APPENDIX 21

Sapphire Wind Farm Riparian Assessment

Eco Logical Australia Pty Ltd

SAPPHIRE WIND FARM RIPARIAN ASSESSMENT

Riparian Assessment

Prepared for
Wind Prospect CWP Pty Ltd

17 August 2011

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1 Introduction

1.1 BACKGROUND

This report has been prepared as an input into the preparation of an Environmental Assessment under Part 3A of the Environmental Planning and Assessment Act 1979 (EP&A Act). It has not been written with the intention of being a 'stand-alone' report, and as such, background and contextual information about the Sapphire Wind Farm development has not been repeated.

The proposed development is in the MacIntrye River catchment (Border Rivers CMA). More geographical detail is provided in Section 3.

This report examines the receiving waters and their associated values downstream of the proposed development. Further it provides guidance on how construction activities can be managed to avoid and reduce potential impacts on those waters.

At this stage of the planning process, water extraction points and/or sources have not be resolved, however will be in line with the requirements of the *Water Management Act 2000* and associated guidelines.

1.2 REGULATORY CONTEXT

The *Water Management Act 2000* (WM Act) and *Water Act 1912* control the extraction of water, the use of water, the construction of works such as dams and weirs and the carrying out of activities in or near water sources in New South Wales. 'Water sources' are defined very broadly and include any river, lake, estuary, place where water occurs naturally on or below the surface of the ground and coastal waters.

Under s75U of the *Environmental Planning and Assessment Act 1979* certain approvals required under s89, s90 and s91 of the WM Act in relation to controlled activities (i.e. works within 40 m of a watercourse and water use or waterfront land[1]) are exempt under Part 3A. Extraction and use of water for other purposes such as a concrete batching plant or dust suppression and environmental protection provisions under the *Protection of the Environment Operations Act* (POEO Act) in relation to water quality do remain relevant.

Despite the EP&A Act Part 3A clauses, Director General Requirements (DGRs) indicates a need to identify likely impacts to the waterways and measures to minimise hydrological, water quality, aquatic and riparian impacts, in areas where the project involves crossing or works close to waterways.

[1] 'Waterfront land' is defined under the WM Act as the bed of any river or lake, and any land lying between the river or lake and a line drawn parallel to and forty metres (40m) inland from either the highest bank or shore (in relation to non-tidal waters) or the mean high water mark (in relation to tidal waters). It is an offence to carry out a controlled activity on waterfront land except in accordance with an approval.

1.2.1 Policies and Plans

Table 1 below outlines the aim and requirements in relation to Sapphire Wind Farm for water related policies and plans that have been considered in this assessment.

Table 1: Relevant Policies and Plans

POLICY/PLAN	AIM/OBJECTIVES	RELEVANCE TO SAPPHIRE
NSW Wetlands Policy	Establishes the framework for the management of rivers and estuaries and related ecosystems. The approach is based on Total Catchment Management philosophy defined in the *Catchment Management Act 1989*.	The construction of infrastructure associated with the proposal will need to consider the potential loss of riparian vegetation and biological diversity, and potential impacts on water quality.
NSW Weir Policy	To halt and, where possible, reduce and remediate the environmental impact of weirs. The policy defines a weir as a structure including a dam, lock, regulator, barrage or causeway across a defined watercourse that will pond water, restrict flow or hinder the movement of fish along natural flow paths, in normal flow conditions.	A requirement for construction of new access tracks or modification of existing farm tracks over the streams. Creek crossings need to be designed to avoid changes that interfere with natural water flow e.g. box culverts or spanned bridges. May represent opportunities to reduce existing impacts.
NSW Groundwater Quality Protection Policy	Acknowledges that ground water is an integral component in many aquatic and terrestrial ecosystems, especially in light of the growing concern about the declining quality of the State's groundwater and its dependent ecosystems.	Proposal will need to avoid activities that risk groundwater and soil contamination.
NSW State Groundwater Dependent Ecosystem Policy	This policy is interrelated with the Groundwater Quality Protection Policy, it has an emphasis on providing for groundwater dependant ecosystems such as wetlands.	Development should aim to minimise adverse impacts on any local groundwater dependent ecosystems (if present) by avoiding polluting, applying ecosystem rehabilitation, and avoiding disruption to groundwater flow.
Border Rivers Catchment Action Plan	The CAP has a goal of ecological sustainable landscape function through natural resource management issues including, biodiversity, soil and land, water, coastal and marine programs.	Development conforms with the principles of ecologically sustainable landscape function at a local and regional level.
Border Rivers Regulated Rivers Water Sharing Plan	WSP prepared under the Water Management Act 2000 to protect the health of rivers whilst also providing water users with greater certainty over future access to water and increased trading opportunities.	WSP identifies the following features: Frazers Creek (unregulated) feeds the MacIntyre River (regulated) Upper reach wetlands and riparian vegetation as flow dependent
NoW Guidelines	The assessment is required to take into account the following DWE Guidelines for Controlled Activities (February 2008), as applicable: • Riparian corridors (and associated Vegetation Management Plans) • Watercourse crossings • Laying pipes and cables in watercourses • Outlet structures • In-stream works	Planning and construction recommendation are made in line with these guidelines.

2 Methods

2.1 DATA

This study was conducted using:

- Available metrological data;
- Desktop assessment of published hydrological and riparian data and reports;
- Existing borehole locations and logs to determine water bearing zones;
- Visual inspection of key watercourses during the ecological assessment (but does not include detailed aquatic ecology assessment);
- GIS analysis and mapping of existing data and the proposed wind farm area.

2.2 ECOLOGICAL FEATURES ASSOCIATED WITH RIPARIAN AREAS

A literature review of web based and ELA research material was made to provide a comprehensive list of potential aquatic and/or riparian and wetland features either immediately downstream of or within the study area.

2.3 RIPARIAN BUFFERS

The Directors General Requirements (DGRs) require identification of likely impacts to waterways and measures to minimise hydrological, water quality, aquatic and riparian impacts. Eco Logical Australia (ELA) have carried out a desktop Strahler Stream Order categorisation, based on the 1:25,000 topographic mapping of drainage lines in the vicinity of the works and identified the extent of the recommended buffers for each stream order category.

The watercourses within and adjacent to the study area have been assessed against NoW guidelines These guidelines require protection of core riparian zones (CRZs) according to stream order as illustrated in Table 2 below.

Table 2: Water Management Act CRZ Widths

TYPES OF WATERCOURSES	CRZ WIDTH
Any first order[1] watercourse and where there is a defined channel where water flows intermittently	10 metres
Any permanent flowing first order watercourse, or any second order[1] watercourse where there is a defined channel where water flows intermittently or permanently	20 metres
Any third order[1] or greater watercourse and where there is a defined channel where water flows intermittently or permanently. Includes estuaries, wetlands and any parts of rivers influenced by tidal waters.	20 – 40 metres[2]

[1] as classified under the Strahler System of ordering watercourses and based on current 1:25,000 topographic maps.

[2] merit assessment based on riparian functionality of the river, lake or estuary, the site and long-term land use.

There are three zones to be considered within riparian corridors, shown in Figure 1 and detailed below;

1. A Core Riparian Zone (CRZ) is the land contained within and adjacent to the channel. NoW will seek to ensure that the CRZ remains, or becomes vegetated, with fully structured native vegetation (including groundcovers, shrubs and trees). The width of the CRZ from the banks of the stream is determined by assessing the importance and riparian functionality of the watercourse, merits of the site and long-term use of the land. There should be no infrastructure such as roads, drainage, stormwater structures, services, etc. within the CRZ.

2. A Vegetated Buffer (VB) protects the environmental integrity of the CRZ from weed invasion, micro-climate changes, litter, trampling and pollution. There should be no infrastructure such as roads, drainage, stormwater structures, services, etc. within the VB. The recommended width of the VB is 10 metres but this depends on merit issues (assessment of risk, stress and conservation value for each locality).

3. An Asset Protection Zone (APZ) is a requirement of the NSW Rural Fire Service and is designed to protect assets (houses, buildings, etc.) from potential bushfire damage. The APZ must not result in clearing of the CRZ or VB. Infrastructure such as roads, drainage, stormwater structures, services, etc. can be located within APZs.

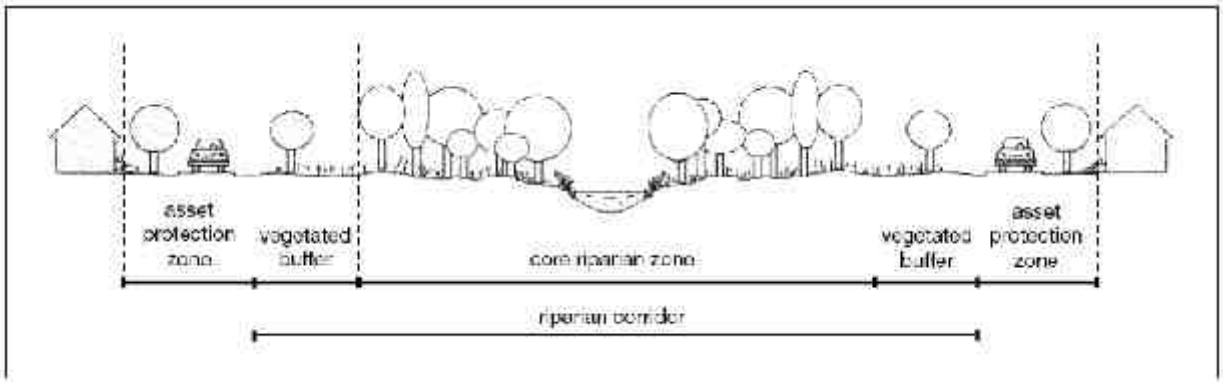

Figure 1: Zones within the riparian corridor

The CRZ widths prescribed by the WM Act guidelines have been applied to the site in order to classify, identify and manage potential development impacts. Due to the study area being surrounded by rural land, the APZ component of the riparian corridor has not been considered in this mapping and is addressed separately in the bushfire risk assessment for this project.

2.4 GROUNDWATER

This report details the water bearing zones of groundwater bores within 10 km of the site in order to illustrate the depth of aquifers in the locality. The water bearing zone (WBZ) depths were correlated to expected excavation depths during construction primarily associated with turbine footings in order to determine if there is likely to be any interaction with groundwater layers as a result of the development.

2.5 AVOIDANCE AND MITIGATION MEASURES

This report recommends measures to be included in construction and operation that will maintain water quality in line with the POEO Act, WM Act and River Flow Objectives.

3 Context

3.1 LANDSCAPE AND TOPOGRAPHY

The Sapphire Wind Farm proposal is located along the spines of the ridges within the Kings Plains district of the northern New England Tableland. The turbines extend over a 10 km span north-south and 15 km span east-west. The landscape is a basin dominated by undulating to steep hills in the eastern, southern and western sections, and Kings Plains nestled between these ridge-lines and heading north. The locality is of moderate to high elevation (750 to 1100 metres above sea level; Australian Height Datum). The individual turbine positions are located on land with elevations ranging from approximately 750 m to 1,100 m AHD.

The project site lies within the MacIntyre Catchment (Figure 3). A number of small creeks and gullies drain the ridges of the project site. Drainage to the south is via Swan Brook into the MacIntyre River. The east, north and west drain into the Seven River catchment via one of five creeks; Kings Plains Creek, Spring Valley, Frazers Creek, Horse Gully and Wellingrove Creek. The Severn River is a principal tributary of the MacIntyre River in the Border Rivers Basin. The MacIntyre River forms part of the headwaters of the Barwon River.

A seasonal hydrograph of Frazers Creek (Figure 2) clearly highlights a reduced average daily average flows (ML) and rainfall (mm) over winter.

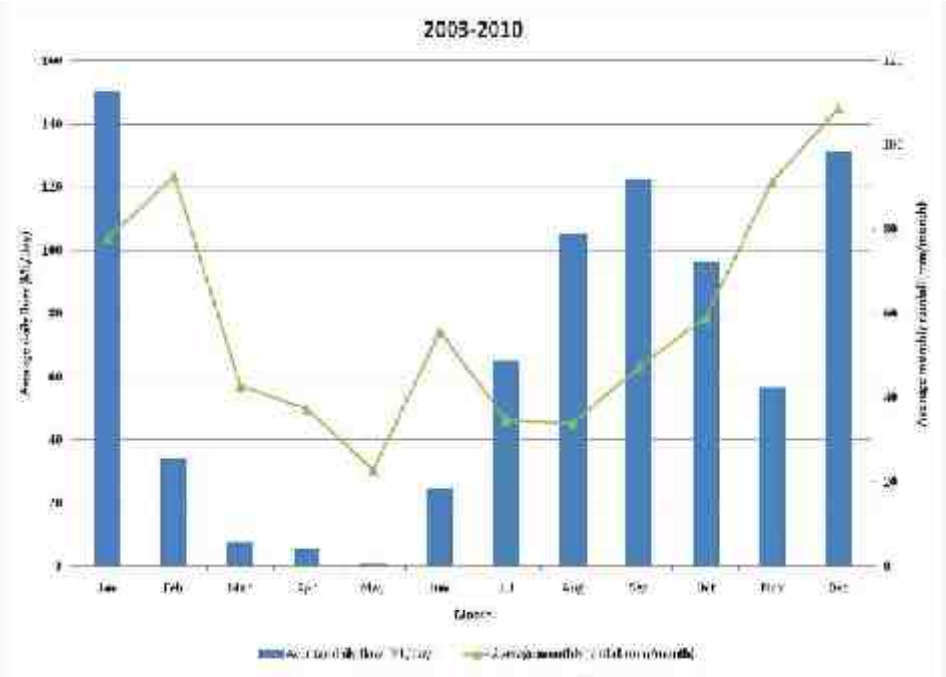

Figure 2: Average daily flow per month (ML/Day) and Average Monthly Rainfall (mm) for Frazers Creek (DLWC Ref# 069 Border Rivers)
Source: Pinneena CD Rom (DLWC 2009)

Slopes within the study area range from high (>30%) along the ridges of the southern portion of the proposal, down to gently undulating and rolling slopes to the north (**Figure 4**).

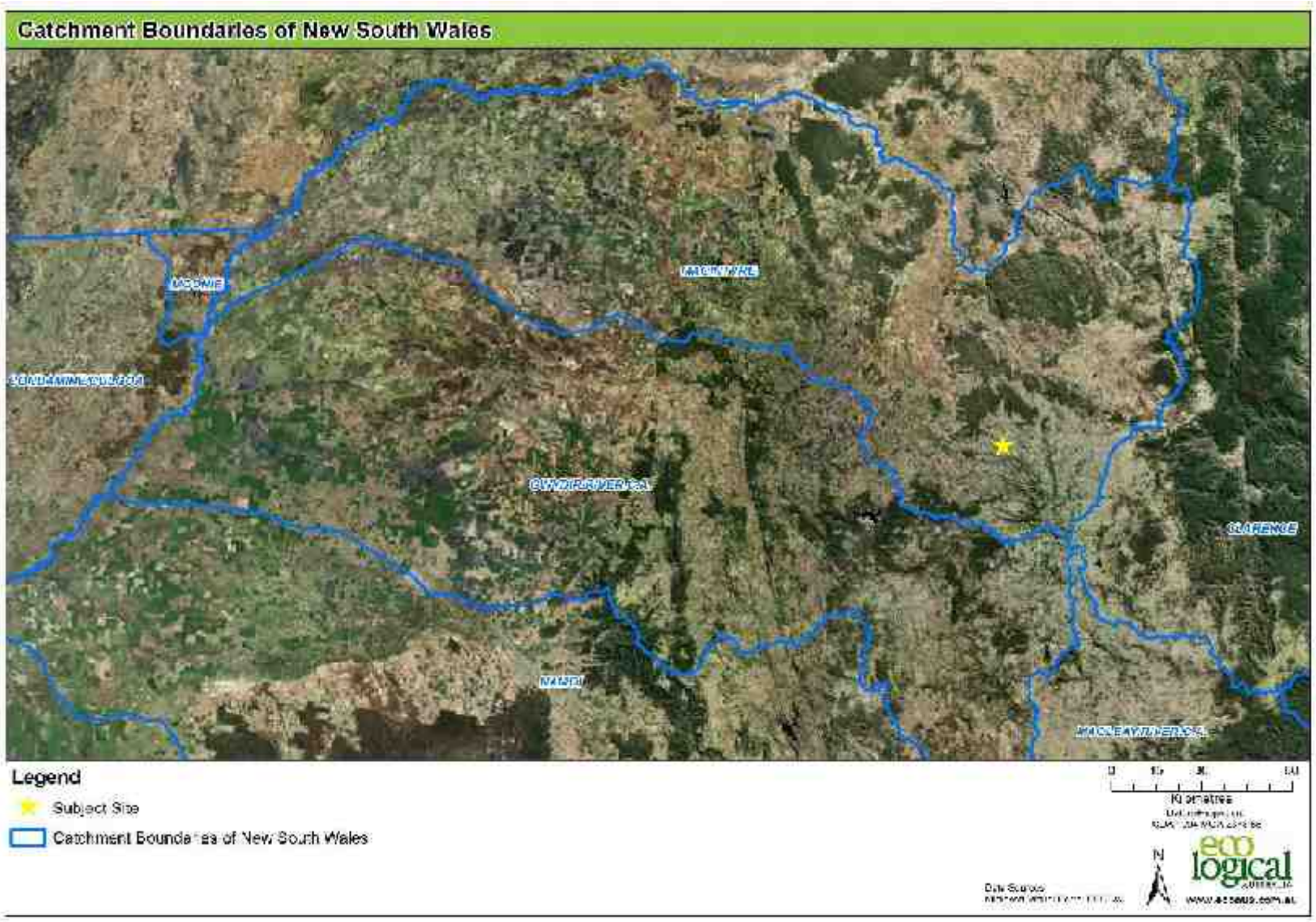

Figure 3: Proposed Windfarm within the MacIntyre Catchment

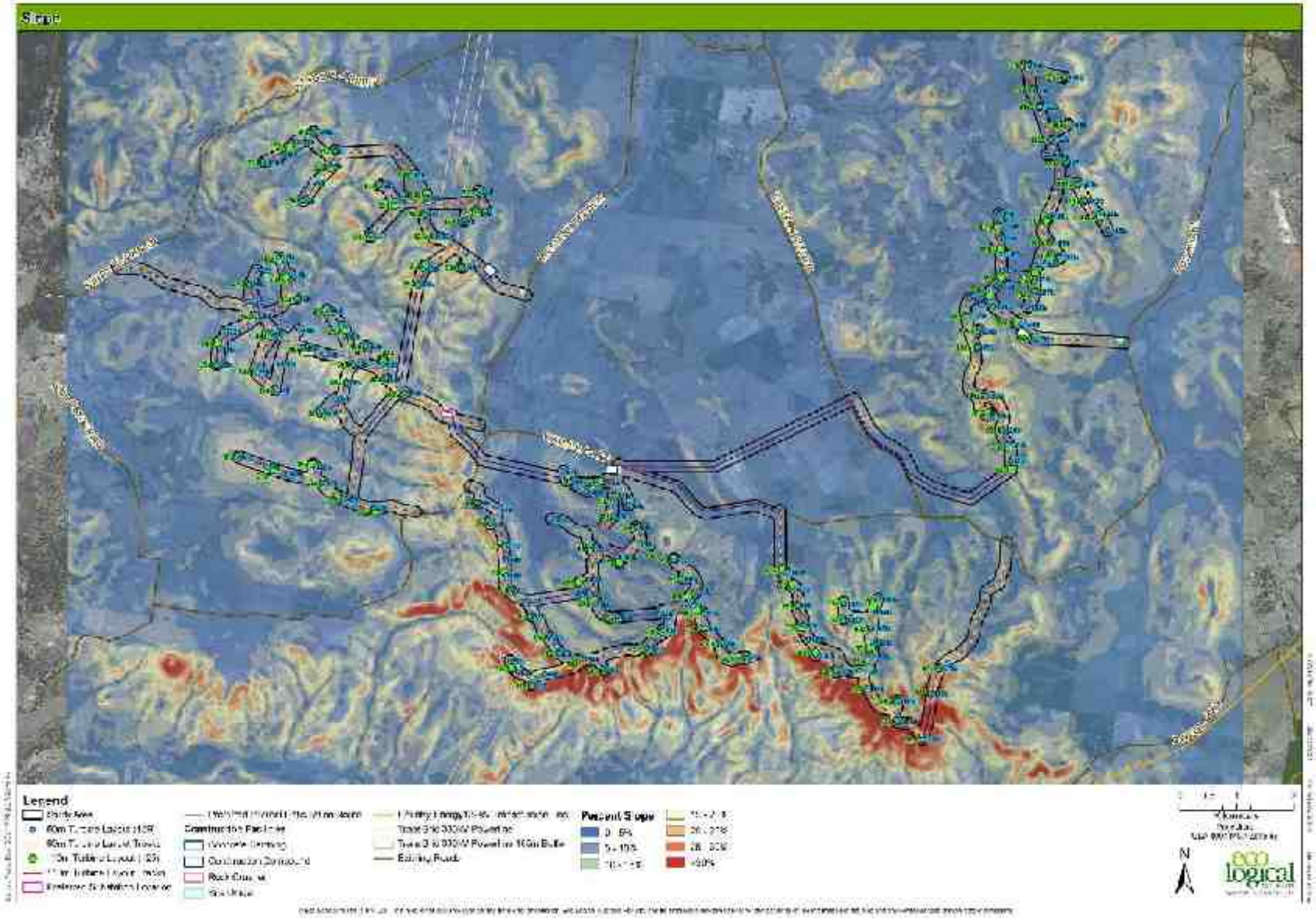

Figure 4: Slopes of the project area

The proposed wind farm will extend along the ridgelines with the access tracks traversing in between the turbines and crossing a number of valleys and watercourses. The site is steeply sloped away from the ridgelines and has gentle slopes along the tops of the ridgelines. Existing access roads are predominantly unsealed farm tracks, and are proposed to be upgraded and surfaced with compactable, engineered base material with suitable drainage. Runoff volume from the proposed site is expected to be small because of the location of most of the site on ridgelines and because the site receives low rainfall.

3.2 PROJECT REQUIREMENTS

The project has the following water related aspects that have been considered in this assessment:

- The project will require the use of water for dust suppression and the concrete batching plants
- The access roads associated with the construction and operation of the windfarm will need to cross a number of creeks
- If not managed and mitigated the construction of the windfarm has the potential to:
  - Increase sedimentation and erosion decreasing local water quality
  - Intercept groundwater if deep excavations are required
  - Contribute to downstream impacts of riparian and aquatic communities

3.3 ECOLOGICAL VALUES ASSOCIATED WITH RIPARIAN CORRIDORS

The table below outlines the ecological values associated with the broader catchment and describes potential interactions (if any) with the proposed project.

Table 3: Identified ecological features in the Border Rivers Regulated River Water Source

ECOLOGICAL FEATURE	LOCATION OF FEATURE	PROJECT INTERACTION
Upper reaches wetlands	These wetlands have been identified between Pindari Dam and Yetman. The significant areas are: • Severn River • Severn River d/s Duncanmara Creek • Severn River u/s of Ashford Power Station • Severn River @ Kwiambal National Park • Macintyre River • Macintyre River d/s of Bedwell Downs • Macintyre River u/s of Holdfast Crossing • Macintyre River d/s of Holdfast Crossing • Macintyre River @ Keetah Road Bridge	**Flow requirements** These areas rely on natural flow variability and medium floods to maintain health and diversity. **Application to Sapphire** Sapphire is in the upper catchment and there no wetland features with or immediately downstream of the study area. The development does not propose to alter natural flows.

ECOLOGICAL FEATURE	LOCATION OF FEATURE	PROJECT INTERACTION
Water plants	Western Floodplain of the Border Rivers Catchment of particular importance are: • A spike-rush species (*Eleocharis blakeana*) which has been listed as rare • A giant waterlily (*Nymphaea gigantea*). • The floodplain area of the Border Rivers catchment extends west of Boggabilla to the Barwon River	**Flow requirements** These areas rely on natural flow variability and medium floods to maintain health and diversity. **Application to Sapphire** The western floodplains are over 200 km downstream and the development does not propose to alter natural flows.
Riparian vegetation	These are mainly: • River She-oak (*Casuarina cunninghamiana*) communities • Bottlebrush (*Callistemon viminalis*) communities • Tea Tree (*Leptospermum brachyandrum*) communities • River Red Gum (*Eucalyptus camaldulensis*)	**Flow requirements** Riparian vegetation requires natural flow variation and medium to high floods to maintain habitats. **Application to Sapphire** These vegetation associations are common downstream of the study on Frazers Creek, however the development does not propose to alter natural flows.
Groundwater	According to NoW there is an important groundwater source under the floodplains of Kings Plains Creek which has been utilised in the past by Sapphire mining companies. There is also high quality groundwater in much of the fractured basalts of the hills.	**Flow requirements** NoW have indicated that the impact on groundwater is usually minimal unless there are some particularly unusual construction features. **Application to Sapphire** There are unlikely to be any construction activities (excavations or drilling) that will intercept water bearing zones.
Bed and Bank stability	NoW have stated that any access tracks (with the exception of crossings) should not be located in any riparian corridor and that all other works and disturbance areas associated with the proposal (with the exception of crossings) also be located outside riparian corridors and are not to compromise the integrity of riparian corridors.	**Flow requirements** Maintenance of natural flow regime. **Application to Sapphire** A requirement for design of creek crossings and a constraint considered in the design and layout of the proposed Windfarm.
Fisheries EEC	The endangered aquatic ecological community of the lowland Darling River was gazetted under the *Fisheries Management Act 1994*. This ecological community refers to all native fish and aquatic invertebrates within all natural creeks, rivers, streams and associated lagoons, billabongs, lakes, flow inversions to anabranches, the anabranches and the floodplains of the Darling River within NSW.	**Flow requirements** Maintenance of natural flow regime as the proposal is upstream of these areas. **Application to Sapphire** No direct application as the endangered ecological community occurs on the Macintyre River below Graman Weir, Severn River downstream of Pindari Dam and the Dumaresq River below the junction with the Mole River.

ECOLOGICAL FEATURE	LOCATION OF FEATURE	PROJECT INTERACTION
Fish	Purple spotted gudgeons (endangered) occur in inland drainages of the Murray-Darling basin as well as coastal drainages of northern NSW and Queensland.	**Flow requirements**
		Prevent sedimentation and poor water quality by improving land management practices, conserving and restoring riparian (river bank) vegetation and using effective erosion control measures.
		Application to Sapphire
		Unlikely to occur in the study area as it prefers slow-moving or still waters of rivers, creeks and billabongs, often amongst weeds, rocks or large woody debris (snags). Such habitat is not common in the catchment.
	Silver perch are listed as a vulnerable species in NSW. They are endemic to the Murray-Darling river system and were once widespread and abundant except for cooler high altitude streams.	**Flow requirements**
		Prevent sedimentation and poor water quality by improving land management practices, conserving and restoring riparian (river bank) vegetation and using effective erosion control measures.
		Application to Sapphire
		Silver perch prefer fast-flowing, open waters, especially where there are rapids and races. Such habitat does not occur in the study area.

Most of the drainage lines in the study area are ephemeral, flow only for a short time post rainfall events and are minor tributaries draining off the ridgelines. Most of these streams surrounding the study area are considered to be first order streams, Frazers Creek and a number of its major tributaries are considered to be 3rd order or greater watercourses (Figure 5).

There are small patches of riparian vegetation along the rivers within the study area, however most of the watercourses are ephemeral and surrounded by rural farming properties and grassland.

Figure 6 shows the application of the recommended CRZ width and additional 10 m VB area. Again, the works which occur on the ridge tops will not occur within any significant riparian corridors. However the works in the gullies, e.g. the internal link roads will be occurring within and crossing the CRZ of the riparian corridors. All crossings will be in line with NoW guidelines for watercourse crossings (see http://www.water.nsw.gov.au/Water-Licensing/Approvals/Controlled-activities/default.aspx) through the use of box culverts as illustrated below.

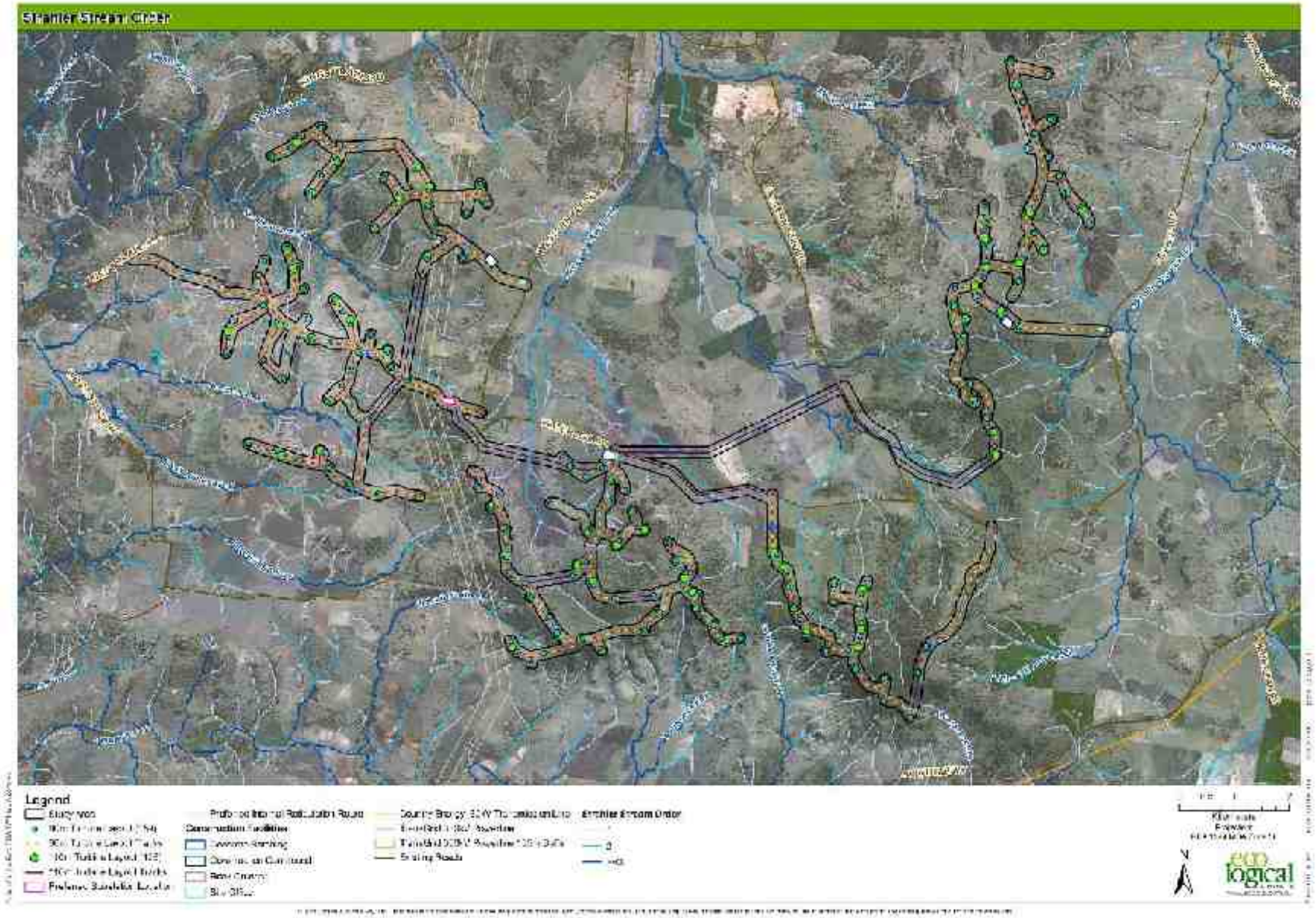

Figure 5: Strahler Stream Order

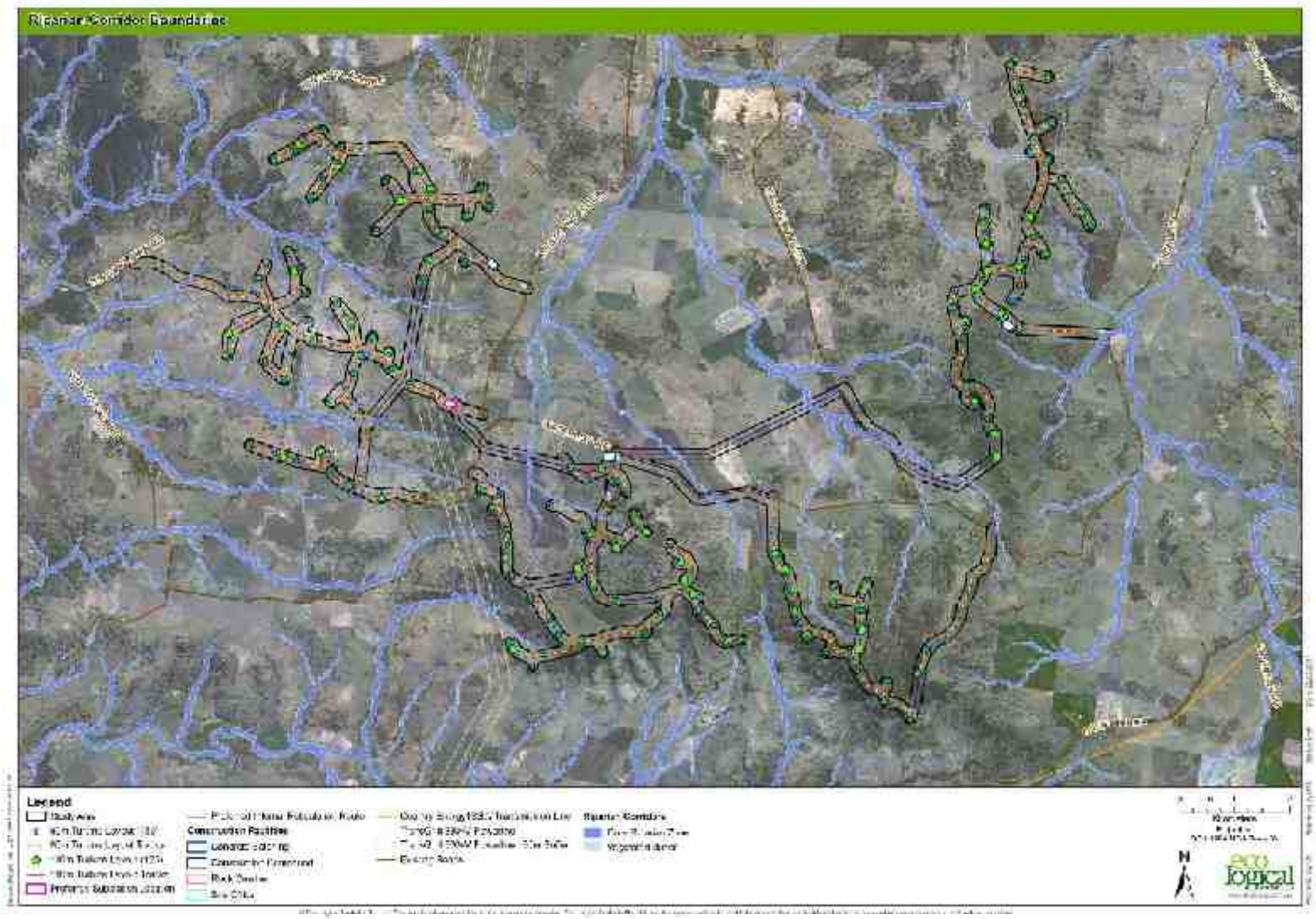

Figure 6: Core Riparian Zone Widths (CRZ) on Site

3.4 WETLANDS

There were a small number of freshwater wetlands identified in Border Rivers vegetation mapping within 10 km of the proposal (Figure 7). These wetland features include River Oak Riverine Forests and Northern Montane Heaths composed on Tea-Tree Shrublands in drainage lines.

The River Oak communities in the drainage lines do occur downstream of the proposal and are a widespread feature in the catchment. The Northern Montane Heaths occur in the upper reaches of neighbouring sub-catchments and will not be directly or indirectly impacted by the proposed development. The Montane Heaths are not part of the *Environmental Protection and Biodiversity Conservation Act 1999* listed Upland Wetlands of New England Tablelands and Monaro Plateau. The EPBC listed wetlands occur in closed, high altitude topographic depressions that are not connected to rivers or streams and are distinguished by the absence or near absence of heath (DEH, 2005).

The wetlands in the locality are not considered to be influenced by groundwater, instead relying upon ephemeral overland flows. The proposed works are not likely to influence the quantity, quality or timing of natural flows of surface water into these wetlands.

3.5 GROUNDWATER CHARACTERISTICS

Groundwater is unlikely to be encountered during construction of most of the proposal due to the wind farm being located along ridgelines and the shallow depth of excavations during construction.

Figure 8 shows the range of borehole locations in the vicinity of the study site and depth to the first water bearing zone (WBZ) (in metres) of each bore. The bores varied in type including wells for stock watering, mining and irrigation. The average registered WBZ of these bores is approximately 26 m, suggesting that the groundwater is unlikely to be significantly influencing terrestrial ecosystems and is unlikely to be encountered during construction activities.

There is potential for footings to be a slab plus rock anchor foundation design. These footings would require drilling of anchor piles up to a depth of up to approximately 20 m. Detailed geotechnical and groundwater surveys are recommended prior to any such footing construction.

For road improvements carried out in the gullies it is unlikely that groundwater will be encountered because the work will be confined to the existing ground level.

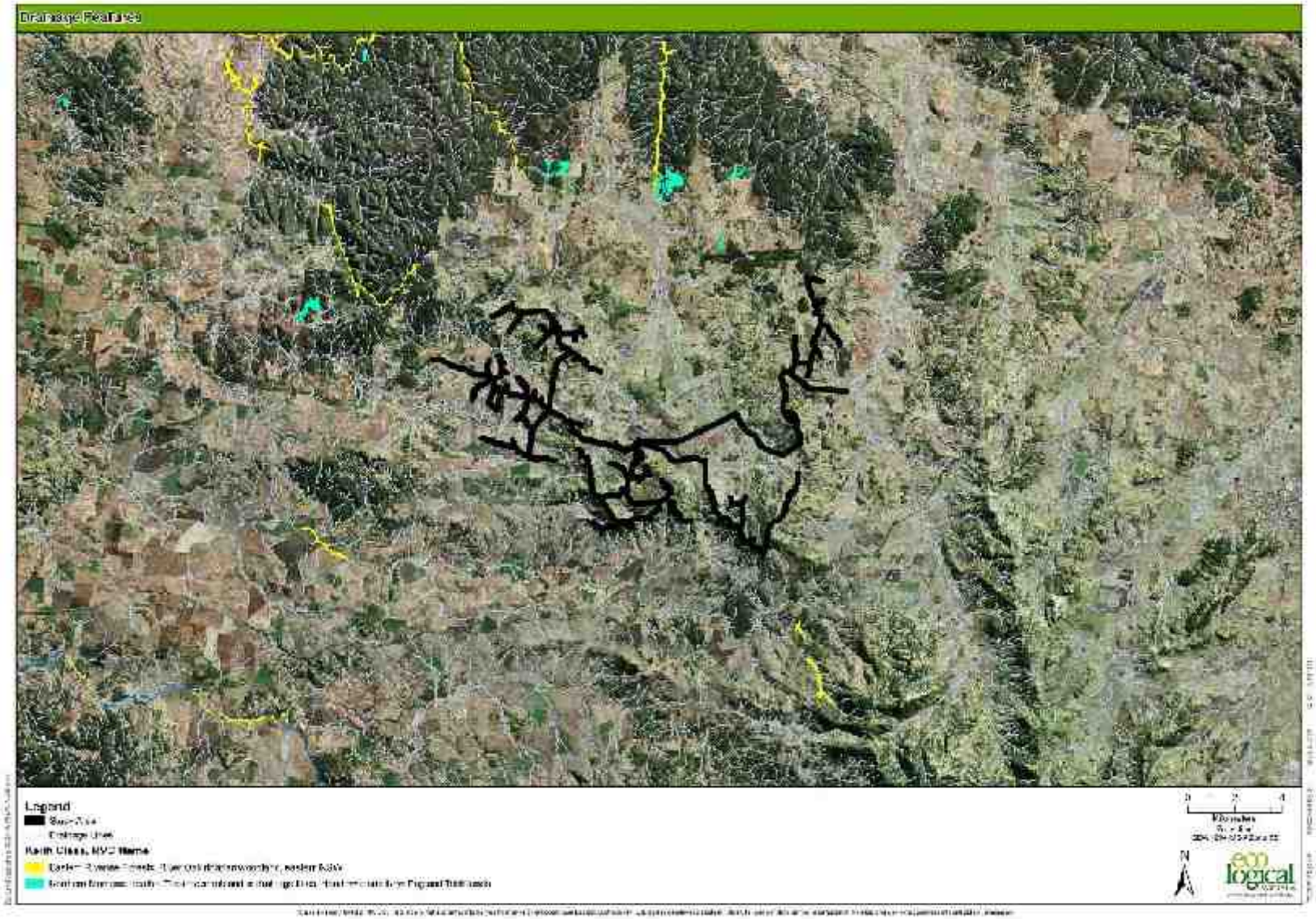

Figure 7: Wetlands Identified in Border Rivers CMA Vegetation Mapping within 10kms.

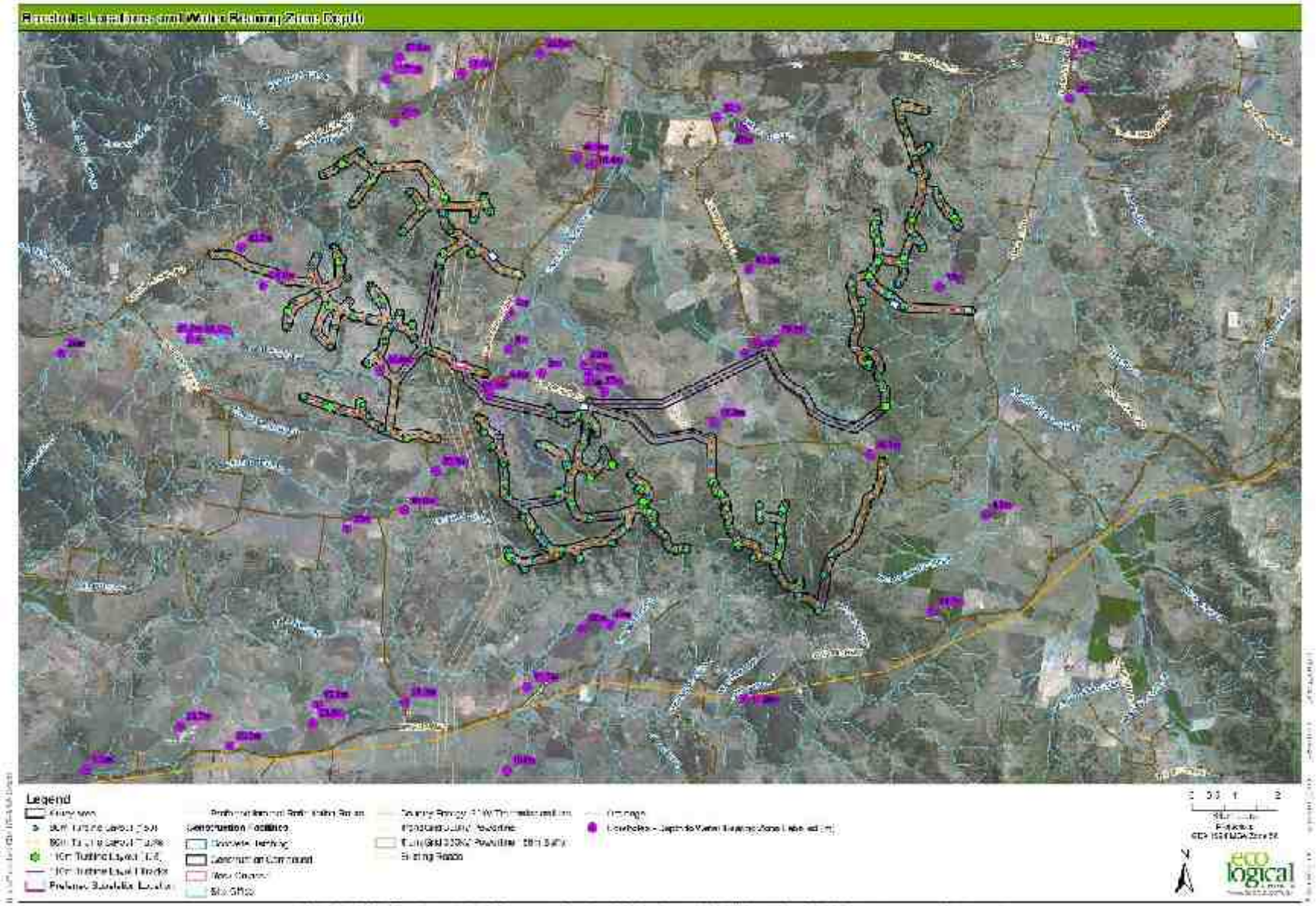

Figure 8: Borehole Locations and Water Bearing Zone Depth

3.6 GROUNDWATER DEPENDENT ECOSYSTEMS

Groundwater Dependent Ecosystems (GDE's) are ecosystems which have their species composition and natural ecological processes wholly or partially determined by groundwater. Types of ecosystems that can rely upon groundwater include:

- Terrestrial vegetation that show seasonal or episodic reliance on groundwater
- River base flow systems which are aquatic and riparian ecosystems in or adjacent to streams/rivers dependent on the input of ground water for base flows
- Aquifer and cave ecosystems
- Wetlands
- Estuarine and near-shore marine discharge ecosystems
- Fauna which directly depend on groundwater as a source of drinking water of that live within water which provide a source.

There are no previously identified groundwater dependent ecosystems within the site. The Montane Heaths have been assessed and are considered to be reliant on episodic surface water events. The majority of the study area is covered in grasslands, which with its shallow root systems, is unlikely to depend upon groundwater for its natural function. The proposed works are not likely to influence the quantity or quality of natural flows of surface water into these wetlands.

The groundwater level data from surrounding bore holes suggests that the ridgelines are unlikely to support an ecosystem which is reliant on groundwater present at such depths.

The established trees within the patches of existing terrestrial vegetation in the gullys along the drainage lines such as the downstream River Oak may rely on groundwater during low flow periods.

Any sourcing of water for the concrete batching plants will need to be done in accordance with the licencing requirement under the WM Act.

4 Mitigation and management recommendations

Recommended management and mitigation measures are detailed. This report does not consider there to be any impacts on groundwater unless extraction for use is sourced from bores. Any requirement for water obtained locally will need to sourced from licensed or permissible sources under The WM Act including farm dams and groundwater bores.

4.1 SEDIMENTATION AND EROSION

There are approximately 18 drainage line crossings. Only two (2) are on second order streams or higher. These two are in Horse Gully and will require more detailed design in order to comply with NoW Guidelines. DWE guidelines for river crossing design will be followed in the design and upgrading of existing roads and the river crossing causeway.

Given the extent of proposed access tracks and the nature of soils of the site, it is recommended that a Soil and Water Management Plan (SWMP) be prepared in line with the 'Blue Book' (Landcom 2004) as part of the Construction Environmental Management Plan for the site. The objective of the SWMP should be:

- To minimise soil disturbance
- To prevent erosion events from surface run-off
- To prevent disturbance of water resources in the area

Specific measures to be addressed in the design of access tracks include:

- All roads to have sufficient cross-fall gradient to allow all runoff to be collected and treated to ensure no water quality impacts on the adjacent watercourses.
- All watercourse crossings are to be designed in accordance with DWE guidelines and ensure that they do not adversely impact on the hydraulic regime of the watercourse (e.g. flooding levels).
- All watercourse crossings are to be designed and constructed in accordance with NSW DPI guidelines (*Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings*) to minimise any impact on the aquatic environment.
- Design and construction footprint and extent of disturbances proposed within the riparian zone should be minimised.
- Maintain existing or natural hydraulic, hydrologic, geomorphic and ecological functions of the watercourse.
- Stabilise and rehabilitate all disturbed areas in order to restore the integrity of the riparian corridor.

Specific measures to be included in the SWMP include:

- Drainage from the study area must be in line with the *Protection of the Environment Operations Act 1997* requirements so that there is no impact on downstream habitats.
- Install water slowing and diversion devices around construction areas including devices to manage surface run-off from hardstand areas and surfaced access tracks.

- Design appropriate sedimentation basins to catch and treat all water from the site and consider utilising existing drainage paths for discharge points.
- Hardstand areas for site office, concrete batching plants, rock crusher, substation and construction compounds should minimise construction and operational impacts on watercourse and riparian corridors. Considerations include but are not limited to;
    - Any stormwater outlets should aim to be 'natural', yet provide a stable transition from a constructed drainage system to a natural flow regime.
    - All ancillary drainage infrastructure e.g. sediment and litter traps should be located outside the riparian corridor. Runoff should be of an appropriate water quality and quantity before discharge into a riparian corridor or watercourse.
    - Discharge from an outlet should not cause bed or bank instability.
    - All stockpiles are to be located away from drainage lines, natural watercourses, road surfaces and trees and are to be appropriately protected to contain sediment and runoff e.g. sediment fencing.
    - All water run-off that contains high silt content should be filtered and flocculated before it drains from the site.
- Changes to the quantity and quality of the receiving waters are to be monitored at the locations on Figure 9 at suitable intervals (daily during construction, monthly during operation) to demonstrate that there is no adverse impact on discharge volumes or water quality parameters.
- Regular inspection, maintenance and cleaning of water quality and sedimentation control devices.
- If erosion is detected as a result of inadequate maintenance of drainage control devices, the relevant Environmental Manager shall be alerted and remedial action is to be undertaken immediately and ensure no reoccurrence of the event.
- Revegetation of all areas disturbed during construction.
- All activities to be carried out with due diligence, duty of care and according to best management practices.
- All personnel should be made aware of their responsibilities in this regard.
- Application of the guidelines:
    - *Managing Urban Stormwater: Soils and Construction*, 4th Edition (Landcom 2004) commonly referred to as the "Blue Book"
    - *Managing Urban Stormwater: Soils and Construction*, Volume 2C Unsealed roads, DECC
    - *Guidelines for Controlled Activities*, NSW Office of Water
    - *Guidelines for planning, construction and maintenance of tracks* (NSW Department of Land and Water Conservation 1994)
    - *Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings*, NSW DPI (Fisheries) (Fairfull & Witheridge 2003).
- The full suite of erosion controls (e.g. catch drains upslope of earthworks, barrier fencing of 'no disturbance' areas) and sediment controls (e.g. sediment basins, sediment fences, stockpile stabilisation, stabilised site access points) be determined during the preparation of the SWMP.

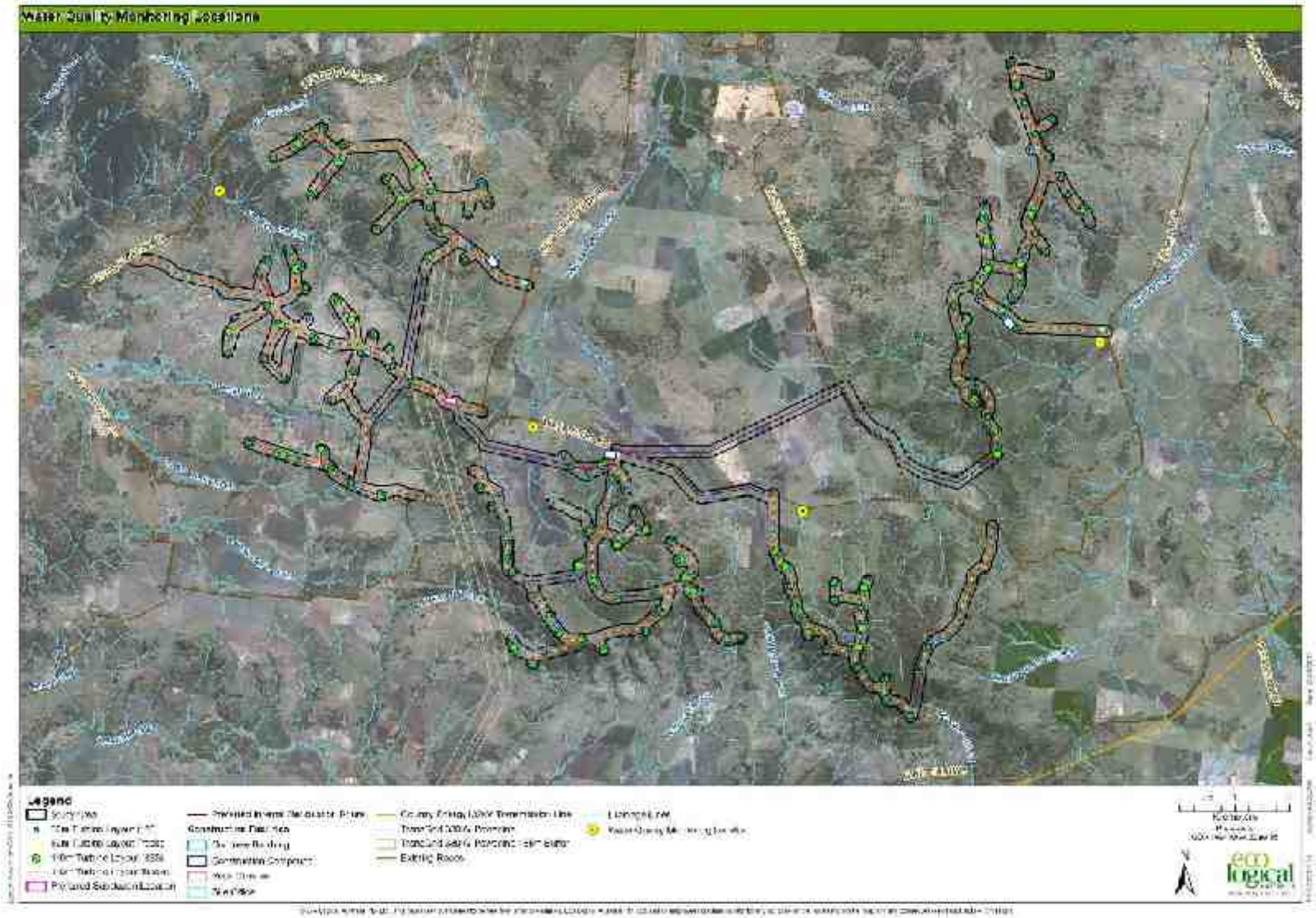

Figure 9: Water monitoring locations

4.2 CONTAMINATION

Potential surface water and groundwater contamination may result from hazardous substances used at the substation and potentially from activities and vehicles on site during construction.

Any concrete batching plant should be located to avoid proximity to creeks. Mitigation measures to protect the surrounding environment would be required to ensure that there are no significant impacts on the surrounding waterways during construction including sufficient bunding around the site to contain any potential spills and controls to prevent any loss of sediment or other contaminated material.

Specifically in relation to the hydrology of the site, the following measures are required to be implemented as part of the SWMP:

- The establishment and operation of the concrete batching plants must be in accordance with the Environment Protection Authority's *Environmental Guidelines for the Concrete Batching Industry* and the Environment Protection Licence issued by DECC.
- Concrete and cement carrying vehicles should be washed out in appropriate wash-down facilities off-site.
- Management of hazardous materials, waste and sewage will ensure no contamination of water resources occur.
- Wastewater produced during construction from temporary onsite toilets would be stored before being trucked off site.
- All hazardous products will be stored and transported appropriately in accordance with relevant DECCW and Workcover guidelines and regulations, to avoid release to the environment.
- All hazardous materials are to be properly classified, stored away from flood prone areas and drainage lines. Appropriate spill kits and fire protection are to be provided on-site during construction.
- Any on-site refuelling must occur in an area greater than 100 m from the nearest drainage line and ensure correct practices are in place, including:
    - Refuelling to be carried out in a specified, bunded area, according to regulatory requirements
    - Use of drip trays and spill mats
    - No refuelling to be carried out in the vicinity of a waterway

4.3 OPERATIONS:

A Soil and Water Management Plan (SWMP) will be required for inclusion in the Construction Environmental Management Plan (CEMP) for the project. As a minimum the SWMP will require an appropriate inspection and maintenance schedule to ensure all erosion and sediment controls are operating efficiently and defects are rectified immediately.

Following construction an Operational Environmental Management Plan (OEMP) should monitor the following:

- A regular inspection program for all facilities, tracks and watercourse crossings and rehabilitation sites.
- Vehicles management e.g. restrict traffic to defined roads; include any wet weather crossing requirements.
- Materials management e.g. control of maintenance activities and spill kits.
- Wastewater management.
- Appropriate containment of refuse, rubbish, etc to ensure no net impact on receiving waters.

5 Conclusions

The following summarises the findings of this assessment:

- The site is characterised by ephemeral drainage lines in the upper catchment with limited incised gullying and a mature river system at the base of the local topographic relief.
- The majority of impacts, access roads and footings will occur on the crest of the ridges within the catchment area.
- With the appropriate design principles and management of access tracks, crossings within riparian zones and of watercourses the works are not expected to significantly affect the watercourses or riparian vegetation within the site, the general locality and downstream.
- The DECCW Director-General's requirements will be met by implementing mitigation measures and recommendations in line with the DWE guidelines and the 'Blue Book' (Landcom 2004).
- No groundwater impacts are expected. Further assessment is required if rock anchor turbine footings are required.
- No impacts on wetlands or groundwater dependent ecosystems are expected.
- A SWMP incorporated into the CEMP and OEMP in addition to monitoring will be required for the works.
- Despite the removal of the controlled activity approval requirements under Part 3A of the EP&A Act, it is recommended that works be carried out in accordance with WM Act and NoW Guidelines as assessed therein.

References

Border Rivers Catchment Management Authority. *Southern Rivers Catchment Action Plan*.

Department of Land and Water Conservation. 1996. *The NSW Wetlands Management Policy*. NSW Government.

Department of Land and Water Conservation. 1996. *The NSW Weirs Policy*. NSW Government.

Department of Land and Water Conservation. 1998. *NSW Groundwater Quality Protection Policy*. NSW Government.

Department of Land and Water Conservation. 2002. *The NSW State Groundwater Dependent Ecosystem Policy*. NSW Government.

Department of Water and Energy, 2009. *NSW Border Rivers regulated river water source Water Sharing Plan, Background Document*. NSW Government

Eco Logical Australia, 2011. *Sapphire Windfarm Soil Assessment*, A report prepared for Wind Prospect.

Environment Protection Biodiversity Conservation Act (EPBC). 1999.

EPBC Protected Matters Search (report created 16/3/11) Department of Sustainability, Environment, Water, Population and Communities.

Environmental Planning and Assessment Act (NSW). 1979.

Fairfull, S. and Witheridge, G., 2003. *Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings*, NSW Fisheries, Cronulla.

http://www.environment.gov.au/biodiversity/threatened/communities/pubs/39-conservation-advice.pdf.

http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0014/5081/Primefact_Silver_perch.pdf.

http://www.dpi.nsw.gov.au/fisheries/species-protection/conservation/what-current/endangered-species/purple-spotted-gudgeonhttp://waterinfo.nsw.gov.au/drr/data/border.river.html.

Landcom, 2004. *Managing Urban Stormwater: Soils and Construction, Volume 1, 4th Edition.*

NSW Fisheries, 1999. *Policy and Guidelines Aquatic Habitat Management and Fish Conservation* (Eds. A.K. Smith and D.A. Pollard), NSW Fisheries, Port Stephens Research Centre.

NSW Office of Water Groundwater Data accessed via Natural Resource Atlas at http://nratlas.nsw.gov.au/wmc/

Protection of the Environment and Operations Act. 1995.

Water Management Act (NSW). 2000.

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