Recommendations for Transmission Line Planning & Management

To Reduce Local Biodiversity Impacts

New England Biodiversity Reference Group

Introduction

EnergyCo released an online map of preliminary transmission line study corridors on 5 June 2023 and subsequently held consultation sessions in Armidale, Uralla and Walcha.

The transmission lines are part of the New England Renewable Energy Zone (REZ) infrastructure that will be built over the next 20 years. The New England REZ will provide 6GW of network capacity by 2033, with a further 2GW by 2043 which will make the New England region and its community important contributors to the transition from fossil fuels to clean energy.

Our interest in forming a reference group is to get the balance right between global environmental outcomes and limiting local loss of biodiversity in this region.

500km of new transmission lines are proposed (not including the lines between solar/wind farms and hubs), each 70-100m wide. Looking at the proposed routes, there is a lot of native vegetation to be cleared in an already fragmented landscape. Much of this will be endangered and critically-endangered woodlands and forests and habitat for threatened flora and fauna.

The transmission lines run approximately north-south, creating a continuous break in connectivity from east to west. While this won't affect animals like galahs and kangaroos, it is wide enough to create an impermeable barrier for many animals including declining woodland birds such as Hooded Robins, Speckled Warblers, Brown Treecreepers unless some vegetation to 3m is retained beneath lines. In addition, cleared transmission corridors create perfect opportunities for pigs and foxes to move into remnant vegetation, hence the recommendation for feral pest management.

The preliminary routes selected for the transmission lines are approximately 1km wide and have opportunities to be refined after community consultation (these will be narrowed to 70-100m in the final iteration). The good news is that the initial route selection has been weighted to avoid National Parks and Reserves and areas of known high biodiversity value. It appears that the route does not go through any National Parks.

We think that, as local conservationists with significant knowledge of the local environment, we are taking a proactive stance to minimise the impacts on biodiversity, while still supporting this necessary REZ infrastructure, with its contribution to averting global biodiversity loss due to climate change. To this end, we have collectively prepared the attached recommendations for planning, construction, maintenance and monitoring of transmission line construction in the New England REZ, and request that these recommendations be employed to guide the work of EnergyCo, its contractors, and the company which is successful in obtaining the tender to construct and operate the infrastructure.

We also acknowledge the interwoven connection between ecology and cultural heritage. We support recommendations such as those made by Newara Aboriginal Corporation for renewable energy developers; that:

> *Renewables companies wanting to operate on Anaiwan Country need to provide concrete assurances that our interests as Anaiwan people will be respected, including but not limited to:*
>
> *1) protective buffer zones around significant bushland areas;*
>
> *2) mitigation of disturbances to our community's cultural practices and use/enjoyment of Country;*
>
> *3) avoidance of substantial clearing of native woodlands; and*
>
> *4) protection of tangible and intangible cultural heritage*

as they apply to transmission line planning.

Biographies of New England Biodiversity Group Members

David Carr

David Carr is the owner and director of Stringybark Ecological, an ecological consultancy business based in Armidale. He holds a Master of Resource Science and a Bachelor of Science from the University of New England. David is a Certified Ecological Restoration Practitioner (CERP) with the Society for Ecological Restoration and an accredited Biodiversity Assessment Method (BAM) Assessor. He is a specialist in ecological restoration, extension theory and practise, farm forestry and bushland management. David has over 40 years' experience with the ecosystems, flora and fauna of the Tablelands, Plains and Slopes.

David is also a past President and current Committee member of Armidale Tree Group, a not-for-profit community business dedicated to maintaining trees and ecosystems in the New England region.

Eric Nordberg

Dr Eric Nordberg is a Senior Lecturer in Applied Ecology and Landscape Management at the University of New England (UNE). He is a wildlife ecologist and leader of the newly formed Renewable Energy Hub at UNE. His research program largely focuses on the impacts of environmental disturbance and land-use change on wildlife communities, with expertise in reptile ecology, conservation, and behaviour. Aside from his recent interest in identifying 'win-win' management strategies for wildlife conservation and renewable energy development, he has studied a range of topics, including the spatial ecology of timber rattlesnakes in agricultural landscapes in the USA, the impacts of feral pigs on turtles in Cape York, and the impacts of habitat modification from cattle grazing on reptile communities, to name a few.

Kate Boyd

Kate has Bachelor of Science with ecology major and Diploma of Natural Resources. She has worked for over 4 decades in natural resource management including environmental impact assessment, wetland protection, water management reform and bushland regeneration. Kate is an Honorary Life Member of the National Parks Association of NSW and active in the Armidale Branch of this Association as well as other community environmental groups.

Maria Hitchcock OAM

BA, M.Prof. St. (Ab. Stds) Hons, (UNE), NSW T. Cert., ZMP (Göttingen).

Maria is a retired High School teacher, environmentalist and author. She is a Life Member of the Australian Plants Society, former leader of the ANPSA Correa Study Group and Waratah & Flannel Flower Study Group and holds the National Correa Collection in her private botanic garden which is registered with BGANZ. She also leads 'Save our Flora' a national online project dedicated to threatened native flora. She is author of *Wattle* (AGPS 1991) *Correas* (Rosenberg 2010), *A Celebration of Wattle* (Rosenberg 2012) and *Australian Bush Foods* (Cool Natives 2020). She is a regular ABC New England North West Radio Garden presenter specialising in Australian native plants**.**

Maria received an Order of Australia medal in 2018 for services to conservation and the environment. She is currently Convenor of an Armidale-based Think Tank New England Visions 2030 Institute.

Paul McDonald

Professor Paul McDonald is a behavioural ecologist with a specialty in ornithological research. He has over 25 years' experience studying primarily avian systems across a range of countries, with research within Australia focusing upon woodland bird conservation, bioacoustic monitoring and vocal signalling, and understanding the social system and ecological impact of *Manorina* honeyeaters.

Elizabeth O'Hara

Elizabeth O'Hara has been the Convenor of Wildlife Habitat Group (an action group of Sustainable Living Armidale) since 2018. She is particularly interested in this project from a perspective of consultative development, after ten years' experience of fossil fuel industry-driven development around the Leard and Pilliga Forests and across the Liverpool Plains. The project provides the opportunity for decision making which is environmentally sensitive, respectful of the knowledge of traditional custodians, responsive to the demands of climate change and to requirements of intergenerational equity.

Annette Kilarr

BA (Hons) Anthropology (USYD), Grad Dip Nat Res Man (UNE), Diploma Project Management.

Annette has been the Convenor of Climate Action Armidale (an action group of Sustainable Living Armidale (SLA)) since 2018. She is also a member of Renewable Energy Education, Advocacy and Community Health (REEACH) (another action group of SLA) that she helped form in 2022 and with support from the Community Power Agency (CPA).

The objectives of REEACH include renewable energy education, advocacy, community benefit, community ownership, and community resilience. We are about enabling/promoting good action locally, facilitating community engagement from ordinary citizens in public policy and with a view that attention to environmental health in all decision making is the bedrock for achieving community health.

Deborah Bower

Debbie Bower (B.Sc., Ph.D) is Associate Professor in Ecosystem Rehabilitation and head of the Laboratory of Applied Zoology and Ecosystem Restoration (LAZER) in School of Environmental and Rural Science and UNE. Her research focuses on the management of invasive species and applied ecology of threatened taxa. This work incorporates experimental techniques to explore disturbances such as wetland weeds, salinisation and emerging infectious diseases.

Sanaz Alian

Dr Sanaz Alian is a lecturer in Urban and Regional Planning at the University of New England (UNE). Sanaz is a town planner and she is a Full Member of the Planning Institute of Australia. Sanaz is passionate about the community and sustainable developments as is demonstrated through her research and teaching. She is currently writing a new unit about community planning and participation. Sanaz is the convener of Renewable Energy Education, Advocacy and Community Health (REEACH) (an action group of Sustainable Living Armidale).

Heidi McElnea

Heidi McElnea (B. Communications) works with Community Power Agency as an Engagement Coordinator for the Northern Tablelands of NSW. Heidi is motivated by the challenge of co-designing sustainable solutions to existing problems in regional Australia through collaboration with the full range of stakeholders in the space. She has experience working with renewable energy projects from the perspective of the community, local government and industry. She is a member of sustainability group ZNET Uralla and is currently undertaking energy, biodiversity and sustainability studies with the University of Tasmania.

Framework for Recommendations

In New South Wales, the management of impacts on biodiversity from development, is covered by several pieces of legislation. The Biodiversity Conservation Act (2016) is the principal Act, along with the Environmental Planning and Assessment Act (1974) and the Biodiversity and Conservation State Environment Planning Policy (2021). The BC Act uses a framework of "Avoid, Mitigate and Offset" to manage impacts of developments on biodiversity. Proponents are firstly encouraged (and expected) to avoid any impacts on threatened biodiversity by moving part or the whole of a development to an area where it will have no, or a reduced, impact. If the development cannot be moved, then there is an expectation that the impacts be mitigated, by modifying the design or timing of the development. Finally, if there are still residual impacts after modifications to avoid and mitigate, then these impacts must be offset using the Biodiversity Offset Scheme within the BC Act.

We have set our recommendations within this framework, with a strong emphasis on avoiding and mitigating the impacts before resorting to offsetting, which in our opinion is a flawed option. We urge the proponents of the new transmission lines to go beyond the legislative minimum requirements in order to avoid as many biodiversity impacts as possible, then to mitigate impacts where they cannot be avoided. Only as a very last resort, should impacts be offset and then, as we suggest, those offsets should be located close to the site of the impact rather than within the bioregion as the legislation allows. If the proponents demonstrate a commitment to minimising the impacts of the transmission lines on biodiversity, then the conservation community will be able to get behind the project to support the global environmental gains from more renewable energy.

Little research has been done on the impacts of transmission lines in Australia. However, a recent review conducted by Richardson et al. (2017) summarised current knowledge and potential mitigation measures to minimise negative impacts to biodiversity. One key outcome was that almost no studies were conducted as part of a large BACI (before-after-control-impact) design, which is vital to understand the true impacts of a disturbance. Most studies only looked at impacts during construction or during the operation phase of projects. Further, no studies published findings from long-term monitoring programs.

The response that plants and animals will have to disturbance are quite varied, with some disturbance-tolerant species likely to thrive post disturbance, while more specialised species decline in the face of disturbances. Groups like some raptors and other visual predators may benefit from cleared patches in the environment, such as high perches for hunting or making nests. However, other groups that are more sensitive to habitat fragmentation and loss are likely to decline as a result of newly cleared land. Targeted management should be implemented to achieve desired outcomes for local species and habitats, which may include limiting access by grazing stock to limit the spread of invasive species, promote the reestablishment of native species, and limit additional stressors on a recovering habitat.

These recommendations, then, extend to monitoring and management practices which can further establish and measure the outcomes of different mitigation strategies.

Recommendations

Avoid

1. Where possible, plan the route of transmission lines to avoid Critically Endangered and Endangered ecological communities and species habitat.

In the New England region, as in many other areas where there has been long-term agricultural use, vegetation clearing, grazing and introduction of weeds and feral animals has led to a significant decline in the extent and condition of pre-existing ecosystems. As a result, many of the ecosystems in this region are now threatened with extinction and as such, are listed under NSW and Commonwealth legislation. Of particular concern are the Critically Endangered Grassy Woodlands, including White Box - Yellow Box - Blakely’s Red Gum Grassy Woodland (Box Gum Grassy Woodland) and New England Peppermint Grassy Woodland. Other grassy woodland communities in the region are listed as Endangered. These Endangered Ecological Communities (EECs) also support many threatened species as well as providing habitat for more common species and connectivity through the landscape.

Grassy woodlands in particular are vulnerable to irreversible change once the ground layer vegetation is removed,as a high proportion of their biodiversity is in or below this layer and they become prone to weed invasion, changes in soil nutrients and soil erosion.

Trees are critical elements of these EECs, providing ecosystem functions and structural elements that enable the whole ecosystem to function and provide a diverse range of habitats for plants and animals. Hollow trees are common in even small remnants of these woodland EECs and must be considered as irreplaceable assets, given that they take up to 200 years to form hollows suitable for use by some threatened species (Glossy Black Cockatoo, Barking Owl, etc).

As a fundamental principle, the route of the transmission lines must avoid all areas of Critically Endangered and Endangered Ecological Communities and any areas with trees with hollows >200mm diameter. The lines must also avoid any areas of known habitat for Critically Endangered and Endangered species, including Regent Honeyeater. In some cases, even small diversions of the transmission line route may be enough to avoid these irreplaceable biodiversity assets.

For example, Regent Honeyeater research in this region demonstrates the importance of River Oaks (*Casuarina cunninghamiana*) along watercourses as feeding and nesting habitat for Regent Honeyeaters, so clearing of this habitat should be largely avoided by siting a corridor parallel to, not along, River Oak-lined watercourses and, where unavoidable, aiming to cross where a bend of the watercourse enables minimisation of habitat loss.

It is essential to avoid siting the transmission network to avoid existing national parks, nature reserves and other protected areas, including those protected by perpetual or long-term conservation agreements. We appreciate that the routes currently proposed achieve this (unless they propose to cross a private agreement area unknown to us). Similarly, it is important to avoid fragmentation of other substantial areas of native vegetation that could in future be considered suitable for protected area status. New England has many ecological communities that are poorly conserved: the large reserves east and south of the Northern Tablelands conserve different communities while protected areas in and southwest of this region are small and of disproportionate value. They should be added to, not diminished.

The New England community highly values the role of Travelling Stock Routes and Reserves (TSRs), roadsides and other Crown Lands in conserving biodiversity and connectivity. TSRs are important biodiversity assets because of historical management practices, which have resulted in much greater diversity of species than on surrounding grazing land. They often form linear samples of formerly widespread ecosystems in areas of high agricultural development and landscape change.

The linear nature of stock routes provides important corridors for the movement of animals through the landscape. The larger blocks of habitat in stock reserves often support threatened or uncommon species due to their size and habitat complexity. TSRs also have very high cultural value, with important cultural heritage (both First Nations and European), recreational, educational and social values. Many road reserves still have some native vegetation including older trees with larger hollows than in the surrounding paddocks.

As a principle, we recommend that the transmission lines avoid TSRs and roadside reserves, particularly where they contain ecosystems in good condition. Where transmission lines must cross linear stock routes or road reserves, we recommend that this be perpendicular to the length of the route so the smallest area is affected as possible.

Undergrounding of transmission lines is an important means to avoid some biodiversity impacts as well as visual or other issues, and should therefore be considered at this route-planning stage. Techniques to minimise surface disturbance and spread of weeds will be particularly important if lines are put underground through areas with high biodiversity values in the ground layer, such as the extensive grassy woodland ecological communities.

The effects of EnergyCo's decisions about location of its hubs on the likely routes and locations of generator connections and transmission routes will have significant influences on the potential biodiversity impacts of those routes. EnergyCo and the Department of Planning should consider how to help avoid those impacts. Since generators will only be permitted to connect to hubs not lines, hubs should be located where there will be minimal biodiversity impacts as the lines approach the hub. The current proposed location of the northern hub between Boorolong Nature Reserve and other areas of native vegetation is likely to lead to significant additional loss of biodiversity in the future. Connection routes may need to be planned by the government to avoid predictable impacts such as clearing across a key biodiversity corridor.

2. Where possible, plan the route of transmission lines to avoid increasing fragmentation of large areas of native vegetation or to clear vegetation in landscapes with <30% vegetation cover.

Fragmentation is a key risk to maintaining biodiversity, particularly in the already heavily impacted woodlands of south-east Australia. Habitat fragmentation reduces the upper limit of patches remaining in systems, and leads to isolation of these smaller areas of habitat that may impact recruitment and gene flow between them. For habitat specialists, particularly those that require large patches of suitable habitat, this may lead to large areas no longer being occupied.

Further to this, increased fragmentation also increases the amount of edge habitat available, as well as reducing the linear distance from modified zones into the centre of remaining habitat patches. This scenario enables encroachment of generalist or edge-specialist species into remaining fragments at the expense of habitat specialists. In south-east Australian woodlands, a key consequence of this is increasing the areas occupied by Noisy Miners (*Manorina melanocephala*), a species that actively excludes other avian species from the areas that they occupy using highly aggressive, coordinated mobbing behaviour. In fragmented landscapes, Miner's preference for edges and ability to penetrate short distances into remaining fragments means that they have a very large impact on woodland bird diversity, and are a key threatening process that is recognised by legislation aiming to preserve biodiversity.

Given this, maintaining large areas of good quality habitat should be prioritised, particularly of resource species such as Mugga Ironbark (*Eucalyptus sideroxylon*) or Yellow Box (*E. melliodora*) that are critical for endangered taxa such as Swift Parrot (*Lathamus discolor*) and Regent Honeyeater (*Anthochaera phrygia).* Beyond these guidelines, ensuring corridors maintaining connectivity, minimising increasing fragmentation should be a key priority of any future land use.

3. Engage with local biodiversity, environmental and wildlife groups and individuals to incorporate existing local knowledge and to enable collaboration of data

Local and specialised knowledge can provide insight into areas where the proposed footprint may overlap or interfere with ecologically sensitive habitat, or disrupt species of concern. In some cases, adjusting the trajectory of the transmission line corridor may allow EnergyCo to avoid these areas of concern prior to construction. Access to shapefiles of the proposed route would provide an opportunity for meaningful community input even before environmental impact assessments are conducted. This process should minimise delays and issues down the track when construction begins. It will also significantly reduce the Biodiversity Credit liabilities resulting from clearing or reduction of habitat for threatened EECs and species.

Vegetation mapping in the region is notoriously inaccurate, so any preliminary assessments based on this mapping will usually be wrong. By engaging with local expertise, likely areas of high biodiversity value can be identified more accurately than relying on low quality vegetation mapping.

The New England Biodiversity Group includes members with extensive experience in the region in identifying and managing EECs and threatened species habitat. We are able, at an early stage, to identify where the proposed route is likely to intercept this habitat so diversions can be planned well in advance of any requirements to conduct detailed surveys, plan (ineffective) offsets and purchase offset credits. Access to mapping of the route will allow this contribution to be made.

4. Avoid reducing wildlife connectivity where possible

Habitat connectivity enables fauna species to disperse through the landscape to feed, breed, escape threats and respond to changes such as climate change, fire and extreme weather. While some species such as galahs and magpies can move freely through highly-fragmented landscapes, other species have very specific limitations on how they can move through the landscape (Doerr et al, 2008). A large suite of declining woodland birds, for example, will not be able to cross a gap devoid of vegetation >70m, such as proposed for transmission line routes. Such gaps in key regional corridors could limit the dispersal of such birds, resulting in loss of populations and reduced genetic diversity in those that survive.

We recommend that, as a fundamental principle, connectivity be retained by avoiding or mitigating habitat loss in areas of important local and regional connectivity. The NSW Government, through DPE, has mapped these connectivity areas at a state and regional scale and in the New England area, at a local scale (M. Drielsma, DPE Armidale, pers. comm.). An example would be the TSR running north from Bendemeer, which the transmission line is marked as crossing. The lines should cross this corridor perpendicularly in order to minimise loss of vegetation in the corridor. Another example would be areas with significant, though patchy, native vegetation that link Boorolong Nature Reserve to other large bushland areas.

Mitigate

5. Adjust the trajectory, timing or management of transmission line corridors to mitigate impacts on biodiversity

Where transmission lines cannot be moved to avoid biodiversity impacts, it may be possible to mitigate some of these impacts.

One option to retain some biodiversity benefits when clearing powerline corridors, is to retain, and enhance, or restore vegetation below the regulated height threshold. EnergyCo documentation suggests this threshold is around 3m. This would result in a novel ecosystem (Hobbs, Higgs and Harris, 2009) without its tree and tall shrub strata. The benefits, or otherwise, to existing biodiversity and the changes in ecosystem functioning are unknown and could be subject to research to determine effectiveness and identify any negative consequences.

Little research has been done on the impacts of transmission lines in Australia. However, a recent review conducted by Richardson et al. (2017) summarised current knowledge and potential mitigation measures to minimise negative impacts to biodiversity.

Many mitigation measures have been suggested to minimise the negative impacts on wildlife and habitat, including altering the width or trajectory of the proposed work to avoid sensitive areas, strategically timing construction to avoid periods of high activity/importance (e.g., breeding season, peak pollination, etc.), and initiating long-term management activities on site to ensure the reestablishment of target species and habitats (e.g., targeted spraying for weeds, watering programs, or seeding/planting programs). One such study (Ferrer et al. 2020) implemented targeted restoration within the footprint of the transmission towers. They planted native shrubs and vegetation and created rock piles from the excavation process while building the towers to create new habitat for biodiversity. They found increased use by invertebrates and small mammals in the restored habitats which provided a patchwork of suitable habitat throughout the transmission line.

Offset

6. Locate ecosystem and species offsets as close as possible to where the impact occurs

Where it is not possible to avoid damaging important habitat, set a standard that ecosystem offsets will be established as close as possible to the impact and all species offsets will be located within the same IBRA subregion. Offset areas and management activities should aim to maintain or increase the actual local populations that are predicted to be impacted by the proposed development, including populations of the many plant and animal species in endangered ecological communities, so they are not reduced or fragmented into unviable populations destined to be lost from the local area. In determining the suitability of possible offset areas, factors such as similar soil type, habitat qualities like shelter, and the dispersal abilities or requirements of species should be considered.

This principle goes beyond the legislative requirement, which is to establish ecosystem offsets within the same IBRA region and species offsets within the state. This will require a proactive approach to landholders near to the transmission line routes, to encourage and enable them to establish Biodiversity Stewardship Agreements on their land to generate credits for the project. This will ensure that the offsets are close to where the impacts are and will generate additional income for affected landholders and neighbours. This initiative could be developed in partnership with the Biodiversity Conservation Trust or the Credit Supply Taskforce.

Species offsets should be established close enough to the impact area that affected populations can move to the offset areas. The distance will depend on the dispersal ability of the affected species and may require the establishment of corridors or improved connectivity. For some fauna species, capture and release into offset areas should be considered and carefully monitored.

Management of offset stewardship areas should be consistent with the National Standards for the Practice of Ecological Restoration in Australia: https://www.seraustralasia.com/pages/standards.html. This would be a means to achieve the specific offset outcomes through either passive or active management, or both.

7. Create a grassy woodland reserve and funding for 20-year long bush regeneration projects

If offsets cannot be found close to all unavoidably impacted areas, offset areas elsewhere in the same IBRA subregion should be secured. Given the substantial areas that may be required, this could be an opportunity to create significant nature reserves protecting ecological communities and habitats that are proposed to be impacted, for example, of critically endangered box-gum grassy woodland. This could involve purchase of areas that partly meet the criteria for this community and funding their regeneration throughout the life of the transmission line. Note that much of the biodiversity in grassy ecosystems is in the ground layer so it needs to be managed and warrants regeneration or even reconstruction, along with maintenance, regeneration or reconstruction of the tree layer. Some of the best examples of grassy woodland ecological communities are in travelling stock routes and reserves but they are not being managed primarily for their biodiversity, so opportunities to change the purpose and management of significant sections of stock routes or reserves could be explored.

Research and Monitoring

8. That a research program be developed to investigate and develop options for habitat retention and restoration under 330 and 500KV transmission lines to mitigate biodiversity impacts.

Some of the measures we propose here to mitigate the impacts of transmission lines on biodiversity are new and have not been widely adopted in Australia, although examples exist throughout the world. Therefore, we propose that these measures are implemented in conjunction with a research program to monitor the environmental, economic and social outcomes.

BACI design projects (before-after-control-impact) would be ideal; access to sites for data collection prior to the start of construction and continuing throughout the life of the project would allow for a more robust assessment of true impacts.

Research project opportunities are extremely wide ranging, but might include:

1. Initial impacts on biodiversity (broad scale plant and fauna assessments)
    a. Investigating population changes in invertebrates, amphibians, reptiles, mammals, birds, plants
2. Restoration measures
    a. Creating new habitat (replant native veg, log piles, rock piles, nest boxes)
3. Create travel corridors
    a. Establishing connectivity through shrubs/native vegetation to increase patch connectivity
4. Interaction between transmission lines, biodiversity and agricultural production
    a. Social and economic research into design options to manage conflicts and achieve multiple benefits

Ongoing monitoring will be key to understanding any impacts, both foreseeable and currently unknown, particularly in regards to flyways and interactions between taxa and infrastructure. Some potential impacts, such as the risk of electrocution to large birds (including threatened taxa such as the white-bellied sea-eagle, little eagle, and square-tailed kite) can be reduced by using infrastructure that prevents birds making contact with more than one live wire. Numerous examples exist, and ensuring that these are installed from the outset would reduce impacts, particularly in areas where breeding territories are present.

Temporal differences in impacts may also be problematic, if for example during north-south movements of birds during biannual migrations. Collision risk is most likely on higher elevation wires, however quantification and assessment of risk during peak movements south for spring/summer, and northwards for autumn/winter would be beneficial. Movements between waterbodies are more stochastic and less well understood, however lines near spans of water heavily used by waterfowl may also need amelioration strategies to reduce risk.

Management

9. That construction management plans outline the use of construction practices for sensitive areas which minimise impacts

A range of recommendations were made in *International Best Practices for Assessing and Reducing the Environmental Impacts of High-Voltage Transmission Lines* (Williams, 2003) that could be useful for minimising impacts in the New England environment. These could include:

- widening span lengths to reduce the number of towers in sensitive habitats
- avoiding construction during periods in which essential natural processes such as wildlife breeding and fish spawning might be disturbed.
- providing stringent control of erosion and sedimentation when vegetation is removed
- using cranes or helicopters for tower installation and other means of minimising road-building in remote areas.
- undergrounding wires on sections where this method would provide better environmental outcomes
- minimising construction duration, noise, and use of explosives
- ensuring that construction equipment is properly cleaned to avoid accidental spreading of invasive species.
- employing cultural experts in the project team to identify and protect valuable archaeological and cultural artefacts and sites encountered during construction.

10. That a percentage of REZ access fee funding be set aside for environmental improvement (net gain) through significant revegetation and management (weeds and ferals) projects.

Revegetation will be most effective to mitigate biodiversity loss due to transmission line construction:

- As a buffer to riparian zones,
- To increase structural and species diversity in degraded woodland,
- To create a more diverse mosaic of vegetation in agricultural landscapes as shelterbelts and woodlots,
- To increase groundlayer species diversity under powerlines, and
- To increase connectivity between isolated remnants.

Management of pest animals such as foxes and cats, can mitigate some of the threats to species caused by increased fragmentation as a result of transmission line construction.

Control of environmental weeds, such as Serrated Tussock (*Nassella trichotoma*), Coolatai Grass (*Hyparrhenia hirta*) and African Love Grass (*Eragrostis curvula*), can prevent these weeds from spreading as a result of construction activity. Management of feral animals and weeds will also have direct benefits to agricultural production.

11. Data collected during surveys of potential or proposed infrastructure locations should be made available to the landowner

This particularly includes data listing the species and habitat characteristics that were found but could also include other environmental data such as soil cores. This information could assist landowners to better understand and steward the land and its ecological components. Data could include:

- an overview of the type of ecosystem
- the value of biodiversity within that ecosystem on their property
- the range of rare and endangered plants
- the range of bird species and other fauna and their importance in maintaining a healthy ecosystem
- an overview of how other landowners have successfully managed such habitats

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