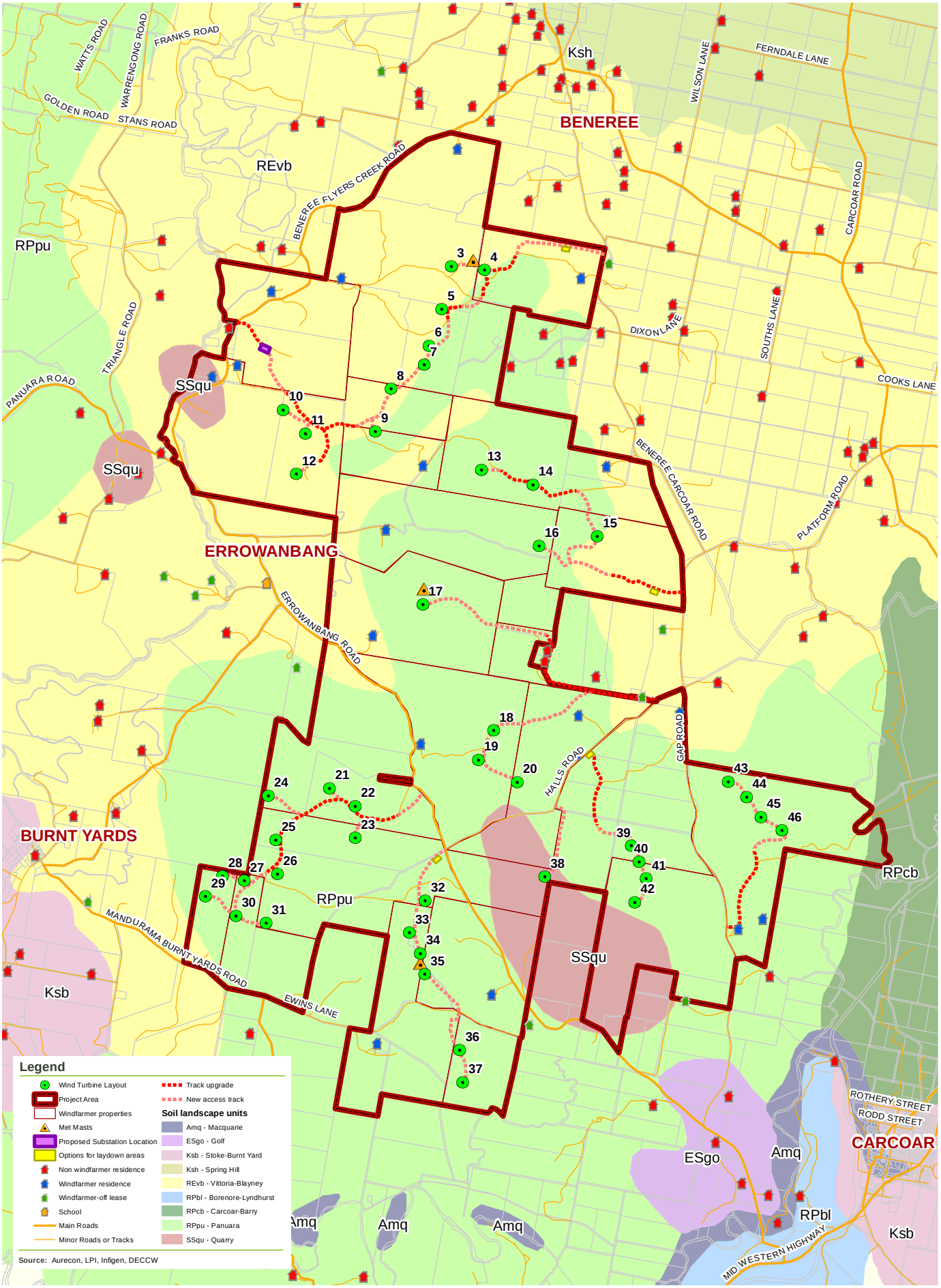


U:\GIS\Project-2\project\Flyers Creek\Maps\s38009_FCWF_soils_240311_fig7-4.mxd\JOB No.\24-03-11\koatRev 0

1:70,000
0 500 1,000 m

Flyers Creek Wind Farm **Environmental Assessment**

Projection: GDA 1994 MGA Zone 55
Notes: Soils base data was created at 1:250,000, therefore mapping boundaries shown at this scale are indicative only

FIGURE 7.5: Soil Landscape

7.5.2 Slope analysis

A slope analysis for the wind farm site is shown in Figure 7.6. The steepest slopes at the wind farm site are the sides of valleys, and in most cases these areas are avoided for the access tracks and as turbine sites and will not be disturbed during the construction works. Most of the development, including the access tracks, will be on flat to gently sloping ground.

There are some areas where sections of the access tracks are located on the steeper slopes, where it is the most suitable route. These locations include the track between Turbines 32 and 33, in the vicinity of Turbine 37 and the ascent to the ridge where turbines 43 to 46 are located. These areas will be specifically designed to minimise the grade and include drainage to avoid erosion of the surrounding slopes. Earthworks in these areas will be designed to ensure that the completed formations are stable in the long term.

7.5.3 Potential impact on the soils

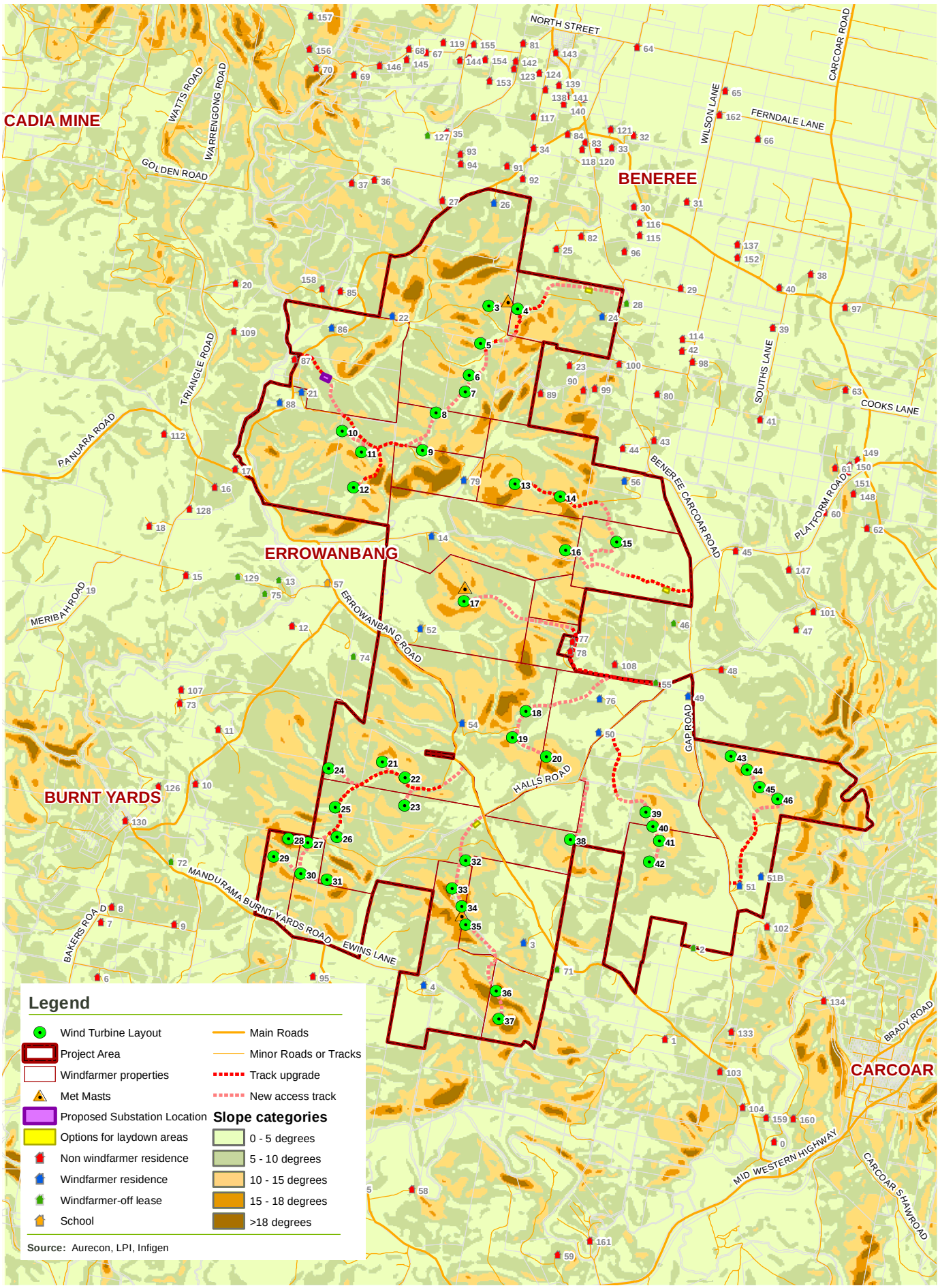
It should be noted that the development of the wind farm will only affect 1-2% of the total land area. Landowners will continue to use the wind farm site for its prior pastoral purposes, with little reduction in the productive area available.

The erodibility of the relevant soil landscapes within the project area, as outlined in the NSW Natural Resource Atlas, is indicated in Table 7.9. The Vittoria-Blayney and Panuara soil landscapes, which cover a significant proportion of the wind farm site (Figure 7.4), have a low to moderate potential for erosion. Observations of slopes in these areas indicate reasonable stability and resistance to erosion. The areas disturbed during construction will be limited and, where practicable, steeper slopes will be avoided. Comprehensive controls will be applied during construction to minimise any potential for erosion.

When undertaking earthworks, it will be necessary to consider each of the component works in regard to the soils that will be impacted, their erodibility, erosion hazard, the extent of soil disturbance, slopes on which the works take place and the season and potential for rainfall events. Based on these factors, appropriate control measures will be assigned for the potential impacts. A Soil and Water Management Plan (SWMP) will be prepared for the project and the contract works will be undertaken in accordance with the plan. The SWMP is further discussed in Section 7.5.4 below. The plan will be prepared in conjunction with the contractor that will undertake the works, based on the work methods that will be developed prior to construction commencing.

Given the elevated nature of the sites and occurrence of strong winds, the potential for dust generation is another important consideration for earthworks. This is particularly applicable for construction undertaken during periods where there is low soil moisture. The wind farm area has low to moderate rainfall, with higher rainfall in winter. Soil moisture will be dependent on time of year, but is expected to be lowest in summer due to the combination of lower rainfall and higher evaporation at this time.

Restoration of areas disturbed by the construction works will also need to consider fertility of the soils in selecting vegetation species for the restoration works. In general, restoration works should have reasonable effectiveness, based on the typical rainfall and the extent and appearance of the existing groundcover. However, the effectiveness and extent of follow up required will depend on circumstances during the restoration period and will be reviewed prior to and during the restoration phases.



U:\GIS\Project-2\project\Flyers Creek\Maps\s38009_FCWF_slope_EA_fig7-6_240311.mxd\JOB No.\24-03-11\koa\Rev 0

1:80,000

0 1 2kilometres

Projection: GDA 1994 MGA Zone 55

Notes: The slope map provides an indication of the degree of slope of the land sampled every 20m. It is based on a terrain model created from a combination of 1m contours over the immediate site and 10m contours over the surrounding site

FIGURE 7.6: Slope Map

7.5.4 Erosion and sediment control

The Soil and Water Management Plan (SWMP) will be prepared as part of the construction EMP. It will outline the water flow control and erosion and sediment control measures that will be utilised to mitigate the potential impacts of the construction works on the soils at the wind farm site. These measures will be designed to:

- Divert surface runoff away from earthwork areas and soil stockpiles
- Reduce the energy of surface flows in areas of potential erosion
- Prevent sediment laden or contaminated water leaving the construction site
- Provide containment for sediment entrained in surface flows
- Reduce susceptibility of disturbed areas to erosion and include prompt revegetation of disturbed areas

Typical erosion and sediment control measures to achieve these objectives include:

- Construction of drains and check dams
- Construction of diversion banks, perimeter banks and level spreader sills
- Use of sediment traps
- Sediment fences around stockpiles and areas of earthworks
- Stabilisation of temporary and permanent batters
- Straw bale and geotextile filter fabric sediment traps and filters
- Minimising periods that disturbed soil remains exposed with potential to be eroded

The SWMP and the detail of the specific measures to be used will be developed by the contractor after review of the final design layout and with the benefit of a more detailed review of activities and risks posed by the works. It will be completed prior to construction commencing.

Disturbed areas will be required to be stabilised in accordance with the following principles:

- Temporary vegetation or mulch will be applied to all disturbed areas, including soil stockpiles that remain exposed for a period of 30 days or more
- All temporary earth diversion banks and sediment basin embankments will be seeded and fertilised as soon as practicable after construction, and take into account the growing seasons
- Stabilisation of all batters will be commenced within one week of completion of formation

Topsoil suitable for stripping and re-use in revegetation will be stockpiled. Stockpile sites will be clearly identified and selected to be free from traffic and away from drainage lines and watercourses. They will be managed to minimise erosion and loss of topsoil, with surface stabilisation to prevent wind erosion where necessary.

Erosion and sediment devices will be inspected regularly after each rain period and during periods of prolonged heavy rain and any defects rectified promptly. All erosion and sediment control devices will be maintained in satisfactory working order until such time as the disturbed areas have been stabilised to the satisfaction of Flyers Creek Wind Farm Pty Ltd and the respective landowners.

The relatively small area (proportionate to total project area) to be disturbed for the installation of the wind turbines, access tracks and associated facilities, combined with the development of detailed site management and rehabilitation procedures will mean that potential problems due to the disturbance of soils on the site can be effectively managed.

At the conclusion of construction, all temporary tracks and areas disturbed by construction work, including cable routes and hardstand areas surrounding the wind turbines, will be reinstated and revegetated. All temporary control measures will be removed when revegetation has established on

formerly disturbed areas, and will be disposed of in a satisfactory manner. Follow up maintenance will be undertaken until the areas are satisfactorily stabilised and restored.

7.6 Site drainage, water resources and water quality

This section describes the following aspects of the wind farm site:

- The existing surface drainage of the project area and region
- The potential impacts of the project on the drainage systems and measures to mitigate any impacts
- The water resources required by the project, the means by which the water will be supplied and an assessment of the ability of the local resources to supply water for the project.

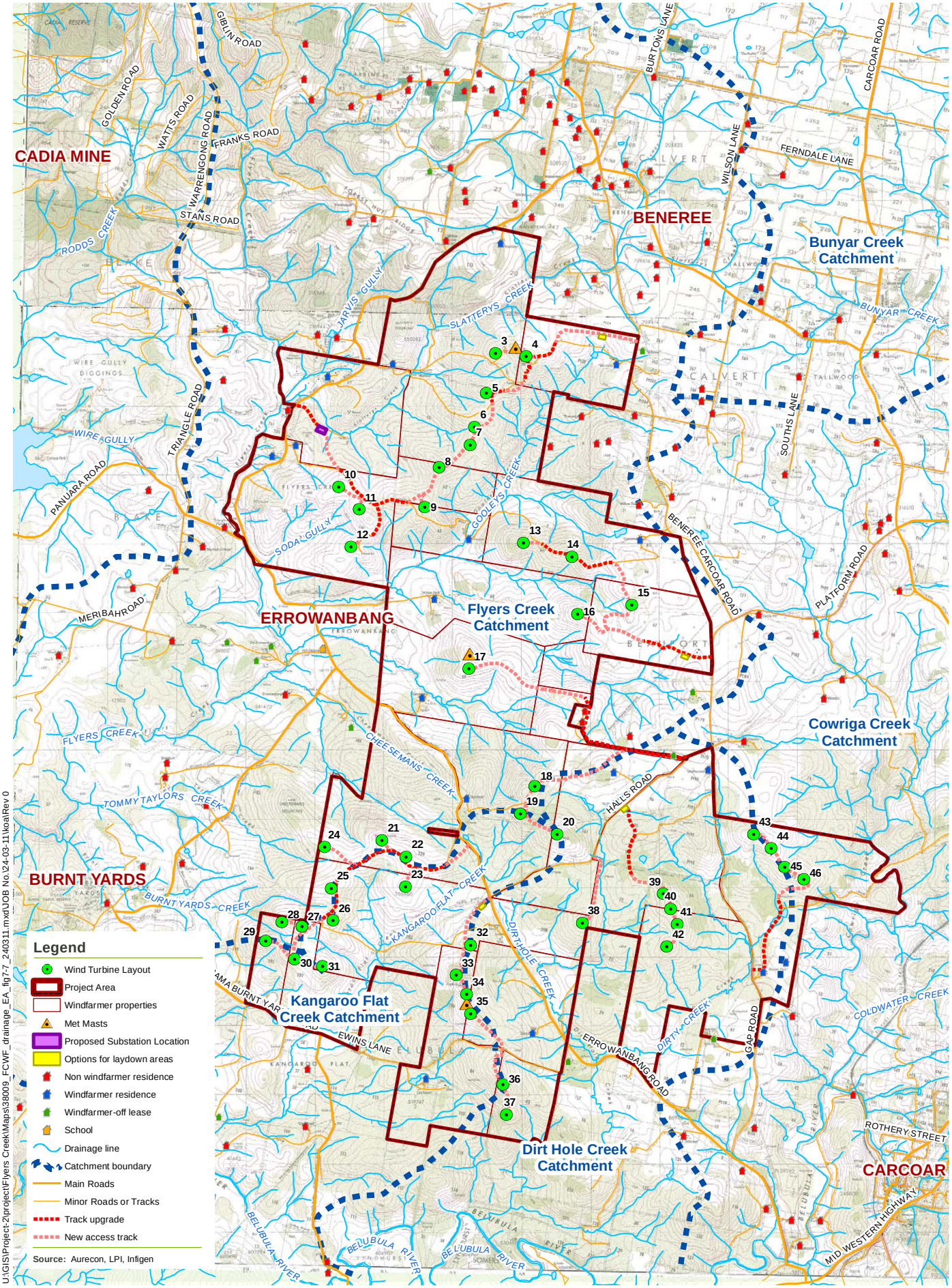
7.6.1 Regional and site drainage

The project area is within the Belubula River Catchment shown in Figure 7.7. This catchment is in turn within the Lachlan River Catchment, which represents about 8% of the Murray Darling Basin system. Carcoar Dam, the closest water storage area, is located less than 10 kilometres to the east of the wind farm site. Drainage of the wind farm site is by several small creeks that subsequently lead to the Belubula River (below Carcoar Dam) as detailed in Table 7.10.

Table 7.10 – Sub-catchments draining the wind farm site

Sub-catchment	Description of location	Measures to prevent impact on waterway
Slatterys and Flyers Creek	Located in the north west part of the site, Slatterys Creek is a tributary of Flyers Creek. The ridgeline containing the Calvert group turbines drain to the west towards Slatterys and Flyers Creek. The substation is within the Slatterys Creek catchment.	Oil spill containment structures for the substation as well as erosion and sediment controls for all earthworks will prevent impact on this watercourse.
Gooleys Creek	Located in the north eastern and middle portions of the wind farm, this minor tributary of Flyers Creek receives runoff from the eastern facing side of the Calvert Group ridgeline and the slopes of the northern half of the Fern Hill turbine group.	Erosion and sediment controls at the wind farm site will minimise any impacts on this watercourse.
Cheesemans Creek	Located to the west of the wind farm, this minor creek has a catchment area that includes the slopes containing the northern Hopkins group turbines. This creek flows west and feeds into Flyers Creek.	Erosion and sediment controls at the wind farm site will prevent impact on this watercourse.
Kangaroo Flat Creek	Located to the south of the site, this creek has a catchment that takes in the hills containing the southern turbines of the Fern Hill group as well as the ridgelines that contain many of the Hopkins Group turbines.	Erosion and sediment controls at the wind farm site will prevent impact on this watercourse.
Dirty Hole Creek	Located in the south east corner of the site, this creek flows south into the Belubula river. Its catchment area covers the eastern turbines of the Hopkins group and Halls Gap group.	Erosion and sediment controls at the wind farm site will prevent impact on this watercourse.
Cowriga Creek	Located east of the project area. Only a small part of the project is within this catchment.	Erosion and sediment controls will prevent impact on this watercourse.

Some creeks listed in Table 7.10 are ephemeral creeks and therefore not always flowing. Flow in the minor creeklines is highly variable dependant on soil moisture and rainfall. Potential impacts on watercourses are outlined in Sections 7.6.2 to 7.6.6 together with an outline of their management. Water supply requirements for construction and operation are described in Section 7.6.7.



U:\GIS\Project-2\project\Flyers Creek\Maps\s38009_FCWF_drainage_EA_fig7-7_240311.mxd\JOB No.\24-03-11\koa\Rev 0

1:75,000

0 1 2 kilometres

Projection: GDA 1994 MGA Zone 55

Flyers Creek Wind Farm **Environmental Assessment**

FIGURE 7.7: Drainage Map and Catchment Boundaries

7.6.2 Drainage considerations and potential impacts on the watercourses

The locality has moderate annual rainfall (about 800 mm/year) typical of the elevated Central West tableland areas away from the coast. Winter is generally associated with higher rainfall and, combined with lower evaporation rates at this time, results in higher winter soil moisture. Storms are possible at any time during the year but are slightly more common in summer periods.

The ridges on which the turbines will be located have few permanent watercourses. There are however a few dams that have been established by landowners on the upper slopes. The surface waters in the immediate vicinity of the project area do not supply drinking water for humans, but can be used by stock.

All construction works will include erosion and sediment control measures to mitigate potential sedimentation impacts on watercourses (Section 7.5). Due to the project being largely on elevated ridgelines there will be few creek crossings by the projects' access tracks. Overhead lines can be constructed such that the lines span watercourses with pole structures set back from the watercourses to minimise potential environmental impacts. In some places the 33 kV underground cable routes may cross water courses and will need to be constructed to avoid obstruction of natural flows or erosion of stream banks. Figures 7.8 and 7.9 provide the potential locations of construction activities which may cross water courses. It should be noted that many of the water courses on this map are ephemeral creeks or drains.

The main locations where underground cable routes may cross watercourses include:

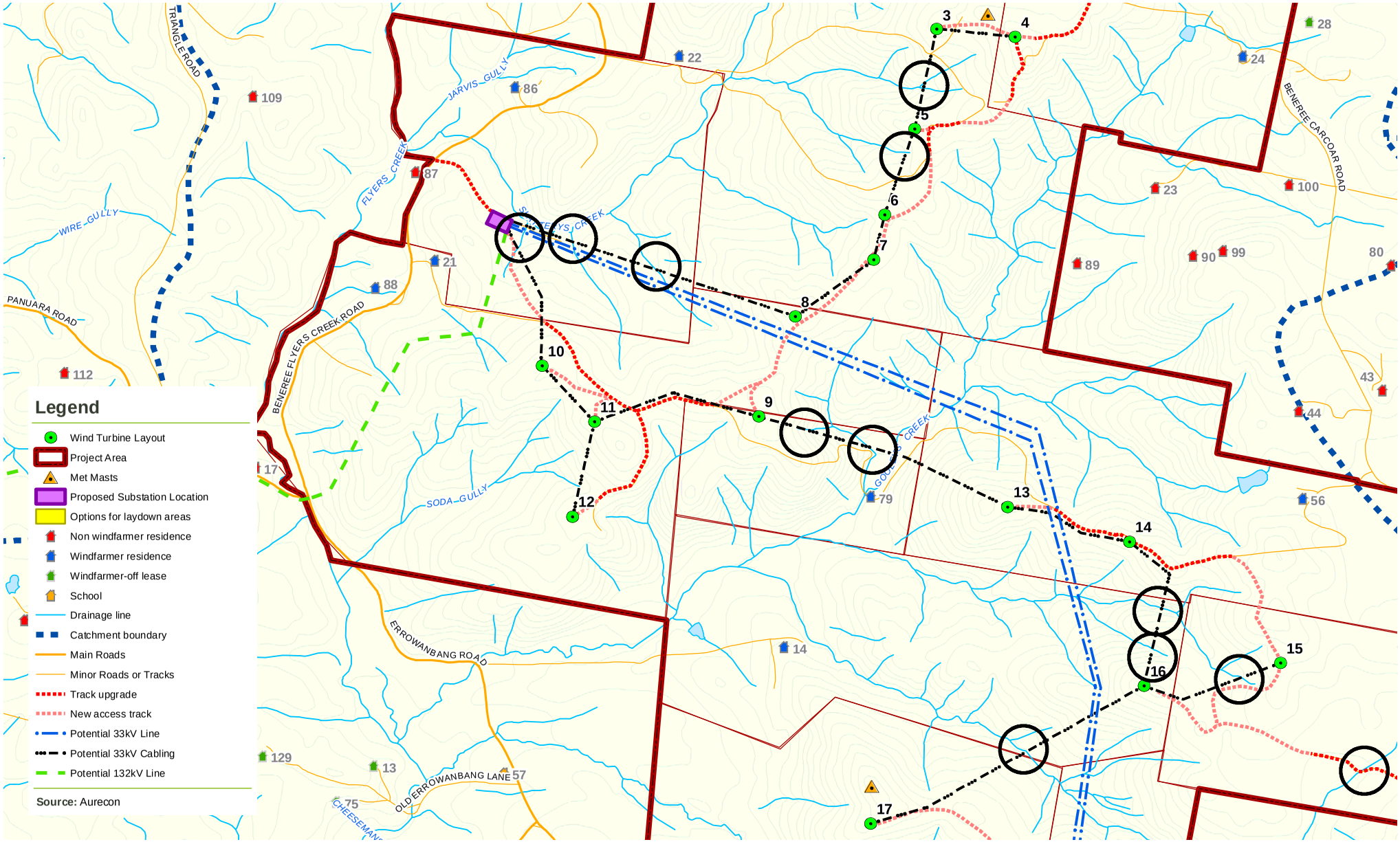
- cable route between Turbines 3 and 5
- cable route between Turbines 5 and 6
- cable route between Turbine 8 and the substation
- cable route between Turbine 10 and the substation
- cable route between Turbines 9 and 13
- cable route between Turbines 14 and 15
- cable route between Turbines 15 and 16
- cable route between Turbines 16 and 17
- cable route between Turbine 22 and the 33 kV overhead line
- cable route between Turbines 32 and 38
- cable route between Turbines 38 and 39
- cable route between Turbines 39 and 43 (crossing of Dirty Creek near Gap Road)

Tracks requiring construction or upgrade works which may cross drainage areas are shown below:

- upgraded track south of Turbine 46
- upgraded track north of Turbine 39
- upgraded track near Residence 78
- upgraded track south east of Turbine 15
- new track south of the Substation

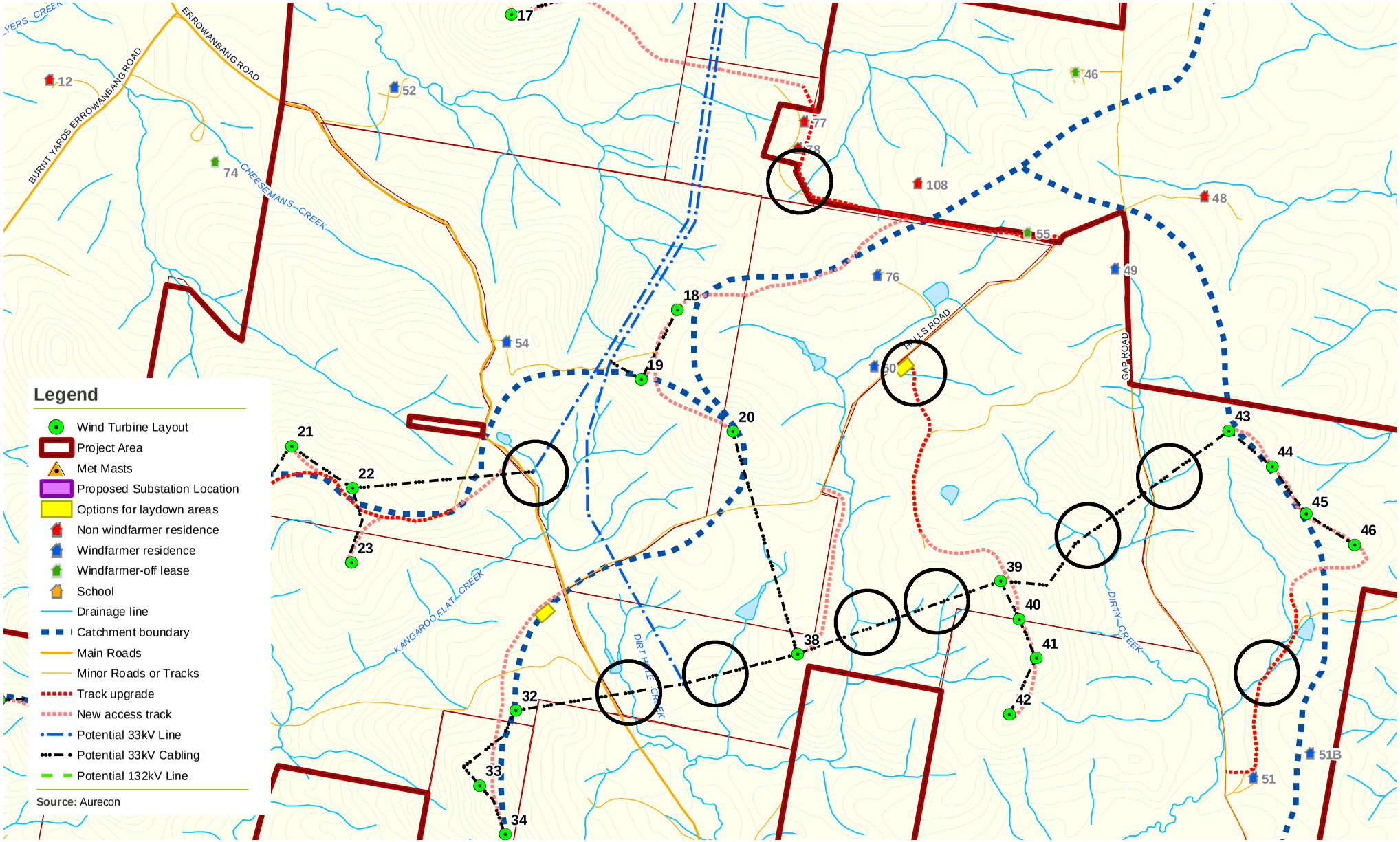
An alternative to use of underground cables would be to utilise 33 kV overhead lines as part of the collection system. While the use of overhead lines has been limited, there are some locations where reduced ground disturbance, and as a consequence, a lower risk of erosion and less impacts on native vegetation may make overhead lines preferable.

Flooding will not affect the ridges where the turbines will be located, but at times of heavy rain some parts of the site may be temporarily affected by swollen creeks or ponded water. Areas of flooding hazard are not likely to significantly affect the Flyers Creek Wind Farm construction or operation. The design and construction of creek crossings for site access will address the potential for occasional short term flooding along some of these water courses.



Flyers Creek Wind Farm **Environmental Assessment**

FIGURE 7.8: Potential Water Crossings North



U:\GIS\Project-2\project\Flyers Creek\Maps\38009_FCWF_drainage_EA_fig7-5_040411_CR_2.mxd\JOB No.\11-04-11\koalRev 0

1:30,000
0 400 800m

Projection: GDA 1994 MGA Zone 55

Flyers Creek Wind Farm **Environmental Assessment**

FIGURE 7.9: Potential Water Crossings South

As most of the project area constitutes elevated areas with low to moderate slopes flanking the turbine sites, a degree of infiltration can be expected and this will mitigate the runoff potential. It is reasonable to infer that the groundwater recharge on the ridges is likely to be less than for more low-lying areas. No springs were observed discharging from the upper slopes.

The potential for the project to impact local watercourses varies with the stage of the project. Sections 7.6.3 and 7.6.4 discuss the potential impacts during the construction and operational phases of the project.

7.6.3 Potential impacts of the construction phase

Activities that will need to be managed during construction to avoid impacts on the local drainage system include:

- Soil disturbance associated with earthworks, including roads, trenches and foundations
- Creation of temporary stockpiles of soil and rock
- Works associated with crossings of watercourses by tracks, underground cable and line routes
- Removal of sewage effluent from construction workforce facilities
- Storage and handling of fuels, oils and chemicals

Some of the activities will take place at multiple locations over a large area and will require that each location has appropriate measures to address potential impacts of the activities.

Underground cables crossing watercourses

As identified in Section 7.6.2, the construction activities most likely to cross watercourses, is the laying of underground cables. The laying of pipes and cables in or across a watercourse is a controlled activity under the *Water Management Act 2000* and as such any controlled activity would require approval (See Section 5.5.8). The NSW Office of Water has prepared a guideline[1] to assist developers with managing any construction activities which may occur in a watercourse. The guideline suggests that the design and installation of pipes and cables on watercourse land should consider a number of principles. For trenching these could include

- locating cables across the watercourse on the downstream side of channel bedrock outcrops
- laying cables across a straight section of the watercourse ie avoid outside bends
- ensure backfilling restores the channel shape and bed level to preconstruction condition
- ensure trench is open for minimal length of time
- avoid 'stopping' the flow of a permanent watercourse by staging the trench across the channel or minimise the time involved in stopping or intercepting flows
- prevent potential water quality issues (turbidity, spills)
- address the recovery and removal of construction plant and materials

Access roads crossing watercourses

A number of tracks have been identified as potentially crossing watercourses. Of these, four tracks will be upgraded and one track will be new. Section 7.5.4 outlines the erosion and sediment control measures that are proposed for the site during construction and through to site stabilisation. Appropriate measures, for example constructing culverts or installing pipes could be employed to ensure that the natural drainage of the watercourse is not impacted. The measures used will be determined during the design phase of the project.

It is considered that with these measures the construction phase of the wind farm will have minor potential for impact on the local drainage system. In addition, should any cables be laid through and/or beneath an existing watercourse, the principles provided in the guideline would be taken into account.

[1] NSW Office of Water – *Controlled Activities: Guidelines for laying pipes and cables in watercourses*

7.6.4 Potential impacts of the operational phase

Potential impacts on the local drainage system for the operational phase of the wind farm are expected to relate to:

- A low potential for loss of oil from electrical or mechanical equipment (See Section 7.6.5)
- A low potential for leakage from batteries on site (See Section 7.6.6)
- The operation of a wastewater septic system at the facilities building
- Potential sedimentation and erosion from access roads and others areas of ground disturbance.

The wastewater septic system will be installed and managed in accordance with all relevant standards and guidelines, and any discharge consents required will be obtained. The site OEMP will include requirements for routine inspection and maintenance as required to ensure the site soils are effectively managed.

It is considered that the operational phase of the wind farm will have minor potential for impact on the local drainage system.

7.6.5 Oil storages on parts of the site

Oil will be permanently utilised at several parts of the site. Some of the transformers to be installed as part of the development will contain significant amounts of oil, and it is possible that loss of oil may occur due to equipment failure. Transformers will be located within the substation site as well as generator transformers within or adjacent to each wind turbine. In addition to the oil used in these transformers, oil will also be used around the site in smaller quantities, mainly in vehicles or mobile plant.

Procedures for maintenance and handling of oils, fuel and chemicals will be documented and followed by construction and maintenance staff. The procedures will also address waste oil removal from site and appropriate disposal or recycling.

In order to minimise the risk of water or soil contamination by any oil spillage, various measures are proposed, as discussed below.

Substation transformers: The two 33 kV to 132 kV transformers (combined rating of up to 160 MVA) located within the substation may together contain about 50,000 litres of oil. Accordingly, the transformers will be located within bunded areas designed to contain any transformer oil in the event of leakage or spillage from either of the transformers.

Secondary containment, utilising an earth dam with underflow discharge or oil/water separator will also be provided. This secondary containment will be of sufficient size to retain the transformer oil in the unlikely event that it was released from the transformer and not contained in the transformer bund. Spill response equipment will be maintained on site and the site will maintain a site-specific emergency response plan.

Turbine generator transformers: The 0.69 kV/33 kV generator transformers associated with each turbine site will be either oil filled if on a pad near the base of the tower, or dry type if located in the nacelle.

If oil filled transformers are used they may contain in the order of 2,000 litres of oil, and would include internal oil containment to retain any oil leakage. Any leakage that escaped the containment would only affect a relatively small localised area around the generator transformer that could be effectively remediated. Regular inspection of the transformers and associated turbine equipment will be carried out to ensure that they remain in good working condition and are leak free.

Additional oil storage: The wind turbine structures (nacelles and supporting towers) will have various equipment that may contain small quantities of lubricating, hydraulic or insulating oils. The turbine structures will be designed to contain this oil in the event of spillage or leakage.

Small amounts of oil will be maintained on-site for maintenance purposes. Any facility for storage of oil will be purpose designed with sufficient containment for potential spillage and include spill recovery equipment and materials.

Procedures for maintenance and handling of oils, fuel and chemicals will be documented and followed by construction and maintenance staff. Staff will also be trained in emergency response and cleanup procedures should these be required. The procedures will also address waste oil removal from site and appropriate disposal or recycling.

7.6.6 Battery systems

A bank of batteries will be required at the substation to supply backup power for control systems in the event of failure of the grid supply. These batteries will be located in the facilities and/or auxiliary services buildings and will be maintained by routine checking and adjustment of electrolyte levels and as necessary replacement of batteries. The building design will ensure that any spillage is contained at the building.

7.6.7 Water supply for the project

Once operational, the project will require a relatively small water supply and this will be supplied primarily from roof drainage at the facilities and auxiliary services buildings and, if necessary, supplemented by importing water from domestic supplies. This is in marked contrast with coal fired electricity generation plants which can utilise over 30,000 megalitres (ML) every year as part of their operation.

The construction phase will have a much greater requirement for water and it is expected that water may be imported during that time. The quantity of water required on site for dust control, domestic use and fire fighting reserves may vary depending on the timing of the works, weather conditions and site practices. Over the construction period of up to 18 months it is estimated that about 10 ML (megalitres) may be required for activities undertaken on site, most of which would be used for dust suppression. The above estimate is based on experience gained during construction of other wind farm projects. As indicated, actual consumption will depend on the conditions experienced at the time of construction. For example, if precipitation during the construction period was similar to the past 12 months, then significantly less water would be required.

If a concrete batching plant is used on site then additional water (about 2 ML) would be required (See Table 13.4). However, as mentioned previously concrete is likely to be imported to the site. If a batch plant is located on site, the actual batching of concrete would only occur on about 50 days during the construction period.

The imported water supply for the construction phase could be obtained from local water supply sources as required. Subject to agreement of Council, Blayney water supply is considered to be the most likely source as adequate supply is indicated and would involve a short cartage distance of about 12 kilometres.

Central Tablelands Water (CTW) handles all water accounts for the Blayney Shire with the main water source being Lake Rowlands. In the 2009/2010 financial year, a total of 2,010 ML of water was consumed. This figure includes bulk sales, supply to industry, residential properties, and water losses through leaks (CTW – 2009/2010). The water requirements for the construction phase of the project would make up less than 1% of the currently consumed water based on the current CTW statistics. The total amount represents a small proportion of the available local water supply and is a temporary requirement. Therefore, water usage is unlikely to compete with other users of local water supplies.

Other potential sources of imported water supply could include:

- Belubula River – this may be a possible supply, but has not been assessed
- Cartage of water from Carcoar Dam would involve transport of about 16 kilometres

- Groundwater supplies may be obtained in valleys around the site. While substantial use of the resource could conflict with local users any short term nature of the extraction is unlikely to significantly affect the groundwater resource contained in alluvial sediments.

In the event that other potential sources are proposed, discussions and negotiations with the regulators of the alternate supplies would be undertaken and any necessary permits and approvals obtained.

The contractor will be required to negotiate arrangements for water supply at the time of construction and the actual amount will depend on the work methods proposed by the contractor as well as conditions at the time. As discussed in Section 5.5, if any licenses or permits are required for extraction of water, these will be obtained as required after consultation with the relevant authority.

7.7 Land use

This section describes the land use applicable to the wind farm site, the neighbouring properties and the immediate locality.

The locality comprises mainly cleared pastoral land with low density rural residential development. The land on which the wind farm would be located is zoned 1(a) General Rural under the Blayney Local Environment Plan (LEP), 2001. According to the LEP's development control table, the wind farm is not a prohibited development, instead it is permissible with development consent. The objectives of Zone 1(a) include protecting and conserving the productive capacity of the land for uses such as agriculture, forestry, mining, water resources and rural residential.

The wind farm development is able to co-exist with the existing use of the land for grazing, and is considered as consistent with the productive use of the natural resources of the locality, including harnessing the wind energy resource at the locality.

The landowners will benefit from the development and this diversification can support the respective landowner's financial security. The existing land use of the wind farm site and neighbouring areas are described in the following sections.

7.7.1 Existing land use on the wind farm properties

The wind farm site is located on moderate sized rural properties that are predominantly used for sheep and cattle grazing. Existing current land uses that are applicable to the wind farm site:

- Grazing currently occurs across the whole of the wind farm site
- Rural residences are present at various locations
- Two survey reference points at Calvert and Hopkins trig stations
- An Optus communications facility near the southern wind monitoring tower
- Two small quarry sites are located at the southern end of the project area
- Former mining sites that are no longer active, exploration licences are current
- Utility easements for gas, electricity and telephones

The wind farm landowners have entered into lease agreements with Flyers Creek Wind Farm for the co-use of their properties for a wind farm. The locations and extent of the properties on which the wind farm would be located are shown in Figure 4.1.

As shown in Table 4.1, there are 44 turbines proposed for construction on the leased properties. The turbines are spread along the ranges, occupying the elevated areas that have a suitable wind energy resource. The number of turbines proposed for the site has been influenced by the capacity of the electricity grid to which the wind farm will connect as well as the negotiations with the landowners involved.

Each of the properties has extensive clearing and now comprises large areas of mainly exotic grassland, with varying degrees of scattered native trees. Some remnant woodland areas exist on

parts of some of the properties, but these areas are generally restricted to the hillsides rather than the more elevated ridgelines and are therefore unsuitable for wind farm development. As far as possible, clearing of these woodland areas for turbine sites, cabling or access roads will be avoided and these woodland areas will be retained.

The density of rural settlement in the vicinity of the wind farm site is low. Settlement density for surrounding areas to the north and northeast is slightly greater. The pastoral and residential activities presently occurring on the wind farm site can continue and will not be significantly affected by the operation of the wind farm. Some limited disruption to the normal land use is expected during the construction stage.

The two existing trig stations within the Flyers Creek Wind Farm site, Calvert Trig Station and Hopkins Trig Station will not be impacted by the construction of the wind farm and survey operations at those sites are expected to continue without significant impact. This is further discussed in Section 7.7.4.

An Optus communications facility is also located at the southern end of the wind farm site. Details of the communication facilities and potential impacts are provided in Chapter 14.

7.7.2 Land use of properties adjacent to the wind farm site

The neighbouring properties to the wind farm site vary in size (Figure 4.1). Most are primarily used for grazing of various types of stock, with or without rural residential use and limited cropping. Several of the smaller neighbouring properties appear to have residential usage as their primary function. It is worth noting that a number of the adjacent properties to the project are owned by landowners involved in the project as shown (pale yellow) in Figure 4.1. The locations of rural residences surrounding the wind farm site are also shown on Figure 4.1 and in figures for this chapter. The distribution of the neighbouring residences within four kilometres of the wind farm is shown in Table 7.11 below. The residence categories in Table 7.11 distinguish whether the owner is a participant of the project (wind-farmer) and has leased their land for the purpose of the wind farm development.

Table 7.11 – Proximity of neighbouring residences to the wind farm

Distance of residence from nearest turbine	Total Number of residences	Wind farmer [1]	Neighbours (non-windfarmer)
0 to 1 kilometres	7	7	0
1 to 2 kilometres	43	19	24 [2]
2 to 3 kilometres	50	4	46
3 to 4 kilometres	34	0	34
Total	**134**	**30**	**104**

Note: [1] A wind-farmer residence is one where the owner has leased part or all of their land for the wind farm development
[2] Includes school – "Residence 57"

About 100 residences are located within three kilometres of a wind turbine, including the 31 wind farmers.

All habitable neighbouring residences are over one kilometre from the nearest wind turbine. Residence 25 is the closest non-landowner residence to a wind turbine and is located 1.1 kilometres from Turbine 4.

Issues that are sometimes raised as potential impacts of wind farm projects on neighbouring residences are visual, noise, shadow flicker, interference to telecommunications, traffic impacts during construction and reduced property values. Each of the issues has been described by this Environmental Assessment as well as the controls to mitigate any potential impacts. The Approval Authority will also review the material provided in the Environmental Assessment together with any submissions of agencies, neighbours and the broader community in the determination of the appropriateness of the proposed development and any approval conditions to be applied.

7.7.3 Review of land use types for the wind farm locality

Grazing: The use of grazing land for development of the wind farm will not significantly affect its future potential for grazing. Once developed, the area of land required by the wind farm structures will be a minor fraction of each property.

During construction there are likely to be short periods where some areas can not be grazed if they are near an active construction area. However, the proponent will work with landowners in the project to minimise any disruption. The environmental management for the construction works is described in Section 3.9.

Grazing activities on neighbouring properties will not be impacted by the construction or operation of the wind farm.

Rural residential: The density of rural residential settlement in the area surrounding the wind farm is mostly low. The impact on the rural residential properties has been discussed in Section 7.7.2 above.

Landing strips: The nearest commercial aerodrome to the Flyers Creek Wind Farm site is Orange Aerodrome, located approximately 13 kilometres to the north of the nearest wind turbine. Orange City Council has been consulted about the proposal and based on information provided by the Council, the turbine sites are well beyond the Aerodrome's Obstacle Limitation Surface. While older maps indicate that seven local airstrips existed at one time within five kilometres of the wind farm, some of these are no longer in use.

The details pertaining to the Orange Aerodrome and the seven airstrips and associated air safety issues are provided in Chapter 16.

Utility infrastructure within the locality: The local area has a network of local roads, power lines and communications. Chapter 13 details the traffic in the area and the potential impacts of the wind farm development. A 132 kV Country Energy line runs from the Cadia Mine, north-west of the Flyers Creek site to Orange Substation. It is proposed that the wind farm be connected to this line (See Chapter 3 for more details). Communication services in the wind farm locality and the potential impacts on these services are described in Chapter 14.

Future changes to land use: The potential future changes to land use at the locality could include different types of pastoral activities, possible subdivision of land and increasing rural residential or industrial development. Such changes may arise from changed economic circumstances, shifting population from cities to rural areas, variations to local climate characteristics or from changed landowner circumstances. However, it is worth noting that the nearby area is all zoned General Rural which discourages and/or prohibits further subdivision or industrial development.

The installation of the wind farm will not limit the future use of the land for grazing. It does not compete for resources in the local area and its benefits flow through to the broader community.

7.7.4 Trigonometric stations

There are two Trigonometrical (trig) stations within the boundaries of the proposed Flyers Creek Wind Farm. Table 7.12 summarises the relevant details of each of these trig stations.

Table 7.12 – Trigonometrical stations in the project area

Trig station and ref no.	Group of turbines	Description	Land Title	Status for survey work (reference LPMA)
Calvert TS 5592	Calvert Group (Northern Group)	Concrete pillar with mast (Damaged)	Non-reserve	Major "Spine" station
Hopkins TS 7069	Hopkins Group (Southern Group)	Concrete pillar with mast (Damaged)	Reserve 37025	Major "Spine" Station

The potential impacts of the development on the use of the trig stations by surveyors relates to:

- Interruption to the “line of sight” to overhead GPS satellites
- Interruption to line of sight for making direct observations between adjoining trig stations using conventional angle and distance observations

The details of the project have been provided to the Survey Infrastructure & Geodesy section of the Land and Property Management Authority (LPMA) seeking comments on any potential impacts on the surveying operations that use the trig stations in the wind farm location. A response was obtained in April 2010 and is provided in Appendix B and summarised in Section 4.4.2.

Line of sight between trig stations and potential for the project to impact on survey operations was a consideration for the array design. The proponent is confident that the final locations of the turbines do not interfere with existing survey sight lines. However, further consultation with LPMA will be undertaken in conjunction with the development of the final turbine sites and if necessary, micro-siting can be used to confirm adequate clearance for the sight lines.

In addition, when there is concern that use of specialised survey instruments may be affected by turbine operation, then the relevant turbine can be shut down during the survey activity for a short period (understood to be about 1 hour in duration). Again this matter will be discussed further with LPMA to achieve a suitable arrangement for turbine siting and continued use of the Trig Stations by LPMA.

	
Plate 7.21 – Calvert Trig Station	**Plate 7.22 – Hopkins Trig Station -**

7.8 Social aspects

The following section reviews the existing social context of the development and its potential social impacts. All statistics in Section 7.8.1 were sourced from the 2006 Census, conducted by the Australian Bureau of Statistics.

7.8.1 Existing social characteristics of the Blayney Shire local area

The Shire of Blayney has a predominant rural character with the majority of the rural activity being sheep and cattle grazing and limited cropping. Statistics for Blayney Shire have been used to describe the social characteristics of this region.

Blayney Shire stretches east towards Bathurst, southwest to Cowra and north towards Orange and has a population of 6,593 (2006 Census). Over a five-year period, between the 2001 and 2006

census, the population increased by 473. This represents a 7.7% increase equating to an annual increase of 1.55%. The nearest town centres have populations as shown in Table 7.13 below.

Table 7.13 – Population for main population centres close to the Flyers Creek Wind Farm

Locality	Population	Reference
Orange	31,544	Census 2006
Bathurst	28,992	Census 2006

The 2006 Census data identified some 2,858 family households with an average household size stated as being 2.6. The vast majority of these dwellings are stand alone houses, with minor townhouse or flat type accommodation.

The region has approximately equal numbers of male and female constituents (3,299 and 3,294 respectively). The median age for the region is 39. In respect to education, 28.3% of respondents indicated that the highest level of schooling completed was Year 12 or equivalent. The average level of schooling in Blayney Shire was ten years, one month. Approximately 46% of people over the age of 15 indicated attainment of a non-school certificate, diploma or degree. The most common qualifications were attained in engineering and related technologies, management and commerce, health, education and agriculture, environmental and related studies.

In terms of employment, 2,864 persons indicated that they are employed, of which 1,877 are employed on a full-time basis. The unemployment rate was 6.7% in 2006, which was approximately 1.5% higher than the national average and 0.8% higher than the NSW average at the same time.

As would be expected in a rural area, there is a very heavy reliance on motor vehicles for transport, which includes work related vehicle use.

Table 7.14 shows the distribution of employment in the top 12 industry sectors for Blayney Shire. The five most common industries of employment are: agriculture, forestry and fishing; health care and social assistance; manufacturing; retail trade and education and training.

Table 7.14 – Blayney Shire (2006) employment by industry sector

Industry of Employment	Number	Percentage
Agriculture, forestry and fishing	451	15.7
Health care and social assistance	304	10.6
Manufacturing	280	9.8
Retail trade	231	8.1
Education and training	210	7.3
Construction	188	6.6
Public administration & safety	184	6.4
Mining	161	5.6
Accommodation and food services	143	5.0
Transport, postal and warehousing	138	4.8
Other services	114	4.0
Professional, scientific and technical services	106	3.7
Wholesale trade	90	3.1
Inadequately described/Not stated	59	2.1
Administrative and support services	49	1.7

Industry of Employment	Number	Percentage
Electricity, gas, water and waste services	38	1.3
Financial and insurance services	34	1.2
Arts and recreation services	34	1.2
Rental, hiring and real estate services	29	1.0
Information media and telecommunications	24	0.8
Total	**2,867**	**100.0**

7.8.2 Social impacts of the wind farm development

The potential factors that could contribute to social impacts of wind farm development include:

- Influx of skilled people into the region during construction
- Small on-site workforce once operational
- Small increase in local business and some additional employment opportunities in the region
- Increased activity for the immediate wind farm locality during construction
- Some increase in tourist visitation to the local area once the wind farm is operational
- Any changes to the social structure of the region

The wind farm site is located on moderate sized rural properties. Despite an extended period of drought between 2000 and mid-2007, these properties are productive and appear to be successful rural businesses. However, many of the landowner families supplement their farm income with off-farm occupations. Owners have indicated that the wind farm income from leases will support maintenance of their properties. The development of the wind farm is unlikely to affect the ongoing rural use of the neighbouring lands. Neighbouring properties include both small to medium properties and larger holdings.

During the consultation undertaken to date, neighbours to the wind farm site have expressed various views in regard to the project. While the majority have indicated support for the project others have expressed concerns relating to visual and noise aspects of the wind farm and potential impact on land values. Visual issues for the Flyers Creek Wind Farm are addressed in Chapter 9, noise issues in Chapter 12 and the issue of land value is addressed in Section 7.8.3.

Employment and economic opportunities will flow to residents of the local district through direct employment during the construction stage of the project or as a result of increased commercial activity flowing to the local area. This beneficial impact is not expected to place undue pressure on local resources. Services such as accommodation, vehicle maintenance, refuelling and food are likely to benefit from the influx of construction staff. Provision of these services may be spread between nearby Orange and the smaller townships of Blayney, Millthorpe and Carcoar, and to a lesser extent Bathurst.

Persons and businesses who could benefit from the employment opportunities may include immediate neighbours to the wind farm or persons living in local towns or on rural properties within the area.

Any influx of tourists that may visit the area to view the Flyers Creek Wind Farm is likely to be relatively modest. The Blayney Wind Farm, which has been operating since 2001, has a well visited tourist viewing area. The proponent will work with Blayney Shire and the landowners to identify a suitable viewing area for the Flyers Creek wind farm to enable visitors to safely view the wind farm and learn more about its operation. While the increase in traffic will not be very large, even small numbers can have a significant positive impact on local small hospitality businesses in Millthorpe, Blayney and Carcoar.

7.8.3 Impact on land values

Some neighbours to the wind farm have expressed concern that their land values may be negatively impacted by the wind farm development. As there have been only a few NSW wind farms developed there is limited quantifiable information available on the impact of wind farm development on land values for NSW.

This issue had been raised previously by neighbours at the Crookwell and Blayney wind farm sites during the Development Application review process. However, once the wind farm was operating the concerns of neighbours appeared to be diminished and the outcome of a number of sales following the wind farm installation did not appear to support the view that the wind farms had resulted in reduced land values.

A review in February, 2006 of the impact of the Crookwell Wind Farm development on land values (based on sales 1990 to 2006) was conducted by property consultants, Henderson and Horning. Their analysis did not identify any measurable reduction in land values.

In the USA the issue that land values may be impacted by wind farm developments led to a comprehensive and systematic review of sales prices for properties in the viewshed of wind farms developments during 1998 to 2002 and comparison with land values at unaffected locations. During that period the installed capacity of wind farms in the USA increased from 1,848 MW to 4,685 MW, an increase of 2,837 MW. An analytical report entitled "The effect of Wind Development on Local Property Values" (Sterzinger et al., 2003) was prepared under the Renewable Energy Policy Project (REPP) in May 2003. The report involved studies of various aspects of land values and reviewed data for some 25,000 property sales. Only wind farm projects of greater than 10 MW were considered by the REPP project. In addition, the review sought projects where there would be sufficient sales data to derive statistically meaningful conclusions from the data.

The REPP report indicated that property values for those properties within a wind farm viewshed have increased faster than those properties outside the wind farm viewshed. While it is difficult to expect the situation to be consistent between areas the case for a negative impact on land values does not appear to be confirmed. Nevertheless, it can be expected that the decisions of some potential purchasers may be affected by the presence of a wind farm and they may decide to purchase elsewhere. While the evidence does not support the conclusion that wind farm development leads to reduced land values it is not unusual for neighbours to developments whether they are wind farms or other developments to have concerns about changes to the existing environment and the concerns to be a source of anxiety for neighbours to such developments.

In August 2009, the NSW Department of Lands published a Research Report titled Preliminary Assessment of the Impact of Wind Farms on Surrounding Land Values in Australia that was prepared for the NSW Valuer General. The Executive Summary of the report states:

> "*This study investigated eight (8) wind farms across varying land uses (rural, rural residential, residential) using conventional property valuation analysis. Two (2) wind farms were selected in NSW and six (6) in Victoria.*
>
> *The main finding was that the wind farms do not appear to have negatively affected property values in most cases. Forty (40) of the 45 sales investigated did not show any reductions in value. Five (5) properties were found to have lower than expected sale prices (based on a statistical analysis). While these small number of price reductions correlate with the construction of a wind farm further work is needed to confirm the extent to which these were due to the wind farm or if other factors may have been involved.*
>
> *Results also suggest that a property's underlying land use may affect the property's sensitivity to price impacts. No reductions in sale price were evident for rural properties or residential properties located in nearby townships with views of the wind farm.*"

7.8.4 Consultation with the local community

As part of the wind farm planning process, extensive community consultation has been undertaken to seek the local community views on the development, identify any issues which may require further investigation and to incorporate relevant matters in the wind farm design parameters. Initial consultation (via individual meetings with neighbours to the wind farm, written communications and community information days) has experienced a range of views on the project, with most expressing positive opinions of wind energy development and the Flyers Creek project, in particular, while some others have indicated concerns in regard to issues such as visual amenity and noise. The availability of the Environmental Assessment will provide a further basis for the local community members to make their own assessment of the impacts and to raise any concerns with Flyers Creek Wind Farm or the NSW Department of Planning.

The close proximity to the existing Blayney Wind Farm as well as articles in the local newspaper (the Central Western Daily) have introduced the local community to the prospect of a wind farm at the Flyers Creek locality over two years ago. A further discussion of community consultation is found in Chapter 6.

7.8.5 Development of renewable technology within the community

Over the last few years there has been an increasing awareness in the Australian community of the potential impacts of anthropogenic climate change. Associated with this awareness there is also an increased understanding that low emission renewable energy technologies such as wind energy will play an important part in reducing greenhouse gas emissions from electricity generation. As has been observed at other wind farms, it is possible that the proposed Flyers Creek Wind Farm could be supported by many in the local community as they associate the wind farm in their community as being a positive step towards reducing greenhouse gas emissions. The proximity of the wind farm to Carcoar and Blayney, and to a lesser extent Millthorpe and Orange, will mean there will be a strong association between residents in these towns and the wind farm.

7.8.6 Summary of social impacts

The proposed project will introduce a second visible renewable energy project into the rural setting. It will provide a significant stimulus to local employment during construction and a smaller stimulus to permanent local employment. The wind farm project will improve the economic viability of the farms involved in the project by effectively “drought proofing” them to some degree. It is unlikely to affect the social structure of the locality or to place an excessive demand on local resources.

The initial planning phase has encountered some anxiety from a few neighbours to the wind farm and some submissions opposing the project are expected. Similar situations at other NSW wind farm sites have been followed by a reduction in concerns once the wind farms were built. Overall, the development is likely to have a minor impact on the towns of Blayney and Carcoar. It is likely to provide a small boost to local businesses and will provide a range of employment opportunities for locals. During the construction stage it is anticipated that much of the construction workforce could be accommodated in Orange due to its close proximity while a smaller proportion of the workforce may stay in the closer townships of Millthorpe, Blayney or Carcoar.

7.9 Economic Aspects

This section reviews the existing economic context of the development and the project's impacts on the local and Australian economy.

7.9.1 Key economic considerations

The key economic considerations for assessing the merits of the Flyers Creek Wind Farm development relate to:

- The economic viability of the development (for the developer and for the broader community)
- The place of renewable energy projects in Australia's future economy
- The wind farm's contribution to the local economy
- Whether it has any adverse economic impacts

7.9.2 Economic viability

The Flyers Creek Wind Farm is being developed as a commercially viable project. The international wind industry has been growing around 25 to 30 % year over year for over a decade. With the growth of the industry, there have been substantial improvements to equipment and there have been substantial reductions in the cost of electricity generated from wind energy.

Flyers Creek Wind Farm will operate in the competitive National Electricity Market and therefore must ensure that its operations are commercially viable. It has undertaken a rigorous review of the income and cost considerations for the project and is satisfied that development of the Flyers Creek Wind Farm is a financially viable development. The output from the wind farm will either be sold to customers under the terms of a power purchase agreement and/or sold into the wholesale electricity market. The viability of the Flyers Creek Wind Farm is supported by the legislated significant expansion of the Renewable Energy Target Scheme (RET) last year. (Section 2.1.2). The "Carbon Pollution Reduction Scheme", or other Carbon Price mechanism, may also improve the viability of renewable energy projects and their competitiveness with fossil fuel based forms of generation (Section 2.1.2). However, the RET scheme is the primary driver for wind energy projects as demonstrated by the more than 1000 MW of wind energy built in the past five years without a price on carbon.

7.9.3 Wind energy's role in Australia's future economy

Predicting Australia's future economic health over the life of the wind farm is indeed difficult in the context of the volatile and changing global circumstances. Australia has traditionally been sustained by strong rural and mineral production and this is likely to continue for some time. Due to the country's vast expanse, a large use of fuels has been required to sustain the rural and mining sectors. Also the associated wealth of the country and its high standard of living has resulted in one of the world's highest per capita consumption of energy. In the past few decades, Australia has consumed a large part of its own oil resources to the extent that these are in decline and Australia is importing increased quantities of oil to maintain our existing lifestyles and sustain our economy.

The outcome of increased reliance on imports of oil mean:

- a greater exposure to global increases in oil price fluctuations
- a negative impact on Australia's trade deficit

In addition, the global decline in oil availability and the likely progressive rise in the price of oil will mean that increased attention will be given to alternative energy sources, coal, gas, nuclear and renewables. As renewables have no associated fuel costs, they provide a degree of insulation from global energy price increases and instability

While increased supply of electricity from wind energy is unlikely to change our pattern of oil use until electric vehicles are operating in significant numbers, it can result in net savings of other fossil fuels such as coal and gas and thereby increase our energy supply options for the future or enable sale of coal for export where not required for Australia's electricity generation.

Given the above, the development of wind energy facilities contributes to the country's future energy security. The development of the Flyers Creek Wind Farm also offers increased employment opportunities for the local and broader Australian communities. The above factors provide positive economic support for wind energy developments and the Flyers Creek Wind Farm development.

The final 'Garnaut Climate Change Review' to the Commonwealth, State and Territory Governments of Australia released in 2008 indicates that Australia "must now put in place effective policies to achieve major reductions in emissions". The Flyers Creek Wind Farm development is consistent with this direction in the 'Garnaut review'

7.9.4 Contribution to the local economy

Blayney Shire has a strong agriculture/forestry industry (15.7% of working population), health care and services sector (10.6%) and manufacturing sector (9.8%). The construction industry (6.6%) also plays a significant role in employing local residents within the Shire. The development of the Flyers Creek Wind Farm will contribute to the local community through stimulation of the local economy and by providing employment opportunities within the Shire, particularly during the construction phase.

Increased income will flow to the local community as a result of the development by way of:

- Income to local service suppliers such as accommodation (motel, hotel and guest houses), food and general supplies (cafes, general stores and newsagents), service stations (fuel and vehicle servicing), engagement of local contractors for specific components of the works and purchase of supplies and services from local outlets (maintenance of equipment or supply of various items required by the construction workforce)
- Increased employment and associated incomes either directly by involvement in the project or indirectly by employment in service industries
- Payments to Blayney Shire Council associated with contribution to local infrastructure
- Payments to landowners on which the wind farm is located

The construction phase, with its import of a temporary workforce into the locality, is likely to provide the greatest stimulus to the local economy with the ongoing operations and maintenance activities having a lesser impact. A small number of on-site staff will be required during the operations phase.

An increase in income to the local community is likely to flow into other areas and have a multiplier effect for the local economy. The local community includes rural residents and nearby towns of Millthorpe, Blayney and Carcoar. The impacts on economic activity are likely to be spread throughout the region and as such it is expected that the economic impact on the local community will be well within its capacity to assimilate.

7.9.5 Potential detrimental economic impacts

In recent times, some rural areas have become increasingly targeted for rural residential development. This has meant that large properties have been carved up to provide smaller properties that are often used for residential purposes rather than their previous pastoral purposes, and the result is reduced agricultural productivity and potential conflict between farming activities and expectations of residential amenity. Blayney Council have zoning restrictions preventing subdivision below 100 hectare lots to seek to prevent this conflict; however, loopholes and "grandfathered" rights may exist to some degree.

One consequence of the wind farm developments is that the land involved in the wind farm site will be less likely to experience subdivision and the proliferation of residences and urbanisation of the rural landscape. However the presence of methods for income derived from new sources that supplement traditional agricultural practices, such as a wind farm, will assist in alleviating pressure for continued subdivision and sell-off of agricultural lands for residential development.

Different people will have varying views on whether the inclusion of wind turbines or residential development in the rural landscape is preferable. However, Blayney Shire Council policy has been to restrict further carving up of pastoral land with a view to maintaining the agricultural potential of the region consistent with the Zone 1(a) (Rural) objectives.

As indicated in Section 6.5 some neighbours to the wind farm have expressed concern that their land values may be negatively impacted by the wind farm development. Studies in the USA have indicated that property values for those properties within a wind farm viewshed have increased faster than those properties outside the wind farm viewshed (Sterzinger et al., 2003). As noted above the report by the NSW Department of Lands found that no reductions in sale price were evident for rural properties or residential properties located in nearby townships with views of the wind farm.

The construction phase of the project will involve a temporary increase in traffic on the access roads to the site and may increase the wear and tear on those roads. Flyers Creek Wind Farm will work with Council to provide any additional maintenance requirements necessary as a result of the project.

Overall, the Flyers Creek project will provide substantial financial benefits to local businesses and the community.

7.9.6 Summary of economic issues

The Flyers Creek project will contribute to the income of landowners at the site and provide economic stimulus to parts of the local economy through local service provision and employment and community benefit contributions. The timing of these economic benefits to the rural economy is considered to be favourable when farming profitability has been at risk due to rising costs and potential impacts of drought related stresses and climate change stress, which can have impacts on individual farm incomes and wider impacts on rural areas.

Given the evident directions of the global economy, the likely decline in oil resources, rising electricity prices and the commencement of a price on Carbon in the not too distant future, increasing our renewable energy generation capability will deliver greater supply diversity leading to positive returns to Australia generally while at the same time assisting local economies. The Flyers Creek Wind Farm contributes to meeting the Renewable Energy Target scheme, which is recognised to comprise mostly wind energy in the short to medium term. It is worth noting that this legislation enjoys bilateral support of both the Federal Labour and Liberal parties.