BASIC ENVIRONMENTAL ASSESSMENT: RIVERINE RABBIT SPECIALIST REPORT.
SOUTRIVIER SITE NEAR LOXTON, NORTHERN CAPE PROVINCE

APRIL 2022

Compiled for:

WKN Windcurrent South Africa (Pty) Ltd

Compiled by:
Bohemian Scientist

Christy Bragg, Pr.Sci.Nat (Ecology and Zoology)
Zoe Woodgate (Ecological Science)
Aliénor Brassine, Pr.Sci.Nat. (Ecological Science)

SPECIALIST DECLARATION

I, Christy Bragg, as the appointed independent specialist, in terms of the 2014 EIA Regulations, declare that:

- I act as the independent specialist in this application;
- I perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I regard the information contained in this report as it relates to my specialist input/study to be true and correct, and do not have, and will not have, any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I have no vested interest in the proposed activity proceeding;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- I have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- all the particulars furnished by me in this specialist input/study are true and correct; and I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

Name of Specialist: Christy Bragg

Date: 22 April 2022

Note: this report was co-authored with Zoe Woodgate and Alienor Brassine. They too adhere to the principles listed above.

SUMMARY OF EXPERTISE – CHRISTY BRAGG

Christy Bragg has had over 10 years of experience with the conservation and research of the Riverine Rabbit, and is one of the few experts understanding the habitat characteristics and behaviour of the species. Christy has a MSc in Conservation Biology and has over 20 years' experience in academic research, monitoring and evaluation, climate change adaptation, ecosystem restoration, and environmental management. Her reports include at least 40 EIA specialist terrestrial ecology reports on various developments, including mining, renewable energy, residential and dam developments, examples of which include:

- Collins, K., Bragg, C. & Birss, C. 2019. *Bunolagus monticularis. In:* The IUCN Red List of Threatened Species 2019: e.T3326A45176532. http://dx.doi.org/10.2305/IUCN.UK.2019-1.RLTS.T3326A45176532.en. SANBI; the Endangered Wildlife Trust.
- *Bunolagus monticularis*. In: (Eds) Andrew T. Smith, Charlotte H. Johnston, Paulo C. Alves, and Klaus Hackländer Lagomorphs**:** Pikas, Rabbits, and Hares of the World. John Hopkins University Press.
- Christy Bragg and Marie Parramon-Gurney. 2013. National, Regional and Local Biodiversity Assessment of the South African Operations of Altron, in Compliance with the Global Reporting Indicators. Prepared for Altron. Cape Town, SA by the Endangered Wildlife Trust.
- Christy Bragg. 2014. Specialist Riverine Rabbit Survey. Proposed Harpuisberg Wind Energy Facility. Prepared for Windlab. Endangered Wildlife Trust's Drylands Conservation Programme.
- Christy Bragg. 2014. Specialist Riverine Rabbit Survey. Proposed Harpuisberg Wind Energy Facility. Prepared for Windlab. Endangered Wildlife Trust's Drylands Conservation Programme.
- Bragg, CJ; Paxton, BR; Shelton, JM; Bovim, L and Dallas HF. 2017. Freshwater Fishes of the Cape Fold Ecoregion and Climate Change: Volume 2: Policy Uptake Strategy. Prepared on behalf of the Table Mountain Fund by the Freshwater Research Centre. Pp. 14.
- Bragg, C. The Green Connection. 2010. Building the Resilience of Small Businesses and Projects to Climate Change: Adaptation of SKEPPIES nature-based enterprises in Namaqualand, South Africa. Cape Town: The Green Connection NGO.
- Bragg, C., Stanford, R., McDaid, L., Dramat, B. Munro, L. 20. Environmental Impact Assessment and Review: SUBTHEME 6: Representative demographics within service providers and civil society: the Green Connection. Written for DEA.
- The Green Connection. Input into the World Bank Energy Strategy Consultative Process- 2010: Best Practice Models for Energy Related Projects. BIC, Cape Town, SA.
- Contributor to the Water Research Commission-funded University of Free State report: Potential Environmental Impacts of Fracking in South Africa: Small and Large Mammals chapter.
- GIZ. 2018. Authors: Knowles, T., Bragg, C.J., and Amend, T. 2018. Entry Points for Mainstreaming Ecosystem-based Adaptation. The Case of Sudafrica. Alejandra Calzada Vázquez Vela (ed). Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Bonn.

- Bragg, C.J., Paxton, B.R. 2018. Realising the Ecological Reserve in a Time of Change: 20 Years On. Summary Report. 27 February 2018, Pretoria National Botanical Gardens. FRC and partners.
- Bragg, C.J. 2021. A preliminary desktop feasibility study on the Riverine Rabbit for two potential Areas of Interest: Sutherland and Loxton. Prepared for Windcurrent (Pty) Ltd.

SUMMARY OF EXPERTISE – ZOE WOODGATE

Zoe Woodgate recently completed her PhD at the University of Cape Town, with her thesis focusing on identifying drivers of species' distributions in the Karoo, South Africa. Previously she worked extensively on Riverine Rabbits in the Western Cape, using novel camera trap methodology and statistics to discover previously unknown details about their occurrence. She has extensive data analysis experience.

SUMMARY OF EXPERTISE – ALIENOR BRASSINE

Aliénor is a professional registered Ecologist with SACNASP and holds an MSc degree in Zoology from Rhodes University. Aliénor has been involved in fauna and avifauna surveys for renewable energy projects since 2015. Her main work focus is the use of camera traps to monitor wildlife populations, including designing and implementing species–specific camera trapping surveys for rare and cryptic species. She has extensive field experience across southern Africa and particularly within the Northern Cape.

CONTENTS

1 INTRODUCTION

WKN Windcurrent South Africa (Pty) Ltd is proposing to develop a wind farm on a ~232.64km^2 site ('Soutrivier') situated approximately 27km south–east of Loxton, in the Beaufort West Local Municipality, Western Cape. The Bohemian Scientist and associates were appointed to provide specialist input on the Critically Endangered Riverine Rabbit (*Bunolagus monticularis*). A feasibility study was conducted, which was then updated to an impact assessment to determine the potential impact of the wind farm site on the Riverine Rabbit.

The Riverine Rabbit's presence has been closely associated with the Karoo's seasonal drainage lines (Duthie et al., 1989), which are characterised by higher plant biomass that offer greater structural complexity important to the local fauna (Dean & Milton, 1999). These drainage lines, and associated fertile soils, are also preferred by farmers for short rotation fodder crops (e.g., lucerne; Ncube, 2018), and are heavily impacted by livestock seeking both shelter and food (Collins & du Toit, 2016, Eccard et al., 2000). Consequently, the Riverine Rabbit population is thought to be decreasing based on perceived and assumed threats linked to these riparian zones (Collins & du Toit, 2016). These threats include the ongoing habitat degradation (Hughes et al., 2008), traditional hunting with dogs by farm workers (Ahlmann al., 2000), climate change (Collins & du Toit, 2016) and catastrophic stochastic events (e.g., floods and disease; Alhmann et al., 2000).

The purpose of this specialist report is to describe and detail the ecological features of the proposed wind farm site relevant to Riverine Rabbits, to provide an assessment of the ecological sensitivity of the affected area and identify the likely impacts on Riverine Rabbit populations that may be associated with the development of the wind farm and associated infrastructure. Two site visits (detailed in Section 2.3), as well as a desktop review of the available ecological information for the area, were conducted in order to identify and characterise the site's abiotic and biotic features. This information was used in conjunction with the initial desktop sensitivity study (Bragg, 2021) to derive a more detailed map to evaluate the habitat suitability for the species within the Area of Interest (AoI). This map was subsequently used in developing a suitable camera trapping survey, whose purpose was to assess the potential presence, abundance and distribution of the Riverine Rabbit within the AoI. Finally, all available data was used to determine the ecological constraints for the development.

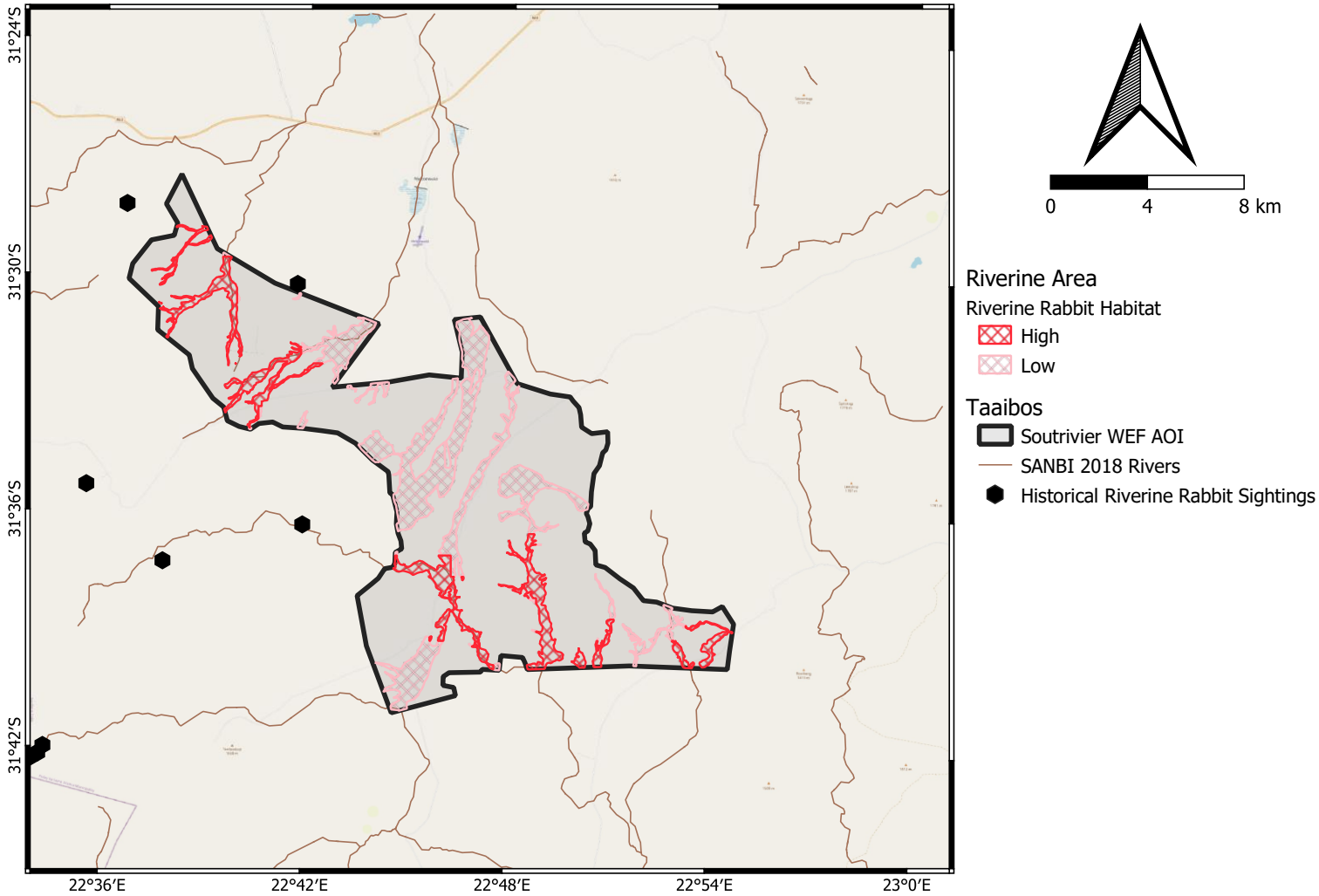

Figure 1: Location of the proposed Soutrivier AOI (polygon encased by the black border) relative to the provincial boundary (Western Cape/ Northern Cape) and the R63. Historical Riverine Rabbit (*Bunolagus monticularis*) sightings are indicated by the black hexagons, whilst rivers, as recorded by the 2018 South African Biodiversity institute (SANBI)'s National Biodiversity Assessment (NBA), are indicated in brown. Riverine Rabbit habitat, as previously determined by Christy Bragg, is highlighted according to sensitivity (see section 3.1).

2 METHODOLOGY

2.1 Scope of Study

The scope of the study includes the following activities:

- a description of the environment that may be affected by the activity and the manner in which the environment and the Riverine Rabbit may be affected by the proposed project
- a description and evaluation of environmental issues and potential impacts (incl. using direct, indirect and cumulative impacts) that have been identified that are relevant to the Riverine Rabbit
- a statement regarding the potential significance of the identified issues based on the evaluation of the issues/impacts
- an indication of the methodology used in determining the significance of potential environmental impacts
- an assessment of the significance of direct indirect and cumulative impacts in terms of the following criteria (as guided by CES' Impact and Risk Assessment Methodologies):
    - the nature of the impact, which shall include a description of what causes the effect, what will be affected and how it will be affected
    - the extent of the impact, indicating whether the impact will be local (limited to the immediate area or site of development), regional, national or internationat
    - the duration of the impact, indicating whether the lifetime of the impact will be of a short-term duration (0-5 years), medium-term (5- 15 years), long-term (> 15 years, where the impact will cease after the operational life of the activity) or Permanent
    - the probability of the impact, describing the likelihood of the impact actually occurring, indicated as Unlikely (improbable), May Occur (low likelihood), Probable (distinct possibility), or Definite (Impact will occur regardless of any preventable measures)
    - the severity/beneficial scale indicating whether the impact will be Very Severe/Beneficial (a permanent change which cannot be mitigated/permanent and significant benefit with no real alternative to achieving this benefit) Severe/Beneficial (long-term impact that could be mitigated/long-term benefit), Moderately Severe/Beneficial (medium- to long-term impact that could be mitigated/ medium- to long-term benefit), Slight or have no effect
    - the significance which shall be determined through a synthesis of the characteristics described above and can be assessed as low medium or high;
    - the status which will be described as either positive, negative or neutral;
    - the degree to which the impact can be reversed;
    - the degree to which the impact may cause irreplaceable loss of resources
    - the degree to which the impact can be mitigated;
- a description and comparative assessment of all identified feasible alternatives
- recommendations regarding practical mitigation measures for potentially significant impacts, for inclusion in the Environmental Management Programme (EMPr)
- an indication of the extent to which the impact could be addressed by the adoption of mitigation measures
- a description of any assumptions, uncertainties and gaps in knowledge
- an environmental impact statement which contains :

a summary of the key findings of the environmental impact assessment;

- an assessment of the positive and negative implications of the proposed activity;
- a comparative assessment of the positive and negative implications of identified alternatives

General Considerations

- Disclose any gaps in information or assumptions made.
- Identify recommendations for mitigatory measures to minimise impacts.

- Outline additional management guidelines.
- Provide monitoring requirements, mitigation measures and recommendations in a table format as input into the Environmental Management Plan (EMP).
- A description of the potential impacts of the development and recommended mitigation measures are to be provided which will be separated into the following project phases:
    - Construction
    - Operational Phase
    - Decommissioning

The following scope is therefore to be assessed:

- A description of the broad ecological characteristics of the site and its surrounds and the suitability for Riverine Rabbits.
- Legal review, including local regulatory requirements, IFC Performance Standards and other relevant local and international regulations, including permit requirements.
- Undertake a Riverine Rabbit survey to describe the baseline faunal characteristics of the affected area and place this in a regional context.
- Using primary and secondary data, provide a detailed baseline assessment
- Compile a sensitivity map depicting the distribution of the species, habitats and sensitive biological areas.
- Comment on faunal sensitivity in terms of Red Data Sensitivity Index Score of species, habitats, ecological corridors and linkages with other ecological systems on and adjacent to the site.
- Describe the existing impacts of current land use as they affect the fauna.
- Describe and assesses the impact to the terrestrial fauna present in the area.
- Assess cumulative impact of development with current and planned developments in the area.

Assessment Approach & Philosophy

The assessment will be conducted according to the EIA Regulations, published by the Department of Environmental Affairs 2014) as well as within the best-practice guidelines and principles for biodiversity assessment as outlined by Brownlie (2005) and De Villiers et al. (2005).

This includes adherence to the following broad principles:

- That a precautionary and risk-averse approach be adopted towards projects which may result in substantial detrimental impacts on biodiversity and ecosystems, especially the irreversible loss of habitat and ecological functioning in threatened ecosystems or designated sensitive areas: i.e. Critical Biodiversity Areas (as identified by systematic conservation plans, Biodiversity Sector Plans or Bioregional Plans) and Freshwater Ecosystem Priority Areas.
- Demonstrate how the proponent intends complying with the principles contained in Section 2 of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended (NEMA), which, amongst other things, indicates that environmental management should.
- In order of priority aim to: avoid, minimise or remedy disturbance of ecosystems and loss of biodiversity;
    - Avoid degradation of the environment;
    - Avoid jeopardising ecosystem integrity;
    - Pursue the best practicable environmental option by means of integrated environmental management;
    - Protect the environment as the people's common heritage;
    - Control and minimise environmental damage; and
    - Pay specific attention to management and planning procedures pertaining to sensitive, vulnerable, highly dynamic or stressed ecosystems.

These principles serve as guidelines for all decision-making matters that may affect the environment. As such, it is incumbent upon the proponent to show how proposed activities would comply with these principles, thereby contributing towards the achievement of sustainable development (as defined by the NEMA).

The following principles are relevant to this study[1]:

Species level

- Red Data Book species (giving location if possible using GPS)
- The viability of an estimated population size of the RDB species that are present (include the degree of confidence in prediction based on availability of information and specialist knowledge, i.e. High=70-100% confident, Medium 40-70% confident, low 0-40% confident)

Other pattern issues

- Any significant landscape features or rare or important vegetation associations such as seasonal wetlands, alluvium, seeps, quartz patches or salt marshes in the vicinity
- The extent of alien plant cover of the site, and whether the infestation is the result of prior soil disturbance such as ploughing or quarrying (alien cover resulting from disturbance is generally more difficult to restore than infestation of undisturbed sites)
- The condition of the site in terms of current or previous land uses

In terms of process, the following will be identified or described:

- The key ecological "drivers" of ecosystems on the site and in the vicinity, such as fire
- Any mapped spatial component of an ecological process that may occur at the site or in its vicinity (i.e. corridors such as watercourses, upland-lowland gradients, migration routes, coastal linkages or inland-trending dunes, and vegetation boundaries such as edaphic interfaces, upland-lowland interfaces or biome boundaries)
- Any possible changes in key processes, e.g. increased fire frequency or drainage/artificial recharge of aquatic systems
- Furthermore, any further studies that may be required during or after the EIA process will be outlined
- All relevant legislation, permits and standards that would apply to the development will be identified
- The opportunities and constraints for development will be described and shown graphically on an aerial photograph, satellite image or map delineated at an appropriate level of spatial accuracy

2.1 Data sourcing and review

Data sources from the literature consulted and used (where necessary) in this study includes the following:

Vegetation

- Vegetation types and their conservation status were extracted from the South African National Vegetation Map (2018 update).

Ecosystem

- Freshwater and wetland information was extracted from the National Freshwater Ecosystem Priority Areas assessment (NFEPA; Nel et al. 2011), as well as the 2018 NBA.

Riverine Rabbit & by-catch fauna

- The conservation status of mammals is based on the IUCN Red List Categories (EWT/SANBI 2016).
- Historical Riverine Rabbit sightings (Figure 1) were provided by the Endangered Wildlife Trust's Drylands Conservation Programme (EWT DCP). The Endangered Wildlife Trust (EWT) also provided feedback on the methodology and the camera placement layout, which were duly integrated into the study.

[1] Please note that this report does not cover Fauna and Flora Biodiversity, except in terms of how these relate to the risks to the Riverine Rabbit and its use of the landscape

Any further relevant literature (e.g. scientific reports and/or journal articles) were sourced through the University of Cape Town's (UCT's) digital databases.

2.2 Initial desktop assessment

An initial desktop study was conducted to produce an initial ecological sensitivity map, delineating all riparian zones throughout the site. This was done through the use of online satellite imagery (Google satellite [2021]). The identified riverine areas were thereafter sub–divided into units, which were rated in accordance to the following sensitivity scale:

- **Low** – Areas of natural or transformed habitat where there is likely to be a negligible impact on local Riverine Rabbit populations. Infrastructure development can proceed within these areas.

- **Medium** – Areas of natural or transformed land where the impacts of any infrastructure development are likely to be largely localised. Development within these areas can proceed with relatively little impact, provided that appropriate mitigation measures are put in place.

- **High** – Areas of natural or transformed land where a high potential impact is anticipated, as they may contain important riparian habitat for Riverine Rabbits. Development within these areas is undesirable. If unavoidable, development should only proceed with caution, as it likely not be possible to mitigate all impacts.

- **Very High** – Critical habitat for the Riverine Rabbit. These areas are 'no–go areas' from a developmental perspective, and should be avoided.

2.3 Site assessment

The site was visited on two occasions for the study, firstly in September (2021) by Christy Bragg and an EWT_DCP employee Hannah Edwards, and secondly in November (2021) by Aliénor Brassine (Fauna Specialist). The fieldworkers were given pre–site training by Christy Bragg on the characteristics of suitable Riverine Rabbit habitat. The site visit was conducted in two phases: an initial assessment of habitat suitability, informed by the desktop study, and a secondary camera trapping study.

Habitat suitability

The AOI was visited in September 2021, where areas previously identified at a desktop level were groundtruthed, with their potential capacity to support healthy Riverine Rabbit populations assessed (Figure 2). Although no formal assessment protocol exists, there are key indicators of habitat suitability that apply throughout the Nama–Karoo. These include: an alluvial floodplain area large enough to support the territory of individual rabbits, specific plant species composition (See Duthie [1989]), a matrix of grass and shrubs (with no clear dominance of either structure), level of disturbance and cover and how all these indicators vary to create different levels of suitability or habitat quality. Areas deemed suitable for Riverine Rabbit occurrence were photographed and given a habitat suitability score, ranging from 0–100%.

Camera trapping

The EWT DCP has successfully utilised remote camera trapping to detect and monitor a number of Riverine Rabbit populations throughout the Karoo, and it remains one of the few methods able to detect presence of this rare, elusive species. Camera traps were therefore used extensively throughout the site in this study to establish the presence or absence of Riverine Rabbit populations. They were also be used to characterise the fauna of the site more generally. A total of 39 Browning Trail Cameras (Command Ops ELITE: model number BTCX–4EX) were deployed throughout the study. Due to the scarcity and nocturnal nature of the target species, Browning Trail Cameras infrared LEDs were preferable to standard flash, as white flashes have been shown to impact species' detectability (Larrucea et al., 2007). All cameras were mounted on metal stakes at a height of approximately 30 – 40cm above

the ground. A 30s delay was programmed between successive photographs, and the sensor sensitivity set to high.

Sites were selected using a random stratified design throughout the riparian zone present in the site (Figure 1, 2). All 39 sites were distributed throughout the three main Riverine Rabbit habitat sensitivity zones (as previously identified by Christy Bragg [namely: Low, Medium, High; Figure 1]). Within sites, cameras are placed where there were signs of target animal activity (e.g. intersecting trails of a diameter suitable for lagomorphs) to maximise detection of Riverine Rabbits. Cameras were placed randomly within each sensitivity unit. All cameras were operational for a minimum of 40 days. The camera placement was submitted for comment, suggested edits were made and the grid approved by the Riverine Rabbit Programme staff at the EWT.

Cameras were active from September 2021 to November 2021. SD cards were only retrieved from cameras at the end the study to minimise human disturbance in the study area (Larrucea et al., 2007). Photographs of the same species were only considered independent if captures were taken >30 minutes apart or were obviously of a new individual (given unique markings or other features that allowed the image to be classified as independent. An independent camera trap night was defined as a 24hr period that begins at 00:00 and ends at 23:59 (Meek et al., 2014). All independent photographs of Riverine Rabbits were extracted for further analyses.

2.4 Sensitivity mapping, assessment and buffers

A final ecological sensitivity map was created by integrating the results of the site visits and camera trapping survey with the available ecological information from the literature and initial desktop assessment. Areas where there appeared to be sufficient suitable habitat to support rabbits were mapped and buffered by 350m and considered to be High sensitivity. Areas demarcated as Medium sensitivity were buffered by 200m, and Low sensitivity areas linking these zones were buffered by 100m.

3 RESULTS

3.1 Site assessment

Habitat suitability

Historically, no Riverine Rabbits had been sighted within the study site, although one was located nearby (>10km), location: –31° 30' 12.02472"S 22° 23' 40.56"E. There are a few minor drainage lines and washes present throughout the study site. The three main drainage lines, each of which are roughly 500 – 1 000m in diameter (although they may be as small as 100m) were considered to be largely degraded and sparsely vegetated. A few (7) sections of these large drainage lines contain riparian habitat suitable for supporting Riverine Rabbit populations, and were subsequently demarcated as High sensitivity (Figure 1, S.2). These riparian zones were considered to largely consist of healthy habitat that may support Riverine Rabbit populations of >20 individuals. These seven High sensitivity drainage lines have low levels of landscape connectivity within the AOI. Most drainage lines present at the site consisted of poor habitat (either consisting of a undesirable species composition, or were significantly degraded as a result of drought and associated overgrazing by domestic livestock)> these zones were thus deemed to be of either Medium or Low sensitivity (Figure 2, 3, S.1). These drainage lines could, however, serve as connections between High sensitivity zones at a local or landscape scale.

Figure 2: The majority of the AoI is Karoo plains, characterized by sparse shrubland, corresponding with the Upper Karoo vegetation type. Typical species include *Pentzia incana, Eriocephalus spp., Rosenia spp., Lycium spp.* Common and dominant species in the drainage lines and within the adjacent floodplain vegetation include *Salsola aphylla, Tribulis terrestris, Felicia muricata, Atriplex vestita, Zygophyllum retrofractum, Cynodon dactylon, Chrysocoma ciliate, Stipagostis namaquensis, Lycium pumilum, Lycium cinereum,* and *Artemisia Africana*.

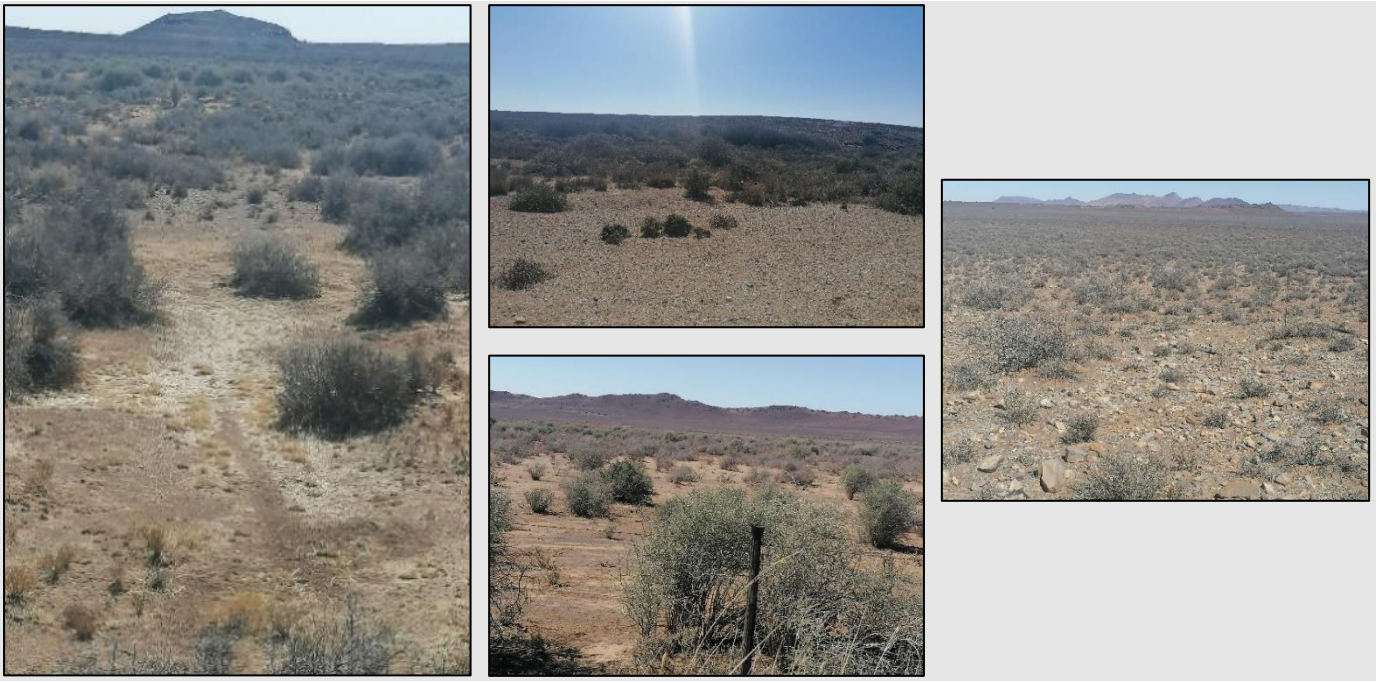

Figure 3: Areas of habitat identified through the desktop study were often small and degraded in nature, without the cover and species diversity typifying optimum habitat.

Camera trapping

Six cameras were placed in High Sensitivity areas, whilst a further 9 were located in Medium sensitivity areas (Figure 1, 4). However, on–site assessments suggest that 23 cameras were located in areas with a habitat suitability score less than 15%, 8 between 15 – 29% and only 6 above 30%.

The final dataset resulted in a total of 90 567 non–blank photographs (Table 1). One camera was disturbed due to disturbance by select species (e.g., baboons and sheep), extreme weather conditions (hail and flooding) or human interference. Overall, 22 species from 13 families of mammal species (>0.5kg). Riverine Rabbits were not detected at any of the 40 sites, despite the high density of cameras within the riparian areas identified as being potentially suitable for this species and the extended (>40) length of the survey. The failure to detect this species within the site is most likely explained by the negligible extent of suitable habitat and high anthropogenic disturbance within the site. Furthermore, given the wide distribution of the camera traps across the site and the large number of records of fauna

that were obtained, the results of the camera trapping are considered to provide a reliable indication of the faunal present community on the site.

3.2 Sensitivity mapping, assessment and buffers

Although no Riverine Rabbit was recorded on the site during this study, its high conservation status (Critically Endangered) requires that a cautious and considered approach is required when considering mitigating measures. While it may not be present on the site itself, this does not mean that there would be no potential impacts on landscape-level Riverine Rabbit populations. Transient individuals may utilise the drainage lines present in the site as a thoroughfare, or future colonisation events may occur post this study. If present, impact on the Riverine Rabbit would predominantly come from turbine noise, habitat loss, disturbance during construction and the potential for deaths from vehicle collisions during construction. A breakdown of all potential impacts is given in section 3 below.

Information derived from the desktop study, site assessment and camera trapping were used in the construction of suitable buffers (Figure 4). Areas where there appeared to be sufficient suitable habitat to support rabbits were mapped and buffered by 350m. This resulted in 31.22km^2 of the site being included in the 350m buffer. Areas unlikely to support rabbits (demarcated as Medium sensitivity) were buffered by 200m, whilst areas linking these zones, but deemed Low sensitivity, were buffered by 100m. This resulted in 21.51km^2 and 51.44km^2 of the site being included in the 200m and 100m buffers, respectively.

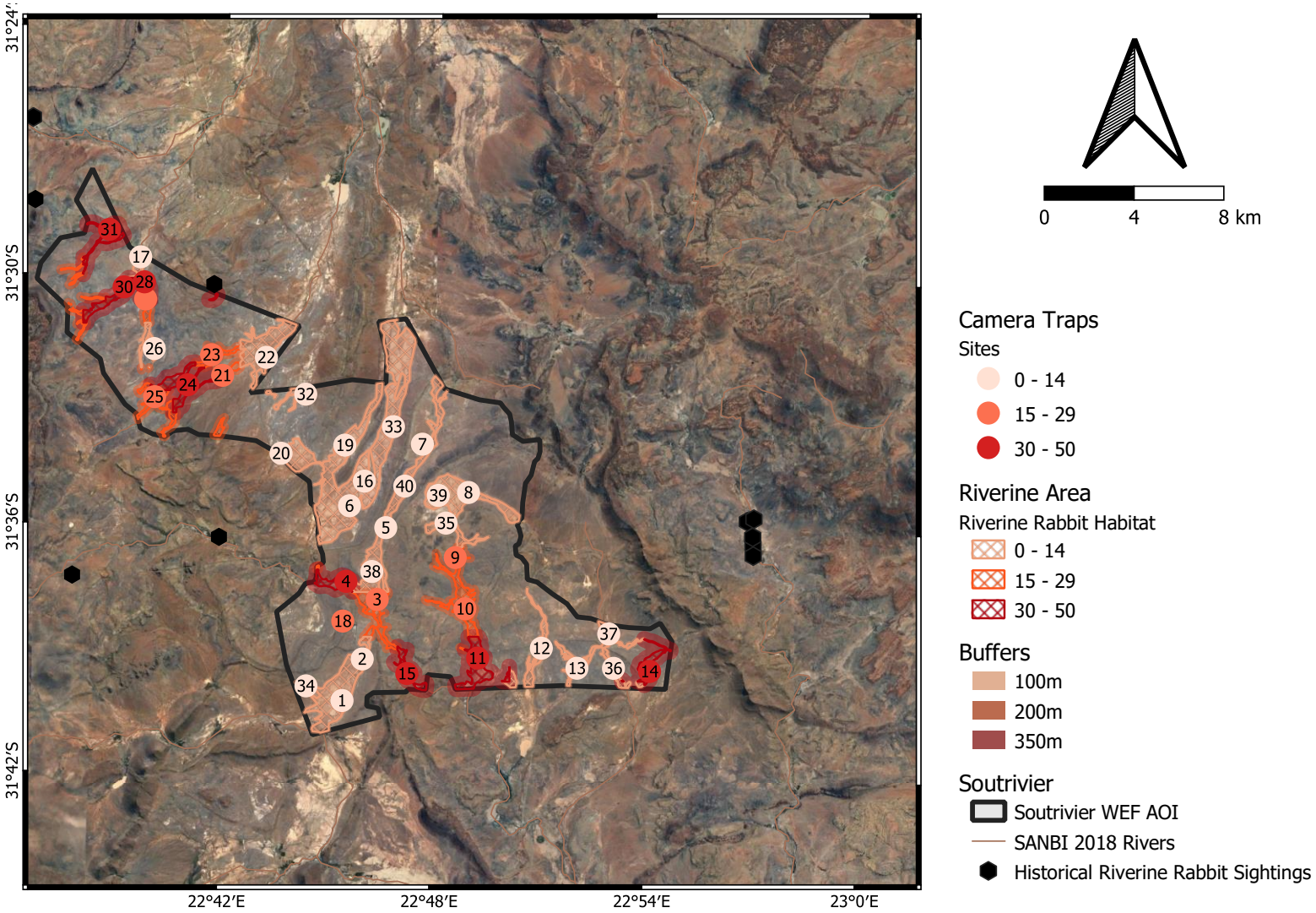

Figure 4: Ecological sensitivity map for, produced by terrestrial specialists. Both riverine areas and camera traps are colour coded by the same sensitivity scale (See section 2.2), indicating the suitability of habitat for potential Riverine Rabbit populations. Buffers, colour coded for sensitivity and size, are superimposed over Low to High sensitivity zones.

Table 1: General results of the camera trapping surveys, presented per family and species. The naïve occupancy is the proportion of sites at which the species was detected.

Family *Species*	Total cameras	Naïve occupancy (%)
Bovidae		
Goat *Capra aegagrus hircus*	1	3
Sheep *Ovis aries*	12	31
Springbok *Antidorcas marsupialis*	16	14
Steenbok *Raphicerus campestris*	16	41
Canidae		
Bat–eared fox *Otocyon megalotis*	9	23
Black–backed jackal *Canis mesomelas*	1	3
Cape fox *Vulpes chama*	17	44
Domestic dog *Canis familiaris*	1	3
Equidae		
Horse *Equus ferus caballus*	3	8
Herpestidae		
Grey mongoose spp. *Herpestes ichneumon* and *Galerella pulverulenta*	3	8
Meerkat *Suricata suricatta*	9	23
Water mongoose *Atilax paludinosus*	1	3
Yellow mongoose *Cynictis penicillate*	8	21
Hyaenidae		
Aardwolf *Proteles cristata*	9	23
Hystricidae		
Porcupine *Hystrix africaeaustralis*	6	15
Leporidae		
Hare spp. *Lepus saxatilis* and *Lepus capensis*	12	31
Mustelidae		
Striped polecat *Ictonyx striatus*	2	5

Family *Species*	Total cameras	Naïve occupancy (%)
Orycteropodidae		
Aardvark *Orycteropus afer*	7	18
Pedetidae		
Springhare *Pedetes capensis*	3	8
Procaviidae		
Rock hyrax *Procavia capensis*	1	3
Sciuridae		
Ground squirrel *Xerus inauris*	7	18
Viverridae		
Genet spp. *Genetta tigrine* and *Genetta genetta*	2	33

4 DISCUSSION

The following impacts were identified as part of the Riverine Rabbit assessment:

Direct and Indirect impacts

Construction Phase

The construction phase of the development would result in the destruction of riparian habitat, leading to habitat loss and fragmentation. Construction activity would also result in noise and disturbance, which could change the behaviour patterns of the species. Construction vehicles in and around the development would also increase the likelihood of roadkill mortalities. This is particularly important where access roads traverse suitable Riverine Rabbit habitat and when vehicles are active between dusk and dawn (peak periods of Riverine Rabbit activity). Construction could increase access to the site by humans and hunting dogs, which increase the likelihood of mortalities through bushmeat hunting.

Operational Phase

The operational phase of the wind farm facility is expected to result in disturbance and vehicle collisions but at significantly lower levels than during the construction phase. Dust and soil erosion may affect nearby High Sensitivity areas, and thus it is important that a form of soil erosion prevention is implemented. Open areas devoid of vegetation along with access roads can create increased runoff and dust, which could detrimentally affect nearby Riverine Rabbit habitat. Finally, during operation, noise generated by turbines may have a negative impact on Riverine Rabbit activity and occurrence, by reducing their ability to detect predators through audial cues and increasing baseline stress levels. This could also lead to displacement of rabbits to suboptimal foraging habitat.

Decommissioning Phase

The activities associated with the decommissioning phase are very similar to the Construction Phase and can thus be considered to have the same impacts and mitigation measures as the Construction Phase.

Note on uncertainties around acoustic impacts of wind farms on riverine rabbits

The amount of negative effects on species will vary depending on the type, size and local location (e.g. if it is situated in High or Low habitat suitability) of the installation, and the stage of the development lifecycle (e.g., construction, operation, maintenance or decommissioning; Helldin et al. 2012; Lovich and Ennen 2013). The size of an individual riverine rabbit's home range (15ha: Duthie 1989) is such that it may be fully enclosed by a single wind farm development, yet large enough for them to avoid local disturbances (such as turbine or road installations) whilst remaining in the area. Yet the lack of scientific literature on in-situ acoustic impacts makes their impact uncertain. In some studies, small mammals (similar in stature to that of the Riverine Rabbit) appear to habituate to turbines, whereas others suggest that there is an negative impact on species. A recent study (Lopucki et al. 2017) found that acoustic factors are likely responsible for suppressed European hare (*Lepus europaeu*s) presence on wind farms, and it is speculated that hares actively avoided installed wind turbines. The authors proposed that permanent high noise levels may cause harmful metabolic stress (Du et al. 2010; Kight and Swaddle 2011), or that hares, like many other lagomorphs, rely heavily on hearing to avoid danger (e.g. predation; Molinari-Jobin et al. 2004). Therefore, it is not inconceivable that the proximity of turbines may represent a risky habitat for Riverine Rabbits, due to the individuals' impaired ability to hear approaching predators or vehicles.

Mitigation and avoidance options
Both the impacts and associated mitigation measures are summarised in table S.1. The breakdown of potential impacts on Riverine Rabbits and the potential mitigation and/or avoidance options that can be implemented to reduce them is given below.

Construction Phase:

Impact 1: Loss of habitat
Cause and comment: The construction of roads, turbine hard-stands, roads and laydown areas will result in the destruction of vegetation and top-soil within areas of potential Riverine Rabbit habitat. No turbines should be constructed in riparian zones demarcated as High sensitivity, or their associated buffers (Figure 2). Furthermore, the developer should strive to reduce the amount of roads intersecting these riparian zones. If these measures are correctly implemented the total extent of habitat loss is likely to be low, and the resulting impact on the species from habitat loss would also be low.

Impact 1: Loss of habitat		
	Before mitigation	**After mitigation**
	HIGH NEGATIVE	LOW NEGATIVE

Mitigation Measures:
- Turbines and pylons should be located outside of the buffers around riverine habitat
- An ECO must be employed to demarcate areas for use during construction, and to ensure that the construction activities remain within the designated area and that no unauthorised activities occur outside of the construction footprint
- Avoid road development transversing riparian areas, where possible

Impact 2: Disturbance through construction noise
Cause and comment: The construction of roads, turbine hard-stands, roads and laydown areas will result in elevated levels of both noise and activity, which may displace potential Riverine Rabbits out of the AoI. Mitigation should include minimizing noise and educating workers. If done, the potential displacement of the species from home range is likely to be very low. As there are limited areas of potentially suitable Riverine Rabbit on the site, this would be a largely minimalised, thus requiring minimal mitigation.

Impact 2: Construction noise disturbance		
	Before mitigation	**After mitigation**
	LOW NEGATIVE	LOW NEGATIVE

Mitigation Measures:
- An ECO must be employed to demarcate areas for use during construction, and to ensure that the construction activities remain within the designated area and that no unauthorised activities occur outside of the construction footprint
- Traffic and loud machinery should be prohibited during the early hours of the morning (04:00 – 09:00) and early evening (18:00 – 22:00)
- Any trenches built must have slopes that allow any dispersing rabbits that fall in to escape and must be backfilled

Impact 3: Mortality from roadkill or bushmeat hunting
Cause and comment: Roadkill is a significant source of mortality for Riverine Rabbits across their range. The probability of vehicle-related mortality in and around the AoI will increase with the added traffic, particularly during the construction phase. This would potentially occur within the site as well as on the nearby larger public roads (such as the R381). During operation, however, this potential impact

would be significantly reduced. As Riverine Rabbit activity is 'crepuscular' (i.e., highest between dusk and dawn), traffic during these periods should be curtailed. In addition, speed limits (<40km) in all areas of potential conflict (i.e. High sensitivity) should be implemented to reduce collision risk. Finally, a limitation of roads within the drainage habitat within the AoI should be considered.

Bushmeat hunting and active interference with Riverine Rabbits by construction employees may also result in reduced Riverine Rabbit occurrence within the AoI. All employees should be educated thoroughly on the potential impact of hunting in the AoI, and encouraged to report any sightings of the species during construction to their line managers.

Impact 3 : Mortality from roadkill or bushmeat hunting.		
	Before mitigation	**After mitigation**
	MODERATE NEGATIVE	LOW NEGATIVE

Mitigation Measures:

- Prohibit all employees from hunting
- Prohibit open fires
- Prohibit any domestic carnivores (e.g. dogs) from entering the site with employees
- An ECO must be employed to demarcate areas for use during construction, and to ensure that the construction activities remain within the designated area and that no unauthorised activities occur outside of the construction footprint
- Avoid road development traversing riparian areas, where possible
- Speed restrictions for all project vehicles (40km/h is recommended) should be in place to reduce road kills of rabbits killed on the project roads. Traffic should be reduced during the early hours of the morning (04:00 – 09:00) and early evening (18:00 – 22:00)
- Any contractor employed for development work must ensure that no rabbit or hare species are disturbed, trapped, hunted or killed by them and their team during the construction phase. Conservation-orientated clauses should be built into contracts for construction personnel, complete with penalty clauses for non-compliance

<u>Operation Phase:</u>

Impact 1: Degradation of habitat by erosion

Cause and comment: The construction of roads, turbine hard-stands, roads and laydown areas etc. will result in the destruction of currently intact vegetation, which may lead indirectly to soils being exposed and facilitating erosion. Erosion leads to river degradation through increased runoff and siltation processes. If erosion control is implemented, the resulting impact from erosion and would also be low.

Impact 1: Loss of habitat		
	Before mitigation	**After mitigation**
	MODERATE NEGATIVE	LOW NEGATIVE

Mitigation Measures:

- Implement a Site Erosion Management and Control Plan to prevent erosion from high-lying areas impacting downstream ecosystems

Impact 2: Disturbance through noise pollution

Cause and comment: During operation, the turbines will generate noise which may have a negative impact on Riverine Rabbit activity and ecology. Wind turbines generate noise within the audible range as well as low-frequency "infrasound". Such noise may reduce the species' ability to detect predators, or may result in elevated stress levels. Although there is little mitigation possible for turbine noise, the potential Riverine Rabbit habitat on the plateau has been buffered by a minimum of 350m, which would

reduce the potential significance of this impact. Given the distance between the turbines and High sensitivity zones, it is assumed, with a low level of certainty, that this impact would be of generally low magnitude.

Impact 2: Disturbance through noise pollution		
	Before mitigation	**After mitigation**
	HIGH NEGATIVE	LOW NEGATIVE

Mitigation Measures:

- Turbines and pylons should be located outside of the buffers around riverine habitat
- Given the lack of knowledge on adequate buffer sizes to effectively mitigate noise impacts on the species, if a population is found on the site in the future, a research project should be instigated and funded to monitor the effect of the turbines on the species

5 CONCLUDING STATEMENT

The site suitability for the Riverine Rabbit was comprehensively assessed (through mapping, surveying and camera trapping) and given the level of effort that has been conducted, we conclude that the development of the site should not lead to significant impacts on the Riverine Rabbit. Through the proposed mitigation measures habitat loss should be reduced to acceptable levels. Although the species was not detected in the camera trap survey, this does not guarantee the species is not present nor does it mean that the site might not occasionally be used during dispersal. Therefore the precautionary principle applies and mitigations are proposed based on ensuring the site does not provide a barrier to dispersing individuals at a landscape level. The majority of potential impacts are likely to occur during the construction phase, however with correct mitigation strategies and adherence to the ecological sensitivity map (Figure 2, Table S.1), these should be largely negligible. During operation, impacts are likely to be reduced, and the main avenue of potential concern is noise generated by the turbines (which would amount to habitat degradation within the affected areas for rabbits affected by noise impacts). However, the impacts of turbine noise are idiosyncratic and not consistent between species, with no studies having been conducted on its potential impact on Riverine Rabbits. Consequently, whether or not this impact would actually occur and its severity for Riverine Rabbits is currently not well–defined and there remains some inevitable uncertainty. Buffers are given to assist in the mitigation of these potential impacts.

Considering the special status of this species and the level of cumulative impact by the ever-increasing wind farm applications in the area more stringent mitigation measures are being required. Despite the survey finding no population on the AoI, this study puts precautionary buffers and mitigations in place for maintaining the site as a potential corridor for use in a landscape that is going to become increasingly fragmented. Further research on the effectiveness of additional mitigation measures, such as investigating the minimum width of buffers required to effectively mitigate acoustic noise and other impacts, is highly recommended.

Given the context of global climate change and the urgent need to reduce our dependence on fossil fuels (e.g. natural gas), there is clearly a strong case for increased supply of renewable energy. Wind farms can be undertaken in a sustainable manner if we take care to proactively align mitigation and monitoring at a landscape scale.

6 APPENDICES

Figure S.1: Example of a very small drainage line with very sparse scrub and not connected to bigger more suitable habitat. Low Habitat Suitability (0–10%). Image © Aliénor Brassine.

Figure S.2: Example of a larger drainage lines outside the AOI with suitable, although degraded, Riverine Rabbit habitat. Medium to high habitat suitability (40–60%). Image © Aliénor Brassine.

Table S.1: Breakdown of potential impacts on Riverine Rabbits and the potential significance thereof.

	Nature	Duration	Extent	Severity	Probability	Overall Significance before mitigation	Reversibility	Irreplaceable Loss	Mitigation Potential	Overall Significance after mitigation
Impacts: Construction										
Impact 1: Loss of habitat										
	Negative	Permanent	Localised	Severe	Probable	HIGH NEGATIVE	Irreversible	Habitat resource will be lost	Achievable	LOW NEGATIVE
Impact 2: Construction noise disturbance										
	Negative	Short term	Localised	Slightly severe	Probable	LOW NEGATIVE	Reversible	Animals may be disturbed.	Achievable	LOW NEGATIVE
Impact 3: Mortality through roadkill or bushmeat hunting										
	Negative	Permanent	National	Moderately Severe	May occur	MODERATE NEGATIVE	Irreversible	Species will be impacted	Achievable	LOW NEGATIVE
Impacts: Operation										
Impact 1: Degradation of habitat by erosion										
	Negative	Long tern	Study area	Moderately Severe	May occur	MODERATE NEGATIVE	Reversible	Habitat will become unsuitable for species presence	Achievable	LOW NEGATIVE
Impact 2: Disturbance from noise pollution										
	Negative	Long term	Study area	Severe	May occur	HIGH NEGATIVE	Irreversible	Population will decline at the site	Uncertainty if this impact can be mitigated	LOW NEGATIVE

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