Vespadelus troughtoni*	V	

Note: For further detail on these and other relevant threatened species refer to the SIS in Volume 2.

5.4.5 Impact Assessment and Mitigation Strategies

Following the selection of the alignment resulting in the least impact, further analysis was undertaken by TransGrid to determine the amount of clearing of forested areas actually required as a result of the proposal. Although it could, at first glance, be expected that all patches through which the transmission line runs would be totally cleared and / or substantially altered, this is not the case.

TransGrid looked specifically at the topographical relationship of the tower locations when compared to the patch locations. In simple terms, not all of the remnant vegetation underneath the powerlines needs to be cleared or altered, as the lines will clear the top of the tree canopy in various locations. These locations primarily consist of valleys or depressions where towers are located on rises, crests or hills.

It has been determined that the actual area of clearing will be 97.5 ha. This compares to the initial impact area calculated by GIS analysis of 130.1 ha. In summary, although it was assumed during the initial alignment option investigation that an area roughly equivalent to the 130.1 ha figure would be impacted, this has been reduced by an estimated 25% (32.6 ha) as a result of the TransGrid additional tower location impact investigation.

5.4.5.1 Fauna Rescue and Pre-clearance Surveys

During the construction phase, when trees and other vegetation will be cleared, native fauna rehabilitation and protection will be considered. The aim of this protocol is to provide for the protection and humane removal of any native fauna disturbed by the clearance operation.

The majority of trees in the study area are regrowth and lack tree hollows. For this reason, it is not anticipated that much wildlife will be disturbed by the minimal clearance operation. Animals such as birds are expected to move away from the areas to be cleared and are not expected to need human assistance to move to safe areas. However, there is still some potential for a variety of less mobile native fauna to be impacted by the clearance and to need to be moved to safe areas.

Provisions will be made to protect such immobile native fauna by the following means:

- All persons working on the transmission line construction will be briefed about the possible fauna present at the time of construction, and what procedures should been undertaken in the event of an animal being injured or disturbed;
- A qualified animal rescue person will be on call at all times during clearing;
- Immediately prior to clearing a brief pre-clearance survey will be made for immobile animals that could be killed or injured by the felling of trees. The inspection will be made by a suitably qualified person;
- If any such animals are detected within trees, the trees will not be cleared until the animals have moved from the trees of their own volition;
- Animals disturbed or dislodged during the clearance but not injured will be assisted to move to vegetation close by that is identified for retention; and
- If animals are inadvertently injured during the vegetation clearance the wildlife carer will be responsible for taking appropriate steps to humanely treat the animal.

5.4.5.2 Nest Box Erection

Nest boxes will be utilised to compensate for the loss of either:

- Trees with hollows that require removal as a result of tower construction / transmission line location; or
- Trees with potential to form hollows within the easement location.

The nest boxes will be of various sizes and contain various sized openings. Such design features provide habitat for a various range of threatened and non-threatened fauna. However, selection of nest boxes will be aimed at providing compensatory habitat for the following threatened fauna known or considered likely to occur within the subject site and / or study area:

- Squirrel Glider (*Petaurus norfolcensis*);
- Bats including Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), Eastern Freetail-bat (*Mormopterus norfolkensis)*, Greater Long-eared Bat (*Nyctophilus timoriensis*) and Yellow-bellied Sheath-tail Bat (*Saccolaimus flaviventris*);
- Brown Treecreeper (Climacteris picumnus victoriae); and
- Other threatened avifauna including Glossy Black Cockatoo (*Calyptorhynchus lathami*), Turquoise Parrot (*Neophema pulchella*), Barking Owl (*Ninox connivens*), Masked Owl (*Tyto novaehollandiae*) and Powerful Owl (*Ninox strenua.*

Although various types of nest boxes are proposed to be used, the most important nest boxes will be for the Brown Treecreeper, Glossy Black Cockatoo and threatened bats, which are definitely known to occur along the transmission line. Squirrel Gliders have also been targeted despite not being recorded by Cumberland Ecology, as they are known to occur in the locality (Resource Strategies 2005b).

Nest boxes are to be placed within the study area in the largest woodland patches. Such patches would be likely to provide more security for species that would potentially inhabit the nest boxes. This is particularly so for species such as the Brown Treecreeper, which is known to prefer large contiguous patches as its habitat.

5.4.5.3 Site-specific Conservation Measures

At two locations along the transmission line certain threatened species have been recorded, for which the terrestrial environment is very important. These species were:

- *Goodenia macbarronii*; and
- Stripe-faced Dunnart.

Goodenia macbarronii was found at Tower 91. For this species, the tower location was moved so as to avoid clearing known habitat of this species. In addition, it is proposed to have a reduced level of understorey management near Tower 91 to maintain north-south connectivity between the areas of habitat for this species. The understorey will be allowed to grow such that shrubs can grow to provide shelter in this location (i.e. slashing will not occur).

The Stripe-faced Dunnart was recorded near Tower 207. In this area, a reduced level of understorey management will occur similarly to that which will happen for *Gooodenia macbarronii*. This will allow for increased shelter to protect this species from predators (such as foxes and owls) when moving across the transmission line between patches of habitat.

5.4.6 Offset Strategies and Sustainability

The proposed development requires the clearing of 97 hectares of woodland, of which approximately half is EEC communities. This will entail an initial net loss of woodland from the study area and from the bioregion, which is the most extensively cleared bioregion in New South Wales. However, the vegetation to be cleared is fragmented and consists predominantly of regrowth trees. Furthermore, the understorey has been extensively modified by livestock grazing.

The known occurrence of the threatened plant *Goodenia mcbarroni* will be protected and will not be impacted by the proposed development.

There will be an initial net loss of fauna habitat, including habitat for a number of threatened fauna species. Among the species most affected are habitat for the listed threatened species of birds and bats including Speckled Warbler, Brown Treecreeper, Diamond Firetail, Yellow-bellied Sheath-tail Bat and other species. There will also be impacts upon Listed Marine species (overfly marine area), including birds such as Rainbow Bee Eater and the Dollar Bird.

As TransGrid does not acquire freehold land for its transmission lines, only easements over land owned by others, it is difficult for TransGrid to undertake to establish environmental enhancement areas as offsets for the transmission line impacts. Even undertaking tree planting for visual screening purposes requires the consent of the land owner.

In recognition of this, TransGrid has supported Greening Australia's coordinated environmental action, including its GreenSweep program. Under a new major agreement TransGrid's GreenGrid project provides financial support annually. TransGrid has to date assisted in rehabilitating 380 ha of degraded land and improving faunal corridors by linking remnant vegetation. Annual funding allows for the planting of over 100,000 trees each year which is the equivalent of approximately 142 ha of woodland equivalent. This is well in excess of the woodland removed by new transmission line projects undertaken by TransGrid.

TransGrid is also involved in joint environmental research programs with Universities, Department of Environment and Conservation (National Parks) and local community groups. Programs include research and monitoring of threatened species and assisting with their recovery throughout NSW.

In addition to state wide initiatives, TransGrid will develop a package of conservation initiatives for this project. These initiatives would need to involve conservation outcomes consistent with the impacts of the project such as revegetation or enhancement of endangered ecological communities, including Grassy White Box Woodland (the EPBC Act EEC) and the closely

related/overlapping White Box - Yellow Box – Blakely's Red Gum Woodland (the TSC Act EEC).

There may be opportunities for TransGrid to also assist Excel Mining in their revegetation program in the Wilpinjong Environment and Conservation Area which is crossed by the transmission line. This may involve additional reafforestation work on land owned by Excel Mining on the mine development land or at other appropriate locations.

This offset strategy may enable TransGrid to compensate specifically for the immediate habitat lost as a result of the project in addition to its ongoing GreenGrid program with Greening Australia.

TransGrid's approach to sustainability is at an organisation level and is assessed on a statewide basis. Environmental initiatives extend beyond replacement of vegetation loss through new transmission line projects and include, pollution reduction programs, waste minimisation, recycling, environmental performance monitoring, education programs, electricity demand management and environmental research.

5.5 Aboriginal Archaeology and European Heritage

OzArk Environmental and Heritage Management Pty Ltd was engaged to undertake an Indigenous and non-Indigenous heritage assessment of the proposed Wollar – Wellington transmission line.

The archaeological investigation included the following aspects:

- a search of all relevant registers of information for both Indigenous and non-Indigenous heritage: the NSW Department of Environment and Conservation (DEC) Aboriginal Heritage Information Management System (AHIMS); the NSW Heritage Office Heritage Register and State Heritage Inventory; the National Trust of Australia (NSW) Register; the Register of the National Estate (Australian Heritage Commission); the Australian Heritage Places Inventory and the Wellington and Mid Western Local Government Area LEP's;

- a review of the relevant literature including previous consulting reports, academic theses and articles and heritage studies undertaken for local councils;

- consultation with the Gallannggabang Aboriginal Corporation (GAC), Warrabinga Native Title Claimants Corporation (Warrabinga), Murong Gialinga ATSIC (MGATSIC) and the Mudgee Local Aboriginal Land Council (MLALC). It should be noted that the Wellington Local Aboriginal Land Council was defunct prior to and during this consultancy;

- pedestrian field survey to identify and record all cultural heritage sites and relics within the proposed impact corridor for the transmission line and

associated access tracks;

- assessments of the significance of any recorded sites and the formulation of appropriate management strategies; and

- completion of documentary evidence (e.g. DEC AHIMS Site Cards, NSW Heritage Council Inventory sheets or Statements of Heritage Impacts (SoHI's) for any sites/relics located during the survey for the notification of the relevant authorities.

The duration of field work totaled 14 days undertaken on:

- 17 – 18 February 2005;

- 10 -11 March 2005;

- 17-18 March 2005;

- 30 March – 1 April 2005;

- 14 – 15 April 2005; and

- 27 – 29 April 2005.

The archaeological assessment is summarised in the following sections and contained in full in **Appendix B** (Volume 2).

5.5.1 Aboriginal Heritage

Aboriginal groups that participated in the survey were the Gallannggabang Aboriginal Corporation (GAC), Warrabinga Native Title Claimants Corporation (Warrabinga) and Murong Gialinga ATSIC (MGATSIC). These groups provided representatives throughout the length of the project and were chosen following public advertising for participation in the Aboriginal Heritage Survey. All organisations provided one – two representatives per day during the field assessments. Mudgee LALC was also invited but did not participate. It is understood that cultural heritage issues in the Mudgee LALC area are frequently managed by MGATSIC.

Previous archaeological research undertaken in the region indicates that a long history of Indigenous occupation has occurred and that the most common type of site (in landforms away from escarpment country) are open sites near watercourses.

The surveys undertaken for this project recorded 28 Indigenous sites. Nineteen of these were open sites, nine of which also have Potential Archaeological Deposit (PAD); seven isolated finds and two PAD's.

Of the 28 recorded sites along the proposed Wellington – Wollar transmission line easement, 11 will be directly impacted by the proposed works, while a further 6 require mitigative measures to ensure they are not impacted. The categorising of these 17 sites into groups according to recommended management simplifies the presentation of the devised management strategies and mitigative measures. Table 5.12 summarises the major features for each of these sites, while full site descriptions can be found in **Appendix B** (Volume 2).

As well as recording these 28 Indigenous sites, the study also identified archaeological sensitivity at several tower locations or creek crossings, often close to recorded sites. These tower sites or creek crossings are listed in Table 5.13.

It should be noted that the access road to be constructed across Wollar Creek to the Wollar Substation Site has been separately assessed in detail as part of the Development Application for the Substation and is not included in the activity assessed in this EIS.

Although there are a number of specific recommendations made for each recorded site, TransGrid intends to apply for a whole of development Section 87(1) / 90 permit at the project outset to cover all monitoring, test excavation and partial site destructions so as to streamline the permit application process.

Table 5.12 - Descriptions of Indigenous sites recorded during the current survey.

Site Number	Site Type	GPS	Artefacts	Landform	Level of disturbance	Arch. Potential
UC-OS1 with PAD	Artefact scatter >20 artefacts	710371 E 6408520 N	good quality quartz flakes and several hornsfeld flakes	Creek bank	Low-Moderate	Moderate
UC-OS2	Artefact scatter <5 artefacts	710270 E 6409577 N	quartz and quartzite flakes	Creek bank	Moderate	Low
UC-OS3 with PAD	Artefact scatter <15 artefacts	709935 E 6409813 N	Chert, good quality quartz, quartzite and hornsfeld whole and broken flakes and cores	Creek bank	Low-Moderate	Moderate
CR-OS4 with PAD	Artefact scatter >1000 artefacts	713405 E 6411246 N	good quality quartz, quartzite, hornsfeld, chert and rhyolite. flakes, cores, retouched tools, and a Bondi point	Elevated terrace near water	Low	High
GC-OS5 with PAD	Artefact scatter >100 artefacts	716819 E 6412701 N	whole and broken flakes, a ground edged axe and cores	Elevated creek bank	Low	High
GC-OS6	Artefact scatter >15 artefacts	717231 E 6412758 N	Whole and broken flakes, a pounder and cores	Elevated creek bank	Moderate	Low
WC-IF1	Isolated Find	730960 E 6419061 N	Quartz flake	Floodplain	Moderate	Low
CT-OS7	Artefact scatter >10 artefacts	717231 E 6412758 N	Chert core fragment, a Quartzite flake, a Chert blade and Chert flakes	Degraded floodplain	Moderate: Erosion and depletion of A horizon soils	Low-Moderate: Landform suggests very little A horizon soils remaining (ca 5 cm)
BSR-OS8	Artefact scatter >10 artefacts	746098 E 6427869 N	Chert core and flake, a Chert scrapper and a number of other Chert and Quartz flakes.	Degraded floodplain	Moderate: Erosion and depletion of A horizon soils	Low-Moderate: Landform suggests very little A horizon soils remaining (ca 5 cm)
SDC-OS9 with PAD	Artefact scatter <5 artefacts	746098 E 6427869 N	Two fine grained volcanic flakes and a mudstone core	Alluvial terrace near water	Low-moderate: Erosion and depletion of A horizon soils	Moderate: Sensitive landform and good depth of A horizon soils
SC-OS10	Artefact scatter <5 artefacts	746098 E 6427869 N	Tuff flake and a Quartzite flake	Plateau above creek (creek level now 4 metres below plateau level)	Moderate: Erosion and depletion of A horizon soils	Low: Landform suggests very little A horizon soils remaining (ca 5 cm)

Table 5.12 - Descriptions of Indigenous sites recorded during the current survey.

Site Number	Site Type	GPS	Artefacts	Landform	Level of disturbance	Arch. Potential
WC-OS11	Artefact scatter <5 artefacts	777749 E 6409065 N	Chert flake with retouch, a mudstone flake, a Chert blade and a broken Chert flake	High ground above Wollar Creek	Moderate: Erosion and depletion of A horizon soils	Low: Landform suggests very little A horizon soils remaining (ca 5 cm)
WC-OS12 with PAD	Artefact scatter <5 artefacts	746098 E 6427869 N	Chert flake and a fine-grey volcanic flake	low terrace 50 m from water	Moderate: Site has been ploughed and it is within the impact zone of severe floods	Moderate: Sensitive landform and good depth of A horizon soils
WC-IF2	Isolated Find	774081 E 6420248 N	Silcrete flake	Floodplain	Moderate: Site has been ploughed and it is within the impact zone of severe floods	Low: Landform suggests artefact not *in situ*
WC-IF3	Isolated Find	771371 E 6419748 N	grey volcanic scraper	Floodplain	Moderate: Site has been eroded and it is within the impact zone of severe floods	Moderate: Part of Navin Officer WCP 174
WC-PAD1	PAD	771627 E 6419797 N		Floodplain	Moderate: Site has been eroded and it is within the impact zone of severe floods	Moderate: Part of Navin Officer WCP 174
WC-PAD2	PAD	770833 E 6419666 N		Floodplain	Moderate: Site has been eroded and it is within the impact zone of severe floods	Moderate: Close to Navin Officer WCP 134
WC-OS13 with PAD	Artefact scatter <5 artefacts	769987 E 6420251 N	Tuff blade, two Quartz flakes, one with single edge retouch, and a fragment of a grindstone	Elevated terrace, 30 metres from water	Moderate: Site has been ploughed and it is within the impact zone of severe floods	Moderate: Sensitive landform and good depth of A horizon soils

Table 5.12 - Descriptions of Indigenous sites recorded during the current survey.

Site Number	Site Type	GPS	Artefacts	Landform	Level of disturbance	Arch. Potential
WC-OS14	Artefact scatter <5 artefacts	769878 E 6420402 N	Quartz flakes	Floodplain	High: Dam construction	Low: Heavy disturbance of archaeological deposits
WC-IF4	Isolated Find	769272 E 6420809 N	Chert Blade	Valley slopes	Moderate: Erosion	Low: Eroded archaeological deposits
WC-OS15 with PAD	Artefact scatter >5 artefacts	769001 E 6421143 N	Tuff blade, a Chert blade and a Quartz flake	Low terrace on floodplain (ca. 1 metre above surrounding land)	Moderate: Site has been cleared and it is within the impact zone of severe floods	Moderate: Moderately sensitive landform and good depth of A horizon soils
WC-OS16 with PAD	Artefact scatter >15 artefacts	767367 E 6422761 N	Chert flake, a Chert core element, a Quartz flake and a Chert blade	Knoll top 250 metres away from water	Low: Some deflation of A horizon soils by erosion	Moderate: Moderately sensitive landform and good depth of A horizon soils
WC-IF5	Isolated Find	767284 E 6422874 N	Chert blade	Valley slope 75 metres from water	High: Artefact probably not *in situ*	Low: 5 degree slope suggests artefact not *in situ*
SHC-IF6	Isolated Find	757719 E 6424379 N	Quartz flake	Floodplain	High: Heavy erosion of creek bank	Low: Heavy erosion suggests artefact not *in situ*
WC-OS17	Artefact scatter >20 artefacts	766479 E 6423495 N	Chert flakes, a Chert core, and Quartz flakes	Knoll above floodplain close to water	Low: Some deflation of landscape through erosion	Moderate: Sensitive Landform and good depth of A horizon soils
WC-OS18	Artefact scatter <5 artefacts	765865 E 6423952 N	Chert flakes	Floodplain	High: Erosion. Artefacts probably not *in situ*	Low: Heavy erosion suggests artefact not *in situ* and a landform with low sensitivity (floodplain)
MC-OS19	Artefact scatter >5 artefacts	758251 E 6424320 N	Quartz flakes/chips	Floodplain/sandy soil	Moderate: Some deflation of landscape through landuse and erosion	Moderate: Moderately sensitive landform and good depth of A horizon soils
WW-IF7	Isolated Find	775615 E 6412143 N	Quartz flake	Valley slope	Moderate: Erosion	Low

Table 5.13 - All tower sites and creek crossings within the study area that have Indigenous Heritage recommendations attached to them.		
Tower Number or Creek Crossing	**Management Recommendation**	**Reason for Recommendation**
9	A temporary onion skin fence should be erected 20 metres west of tower 9	**WW-IF7** lies 30 m west of tower 9.
30	Section 87(1) Monitor excavation of tower foundations.	Moderately sensitive landform. Proximity to Wilpinjong Creek and **WC-OS12 with PAD**
32	Section 87(1) Monitor excavation of tower foundations.	Moderately sensitive landform. Proximity to Wilpinjong Creek and **WC-IF2**
35	Section 87(1) Monitor excavation of tower foundations.	Moderately sensitive landform. Proximity to Wilpinjong Creek and previously recorded sites (Navin Officer WCP 193 and 151: open artefact scatters)
36	Section 87(1) Test excavation within impact footprint of tower.	**WC-PAD1**. Moderately sensitive landform. Proximity to Wilpinjong Creek. Depth of deposit. Proximity to Navin Officer WCP 174: open artefact scatter with >500 artefacts and, on other side of creek WCP 134 (artefact scatter)
37	Section 87(1) Test excavation within impact footprint of tower.	**WC-PAD1**. Moderately sensitive landform. Proximity to Wilpinjong Creek. Depth of deposit. Proximity to Navin Officer WCP 174: open artefact scatter with >500 artefacts and, on other side of creek WCP 134 (artefact scatter)
38	Section 87(1) Test excavation within impact footprint of tower.	**WC-PAD2**. Moderately sensitive landform. Proximity to Wilpinjong Creek. Depth of deposit. Proximity to Navin Officer WCP 134 (artefact scatter)
41	Section 87(1) Monitor excavation of tower foundations.	Proximity to **WC-OS13**
46	Section 87(1) Monitor excavation of tower foundations.	Moderately sensitive landform. Proximity to Wilpinjong Creek and **WC-OS15 with PAD**
Wilpinjong Creek crossing	Section 87(1) Monitor. Wilpinjong Creek crossing west of tower 50. No construction 40 m east of proposed crossing	Unrecorded site present on low knoll 80 m east of creek crossing.
51	Section 87(1) Monitor excavation of tower foundations.	Proximity to Wilpinjong Creek and **WC-OS16 with PAD** and **WC-IF5**

Table 5.13 - All tower sites and creek crossings within the study area that have Indigenous Heritage recommendations attached to them.		
Tower Number or Creek Crossing	**Management Recommendation**	**Reason for Recommendation**
53	Section 87(1) Test excavation within impact footprint of tower.	Right on site **WC-OS17 with PAD**
80	Section 87(1) Monitor excavation of tower foundations.	Moderately sensitive landform. Proximity to **MC-OS19** and Moolarben Creek
112	Section 87(1) Test excavation within impact footprint of tower.	Proximity to **BSR-OS8**.
128	Section 87(1) Monitor excavation of tower foundations.	Proximity to **SC-OS10**.
134	Section 87(1) Monitor excavation of tower foundations.	Proximity to **SDC-OS9**
Slapdash Creek Crossing	Monitor creek crossing construction under a Section 87(1).	Slapdash Creek Crossing. **SDC-OS9 with PAD** in vicinity, moderately sensitive landform
155	Section 87(1) Monitor excavation of tower foundations.	Proximity to **WC-IF1**
191	Section 87(1) Test excavation within impact footprint of tower.	Right on site **GC-OS5 with PAD** Archaeologically sensitive landform. Depth of deposit
198	Section 87(1) Monitor excavation of tower foundations.	Right on site **CR-OS4 with PAD** Archaeologically sensitive landform. Depth of deposit

The majority of sites were found within 200 m of water, either on the valley slopes or the valley floors (terraces / banks of watercourses).

The majority of areas surveyed have been impacted by agricultural practices and it is highly likely that a number of potential archaeological deposits or other site types along the corridor have been destroyed either directly by these practices or from the resulting erosion and saltation processes.

As the proposed work is the construction of an electricity transmission line, the potential for adverse impacts to archaeological deposits within the proposed corridor is relatively limited. This impact will arise both from the construction phase of the proposed works (excavation of tower foundations and transport of materials on access roads) and the maintenance phase (infrequent use of access tracks by soft-wheeled vehicles and periodic clearing of vegetation along the corridor). Thus, between tower sites, potential impact to archaeological deposits

by the proposed works is low. Further minimising the potential for adverse impacts on archaeological deposits is the fact that the majority of the survey traversed landforms that the predictive model indicated have low potential for the occurrence of Indigenous sites.

5.5.1.1 Archaeological Significance

Cultural

A general discussion was held on site with representatives from GTAC, MGATSIC and Warrabinga to initiate a determination of the cultural significance of the sites recorded in the vicinity of proposed transmission corridor. All sites recorded are of high cultural significance to the Aboriginal community . The community would like to see sites avoided when at all possible.

Scientific

The overall location of sites discovered during the current survey conforms to the general archaeological settlement pattern that has already been established throughout the broader region. Namely the sites are open camp sites or isolated finds in association with seasonal water courses or springs. All sites discovered during the survey were on flat to gently sloping land, again conforming to a pattern that has been noted elsewhere.

Table 5.14 details the scientific assessment of each site recorded during the current survey. Each site has been assessed according to levels of disturbance (low, moderate or high) to the archaeological deposits or site manifestations that comprise each site.

Table 5.14 - Scientific assessment of sites recorded during this survey

Site Number	Type of Site	Disturbance Levels	Archaeological Potential	Scientific significance
UC-OS1 with PAD	Artefact scatter >20 artefacts	Low-Moderate	Moderate	Preliminarily Moderate-High
UC-OS2	Artefact scatter <5 artefacts	Moderate	Low	Low
UC-OS3	Artefact scatter <15 artefacts	Low-Moderate	Moderate	Low-Moderate
CR-OS4 with PAD	Artefact scatter >1000 artefacts	Low	High	High
GC-OS5 with PAD	Artefact scatter >100 artefacts	Low	High	Preliminarily High
GC-OS6	Artefact scatter >15 artefacts	Moderate	Low	Low
WC-IF1	Isolated Find	Moderate	Low	Low
CT-OS7	Artefact scatter >10 artefacts	Moderate	Low-Moderate	Low-Moderate
BSR-OS8	Artefact scatter >10 artefacts	Moderate	Low-Moderate	Low-Moderate
SDC-OS9 with PAD	Artefact scatter <5 artefacts	Low-moderate	Moderate	Preliminarily Moderate

Table 5.14 - Scientific assessment of sites recorded during this survey

Site Number	Type of Site	Disturbance Levels	Archaeological Potential	Scientific significance
SC-OS10	Artefact scatter <5 artefacts	Moderate	Low	Low
WC-OS11	Artefact scatter <5 artefacts	Moderate	Low	Low
WC-OS12 with PAD	Artefact scatter <5 artefacts	Moderate	Moderate	Preliminarily Moderate
WC-IF2	Isolated Find	Moderate	Low	Low
WC-IF3	Isolated Find	Moderate	Moderate	Low
WC-OS13 with PAD	Artefact scatter <5 artefacts	Moderate	Moderate	Preliminarily Moderate
WC-OS14	Artefact scatter <5 artefacts	High	Low	Low
WC-IF4	Isolated Find	High	Low	Low
WC-OS15 with PAD	Artefact scatter >5 artefacts	Moderate	Moderate	Preliminarily Moderate
WC-OS16 with PAD	Artefact scatter >15 artefacts	Low	Moderate	Preliminarily Moderate
WC-IF5	Isolated find	High	Low	Low
SHC-IF6	Isolated find	High	Low	Low
WC-OS17 with PAD	Artefact scatter >20 artefacts	Low	Moderate	Preliminarily Moderate
WC-OS18	Artefact scatter <5 artefacts	High	Low	Low
MC-OS19	Artefact scatter >5 artefacts	Moderate	Moderate	Moderate
WW-IF7	Isolated Find	Moderate	Low	Low
WC-PAD 1	Potential Archaeological Deposit	Low	High	Preliminarily Moderate
WC-PAD 2	Potential Archaeological Deposit	Low	High	Preliminarily Moderate

Public

All but one of the recorded open sites (OS) and Potential Archaeological Deposits (PADs) located during the present survey are assessed as having low public significance due to the nature of the sites (i.e. they are artefact scatters with relatively low numbers of artefacts per square metre). They are also all located on privately owned land causing them to be inaccessible to the general public. As such these sites are therefore difficult for the lay person to interpret.

The only site that may be of public significance is CR-OS4. The extensive distribution of the surface artefacts at this site and the unusually high frequency of artefacts eroding from *in situ* deposits causes this site to be more interpretable to the lay person, especially with the aid of interpretation.

5.5.1.2 Impact Assessment

Table 5.15 below details the assessed likely impacts to recorded sites after the mitigative measures developed during the project have been applied.

Table 5.15 - Summary of Likely Impacts to Recorded Indigenous Sites.

Site Number	Type of Site	Detailed Impacts from Proposed Works	To be Impacted
UC-OS1 with PAD	Artefact scatter >20 artefacts	UC-OS1 will be impacted by the construction of an access track across Uamby Creek.	Yes
UC-OS2	Artefact scatter <5 artefacts	UC-OS2 will be not impacted as it has been decided not to use this access track	No
UC-OS3	Artefact scatter <15 artefacts	UC-OS3 is near a creek crossing of Uamby Creek that requires excavation to reduce the grade of the bank such that an access track can be constructed.	Yes
CR-OS4 with PAD	Artefact scatter >1000 artefacts	Although TransGrid have tried to shift this tower to avoid this site, it has proven impossible to do. Tower 198 is located within the boundaries of this site, although near a disturbed portion of it.	Yes
GC-OS5 with PAD	Artefact scatter >100 artefacts	Under the current proposed impact plan GC-OS5 will be impacted by tower 191, although TransGrid are seeking to move this tower so as to span the site.	Yes
GC-OS6	Artefact scatter >15 artefacts	GC-OS6 will not be impacted by the proposed development if all vehicles follow the existing agricultural fence lines and do not cut across the paddock	No
WC-IF1	Isolated Find	WC-IF1 will be impacted by tower 155.	Yes
CT-OS7	Artefact scatter >10 artefacts	Although originally within the proposed impact zone, TransGrid shifted tower 91 such that CT-OS7 will now not be impacted.	No
BSR-OS8	Artefact scatter >10 artefacts	BSR-OS8 lies within the impact zone of tower 128.	Yes
SDC-OS9 with PAD	Artefact scatter <5 artefacts	SDC-OS9 lies to the west of the easement corridor and will not be impacted by the proposed works or access roads.	No
SC-OS10	Artefact scatter <5 artefacts	SC-OS10 will be impacted as it is on the access track that will be used during construction of tower 128.	Yes
WC-OS11	Artefact scatter <5 artefacts	WC-OS11 will not be impacted as the proposed creek crossing will not be constructed here.	No
WC-OS12 with PAD	Artefact scatter <5 artefacts	WC-OS12 lies 20 m north of tower 30 and will not be impacted by the proposed works.	No

Table 5.15 - Summary of Likely Impacts to Recorded Indigenous Sites.

Site Number	Type of Site	Detailed Impacts from Proposed Works	To be Impacted
WC-IF2	Isolated Find	WC-IF2 lies within the easement corridor but will not be impacted by the proposed works or access tracks.	No
WC-IF3	Isolated Find	WC-IF3 lies within the easement corridor but will not be impacted by the proposed works or access tracks.	No
WC-OS13 with PAD	Artefact scatter <5 artefacts	WC-OS13 lies 30 m south of tower 41 and will not be impacted by the proposed works.	No
WC-OS14	Artefact scatter <5 artefacts	WC-OS14 lies to south of the easement corridor and will not be impacted by the proposed works.	No
WC-IF4	Isolated Find	WC-IF4 lies 21 m south of the centre line of the easement corridor and will not be impacted by the proposed works.	No
WC-OS15 with PAD	Artefact scatter >5 artefacts	WC-OS15 lies to the north of the easement corridor and will not be impacted by the proposed works.	No
WC-OS16 with PAD	Artefact scatter >15 artefacts	WC-OS16 lies 26 m south of the centre line of the easement corridor and will not be impacted by the proposed works.	No
WC-IF5	Isolated find	WC-IF5 lies to the north of the easement corridor and could be impacted by the proposed works as it lies on a track that could be used as access during construction.	Yes
SHC-IF6	Isolated find	SHC-IF6 lies 100 m to the east of the easement corridor and will not be impacted by the proposed works.	No
WC-OS17 with PAD	Artefact scatter >20 artefacts	WC-OS17 will be directly impacted by the building of tower 53.	Yes
WC-OS18	Artefact scatter <5 artefacts	WC-OS18 lies outside of the easement corridor and will not be impacted by the proposed works.	No
MC-OS19	Artefact scatter >5 artefacts	MC-OS19 lies to the north of the easement corridor and will not be impacted by the proposed works.	No
WW-IF7	Isolated Find	WW-IF7 lies outside of the easement corridor and will not be impacted by the proposed works.	No
WC-PAD 1	Potential Archaeological Deposit	WC-PAD 1 will be directly impacted by the construction of tower 37a.	Yes
WC-PAD 2	Potential Archaeological Deposit	WC-PAD 2 will be directly impacted by the construction of tower 38.	Yes

5.5.1.3 Management

In terms of management options that have been utilised for the project, these are best summarised into the following groups as follows:

Group 1 – Sites to be fenced off (6): WC-OS12 with PAD; WC-OS13 with PAD; WC-OS15 with PAD; WC-OS16 with PAD; MC-OS19; WW-IF7.

Sites of this group will be identified in the field prior to any construction impacts occurring. An appropriate curtilage should be delineated around these sites using a highly visual physical barrier (i.e. 1 m high orange roadwork fencing). This will ensure all sites can be easily identified and protected from inadvertent machinery impacts. Members of the construction team, including sub-contractors, machine operators and truck drivers should undergo site induction concerning cultural heritage issues, prior to working on the site. The induction will inform workers/contractors of the location of nearby sites, and of their legislative protection under Section 90 of the NSW National Parks and Wildlife Act 1974.

Group 2 – Sites requiring a Section 87(1) permit for collection or relocation (2): WC-IF1; WC-IF5.

The two sites of this group will require application by TransGrid to the NSW DEC for a Section 87(1) permit to collect and relocate these isolated finds prior to any development impacts occurring.

Group 3 – Sites requiring a Section 87(1) permit for monitoring (3): UC-OS1 with PAD; UC-OS3; SC-OS10.

The sites of this group will require application by TransGrid to the NSW DEC for a Section 87(1) permit to monitor earthworks at these locations. Monitoring will be undertaken by an archaeologist or suitably qualified Aboriginal community members. The fate of any artefacts recovered will be determined by the Aboriginal community as to whether they wish the artefacts to be reburied in a recorded location or retained through application to the NSW DEC for a Care and Control permit.

Group 4 – Sites requiring a Section 87(1) permit for test excavation (6): GC-OS5 with PAD; CR-OS4; BSR-OS8; WC-OS17 with PAD; WC-PAD 1 and WC-PAD 2.

These sites are characterised by having, at minimum, low-moderate potential for intact, sub-surface deposits. Sites of this group to be impacted by the proposal will require application by TransGrid to the NSW DEC for a Section 87(1) permit to undertake test excavation at these sites. The results of test excavation will allow an accurate characterisation of the archaeological resource (i.e. nature, extent and integrity of sub-surface deposits) subsequently enabling the formulation of appropriate management strategies. It is important to note that test excavation at these locations will only be required within the areas that are to be impacted as a result of the proposed development. This, in many cases, will mean test pitting in very limited areas.

Site specific management recommendations and mitigation measures are detailed in Table 5.16.

Table 5.16 - Impacts and mitigation measures for recorded archaeological sites within the study area.

Site Number	Management Recommendations
UC-OS1 with PAD	UC-OS1 will be impacted by the construction of an access track across Uamby Creek. During construction the site will have to be monitored under Section 87(1). Excavation to the northwest of the creek crossing should be kept to a minimum and geotextile should be used to contain the northwest bank during construction.
UC-OS2	UC-OS2 will not be impacted as a new access track has been chosen so as to avoid this site.
UC-OS3	UC-OS3 is near a creek crossing of Uamby Creek that needs excavation to reduce the grade of the bank. Excavation, with monitoring under a Section 87(1), can take place from the creek up to a point 10 metres beyond the farm gate on the north bank (as erosion has disturbed the archaeological deposits in this area). If excavation north of this point is necessary, a test excavation will be necessary to determine the nature and extent of UC-OS3, although at present proposed impacts only require monitoring.
CR-OS4 with PAD	CR-OS4 is a culturally and archaeologically sensitive site. Although TransGrid attempted to shift tower 198 which impacts this site this has proven impossible. Consequently, test excavation of this site will be required. To mitigate against further inadvertent disturbance to this site fencing will be required along Uamby Road, as well as along the access tracks to Tower 198 and around the construction zone for this tower. It is further recommended that this site be recorded in detail prior to the Proponent undertaking some site preservation measures such as stabilising erosion areas with soil and subsequently planting grasses to inhibit further erosion.
GC-OS5 with PAD	GC-OS5 will require test excavation if the position of tower 191 can not be moved. TransGrid investigated the option to replace tower 191 with two towers to span the site. Although TransGrid attempted to span site GC-OS5, with two towers this has proven not possible. Consequently Tower 191 has been shifted 45m to the west to avoid the main site area. None the less GC-OS5 will be impacted and consequently test excavation of the impact area will be required.
GC-OS6	GC-OS6 will not be impacted by the proposed works if all vehicles follow the existing agricultural fence lines and do not cut across the paddock.
WC-IF1	WC-IF1 will be collected under a Section 87(1) and earthworks on nearby tower 155 will be monitored. The landform containing WC IF 1 is a floodplain and therefore archaeological deposits may have been disturbed by flood action. Intact sub-surface deposits unlikely.
CT-OS7	Although originally impacted by tower 91, CT-OS7 will now be avoided as TransGrid have been able to shift the location of this tower.
BSR-OS8	BSR-OS8 lies within the impact zone of tower 112. Although tower 112 was moved eight meters to the east it will still impact BSR-OS8. As a result test excavation within the impact area will be necessary. Further, when timber is felled across the drainage line all timber should be left in place and not dragged

Table 5.16 - Impacts and mitigation measures for recorded archaeological sites within the study area.

Site Number	Management Recommendations
	across the area of BSR-OS8.
SDC-OS9 with PAD	SDC-OS9 lies to the west of the easement corridor and will not be impacted by the proposed works or access roads.
SC-OS10	SC-OS10 will be impacted as it is on the access track that will be used during construction of tower 128. For the duration of this construction phase conveyor belting should be laid on the access track from the farm gate back down to the vicinity of where erosion has removed A horizon level soils (where the track turns to start the creek crossing). As excavation for the access road will occur more than 6 m upslope from the present north bank, monitoring is recommended under Section 87(1).
WC-OS11	WC-OS11 will no longer be impacted as a different creek crossing is to be used.
WC-OS12 with PAD	WC-OS12 lies 20 m north of tower 30 and will not be impacted by the proposed works. To avoid inadvertent damage by vehicle traffic, a temporary onion skin fence should be erected 15 m north of tower 30 (before the stock tracks) during the construction phase of the electricity towers.
WC-IF2	WC-IF2 lies within the easement corridor but will not be impacted by the proposed works or access tracks.
WC-IF3	WC-IF3 lies within the easement corridor but will not be impacted by the proposed works or access tracks.
WC-OS13 with PAD	WC-OS13 lies 30 metres south of tower 41 and will not be impacted by the proposed works. To avoid inadvertent damage by vehicle traffic, a temporary onion skin fence should be erected along the eastern boundary of the easement during the construction phase of the electricity towers.
WC-OS14	WC-OS14 lies to south of the easement corridor and will not be impacted by the proposed works.
WC-IF4	WC-IF4 lies 21 metres south of the centre line of the easement corridor and will not be impacted by the proposed works.
WC-OS15 with PAD	WC-OS15 lies to the north of the easement corridor and will not be impacted by the proposed works. As WC-OS15 is concentrated around the present gate, a new gate should be placed in the fence within the proposed easement. To avoid inadvertent damage by vehicle traffic, a temporary onion skin fence should be erected along the northern boundary of the easement during the construction phase of the electricity towers.
WC-OS16 with PAD	WC-OS16 lies 26 metres south of the centre line of the easement corridor and will not be impacted by the proposed works. To avoid inadvertent damage by vehicle traffic, a temporary onion skin fence should be erected along the southern boundary of the easement during the construction phase of the electricity towers.
WC-IF5	WC-IF5 lies to the north of the easement corridor and could be impacted by the proposed works as it lies on a track that could be used as access during

Table 5.16 - Impacts and mitigation measures for recorded archaeological sites within the study area.

Site Number	Management Recommendations
	construction. Under a Section 87(1), move WC-IF5 to the site WC-OS16.
SHC-IF6	SHC-IF6 lies 100 m to the east of the easement corridor and will not be impacted by the proposed works. There is no new creek crossing for vehicles planned in the vicinity of SHC-IF6
WC-OS17 with PAD	WC-OS17 will be directly impacted by the building of tower 53. Consequently test excavation will be required prior to the construction of the tower.
WC-OS18	WC-OS18 lies outside of the easement corridor and will not be impacted by the proposed works. There is no new creek crossing for vehicles planned in the vicinity of WC-OS18
MC-OS19	MC-OS19 lies to the north of the easement corridor and will not be impacted by the proposed works. To avoid inadvertent damage by vehicle traffic, a temporary onion skin fence should be erected along the northern boundary of the easement during the construction phase of the electricity towers. There is also potential for further artefacts to be located along the banks of Moolarben Creek and this area should be avoided.
WW-IF7	WW IF 7 lies outside of the easement corridor and will not be impacted by the proposed works. To avoid inadvertent damage by vehicle traffic, a temporary onion skin fence should be erected 20 metres west of tower 9 during the construction phase of the electricity tower.
WC-PAD1	WC-PAD1 will be directly impacted by the construction of tower 36 and 37. Consequently, test excavation will be necessary prior to impacts.
WC-PAD2	WC-PAD2 will be directly impacted by the construction of tower 38. Consequently, test excavation will be necessary prior to impacts.

Beyond the identification of Indigenous sites, the current study also identified archaeological sensitivity at several tower locations and creek crossings, often close to recorded sites. Due to the potential for artefacts, in all likelihood from disturbed deposits, it is recommended that the Proponent seek a Section 87(1) permit to monitor works at these locations as detailed below:

- Tower sites 30, 32, 35, 41, 46, 51, 80, 128, 134 and 155;
- Creek crossings for access roads at Wollar Creek – tower 50, Slapdash Creek – tower 134.

Should any previously unidentified ‘relics’ or other Aboriginal sites (such as burials) be uncovered during the course of construction, work in that area should cease and the DEC Western Regional Archaeologist (Dubbo Office), the Gallannggbang Aboriginal Corporation, Warrabinga Native Title Claimants Corporation, Murong Gialinga ATSIC and Mudgee Local Aboriginal Lands

Council be contacted to discuss how to proceed.

As a result of close consultation with the Indigenous community and the implementation of a range of mitigation strategies involving a combination of avoidance, protection and additional research initiatives, the residual impacts on cultural heritage as a result of the construction and operation of the transmission line is considered acceptable.

5.5.2 European Heritage

The history of the towns of Wellington, Gulgong and Wollar are described in detail in **Appendix B** (Volume 2). A search of the State Heritage Office Inventory revealed two statutory listed items in the Mid-Western Regional Council area and three in Wellington Council's boundaries located within close proximity (2 km) to the proposed Wollar to Wellington 330kV electricity easement. These items were:

- Gulgong railway bridge over Wialdra Creek;
- Yamble Homestead and Outbuildings;
- Macquarie Farm, Wellington;
- Gobolion Homestead, Wellington; and
- Keston "Bella Vista" homestead, Wellington.

None of these items will be impacted by the proposed development.

A search of the *Environmental Protection Biodiversity Act* – Protected Matters Report (search date 26.5.05) within the Mid-Western Regional and Wellington Council tenure revealed two items of Commonwealth heritage within the Wellington Council boundaries (within c. 2 km from the impact corridor):

- Nanima Homestead, Wellington; and
- Yamble Homestead and Outbuildings.

None of these items will be impacted by the proposed development.

5.5.2.1 Survey Results - European Heritage

The field survey of the Wollar - Wellington 330kV Electricity Transmission line site found evidence of 12 non-Indigenous potential heritage features. Details were recorded for each and they are listed below.

Shale Oil Mine

Located c.100 m to the east of Tower 25A. This site consists of two main features (a) mine shaft and (b) former infrastructure area. Several smaller features exist within the general locality including a cut hard wood stock pile which is near the entrance to the mine. Closer to the infrastructure area at least one small pit was

located within close proximity to a slurry heap where the oil was presumably extracted.

The mine shaft appears to be in good condition; however, a portion of the roof at the entrance has collapsed.

Stone Cottage

Located just outside the northern impact corridor adjacent to tower 35. This sandstone cottage was built in 1912 by E Marskell. The building was unoccupied and in fairly good condition and comprised of a number of large bocks of flat sandstone with rounded adzed cypress pine roof beams. This cottage was demolished the day after the photographs were taken. No artefacts were found in the area of the historic feature.

Remnant post and rail fence

Located between towers 36a and 37a. This remnant fence of undressed timber is in derelict condition, all but four (two groups of two) posts are fallen and no trace of the rails was found. The fence and the fallen remains of its other posts are on the immediate bank / break of slope defining the flat alluvium and the Wilpinjong Creek. No other European artefacts were found in the area of the historic feature.

Remnant sheep yards and dip

Located between towers 52 and 53 c. 100 m outside the southern extent of the impact corridor. This remnant sheep yard and former dip are in derelict condition, portions of the undressed timber fence have fallen and weight bearing is likely to cause the structure to collapse. The structure is adjoining the bank / break of slope defining the gentle slope and the Wilpinjong Creek into which the former dip drained. Other European artefacts were found in the area and included old dip containers and bottles.

Remnant farm structures and equipment

Located between towers 53 and 54 within the alignment corridor on the bank of the Wilpinjong Creek. This former cottage site (30 x 30 m) and remnant fences, water tower, out building infrastructure with machinery and well (1.5 x 1.5 m) are in deteriorating condition. No physical traces of the homestead are visible however all of the above-mentioned relicts are still standing and or present. The fence surrounding the former homestead site is of undressed timber and chicken wire, the well is made from slab cut hardwood with deteriorating cover of wooden slats on top, the outhouse (former machinery shed c. 4 x 3 m) remains only as five standing and one fallen rough cut posts with two intact bearers. A former piece of farm machinery is housed within the structure. Additionally within 200 m is an agricultural seed sowing device in relatively good condition. Occasional bottles dating from the 1950's to 1970's were found in the area of the historic feature.

Unknown origin dam wall

Located between towers 87 & 88. It is difficult to determine its exact location in relation to the impact corridor due to extremely rugged terrain and thick scrub that hampered all visibility of survey posts; however this structure is most likely out of the impact corridor. A 7 x 4 x 0.5m granite wall was found within a large ephemeral drainage line. The area behind the wall appeared to be naturally elevated at that point and was currently filled with sand and silt. Numerous granite / sandstone boulders were piled in a manner so to create a wall between a natural rock features however, even when new the structure would have not held water due its permeability and large gaps between the rocks. A thick stand of blackberry immediately below the wall obscured all ground visibility. A logical possibility was that some early mining activity may have resulted in the creation of this structure and as noted above the only suitable location for a shaft was within the blackberry patch. Note: blackberries grow in disturbed soils. No other European artefacts were found in the area of the historic feature.

Unknown origin rock wall / shelter

Located at the tower 87 survey post. A 5 x 2 x 1 m granite / sandstone shelter of natural boulders with a small 1.5 x 1 x 0.5 m wall in a former natural inter-boulder gap was found within a locally occurring rock formation. Numerous small granite / sandstone rocks were piled in a manner so to create a wall between a small gap in the natural rock feature. The structure was very rudimentary and no indication of age other than a thin layer of lichens growing on the uppermost surface. An old wooden fence post occurs within close proximity and the alignment of the wall is the same as the former fence. Note: Lichens are a natural feature on the locally occurring boulders and are often the first colonists of newly exposed rocky areas (Raven *et al* 1992:224) therefore, despite the very harsh local environmental conditions only a thin layer of lichens occur and it is unlikely that this structure is of an age to be a European heritage item (more than 50 years old). A single timber fence post was found in the area of the feature.

Former timber cutters work site

Located between towers 176 and 175 c. 100 m south east of the alignment corridor. This former timber cutters work site appears to be less than 50 years of age as a hand held chainsaw was used to dress the hardwood into slabs. Off cuts and the supporting logs on the ground are all that is left of this site. This area is not consistent with the definition of a relict under the relevant guidelines.

Former mine shafts (x2)

Located between towers 174 and 175 c. 100 m north east of tower 175. These former mine shafts are mostly filled leaving only a c. 1.5 m depression in the ground and tailings near the entrance (2 x 2 m). It is unknown when the shafts were originally sunk. No other European artefacts were found in the area of the historic feature.

Sandy Hollow to Gulgong Railway

Located between Towers 185 & 186. In 1918 a route for a railway line between Maryvale and Sandy Hollow was surveyed. Construction started in 1941, stopped towards the end of World War II and then resumed in 1946, only to be wound up again in 1950. Finally, in 1977, White Industries opened a coal mine at Ulan and the railway was completed to Ulan in 1982 to transport coal to the Port of Newcastle (Muswellbrook Shire Council 2005). The portion of railway at this location was never completed

Sandy Hollow to Gulgong Railway

The preferred easement alignment will also cross a portion of the rail track constructed to service Ulan mine between towers 28 and 28.1. This railway line is currently in operation and no impacts to this area will occur as a result of the proposed work.

Uamby homestead and cemetery

Located c. 1 km south of towers 198 – 201. ERM (2003) identified this heritage item as having local significance. This location was not assessed at it was well outside the impact corridor.

These items are not entered in any heritage register and those occurring within the impact corridor have minor local historic significance.

5.5.2.2 Significance

The following summary statement is based on assessment against the significance criteria of the Heritage Council of NSW:

The Shale Oil Mine ruins are considered to be important at a local level and not important in the broader context of NSW's historical development. There are no known associations with significant people, or groups of people, only to the development of the local area for mining and farming. The items do not have any particular aesthetic, technical or scientific characteristics which make them important to NSW or the local area. The items are unlikely to yield any further information about the cultural or historical development of NSW that is not already known. The items, however, may hold some value for the local community, representing an aspect of the historical development of the area for settlement through early mining technologies and the shaft itself provides an intact example of mining techniques and infrastructure.

Stone Cottage. This stone cottage has subsequently been demolished by Excel Mining Company to develop Wilpinjong Coal after initial photographing. Although close to the Wollar to Wellington 330 kV transmission line impact corridor its management and assessment prior to its destruction is the sole responsibility of the land owner and as such its historical assessment will not be undertaken within the framework of the Proponent's heritage report.

The following items:

- remnant post and rail fence;
- sheep yards and dip;
- farm structures and equipment;
- unknown origin dam wall;
- unknown origin rock wall / shelter; and
- former mine shafts.

are considered to be of limited significance at a local level and not significant in the broader context of NSW's historical development. There are no known associations with significant people, or groups of people, only to the development of the local area for farming. The items do not have any particular aesthetic, technical or scientific characteristics which make them important to NSW or the local area. The items are unlikely to yield any further information about the cultural or historical development of NSW that is not already known. The items are unlikely to hold some value for the local community.

The Sandy Hollow to Maryvale Railway is considered to be of some importance at a local level and of some importance in the broader context of NSW's historical development. It has an association with significant people, or groups of people of the local area for mining with its association with Ulan Coal but having no importance to the development for the area within the limits of the study corridor thereafter. The railway holds some value for the local community, particularly railway enthusiasts.

The cultural landscape of the non-Indigenous relics will not be altered by the proposed Wollar to Wellington 330 kV transmission line construction. The items are considered to be of possible limited local significance, but are only representative of other such ruins and items in the region and NSW.

None of the proposed works will have any impact on the non-Indigenous heritage noted during the survey. For a summary of these impacts see Table 5.17.

Table 5.17 - Summary of Likely Impacts to Recorded Non-Indigenous Sites.

Site Name	Location	Possible Impacts
Shale Oil Mine and Remnant Infrastructure	100 m west of Tower 25a	No direct impacts are associated with the current proposal. Potential impacts are associated with encroachment from contracting staff and vehicles to investigate the feature.
Stone Cottage	50 m north of Tower 35	No direct impact from the current proposal. The building was subsequently demolished by the property owner after initial photography.
Remnant Post and Rail Fence	Within the impact corridor between Towers 36a and 37a.	No direct impact from the current proposal. Potential impacts are associated with inadvertent impacts from contracting staff and vehicles working between the tower sites.
Remnant Sheep Yards and Former Dip	c. 80 m south of the impact corridor between Towers 52 - 53	No direct impact from the current proposal. Potential impacts are associated with inadvertent impacts from contracting staff and vehicles working between the tower sites.
Remnant Farm Structures and Equipment	90 % Within the impact corridor between Towers 53 – 54. 1 piece of farm machinery c. 150 south of the impact corridor along the access track.	No direct impact from the current proposal. Potential impacts are associated with inadvertent impacts from contracting staff and vehicles working between the tower sites.
Unknown Origin Dam Wall	c. 100 south of the impact corridor between Towers 87 - 88	No direct impact from the current proposal. Very unlikely potential impacts are associated with inadvertent impacts from contracting staff between the tower sites due to steep and rugged topography.
Unknown Origin Rock Shelter	Within impact corridor at the location for Tower 87	This feature may be possibly destroyed by the tower placement. It must be noted that this feature is unlikely to be a relic as defined by the Act.
Former Mine Shafts	Outside of impact corridor between Towers 1. 174 – 175 and 2. Tower 180	No direct impact from the current proposal. Very unlikely potential impacts are associated with inadvertent impacts from contracting staff.
Sandy Hollow – Gulgong Railway Line	Within impact corridor between Towers 185 – 186.	No direct impact from the current proposal. Very unlikely potential impacts are associated with inadvertent impacts from contracting staff.
Uamby Homestead and Cemetery	Outside of impact corridor (c. 1.5 km) near towers 198 -201	No direct impacts are associated with the current proposal. Potential impacts are associated with encroachment from contracting staff and vehicles to investigate the feature.

5.5.2.3 Mitigation and Management Measures for Non-Indigenous Heritage

Appropriate management of heritage items is primarily determined on the basis of their assessed significance, as well as the likely impacts of the proposed development – in this case, the construction of towers and access tracks in the area of historic ruins (or relics).

The Wollar - Wellington 330kV transmission line and access roads will not affect the historic items found in the site area. However, where the construction works are to be in close proximity to the ruins or items, a temporary fence may be

constructed for the duration of the construction to avoid any disturbance.

Specific recommendations are as follows:

Unknown Origin Stone Shelter / Wall

This feature is unexplainable within the confines of the field assessment. Although it does not appear to be of an age to classify as a relic under the relevant legislation, management of this site should be precautionary so that due diligence takes precedence. If the site can be avoided it should be fenced with highly visible curtilage and the contractors should be inducted so that any disturbance to the structure. If destruction is unavoidable then it should be recorded with detailed photographs, measurements and drawings so that any potential heritage value can be documented.

Post and Rail and other early agricultural fencing

Rural or agricultural fences have generally tended to be undressed timber post and wire, with early post and rail fences remaining in some areas. Early rural timber and wire fences, post and rail fences, log and chock fences are rare and should be retained and conserved.