STRATEGIC ENVIRONMENTAL ASSESSMENT FOR GAS PIPELINE DEVELOPMENT IN SOUTH AFRICA

Biodiversity and Ecological Impacts - Bats

STRATEGIC ENVIRONMENTAL ASSESSMENT FOR GAS PIPELINE DEVELOPMENT

Draft v3 Specialist Assessment Report for Stakeholder Review

BATS

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ABBREVIATIONS AND ACRONYMS

AoO	Area of Occupancy
CSIR	Council for Scientific and Industrial Research
DEA	Department of Environmental Affairs
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
EWT	Endangered Wildlife Trust
EoO	Extent of Occurrence
IWS	Inkululeko Wildlife Services
NEMA	National Environmental Management Act
SABAA	South African Bat Assessment Association
SABAAP	South African Bat Assessment Association Panel
SANBI	South African National Biodiversity Institute
SEA	Strategic Environmental Assessment
WEF	Wind Energy Facility

SUMMARY

A Strategic Environmental Assessment (SEA) methodology is being adopted to identify and pre-assess suitable gas routing corridors. Inkululeko Wildlife Services (IWS) were appointed as the bat specialist to provide input into high level strategic mapping, provide guidance on the site specific assessment requirements that should be followed in each of the four sensitivity tiers, and provide input into some of the high level potential impacts relevant to bats and the gas routing corridors. This high level assessment is deemed suitable for an SEA study of this nature and where necessary, future site-specific investigations and appropriate specialist studies will provide more detail.

Terrestrial ecoregions, geology, known bat roosts, vegetation, irrigated agricultural areas, urban areas, eroded areas, wetlands, rivers, dams and extent of occurrence of conservation important bat species were selected as features relevant to bats. These features were mapped per corridor and then each feature or feature sub-class was assigned a sensitivity class and where appropriate, a buffer. The feature maps and sensitivity maps for each of the corridors are provided in this report.

Very High sensitivity areas were considered as such due to very high roosting and/ or foraging potential and/ or due to very high bat activity levels and/ or potential occurrence of Vulnerable, Data Deficient or Endangered species. These areas are probably unsuited to development from a bat perspective owing to the very high bat importance. High sensitivity areas were considered to have high roosting and/ or foraging potential and/ or due to high bat activity levels. These areas are potentially unsuited to development from a bat perspective owing to the high bat importance. Medium sensitivity areas were considered to have moderate roosting and/ or foraging potential and/ or due to moderate bat activity levels and/ or due to unknown bat activity levels and/ or potential occurrence of Near-threatened or Rare species. These areas are potentially more suitable for development from a bat perspective, but potential on-site sensitivities must be fully investigated and effective mitigation options clearly identified. Low sensitivity areas were considered to have low roosting and/ or foraging potential and/ or due to low bat activity levels and no known occurrence of conservation important species. These areas are probably the most suitable for development compared with the Medium to Very High sensitivity areas.

The potential impacts to bats by the gas pipeline developments during the construction phase (and possibly during the operational phase if maintenance or repair on the pipeline is required) could include roost disturbance and foraging habitat loss associated with clearing the right of way, and sensory disturbance due to increased levels of noise and dust associated with heavy vehicles and other machinery, and sedimentation of water bodies and wetlands. Measures to avoid and minimize impacts would include, in the planning phase, staying away from Very High and High sensitivity areas where possible. In these areas, detailed Bat Impact Assessments, including field work, must be performed to inform whether the project would have adverse effects on bats and whether it should proceed or not or to make informed mitigation recommendations. Such recommendations could be micro-siting to avoid key roosts or foraging habitat, avoiding construction in certain seasons, keeping the development footprint to a minimum, dust prevention and prevention of sedimentation runoff into water bodies, etc.

1 INTRODUCTION

A Strategic Environmental Assessment (SEA) methodology is being adopted to identify and pre-assess suitable gas routing corridors. The Council for Scientific and Industrial Research (CSIR) (in collaboration with the South African National Biodiversity Institute (SANBI)) were appointed by the Department of Environmental Affairs (DEA) to undertake the Phased Gas Pipeline Network SEA. As such, the CSIR appointed Inkululeko Wildlife Services (IWS) as an independent, suitably qualified bat (order Chiroptera) specialist to provide expert high level bat input on the impacts of the development of a gas pipeline network.

Bats (Order: Chiroptera), the second most diverse mammal group on the planet, provide vital ecosystem services. They warrant consideration and protection at the very least due to their economic value, although tourism and biodiversity heritage value is also very important. Insectivorous bats are known to eat up to their body weight in insects daily; much of their prey considered pests. They thus act as vital pest-control agents, and their value has been estimated at $1bn in global savings in the agricultural industry (Kalka et al., 2008; Kunz et al., 2011; Maine and Boyles, 2015). Gonsalves et al. (2013) found that they have also proven to be effective at controlling mosquitoes carrying the Malaria parasite, a disease which ravages the African continent and is spread over many parts of South Africa. Fruit and nectar-eating bats are known to act as vectors for seed dispersal and pollination of 528 plant species - both important agricultural crops and naturally occurring species (Fleming et al., 2009). Cave-dwelling bats play important roles in nutrient cycling via the production of guano, a vital input of energy in most cave systems (IUCN SSC, 2014). Bats are thus important keystone species for most ecosystems and act as a good indicator of ecosystem health.

Although there are no publicly available studies investigating the impacts of gas pipeline development on bats, potentially adverse effects can be inferred based on other human-induced landscape-level changes (Hein, 2012). Potential impacts on bats include:

- The clearance of vegetation can cause destruction of roosting and foraging habitat.
- The digging of trenches during construction and maintenance activities during operation creates noise and vibrations that could displace local bats. This is particularly significant if there are species of conservation importance roosting within less than 200 m of the development activities.
- Indirect impacts during the construction and maintenance phases would include increased dust in the air and sedimentation in wetlands, rivers or open water bodies.
- It is unlikely that any potential gas leaks will have any significant impact on bats.

Bats are already nationally and globally under severe pressure due to disease, roost disturbance, habitat decline (IUCN SSC, 2014) and wind energy (Arnett and Baerwald, 2013; MacEwan, 2016). Therefore, there is public outcry in the USA where energy companies want to run large natural gas pipelines through and near roosting areas for severely threatened bat species.

2 SCOPE OF THIS STRATEGIC ISSUE

- Attend a briefing session at the beginning of the specialist assessment process and a multi-author team workshop to discuss the first draft report (V1).
- Provide a brief report and/or GIS files of key bat features for the gas pipeline corridor features.
- Provide input into the key features mapping from a bat perspective.
- Provide bat input into the environmental four tier sensitivity map.
- Develop/verify the approach for classing each sensitivity feature according to a four-tiered sensitivity rating system.
- Identify any gaps in information and based on the findings of the assessment.

3 APPROACH AND METHODOLOGY

As per the terms of reference supplied, the current high level study was based on a brief desktop review and high level strategic mapping.

3.1 Desktop Review

- Analysis of IWS collected bat call data from over 25 Wind Energy facility (WEF) Monitoring Studies within the various Terrestrial Ecoregions to determine an average annual bat activity level per Ecoregion for comparative analysis;
- Based on several years of experience and literature reviews, assessment of environmental parameters relevant to bat ecology and their distributions;
- A list of bat species of conservation importance was compiled for each of the nine gas corridor phases.

3.2 Spatial Data Analysis

Whilst various environmental parameters and spatial data sources were considered for the bat sensitivity spatial mapping exercise, only those parameters considered important for bats, as either important for roosting or foraging or of conservation significance were selected and used. The relevant sensitive environmental spatial layers were selected on the maps and buffered according to defendable criteria. This is further explained in Sections 4 and 5.

3.3 Impact characterisation

Whilst a detailed impact assessment was not undertaken, this report does discuss some of the potential impacts relevant to bats and gas pipeline development and does provide guidance on the site specific assessment requirements that should be followed in each of the four sensitivity tiers. This high level assessment is deemed suitable for an SEA study of this nature and where necessary the specialist studies will provide more detail.

4 FEATURE SENSITIVITY MAPPING

4.1 Feature identification, description and data sources

Table 1: Data sources used in this assessment.

Sensitivity Feature Class	Source and Date of Publication	Data Description and Processing	Relevant Corridor
Terrestrial Ecoregions	Terrestrial Ecoregions. 2009. The Nature Conservancy, Arlington, VA. Available at http://maps.tnc.org/gis_data.html	The terrestrial ecoregions (Olson et al., 2001) were clipped to the South African Borders, Swaziland and Lesotho Borders. From numerous monitoring assessments, IWS has calculated average bat passes per hour for the seven of the ecoregions to gain an understanding of the bat activity levels in each.	All
Geology	Council for Geosciences SA, 1997	Geology wr90 shapefile and Geology_Geoscience shapefile. Limited metadata are available but date of creation is 1997. Four main lithologies were selected as relevant to bats in terms of roosting potential: Limestone, Dolomite, Arenite and Sedimentary and Extrusive rock	All
Bat Roosts	Database from a collection of scientists, collated by the CSIR in 2017 and desktop refined by IWS in 2018. Main sources were: Bats KZN database, IWS database,	A few of the points were removed, as IWS knows them to not be true bat roost locations. Some points were moved, as the projection had put them in the ocean. Due to mainly construction phase impacts being the	All

Sensitivity Feature Class	Source and Date of Publication	Data Description and Processing	Relevant Corridor
	Herselman and Norton (1985), Wingate (1983), Rautenbach (1982), David Jacobs database, Animalia database	concern for bats, a minimum 500 m radial buffer was placed on each roost, irrespective of size or species.	
Vegetation	2013 – 2014 South African National Land-Cover Dataset. Created by GeoterraImage for the DEA, Pretoria. Version 05, February 2015. Available at https://egis.environment.gov.za/data_egis/data_download/current or http://bgis.sanbi.org/Projects/Detail/44	The following land cover classes were used: thicket/dense bush, plantations and indigenous forest (LC classes 4, 5, 32 and 33). For detailed descriptions of these classes please see Appendix A in http://www.geoterraimage.com/uploads/GTI%202013-14%20SA%20LANDCOVER%20REPORT%20-%20CONTENTS%20vs%2005%20DEA%20OPEN%20ACCESS%20vs2b.pdf Forests, plantations and thick bush provide refuge for several species of bats.	All
Irrigated Agricultural Areas	2013 – 2014 South African National Land-Cover Dataset. Created by GeoterraImage for the DEA, Pretoria. Version 05, February 2015. Available at https://egis.environment.gov.za/data_egis/data_download/current or http://bgis.sanbi.org/Projects/Detail/44	The following land cover classes were used: Vines, Subsistence cultivation, Pineapple agriculture, sugarcane plantations, commercial fields, and commercial pivots (LC classes 16-31). For detailed descriptions of these classes please see Appendix A in http://www.geoterraimage.com/uploads/GTI%202013-14%20SA%20LANDCOVER%20REPORT%20-%20CONTENTS%20vs%2005%20DEA%20OPEN%20ACCESS%20vs2b.pdf	All
Built-up and disturbed areas	2013 – 2014 South African National Land-Cover Dataset. Created by Geoterra Image for the DEA, Pretoria. Version 05, February 2015. Available at https://egis.environment.gov.za/data_egis/data_download/current or http://bgis.sanbi.org/Projects/Detail/44	The following land cover classes were used: Commercial, Industrial, Informal Settlements, Residential Areas, Schools and Sports Grounds, Smallholdings, Gold Courses, Townships, Villages and other built-up areas (LC classes 42-72), as well as erosion and dongas (LC class 40). For detailed descriptions of these classes please see Appendix A in http://www.geoterraimage.com/uploads/GTI%202013-14%20SA%20LANDCOVER%20REPORT%20-%20CONTENTS%20vs%2005%20DEA%20OPEN%20ACCESS%20vs2b.pdf.	All
Wetlands and Dams	Wetlands = National Freshwater Ecosystem Priority Areas (NFEPA). CSIR. July 2011. Dams = dams500g_wgs84 shapefile. Dept. Water and Sanitation.	Wetlands and dams provide drinking and foraging opportunities for bats.	All
Main Rivers	Rivers = wriall500_primary shapefile. Dept. Water and Sanitation	There is strong support for the importance of rivers and riparian areas for bats (Serra-Cobo et al., 2000; Akasaka et al., 2009; Hagen & Sabo, 2012).	All
Bat species occurrence data	Database from a collection of scientists and organisations. Collated by SANBI and the EWT in 2016 for use in the National Bat Red Data listings.	Extent of Occurrences (EoOs) were compiled for conservation important and certain high-risk bat species using the Child et al. (2016) species point data. These are simply points where one or more individuals from a particular species were confirmed from museum and scientific records. Because bats travel extensive distances nightly and some seasonally, these points are an under-estimation of the area each individual will occupy in their lifetime. Therefore, an arbitrary 50 km radius was placed around each confirmed point record to buffer for some or all of the potential movement or habitat spread. Then, a best fit polygon (the tightest possible polygon) was drawn around these radii to create an EoO for each relevant species. This is deemed as the maximum known extent that each species occurs in. However, the process did not exclude areas within the polygon where the bats are unlikely to occur due to disturbance or unfavourable habitat, i.e. the polygons did not represent the true area of occupancy (AoO). AoO is defined as the area within its EoO which is occupied by a taxon, excluding cases of vagrancy. In	All except Phase 2

Sensitivity Feature Class	Source and Date of Publication	Data Description and Processing	Relevant Corridor
		other words, the AoO is a more refined EoO that takes the detailed life history of each species into account. An AoO reflects the fact that a taxon will not usually occur throughout its entire EoO because the entire area may contain unsuitable or unoccupied habitats. To compile more AoOs per species is a significant task, beyond the scope of this SEA.	

4.2 Bat species of conservation importance relevant to the corridors

The following bat species of Conservation Importance are found within the proposed gas pipeline corridors.

Table 2: Red Data bat species that occur in the proposed gas pipeline corridors which are sensitive to development (LC = Least Concern; NT = Near Threatened; VU = Vulnerable; EN = Endangered).

Species Name	Common Name	Conservation Status (Child et al, 2016)	Corridor Phase
Cistugo seabrae	Angolan Hairy Bat	NT (Jacobs et al., 2016a)	6
Cloeotis percivali	Short-eared Trident Bat	EN (Balona et al., 2016)	3, 4, 7, 8
Kerivoula argentata	Damara Woolly Bat	NT (Monadjem et al., 2016a)	3, 4, 7, 8
Laephotis namibensis	Namib Long-eared Bat	VU (Jacobs et al., 2016b)	1, 5, 6
Laephotis wintoni	De Winton's Long-eared Bat	VU (Avenant et al., 2016)	7
Miniopterus inflatus	Greater long-fingered bat	NT (Richards et al. 2016a)	3, 4, 7, 8
Neoromicia rendalli	Rendall’s serotine	LC (Monadjem et al., 2016b) Rare in SA	4, 7
Otomops martiensseni	Large-eared free-tailed Bat	NT (Richards et al., 2016b)	3, 4, 7, 8
Rhinolophus blasii	Peak-saddle Horseshoe Bat	NT (Jacobs et al., 2016c)	3, 4, 7, 8
Rhinolophus cohenae	Cohen's Horseshoe Bat	VU (Cohen et al., 2016)	8
Rhinolophus denti	Dent's Horseshoe Bat	NT (Schoeman et al., 2016)	3
Rhinolophus smithersi	Smither's Horseshoe Bat	NT (Taylor et al., 2016)	8
Rhinolophus swinnyi	Swinny's Horseshoe Bat	VU (Jacobs et al., 2016d)	3, 4, 7, 8
Scotoecus albofuscus	Thomas' House Bat	NT (Richards et al., 2016c)	4, 7
Scotophilus nigrita	Giant Yellow House Bat	NT (Fernsby et al., 2016)	3, 4, 7, 8
Taphozous perforatus	Egyptian Tomb Bat	NT (Richards et al., 2016d)	3, 4, 7, 8

4.3 Bat feature and sensitivity maps

The following features have been mapped and then in a separate series of maps assigned varying sensitivities according to their bat importance. Where appropriate, buffers with a specific sensitivity have been assigned. The exact bat roost points have remained confidential in order to protect the roosts.

Table 3: Sensitivities assigned to features.

Feature Class	Feature Sub-class	Feature Sub-class Sensitivity	Buffer Distance	Buffer Sensitivity
Ecoregions	KwaZulu-Cape Coastal Forest Mosaic	Very High	None	None
	Maputuland Coastal Forest Mosaic	Very High	None	None
	Maputuland-Pondoland Bushlands and Thickets	Medium	None	None
	Lowland Fynbos and Renosterveld	Medium	None	None
	Knysna-Amatole Montane Forests	High	None	None
	Albany thicket	Medium	None	None
	Nama Karoo	Low	None	None
	Drakensberg Montane Grasslands, Woodlands and Forest	Medium	None	None
	Drakensberg Alti-Montane Grasslands, Woodlands and Forest	Medium	None	None
	Highveld Grassland	Low	None	None
	Kalahari Acacia-Baikiaea Woodlands	Medium	None	None
	Southern African Bushveld	Medium	None	None
	Southern African Mangroves	Low	None	None
	Zambesian and Mopane Woodlands	Medium	None	None
	Succulent Karoo	Low	None	None
Geology	Limestone	Very High	200 m	Very High
	Dolomite	Very High	200 m	Very High
	Arenite	Medium	200 m	High
	Sedimentary and Extrusive Rock	Medium	200 m	Medium
Bat Roosts	Bat Roost Points	Very High	500 m	Very High
Land Cover: Vegetation	Indigenous Forest: Very High	Very High	200 m	Very High
	Plantations / Woodlands: Mature	Medium	200 m	Medium
	Plantations / Woodlands: Young	Medium	200 m	Medium
	Thicket/ Dense Bush	Medium	200 m	Medium
Irrigated Agricultural Areas	All irrigated crops	Medium	None	None

Feature Class	Feature Sub-class	Feature Sub-class Sensitivity	Buffer Distance	Buffer Sensitivity
Land Cover: Urban Built-up Areas	Urban Areas	Medium	None	None
	Disturbed Land (Eroded)	Low	None	None
Wetlands	All Wetlands	Very High	200m	High
Rivers	Major Perennial Rivers	Very High	200m	Very High
Dams	Farm Dams and Natural Dams	Very High	200m	High
EoO is defined as the area contained within the shortest continuous imaginary boundary that can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon, excluding cases of vagrancy (IUCN, 2012). Only species, where their EoO overlaps with the Gas corridors were included.	*Cistugo seabrae*	Medium	No additional buffer on the EoO but there is a 50 km buffer on the individual record points	
	Cloeotis percivali	High		
	Kerivoula argentata	Medium		
	Laephotis namibensis	Medium		
	Laephotis wintoni	Medium		
	Miniopterus inflatus	Medium		
	Neoromicia rendalli	Medium		
	Otomops martiensseni	Medium		
	Rhinolophus blasii	Medium		
	Rhinolophus cohenae	High		
	Rhinolophus denti	Medium		
	Rhinolophus swinnyi	Medium		
	Scotoecus albofuscus	Medium		
	Scotophilus nigrita	Medium		
	Taphozous perforates	Medium		

5 FEATURE MAPS AND FOUR-TIERED SENSITIVITY MAPS

The bat feature and sensitivity maps constructed for each of the proposed gas pipeline corridors, using the criteria specified in Section 4.3 above, are presented in Figure 1 to Figure 18. Note, bat roosts are not indicated in the feature maps, but have been considered in this assessment and buffered by a distance of 500 m.

5.1 Phase 1

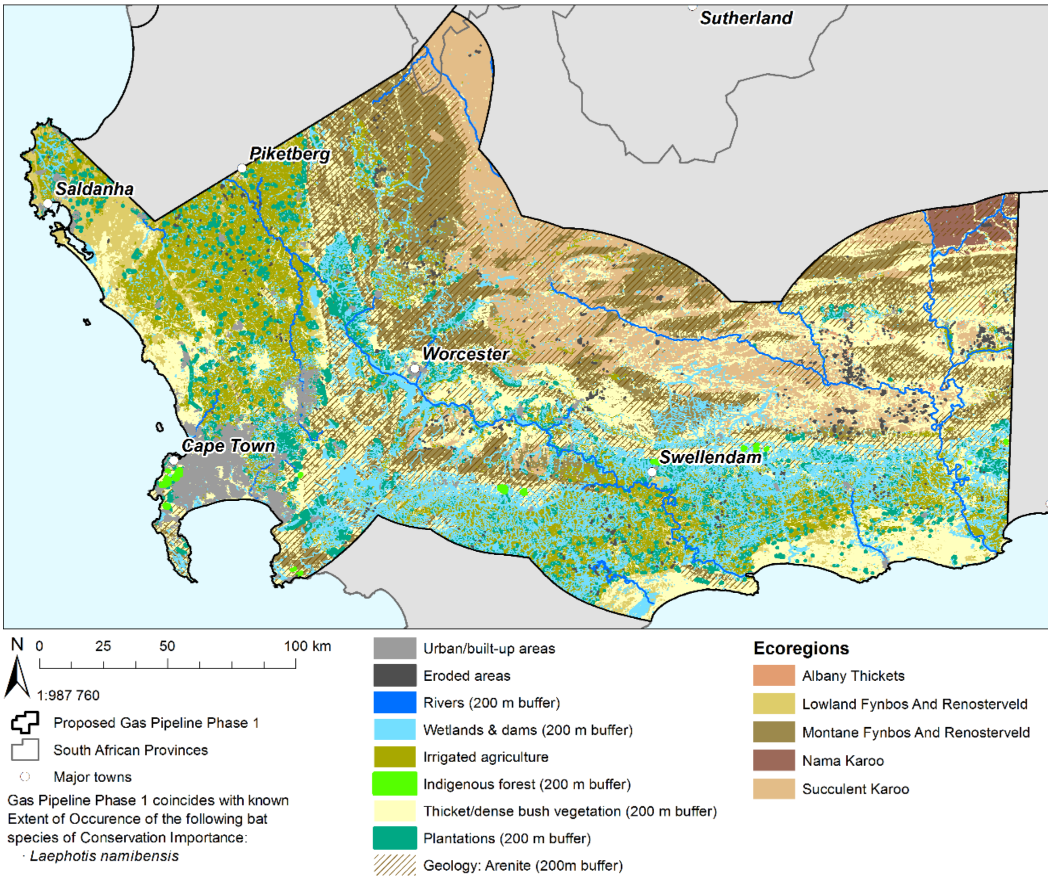

Figure 1: Key habitat features for bats, as well as an indication of the species of Conservation Importance that may be encountered in the proposed Phase 1 gas pipeline corridor.

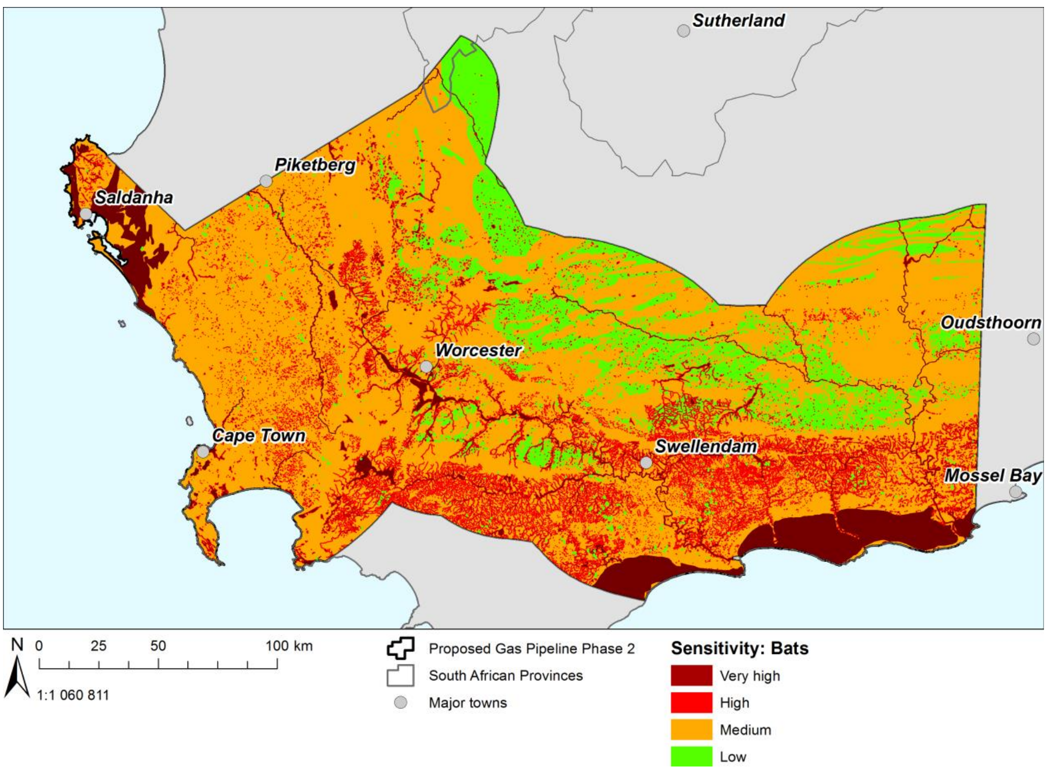

Figure 2: Bat sensitivity map for the proposed Phase 1 gas pipeline corridor.

5.2 Phase 2

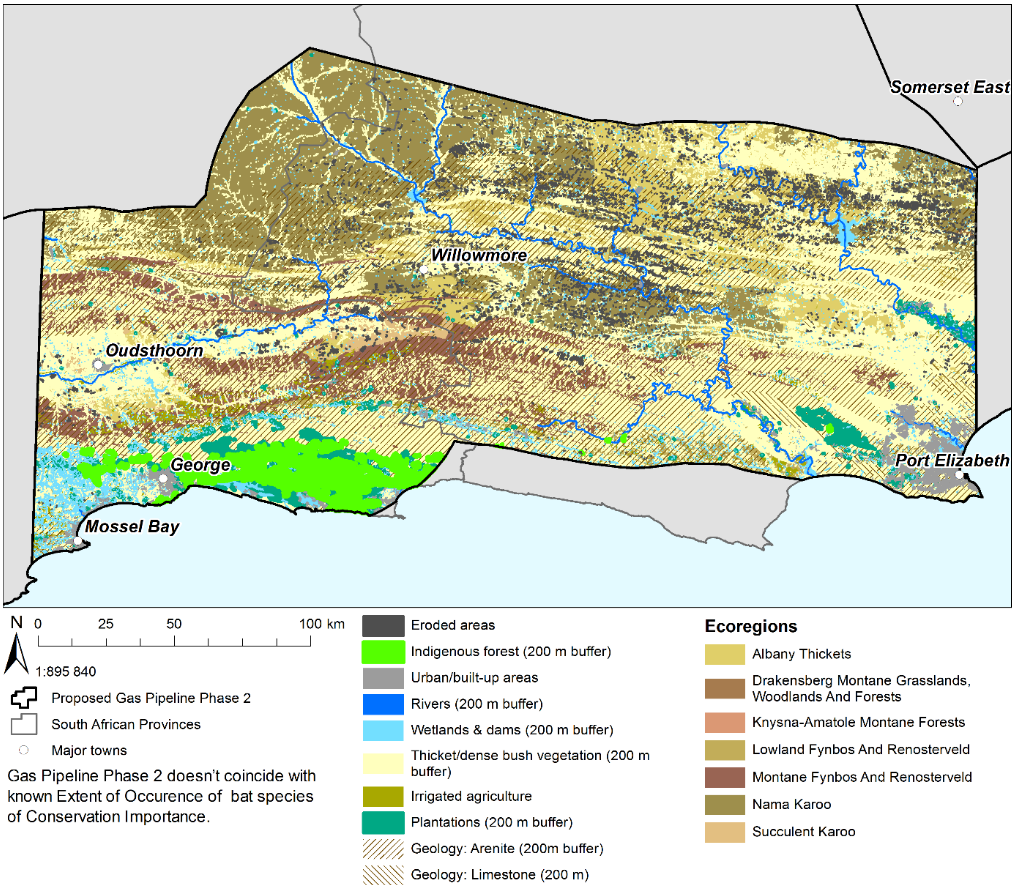

Figure 3: Key habitat features for bats, as well as an indication of the species of Conservation Importance that may be encountered in the proposed Phase 2 gas pipeline corridor.

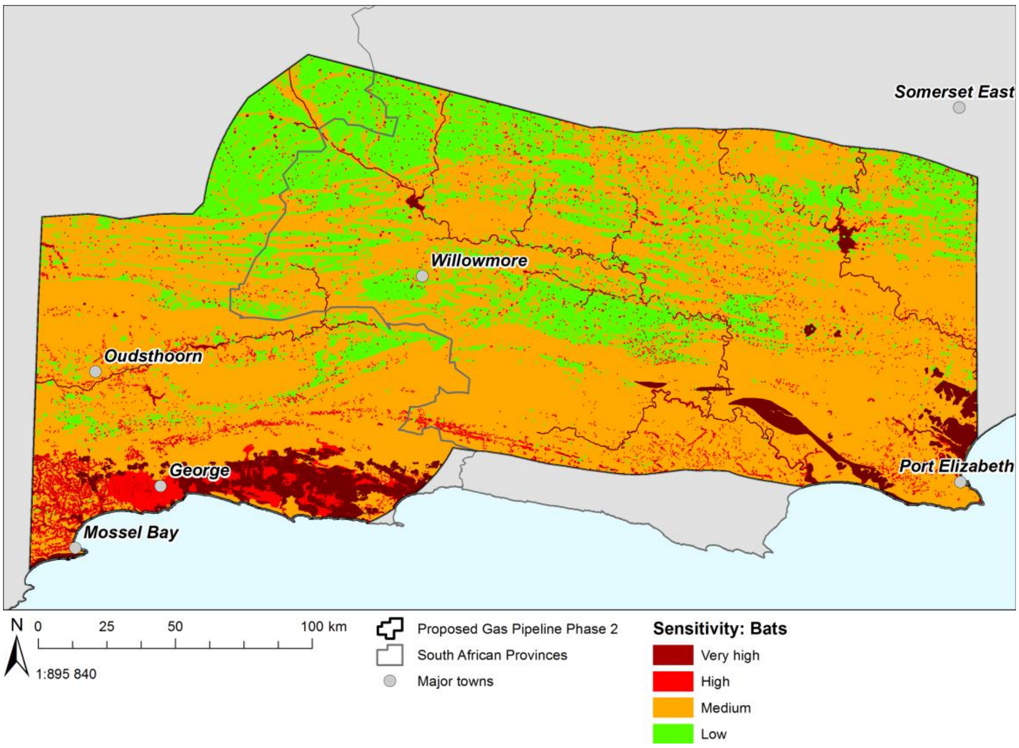

Figure 4: Bat sensitivity map for the proposed Phase 2 gas pipeline corridor.

5.3 Phase 3

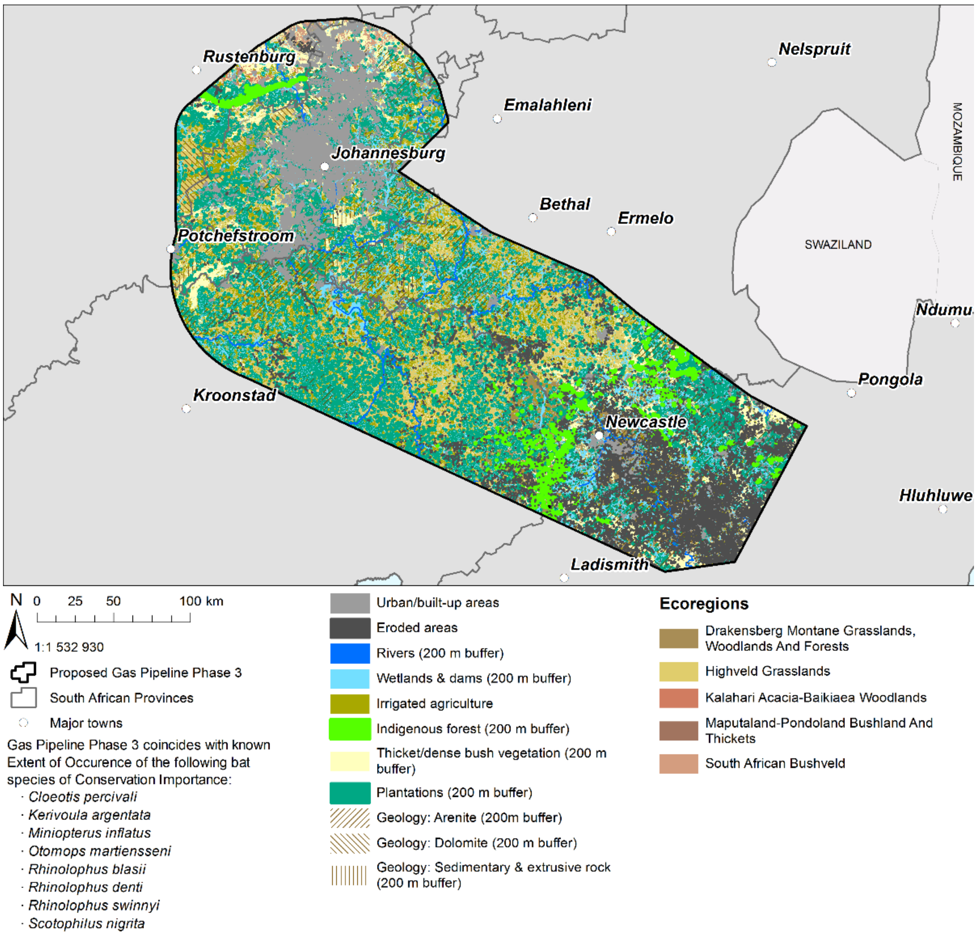

Figure 5: Key habitat features for bats, as well as an indication of the species of Conservation Importance that may be encountered in the proposed Phase 3 gas pipeline corridor.

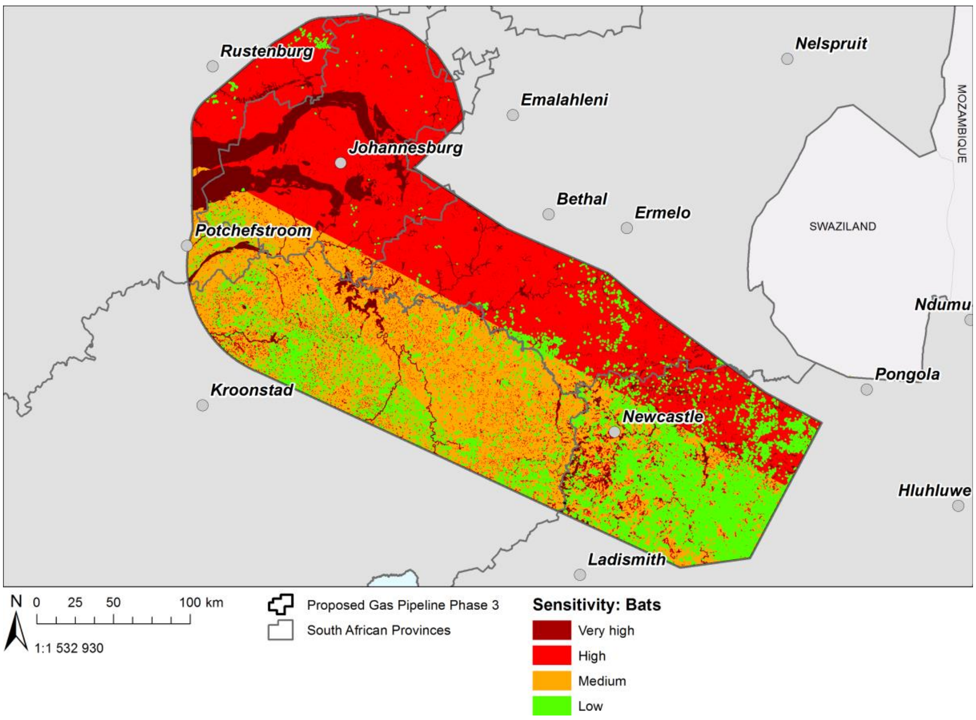

Figure 6: Bat sensitivity map for the proposed Phase 3 gas pipeline corridor.

5.4 Phase 4

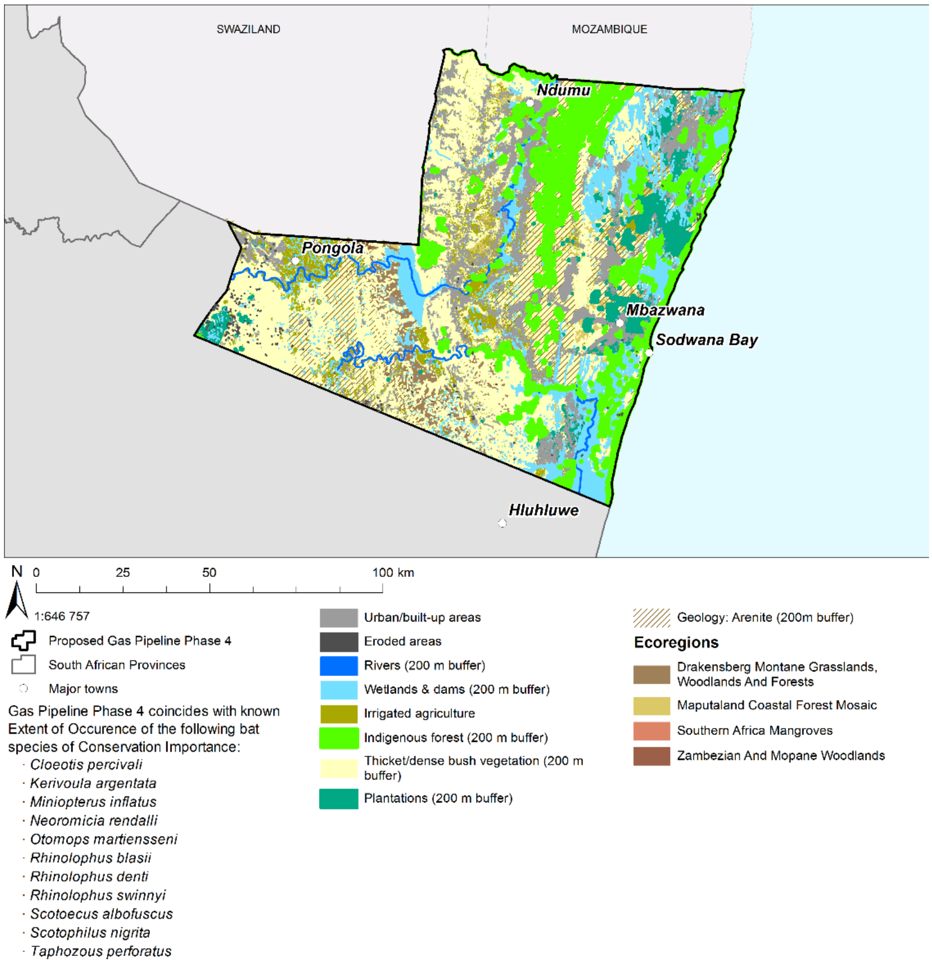

Figure 7: Key habitat features for bats, as well as an indication of the species of Conservation Importance that may be encountered in the proposed Phase 4 gas pipeline corridor.

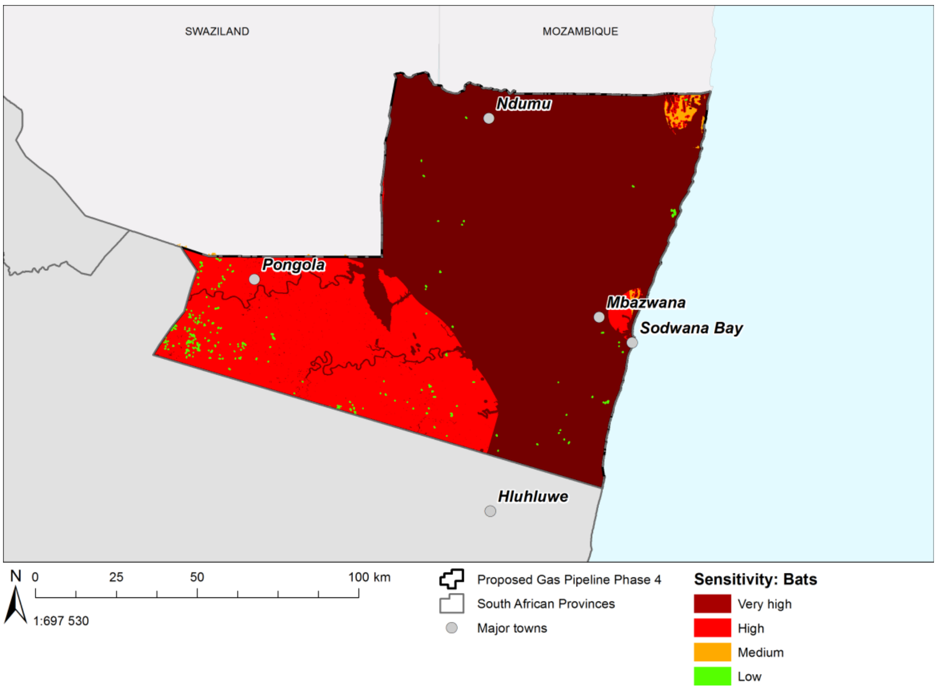

Figure 8: Bat sensitivity map for the proposed Phase 4 gas pipeline corridor.

5.5 Phase 5

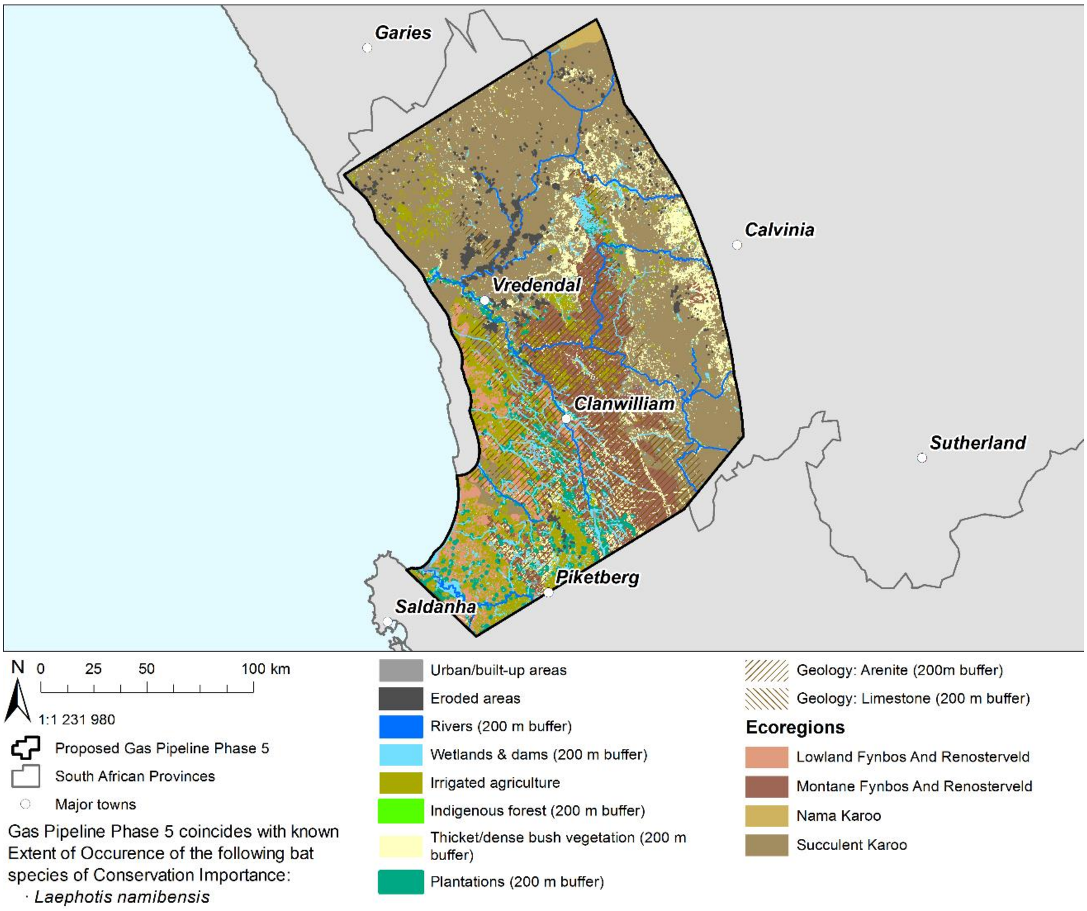

Figure 9: Key habitat features for bats, as well as an indication of the species of Conservation Importance that may be encountered in the proposed Phase 5 gas pipeline corridor.

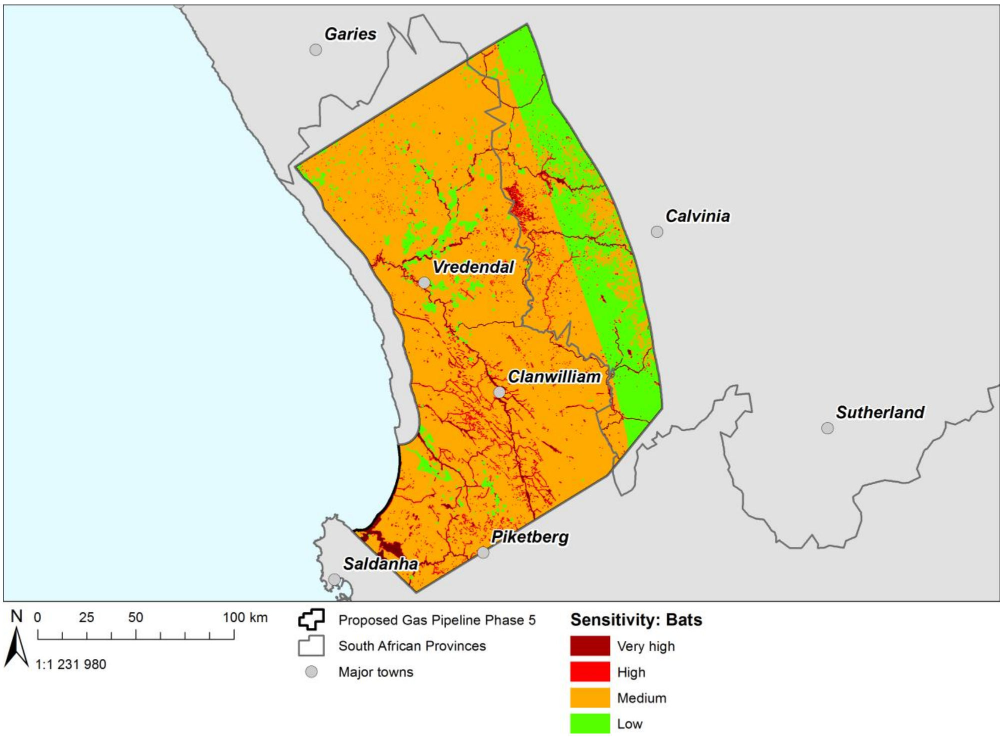

Figure 10: Bat sensitivity map for the proposed Phase 5 gas pipeline corridor.

5.6 Phase 6

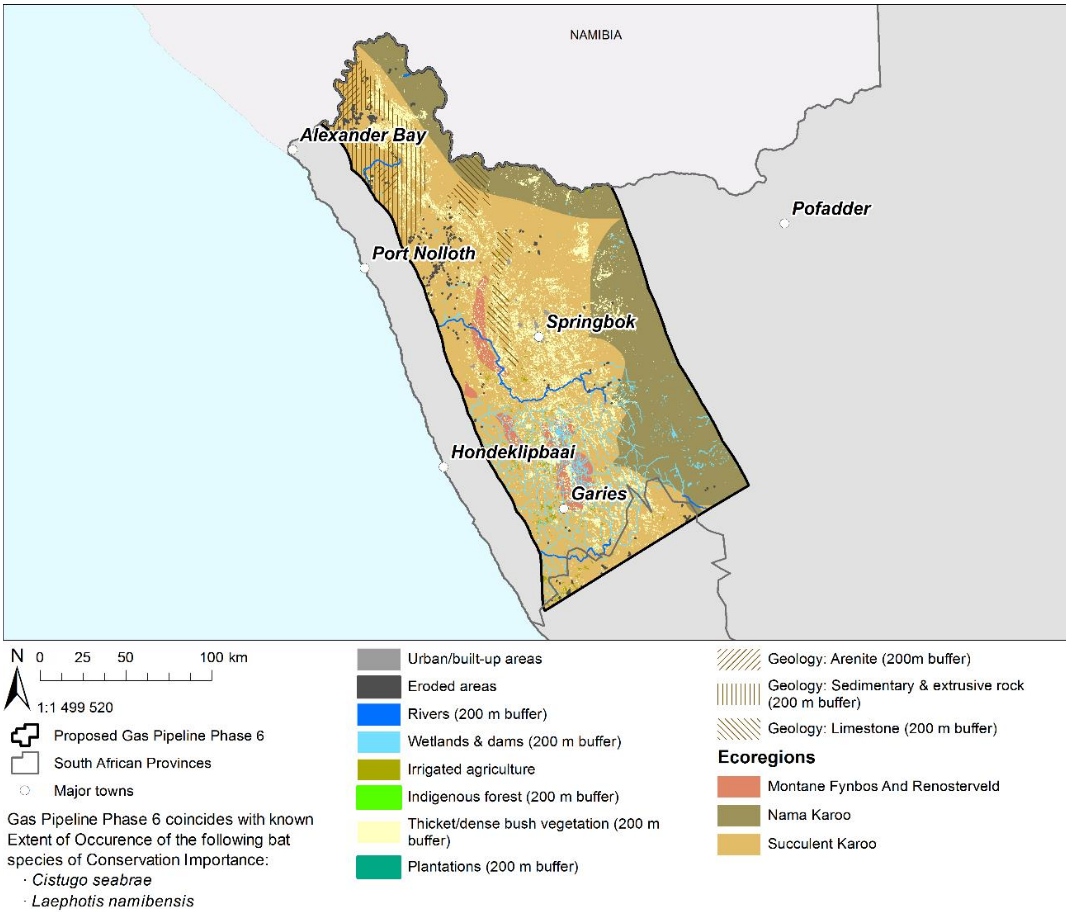

Figure 11: Key habitat features for bats, as well as an indication of the species of Conservation Importance that may be encountered in the proposed Phase 6 gas pipeline corridor.

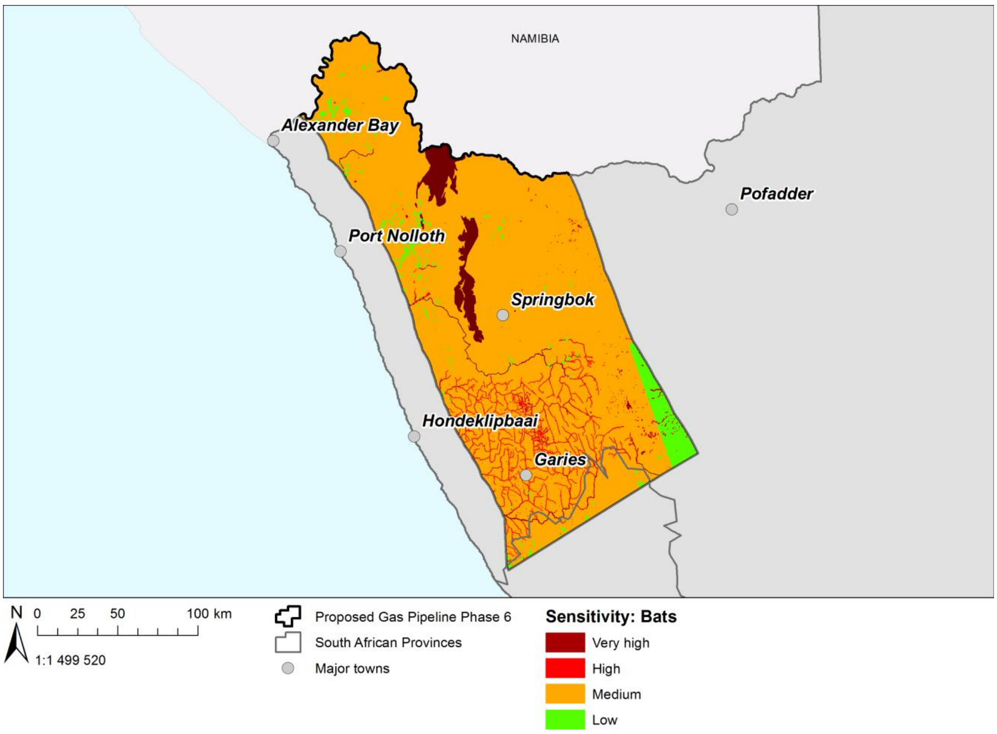

Figure 12: Bat sensitivity map for the proposed Phase 6 gas pipeline corridor.

5.7 Phase 7

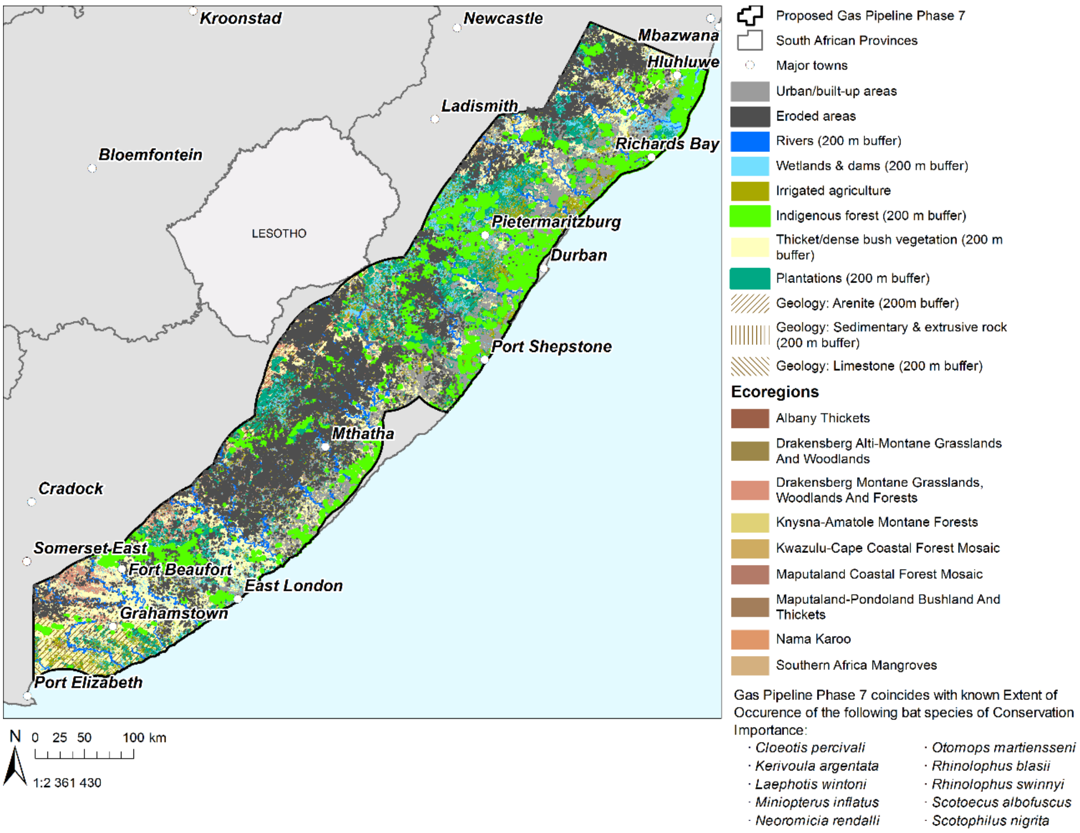

Figure 13: Key habitat features for bats, as well as an indication of the species of Conservation Importance that may be encountered in the proposed Phase 7 gas pipeline corridor.

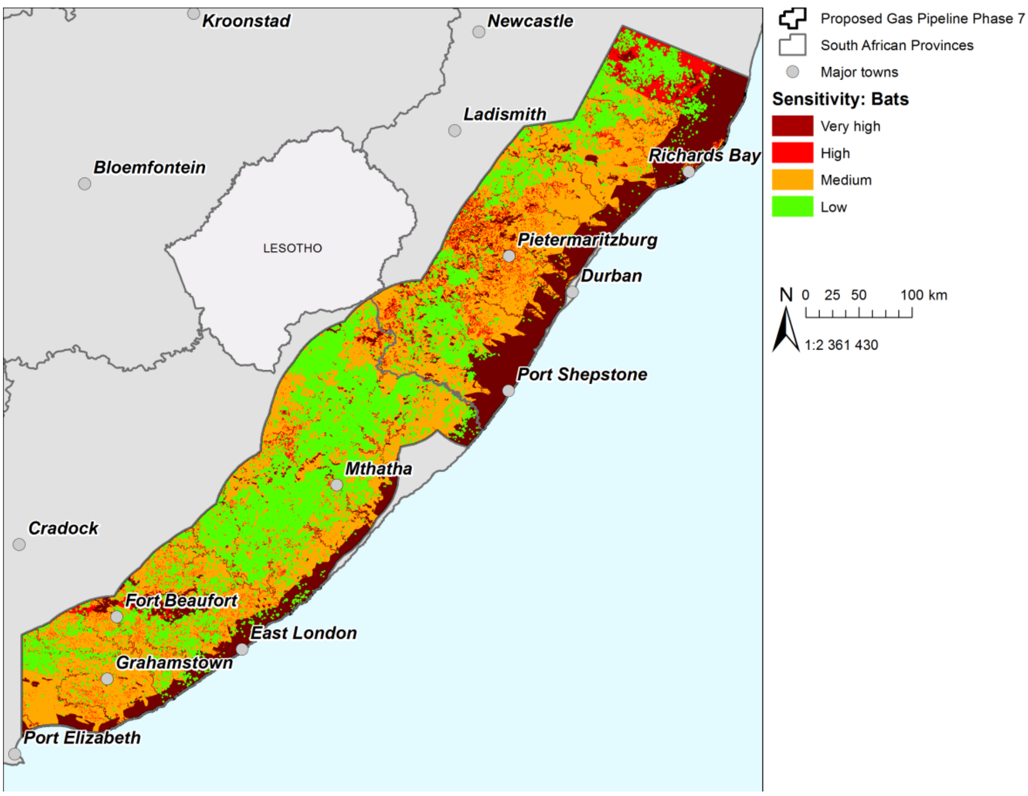

Figure 14: Bat sensitivity map for the proposed Phase 7 gas pipeline corridor.

5.8 Phase 8

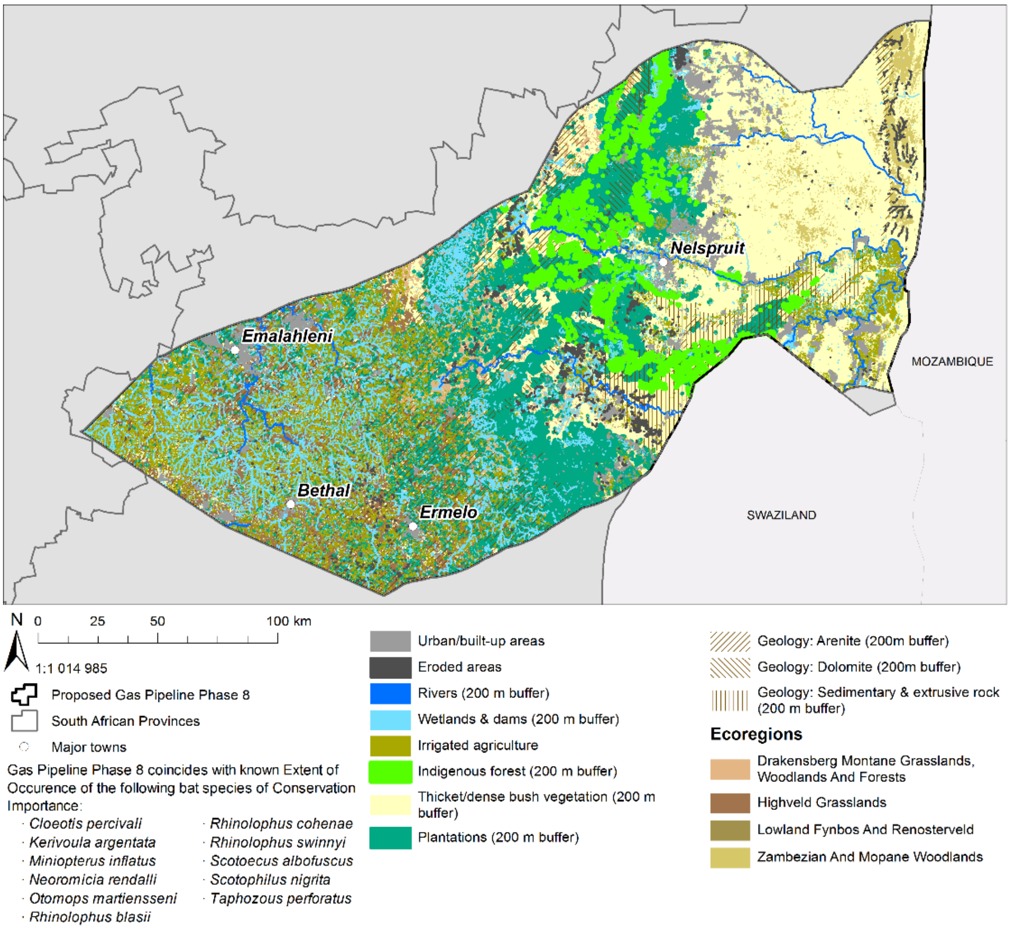

Figure 15: Key habitat features for bats, as well as an indication of the species of Conservation Importance that may be encountered in the proposed Phase 8 gas pipeline corridor.

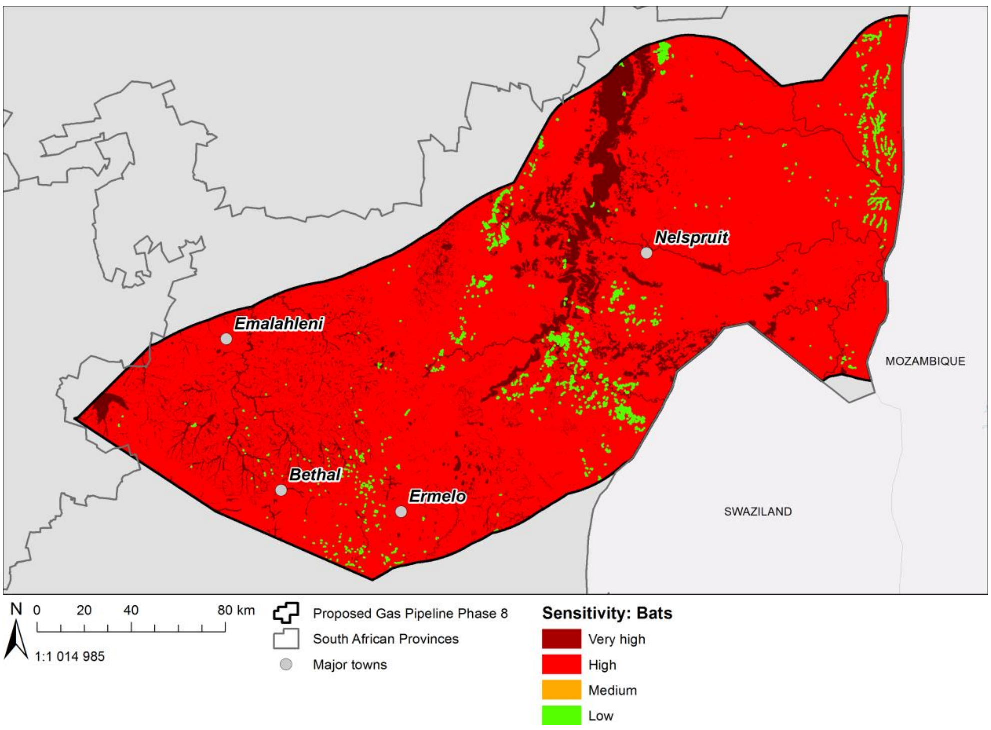

Figure 16: Bat sensitivity map for the proposed Phase 8 gas pipeline corridor.

5.9 Inland

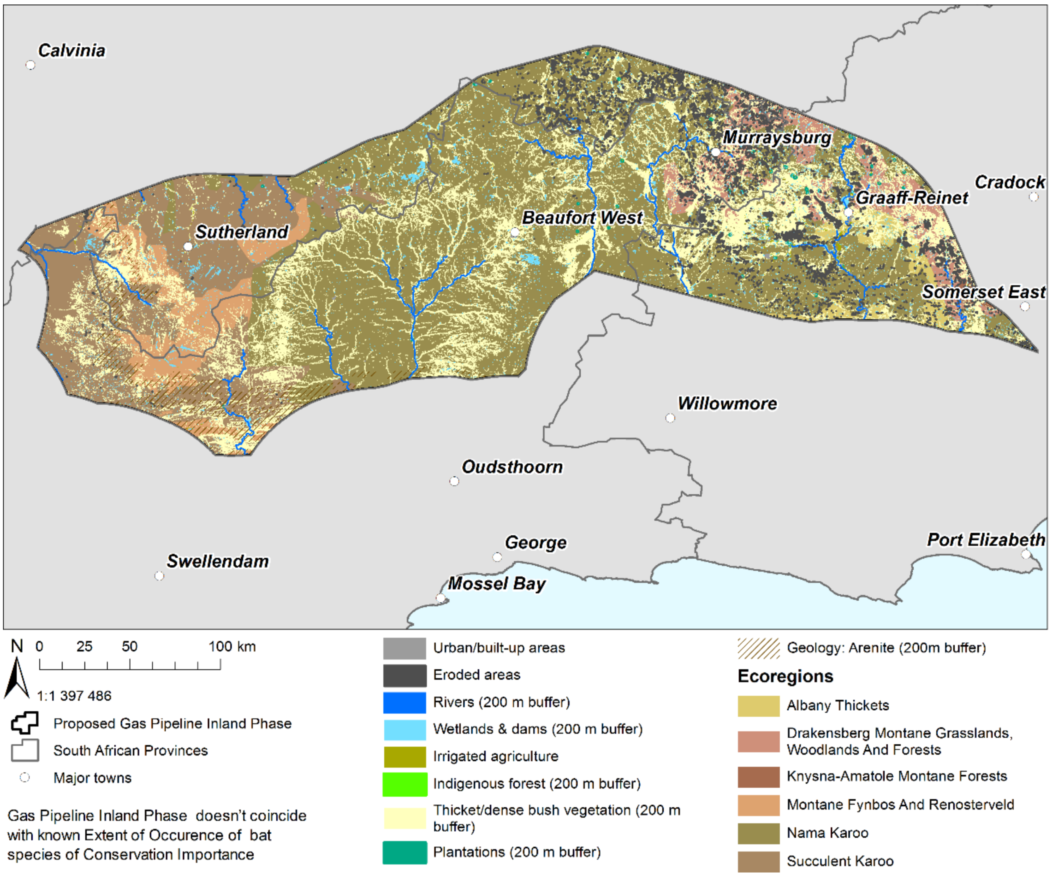

Figure 17: Key habitat features for bats, as well as an indication of the species of Conservation Importance that may be encountered in the proposed Inland Phase gas pipeline corridor.

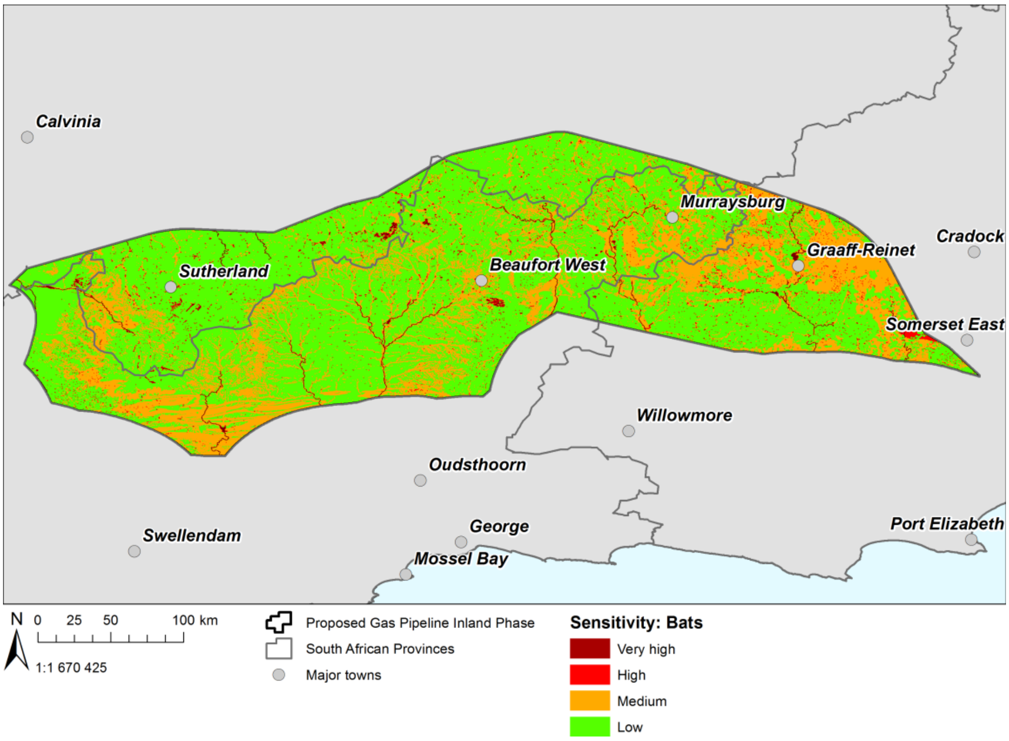

Figure 18: Bat sensitivity map for the proposed Inland Phase gas pipeline corridor.

6 KEY POTENTIAL IMPACTS AND MITIGATION

Construction activities, such as trenching, blasting and vehicle movement could cause noise, dust and vibrational disturbances to roosting colonies, especially during the breeding season from approximately October to March. The best measure to avoid potential negative consequences for bats would be to avoid placing infrastructure in the vicinity of known and potential roosts, especially known large maternity roosts and near areas utilized by bats of conservation importance. While species differ in their preferences, the following act as ideal habitats for bats to roost:

- Large trees or bush clumps;
- Caves and sinkholes;
- Rock crevices;
- Disused or old mining adits;
- Tunnels; and
- Dwellings/buildings with sufficient roosting space under roofs.

Additionally, bats require adequate surface water for feeding and drinking (Sirami et al., 2013; Lisóon and Calvo, 2014), particularly for insectivorous bats which hunt insects congregating above water bodies or wet soil. Potential impacts on bats include but are not limited to (Table 4):

Table 4: Potential impacts from gas pipeline development to bats, and recommended mitigation actions.

Key Impacts	Site Specific Descriptions	Possible Effect	Mitigations
Displacement and disturbance	During the construction phase, the clearing of vegetation, digging and laying of pipelines, and noise and vibrations from construction activities.	Loss of ecologically significant habitats and associated species.	Avoidance of verified high and very high bat sensitivity areas where possible, and minimise the development footprint. Particular attention in the bat impact assessments and specialist opinions should be given to species of conservation importance as per Section 4.2. If development does take place in areas of High or Very High sensitivity, a bat specialist must be appointed to undertake site visits to recommend micro-siting measures, and advise on the least harmful time in terms of the breeding season of the relevant bats in the area.
Dust generation	During construction, there is likely to be dust generated from the construction activities. This dust goes into the air and covers surfaces. Dust covered vegetation and fruit will reduce the foraging potential of an area.	Reduction in food availability and displacement of bats.	Avoidance of verified high and very high bat sensitivity areas where possible, and keep working areas damp to reduce dust production. Particular attention in the bat impact assessments and specialist opinions should be given to species of conservation importance as per Section 4.2.
Sedimentation of water bodies and wetlands	Soil movement during construction could result in dust, erosion and soil sedimentation of wetlands, rivers and open water bodies.	Reduction in fresh water availability and displacement of bats.	Avoidance of verified high and very high bat sensitivity areas where possible, and keep soil workings contained. The bat impact assessments and specialist opinions should conduct a desktop review on any possible new developments in this area of research.

7 BEST PRACTICE GUIDELINES AND MONITORING REQUIREMENTS

The only guidelines available in South Africa relating to the protection of bats in the context of development are those released by the South African Bat Assessment Association Panel (SABAAP) (Sowler et al, 2017; Aronson et al, 2014) in reference to wind energy development. However, IWS will contribute to the Decision-Making Tools that will be compiled for this specific SEA, in order to inform the site specific assessment requirements that are needed prior to commencement of the development.

7.1 Planning phase

Ensure site specific Bat Impact Assessments/ Bat Specialist Opinions are conducted to inform planning and placement.

7.2 Construction, Operation, Rehabilitation and Post Closure phases

Site specific Bat Impact Assessments/ Bat Specialist Opinions to conduct impact assessments and provide mitigation and monitoring requirements for each phase of development. The principles of avoidance, minimization, mitigation and only if unavoidable offset/ compensation should apply.

7.3 Monitoring requirements

The EMPr should be audited bi-annually to ensure that any mitigation measures listed were and continue to be adhered to.

8 CONCLUSIONS AND FURTHER RECOMMENDATIONS

Bats, the second most diverse mammal group on the planet, warrant consideration and protection at the very least due to their economic value and the ecosystem services they provide, although tourism and biodiversity heritage value is also very important.

The potential impacts to bats by the gas pipeline developments during the construction phase (and possibly during the operational phase if maintenance or repair on the pipeline is required) could include roost disturbance and foraging habitat loss associated with clearing the right of way, and sensory disturbance due to increased levels of noise and dust associated with heavy vehicles and other machinery, and sedimentation of water bodies and wetlands.

Measures to avoid and minimize impacts would include, in the planning phase, staying away from Very High and High sensitivity areas where possible. In these areas, detailed Bat Impact Assessments, including field work, must be performed to inform whether the project would have adverse effects on bats and whether it should proceed or not or to make informed mitigation recommendations. Such recommendations could be micro-siting to avoid key roosts or foraging habitat, avoiding construction in certain seasons, keeping the development footprint to a minimum, dust prevention and prevention of sedimentation runoff into water bodies, etc.

9 GAPS IN KNOWLEDGE

Gaps in knowledge from a bat data perspective include:

- No publicly available studies investigating the impacts of gas pipeline development on bats. We can only infer potentially adverse effects based on other human-induced landscape-level changes.
- Bat roost data is limited to data voluntarily supplied by bat specialists and published literature. The co-ordinates provided by some of the published sources are old and/ or they are only provided in degrees and minutes, therefore there are potentially accuracy concerns.

- It would be more accurate to map AoO vs EoO for species of conservation importance, but this level of detail was beyond the scope of this high level SEA. Commissioning such a detailed mapping exercise of the AoO for all species of conservation importance, both plants and animals, would be a worthwhile exercise for the DEA to consider for future conservation planning.

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