TRONOX KZN SANDS PROJECT – MINING OF HEAVY MINERAL SANDS AT PORT DURNFORD, KWAZULU-NATAL

Invertebrate Assessment

May 2023
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DECLARATION OF INDEPENDENCE

I, Lukas Niemand (Pachnoda Consulting CC) declare that:

- I act as the independent specialist in this application to WSP (Pty) Ltd and Enviro-Insight (Pty) Ltd;
- I will 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 declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have no vested financial, personal or any other interest in the application;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- 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; and
- All the particulars furnished by me in this form are true and correct.

Lukas Niemand (Pr.Sci.Nat)
19 May 2023

Lukas Niemand is registered with The South African Council for Natural Scientific Professionals (400095/06) with more than 20 years of experience in ecological-related assessments and more than seven years in the field of entomological assessments. He has conducted numerous ecological and entomological impact assessments in South Africa, the Middle East (Saudi Arabia) and other African countries (e.g. Republic of Congo, Liberia, Mozambique, Zambia, Malawi, Guinea, Ethiopia and Gabon).

EXECUTIVE SUMMARY

Tronox is applying for a consolidated Mining Right for heavy mineral sands near Port Durnford in the KwaZulu-Natal Province. This report assesses the potential impacts of the proposed mining activities on invertebrate species of conservation concern (SCC).

The invertebrate taxon attributes on the proposed project area were investigated during the austral wet season (07-13 February 2023) with emphasis on determining the occurrence of invertebrate taxa of conservation concern and to determine, according to the occurrence of these invertebrate taxa, the ecological importance (or conservation value) of the natural habitat units on the project area

Key findings include the following:

- The globally vulnerable Flat-Necked Shieldback (*Arytropteris basalis*) was confirmed from the project area, occupying the mid to tall terrestrial forest patches.
- Suitable habitat is also present for the East Coast Katydid (*East Coast Katydid*) and the Natal Yellow-banded Sapphire butterfly (*Iolaus diametra natalica*). These species share a similar habitat to *Arytropteris basalis*, thereby occupying the mid to tall terrestrial forest patches.
- The millipede *Centrobolus richardii* was prominent and widespread in the forest leaf litter and was regarded as a common species on the project area. *Centrobolus richardi* and *Centrobolus. sp. nr fulgidus* (also confirmed) are both narrow-endemic taxa to the KZN coastal region.
- Various broad-scale habitat units were present, of which the terrestrial forests (mid to tall coastal belts forests) and swamp forests were classified with a Very High Site Ecological Importance (SEI).
- Mining operations (mainly during Phase 2) is expected to remove approximately 25% of Very High SEI Forest habitat (with buffers applied).
- Additional impacts related to the proposed mining operations included loss of invertebrate habitat, forest fragmentation and impact associated with noise pollution and vibration disturbances.
- Mitigation remains challenging since all habitat of Very High SEI should preferably be avoided according to the Species Environmental Assessment Guidelines (SANBI, 2020).
- The proposed mine, as well as existing and planned mining project in the wider project area will have increased negative cumulative impacts on the entomofauna of the area, which could result in the fragmentation of viable landscape corridors in the region.
- It was recommended that the proposed mine, especially the current mine layout be amended to promote *in situ* habitat preservation of natural habitat with a Very High SEI (in the absence of any scientifically defensible/sound offset and rehabilitation plan).

- A “corridor offset and rehabilitation” plan was proposed by the applicant/client, which will need additional specialist/scientific input from both specialists and conservation authorities to determine its feasibility **prior to any mining activity**.

1. INTRODUCTION

1.1 Background

Pachnoda Consulting cc was appointed by of Enviro-Insight (Pty) Ltd on behalf of WSP (Pty) Ltd to undertake an Invertebrate Impact Assessment Report for the proposed mining of heavy mineral at Port Dunford along the eastern coastal belt of the KwaZulu-Natal (KZN) Province.

Tronox KZN Sands (Pty) Ltd ("Tronox") holds a prospecting right under the Department of Mineral Resources and Energy ("DMRE") Reference: KZN 30/5/1/1/2/296 PR in respect of ilmenite, rutile and zirkon on the farms [Sub 1 and Remainder of Lot 102 uMlalazi No. 13860, Sub 1,2 and Remainder of Lot 131 uMlalazi No. 14098, Sub 1 and Remainder of Lot 103 uMlalazi No. 13880, Sub 2,3 and Remainder of Lot 104 uMlalazi No. 13853 and Sub 1 and Remainder of Lot Hibbert No. 15714] measuring 843.72 hectares in extent within the uMlalazi and uMhlathuze Municipality, KwaZulu-Natal (KZN) Province (the "Waterloo PR"), which prospecting right was renewed by the DMRE pursuant to section 18 of the Mineral and Petroleum Resources Development Act, 2002 ("MPRDA").

Historically, Tronox held the following two prospecting rights in terms of section 17 of the MPRDA:

- DMRE Ref: KZN 30/5/1/1/2/10708 PR (formerly 771 PR) in respect of ilmenite, rutile, zirkon and heavy minerals on the farms measuring 3 945.95 hectares in extent in the uMlalazi and uMhlathuze Municipality, KwaZulu-Natal (KZN) Province (the "Port Durnford PR"); and
- DMRE Ref: KZN 30/5/1/1/2/279 PR in respect of ilmenite, rutile, zirkon and heavy minerals on the farms measuring 258.27 hectares in extent in the uMlalazi and uMhlathuze Municipality, KwaZulu-Natal (KZN) Province (the "Penarrow PR")

Tronox is now applying to convert these Prospecting Rights into a consolidated Mining Right and seeks environmental authorisation to support this. A Scoping and Environmental Impact Reporting (S&EIR) Process is required to support this Mining Right Application in terms of the legislation detailed above

The proposed mining project will be undertaken in two phases: Phase 1, between 2025 and 2036 which will entail the mining of 70 400 tpa and Phase 2, which will operate between 2036/2037 at 3000tph (26 280 000 tpa) and continue until mine closure in 2070. The planned infrastructure for the proposed project is shown in Figure 1.

Figure 1: A map illustrating the proposed planned infrastructure for the proposed project.

1.2 Objectives and Scope of Work

Lukas Niemand of Pachnoda Consulting CC was appointed as the specialist for the section dealing with the invertebrate component for this project. He is a registered scientific professional in the fields of zoological and ecological science with experience spanning more than 20 years.

The study aims and focus primarily on providing a “Terrestrial Animal Species Specialist Assessment Report” as required for the environmental authorisation process for a proposed development. Therefore, the report was conducted in alignment with the terrestrial animal species protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species in terms of sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998 (Act No. 107 of 1998), hereafter referred to as “the terrestrial animal species protocol”.

The main objectives of the study were based on the results of the Screening Report, which were to:

- Providing an evaluation of **selected invertebrate taxa** importance in a local, regional or national context, especially “rare” and/or threatened species;

- Identification of habitat units or discrete habitat areas containing invertebrate species on the project area that are threatened or near-threatened (Red Data);

- An evaluation of the occurrence and importance of the project area as habitat for the following invertebrate species of conservation concern (SCC):
    - Flat-necked Shieldback (*Arytropteris basalis*) - a globally vulnerable insect (katydid) species;
    - East Coast Katydid (*Pomatonota dregeii*) - a globally vulnerable insect (katydid) species;
    - Bladder grasshopper (*Physophorina livingstonii*) - a globally endangered insect species;
    - Millar's Buff (*Deloneura millari millari*) – a rare butterfly species occurring at low density;
    - Zulu Buff (*Teriomima zuluana*) - a rare and endemic butterfly species occurring at low density; and
    - Natal Yellow-banded Sapphire (*Iolaus diametra natalica*) - a rare and endemic butterfly species occurring at low density.
- In addition to providing an estimate on the occurrence of the aforementioned SCCs, **forest litter sampling** was conducted to search for provincial endemic millipedes and land snails/slugs, with emphasis on the following taxa: *Teriomima zuluana* (butterfly), *Centrobolus fulgidus* (millipede), *Doratogonus falcatus* (millipede), *Doratogonus peregrinus* (millipede), *Orthoporoides corrugatus* (millipede), *Orthoporoides laccatus* (millipede), *Gnomeskelus spectabilis* (millipede), *Euonyma lymneaeformis* (snail), *Gulella separata* (snail) and *Gulella zuluensis* (snail). These taxa are a conservation priority group according to the KwaZulu-Natal (KZN) Biodiversity Sector Plan and the KZN Biodiversity Spatial Planning Terms and Processes (Ezemvelo KZN Wildlife, 2016). Searches for these taxa will be required by Ezemvelo KZN Wildlife (Figure 2).
- A brief examination of the ecological relationships/associations between recorded species and taxa, and the different habitat types in which they are found; and
- An identification of any specific areas in the project area that may require special protective measures to avoid future degradation or environmental damage.
- Provide an impact assessment of the proposed mining operation on the invertebrate community and habitat thereof.

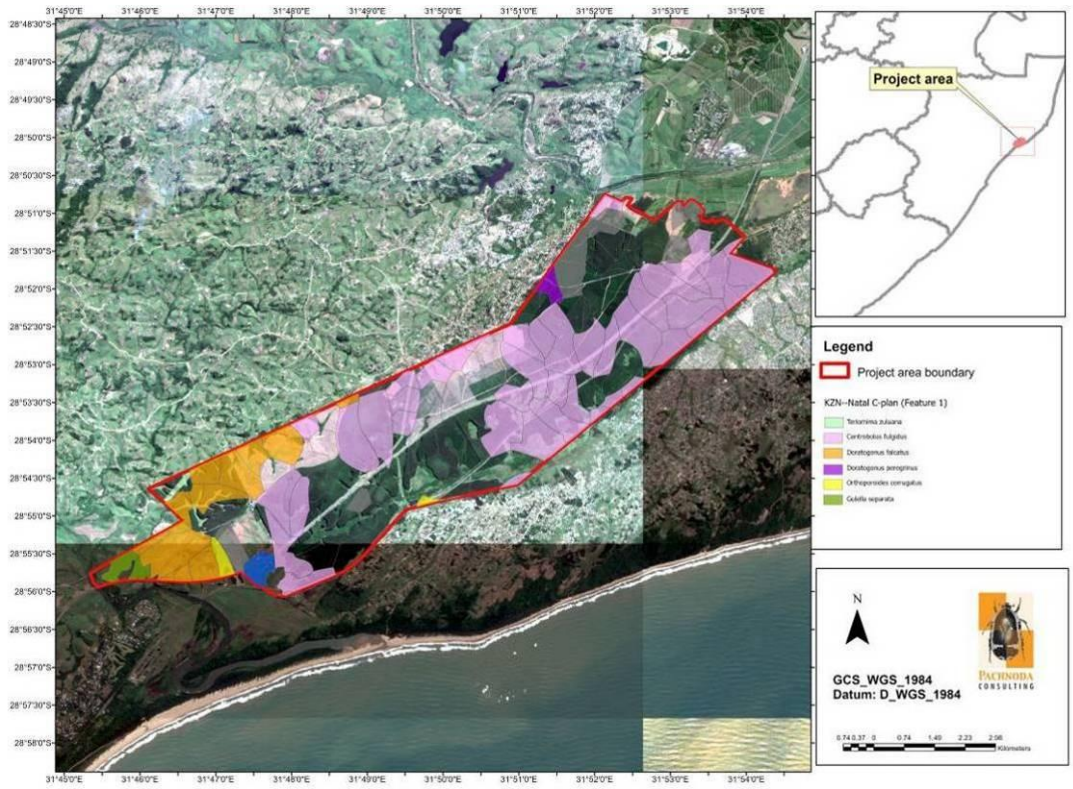


Figure 2: A map illustrating the KwaZulul-Natal (KZN) Conservation Plan and the potential occurrence of first-order (endemic) invertebrate species modelled for the project area (Ezemvelo KZN Wildlife, 2016)**.**

2. DESCRIPTION OF THE PROJECT AREA

2.1 Locality

The project area is located along the east coast littoral between the town of Richard's Bay in the north and the town of Mtunzini in the south. The Umlalazi River forms the southern boundary of the project area (Figure 3). The centre of the project area is located at approximately S28° 53' 33.9" E31° 50' 44.8" while it corresponds to the quarter-degree grid square 2831DD. Figure 4 illustrates the proposed location of the Phase 1 site layout of the proposed mine, while Figure 5 illustrates the proposed Phase 1 haul roads.

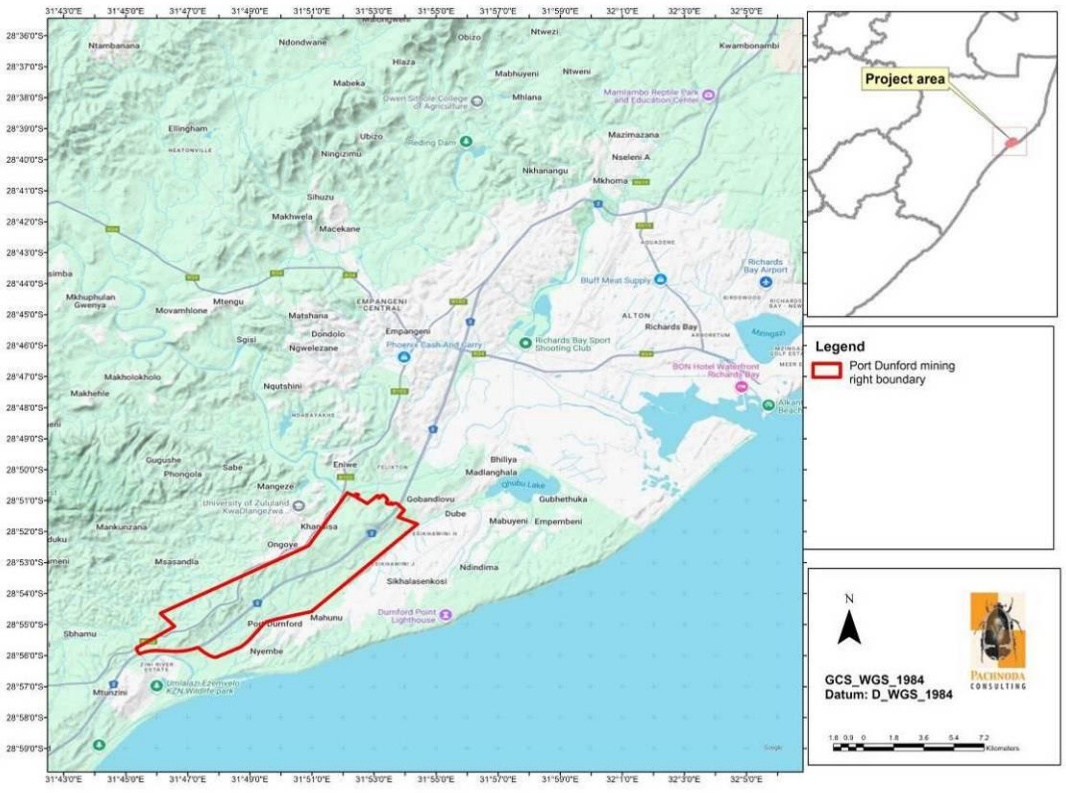


Figure 3: A terrain map illustrating the spatial locality of the Port Durnford mining right boundary (image courtesy oof Google Corporation).

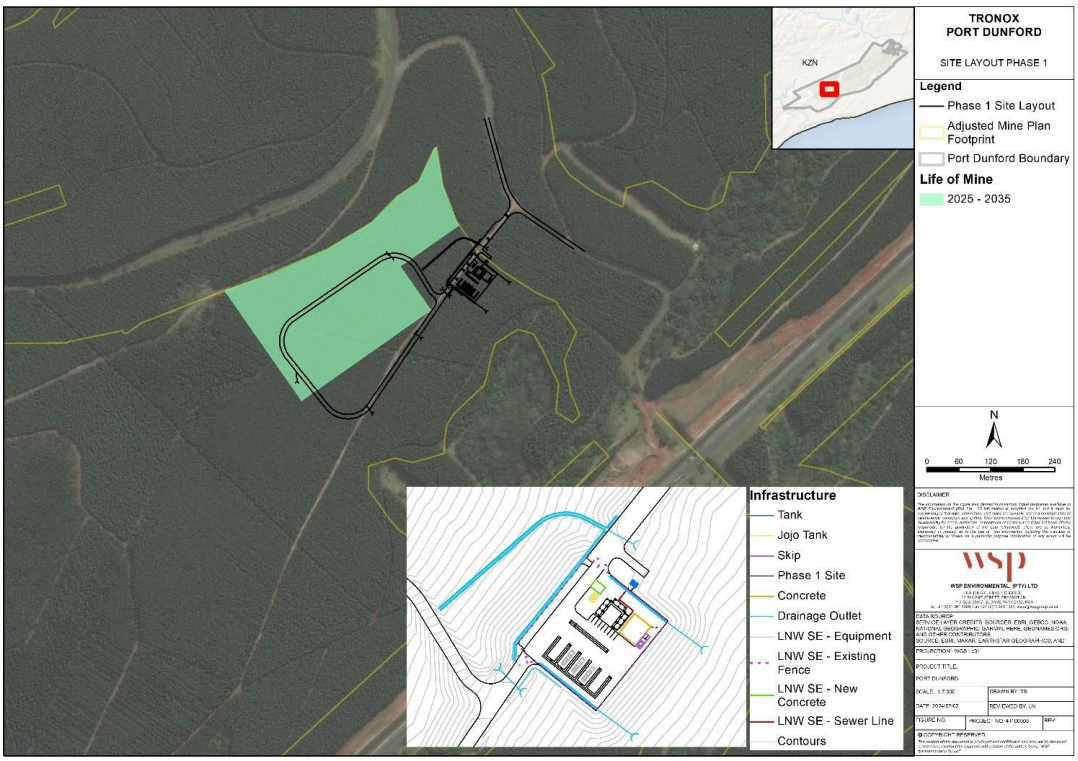


Figure 4: The location of Phase 1 site layout of the proposed Port Dunford mine.

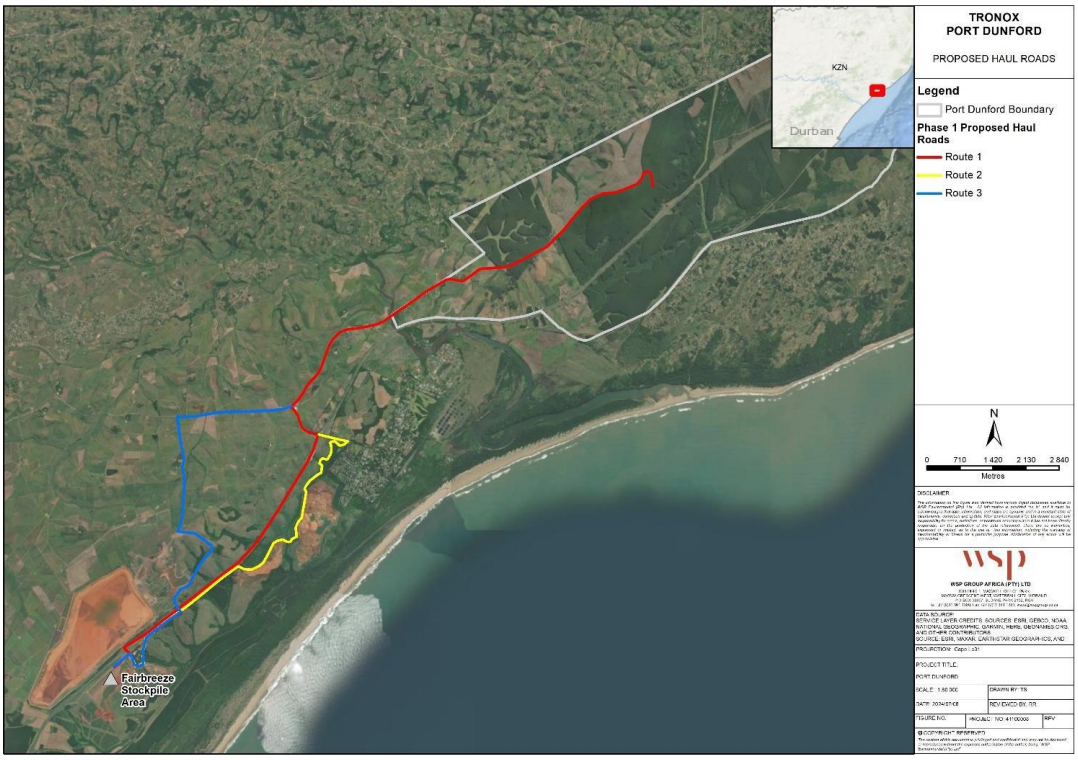


Figure 5: A terrain map illustrating the proposed Phase 1 haul roads.

2.2 Broad-scale Habitat Units

The project area is located in the Indian Ocean Coastal Belt Biome, which is found along the eastern coastal littoral. It corresponds to a regional vegetation type known as the Maputaland Costal Belt (Mucina & Rutherford, 2006) which is also a Vulnerable ecosystem. In the broad sense, the floristic composition and structure of the project area consists of a mosaic of coastal belt forest, hygrophilous grasslands and *Eucalyptus* plantations. Large sections of natural coastal belt forest on the project area were transformed and converted in afforested timber plantations, while many of the natural remaining forest patches show some degree of perturbation owing to anthropogenic activities such as inappropriate grazing regimes, deforestation for firewood and infestation by alien weeds (e.g. *Chromolaena odorata*).

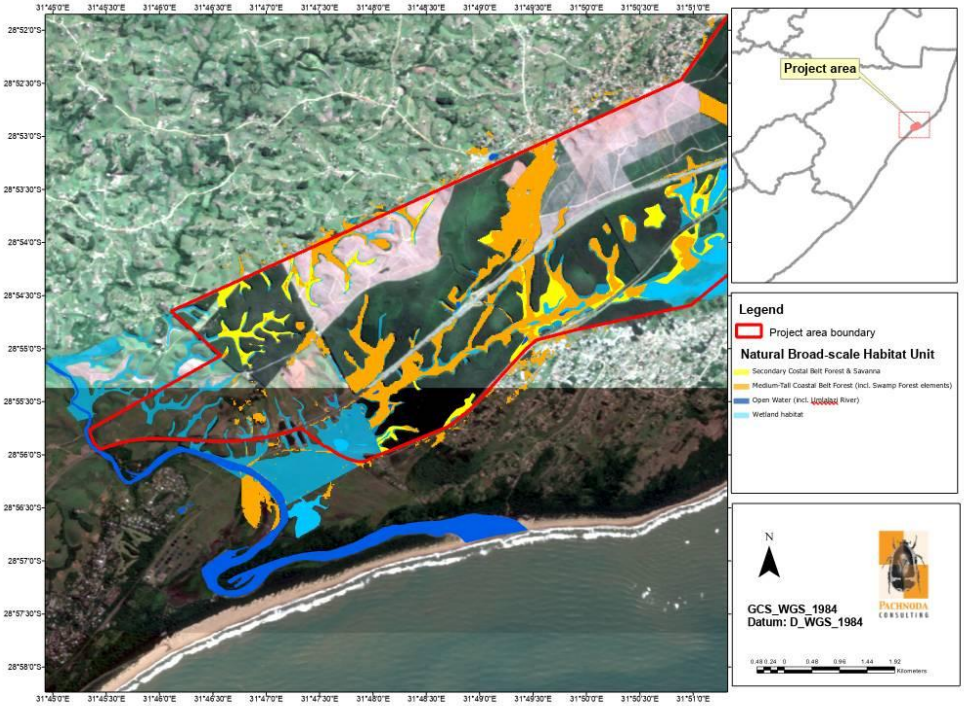
For the purpose of the invertebrate survey, a well-defined undergrowth consisting of a high soil moisture content, shade and the occurrence of dead organic base layer (mainly leaf litter) is essential for a diversity of terrestrial invertebrate species. Therefore, the project area can be classified into (1) natural coastal belt forest of mid- to late successional stage (mainly medium to tall forest with a well-developed undergrowth) with some swamp forest element where soil water retention remains high throughout the year. The project area also encompasses numerous sections of (2) short secondary coastal forest and savanna which consists mainly of secondary regenerating and post-disturbed coastal forest. The vertical heterogeneity of these forest remnants is often low, and due to increased edge effects, the soil moisture content is often low or subject to extremes. The remaining natural habitat consists of

(3) wetland-associated habitat (e.g. swamp forest remnants, ponds) and hygrophilous grassland (Figure 6 and Figure 7).

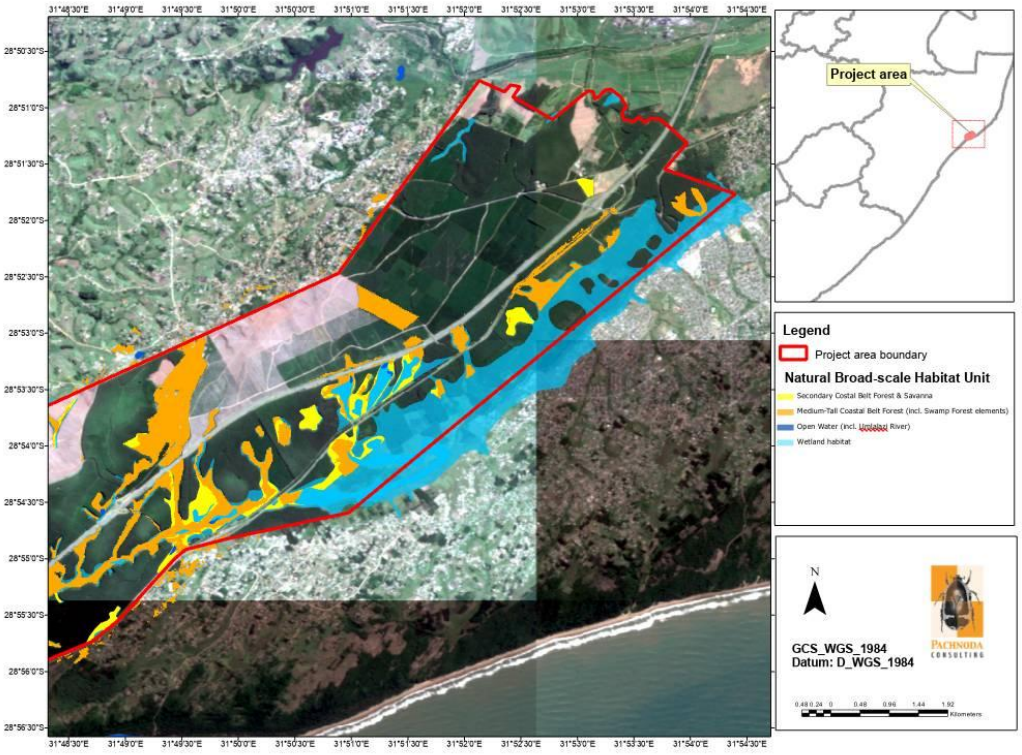
Previous floristic surveys (CES, 2008) have found that the following floristic families are prominent on the project area:

- Legume (Pea) family (Fabaceae), which mainly consists of herbs, creepers, some trees and shrubs;
- Rubiaceae family, which mainly consists of trees and shrubs;
- Euphorbia family, mainly trees and shrubs and occasional herbs, which is typical of forest vegetation;
- Daisy family (Asteraceae), which was well represented both inside and outside of the forests in the form of a few shrubs and trees, but mainly in the form of herbs, some creepers and grasses.
- Grass family (Poaceae), which had a strong presence within the grassland communities, as well as inside the forest margins, for example, *Oplismenus hirtellus, Setaria megaphylla* and *Olyra latifolia* were found inside the forest or on the margins.

Of the common genera, a high prevalence of forest species such as fig trees (*Ficus* spp.), *Hibiscus* spp. (herbs and shrubs), sedges (Cyperaceae*)* and lianas (e.g. *Dalbergia* spp.) were characteristic of the coastal belt forest community.



(a) Western extent



(b) Eastern extent

Figure 6: A simplified map illustrating natural broad-scale habitat units on the (a) western extent and (b) eastern extent of the project area according to floristic structure.


a


b


c


d


e


f

Figure 7: A collage of images illustrating examples of the broad-scale habitat units on the project area: (a - d) medium to tall coastal belt forest with a well developed undergrowth (e - h) medium to tall swamp forest with wetland-associated habitat and (i-j) short to medium secondary and regenerating coastal belt forest.

2.3 Annotations on the National Web-Based Environmental Screening Tool

Regulation 16(1)(v) of the Environmental Impact Assessment Regulations, 20145 (EIA Regulations) provides that an applicant for Environmental Authorisation (EA) is required to submit a report generated by the Screening Tool as part of its application. On 5 July 2019, the Minister of Fisheries, Forestry and the Environment published a notice in the Government Gazette giving notice that the use of the Screening Tool is compulsory for all applicants to submit a report generated by the Screening Tool from 90 days of the date of publication of that notice.

The Screening Tool is intended to allow for pre-screening of sensitivities in the landscape to be assessed within the EA process. This assists with implementing the mitigation hierarchy by allowing developers to adjust their proposed development footprint to avoid sensitive areas. The Screening Tool report will indicate the (preliminary) environmental sensitivities that intersect with the proposed development footprint as defined by the applicant as well as the relevant Protocols.

As the Screening Tool contains datasets that are mapped at a national scale, there may be areas where the Screening Tool erroneously assigns, or misses, environmental sensitivities because of mapping resolution and a high paucity of available and accurate data. Broad-scale site investigations will provide for an augmented and site-specific evaluation of the accuracy and 'infilling' of obvious and large-scale inaccuracies. Information extracted from the National Web-based Environmental Screening Tool (Department of Environmental Affairs, 2020), indicated that the project area holds a **medium** sensitivity with respect to the relative animal species protocol for invertebrate taxa (Figure 8) (report generated 05/02/2023):

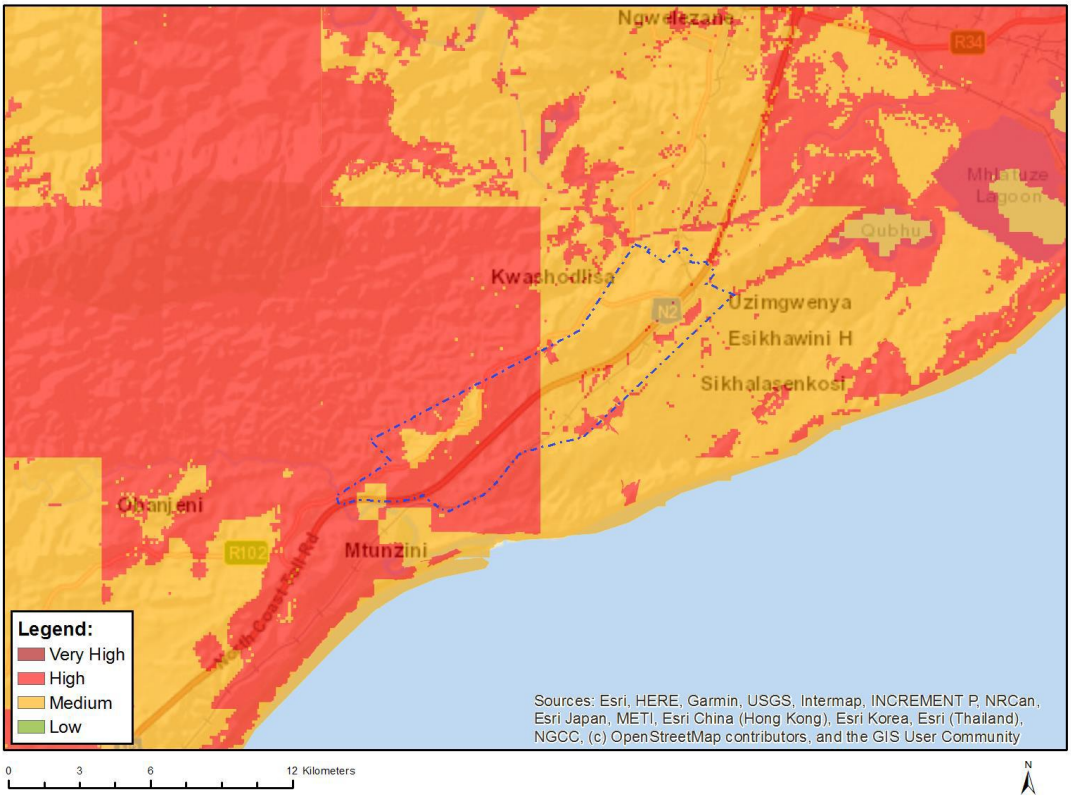


Figure 8: The animal species sensitivity of the project area according to the Screening Tool.

Sensitive features include the following:

Sensitivity	Feature(s)
Medium	Insecta-*Deloneura millari millari*
Medium	Insecta-*Iolaus diametra natalica*
Medium	Insecta-*Teriomima zuluana*

Medium	Invertebrate-Forest invertebrates
Medium	Invertebrate-*Arytropteris basalis*
Medium	Invertebrate-*Pomatonota dregii*
Medium	Invertebrate-*Physophorina livingstonii*

It is evident from the results of the Screening Tool report that the north-eastern part of the project area is highlighted with a medium sensitivity owing to the probability for threatened or highly localised invertebrate species to occur. The south-western part of the project area is highlighted with the high sensitivity mainly due to the high potential for threatened bird and amphibian species to be present. The forest invertebrate component refers mainly to the potential occurrence of endemic millipedes, endemic mollusc taxa, harvestmen and velvet worms.

3. METHODS AND APPROACH

The invertebrate taxon attributes on the proposed project area were investigated during the austral wet season (07-13 February 2023; refer to Figure 9 for coverage of the project area) with emphasis on determining the occurrence of invertebrate taxa of conservation concern and to determine, according to the occurrence of these invertebrate taxa, the ecological importance (or conservation value) of the natural habitat units on the project area. It should be noted that the survey focussed primarily on selected invertebrate taxa based on the results of the National Environmental Screening Tool Report as promulgated in sections 24(5)(a) and (h) and 44 of the National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998).

The methods and approach follow the "Guidelines for the implementation of the Terrestrial Fauna and Terrestrial Flora Species Protocols for environmental impact assessments in South Africa" (SANBI, 2020), which provide guidance regarding the method in which specialist studies should be undertaken in order to meet these minimum requirements.

3.1 Literature Review and Database Acquisition

- The global conservation status for butterfly was based on the International Union for Conservation of Nature (IUCN) Red List (2023), while Mecenero et al. (2013) was also consulted regarding the national conservation status of butterflies.

- The historical and extant (recent) distribution range of butterfly taxa was sourced from the Animal Demography Unit's online database, LepiMap (2831DD and 2831DC, including bordering grids; refer Figure 10), Mecenero et al. (2013) and various applicable field guides, in particular Woodhall (2020).

- The historical and extant (recent) distribution ranges of the katydid and Orthopteran genera *Arytropteris, Pomatonota* and *Physophorina* were sourced from the IUCN Red List (2023), while, taxonomic descriptions and ecological notes were obtained from Rentz (1988), Naskrecki (1994) and Dirsh (1965) and the online Orthoptera Species File (http://orthoptera.speciesfile.org/).

- The historical and current distribution range, including taxonomic descriptions of millipede genera, especially *Doratogonus* and *Orthoporoides* were sourced from Lawrence (1958; 1953) and Hamer (1998). The conservation status of the myriapoda on the project area was also sourced from the IUCN Red List (2023).

- The distribution range of terrestrial mollusca (land snails and slugs) was sourced from the IUCN Red List (2023) and from Herbert and Kilburn (2004).

- The online web-based database iNaturalist dataset was also consulted, while additional information and preliminary identifications (determinations) of captured/collected specimens were generously provided by Dr Adrian Armstrong (Entomologist & Herpetologists at Ezemvelo KZN Wildlife) and Dr. Michelle Hamer (SANBI and taxonomist on Myriopoda).

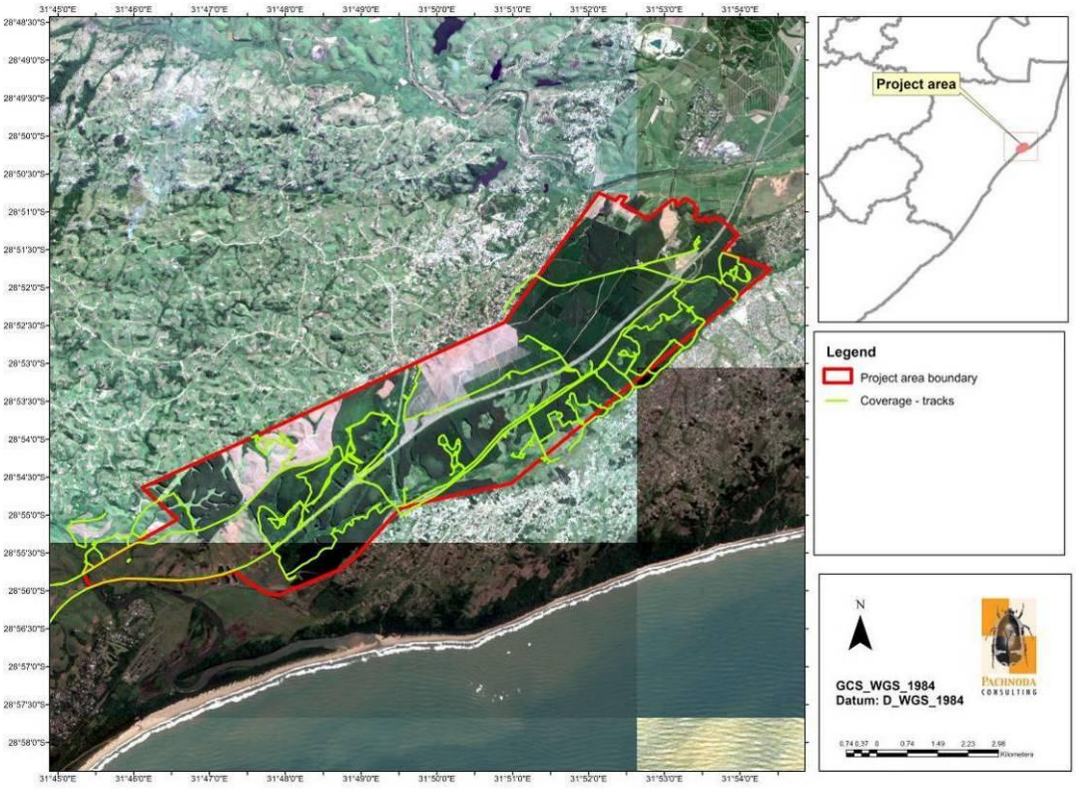


Figure 9: The general coverage (tracks) of the project area during the February 2023 field survey.

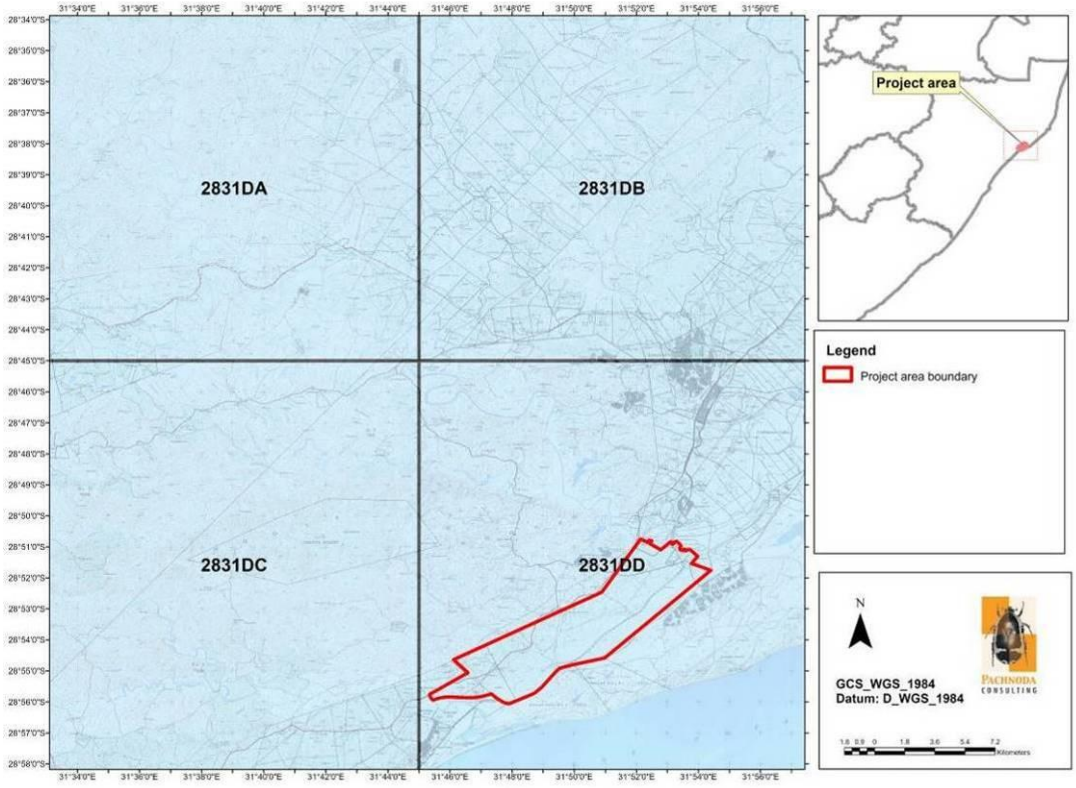


Figure 10: The quarter-degree grid squares (sensu ADU) relevant to the project area (mainly for butterfly distribution ranges).

3.2 Field Surveys

- The occurrence of threatened and restricted-range (rare and localised) taxa was verified during 07-13 February 2023 on areas comprising of suitable habitat by means of standard *handnetting procedures*, especially during optimal times of the day from 10h30 to 14h00 in full sunshine. To aid the detection of these species (c. *Deloneura millari millari*, *Teriomima zuluana* and *Iolaus diametra natalica*) suitable habitat was also inspected for larval host plant species (c. *Actinanthella wyliei* for *Iolaus diametra*) and cyanobacteria (the food of the larvae of *Deloneura and Teriomima*).

- The occurrence of katydids (genera *Arytropteris* and *Pomatonota* species) and *Physophorina livingstonii* was based on the following field techniques:

    - *Active searching*: Katydis (Tettigoniidae) and *Physophorina livingstonii* (Pneumoridae) were sampled by means of active searching at night using a flashlight. This technique was implemented on most of the field work nights from sunset to approximately 22h00, which proved to be the most successful method to detect and collect stridulating male *Arytropteris basalis* from the vegetation canopy by hand.

- *Auditory searches*: Nocturnal auditory searches were used to locate katydid species (Tettigoniidae) and *Physophorina livingstonii* (Pneumoridae) to enable the capture of individuals by hand. It proved to be a highly effective way to locate and capture *Arytropteris basalis*. Since recordings of the auditory mate recognition signals are currently widely unavailable, call recordings were also obtained from stridulating *A. basalis* males, and these recordings will subsequently be made available as confirmation of SCC presence and to assist in establishing a library of recordings for download by specialists to facilitate further surveys and conservation efforts in South Africa.

- The occurrence of forest invertebrates (c. millipedes and land snails /slugs) was based on the following field techniques:

  - *Quadrate sampling*: Seventeen 2x10 m quadrates were set up in different localities within forest habitat on the project area (Figure 11 and Table 1). The entire area of each quadrate was thoroughly searched by two to three observers ("scrapers"), while searching through the leaf litter and topsoil, and to a depth of 2-5 cm around the base of trees, searching under fallen logs. Decaying logs were also opened to search inside the logs. The total time spent searching (n=17 quadrates) was approximately 10 hours, while the average time spent per quadrate was 30-40 minutes (range = 20-60 minutes). Sampling priority was given to medium to tall mid- to late successional forest patches.

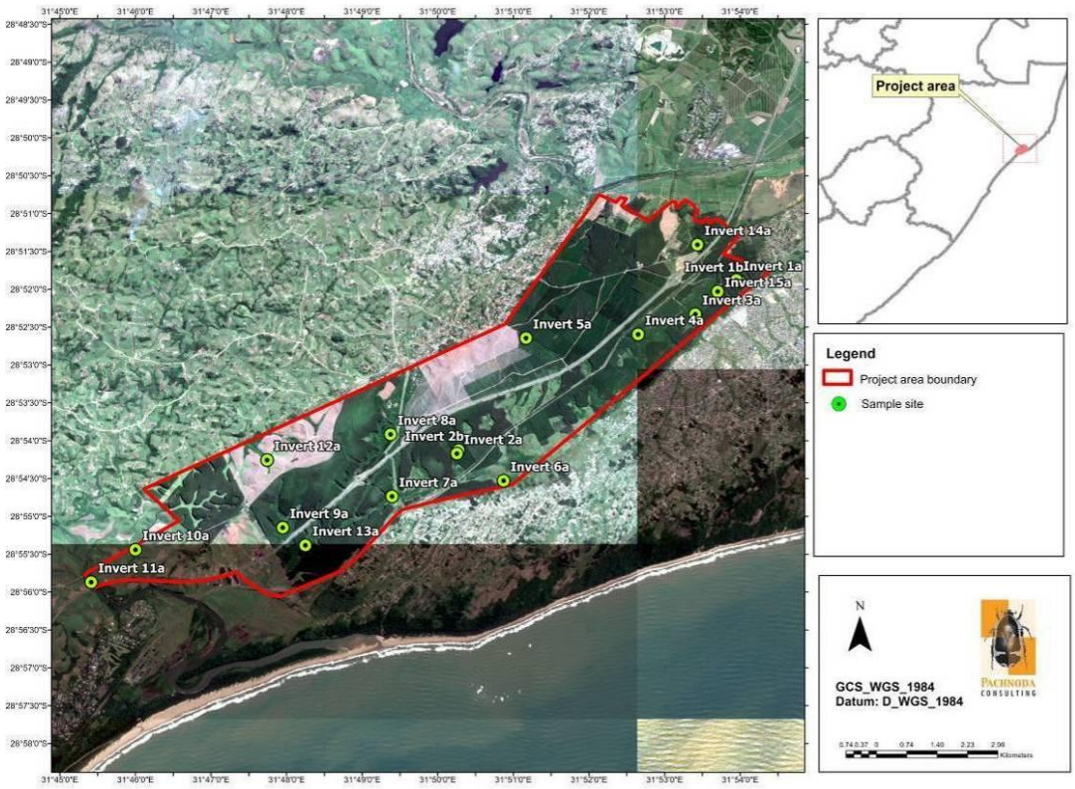


Figure 11: The spatial position of sampling sites (quadrates) during the forest invertebrate sampling session.

Table 1: A summary table of the sample sites (quadrates) and an indication of the floristic structure of each sample site. Structure refers to: 1 – short secondary and regenerating forest, 2 – short to medium forest of mid-successional stage and 3 – medium to tall mature (slightly disturbed) forest.

Site #	Date	Time start	Time end	Understory structure	Number of observers (Scarpers)	Canopy Structure
1A	07/02/2023	11:40	12:20	Intact understory	*2*	*1*
1B	07/02/2023	12:30	13:00	Intact understory	*3*	*3*
2A	08/02/2023	11:00	11:45	Intact understory	*2*	*3*
2B	08/02/2023	12:00	12:40	Intact understory	*3*	*3*
3A	09/02/2023	09:00	10:00	Understory very dense and regenerating	*2*	*3*
4A	09/02/2023	11:15	12:00	Intact Understory	*3*	*3*
5A	09/02/2023	13:55	14:30	Intact understory	*3*	*3*
6A	10/02/2023	10:00	10:55	Intact understory	*3*	*3*
7A	10/02/2023	12:50	13:10	Dense understory	*3*	*1*
8A	11/02/2023	09:20	09:45	Intact understory	*3*	*2*
9A	11/02/2023	10:45	11:25	Intact understory	*2*	*1*
10A	11/02/2023	13:00	13:20	Medium dense climbers	*3*	*3*
11A	12/02/2023	08:45	09:10	Very open/disturbed	*3*	*3*

Site #	Date	Time start	Time end	Understory structure	Number of observers (Scarpers)	Canopy Structure
12A	12/02/2023	10:30	11:00	Very open/ disturbed, narrow	2	1
13A	12/02/2023	13:20	13:50	Understory very dense	3	3
14A	13/02/2023	10:00	10:30	Intact understory	2	2
15A	13/02/2023	11:00	11:30	Dense understory	3	3

3.3 Assumptions and limitations

- It is assumed that third party information (obtained from government, academic/research institution, non-governmental organisations) is accurate and true.
- Some of the datasets are out of date and therefore extant distribution ranges may have shifted although these datasets provide insight into historical distribution ranges of relevant species.
- The datasets are mainly small-scale and could not always consider azonal habitat types that may be present on the project area (e.g. smaller forest patches). In addition, these datasets encompass surface areas larger than the project area, which could include habitat types and taxa that are not present on the project area. Therefore, the potential to overestimate species richness is highly likely while it is also possible that certain cryptic or specialist species could have been overlooked in the past.
- Some of the datasets (e.g., Virtual Museum) managed by the Animal Demography Unit of the University of Cape Town are based on observation made by citizen scientists and may therefore be incomplete due to reasons such as access and safety.
- Findings, results, observations, conclusions, and recommendations presented in this report are based on the authors' best scientific and professional knowledge as well as the interpretation of information available to them at the time of compiling this report.
- The information presented in this document only has reference to the investigated project area and cannot be applied to any other area without prior investigation.
- Results presented in this report are based on a "snapshot" investigation of the project area and not on detailed and long-term investigations (e.g. one to several months or years) of all the environmental attributes and the varying degrees of invertebrate diversity that may be present in the project area. Specifically, no long-term survey methods were employed in the collation of data from the site. Although as much data as possible was obtained from ad-hoc observations and quadrate sampling during the field work, these surveys are customarily limited by budgetary and time constraints – results presented in this report need to be interpreted with these limitations in mind.

- Rare (localised) and endemic species normally do not occur in great densities and, because of customary limitations in the search and identification of Red Listed species, any detailed autecological investigations of these species was not possible. Results are ultimately based on inferred estimations and specialist interpretation of survey data.
- Where possible, all sampled specimens were identified to species level. When not possible, the specimens were classified into morphospecies and used in this report without their recognised scientific names or was designated to the nearest species with similar morphological features.
- Please note that the sampling period corresponded to the calendar month of February which is considered as an optimal time of the year to survey forest invertebrate species at the project area. However, extreme wet and cold conditions (accompanied by heavy rain and wind) prevailed during the survey period, even though it corresponding to the austral summer season, which may impose undesirable sampling results for terrestrial forest species such as millipedes. However, most of the nights provided favourable conditions for acoustic surveys to search for threatened katydid taxa.
- This company, the consultants and/or specialist investigators do not accept any responsibility for conclusions, suggestions, limitations and recommendations made in good faith, based on the information presented to them, obtained from the surveys or requests made to them at the time of this report.

4. RESULTS AND DISCUSSION

4.1 Annotations on invertebrate species of conservation concern (as per the screening tool results)

4.1.1 Arytropteris basalis (Flat-Necked Shieldback)

Arytropteris basalis is a katydid belonging to the Tettigoniinae (Tribe: Arytropteridini), where it was previously known from only nine localities during the 2014 conservation assessment (according to Bazelet and Naskrecki, 2020, amended version of the 2014 conservation assessment) corresponding to coastal forest mosaics in KwaZulu-Natal (KZN). It was last collected in 1982 (Bazelet and Naskrecki, 2020), with the type locality being Durban (Rentz, 1988). Recent observation of this species remains scant with a specimen observed during March 2022 at Chelmsfordville in Durban which is approximately 133km to the south of the project area (sensu iNaturalist). Another recent location refers to the Simbithi Eco-estate whereby a series of individuals was observed in forest habitat during November 2020 which is located 82 km south of the project area (pers. obs.).

Since its preferred habitat is geographically restricted (and since it is also endemic to KwaZulu-Natal (KZN) - from Durban northwards to Cape Vidal) its

habitat is under continuous threat due to cultivation (e.g. sugar cane), afforestation and urbanisation. Its conservation status is classified as globally Vulnerable under criteria [1ab(ii,iii)+2ab(ii,iii)]. In addition, its area of occupancy is small (ca. 32 km^2) and its known natural habitat only consists of 0.1 % of South Africa's surface area, which emphasises the threatened conservation status of this species.

It is distinguished from other members of the *Arytropteris* genus by its smaller size, the produced caudal margin of the pronotum, a black caudal margin to the tegmen (in males) and a stridulatory file with 70-100 teeth (Rentz, 1988). It is primarily a nocturnal, predacious and flightless species inhabiting the lower strata to the upper canopy of forest and wooded thickets, whereby it appears to be relatively easily collected when stridulating (pers. obs.).

4.1.2 The occurrence of Arytropteris basalis on the study site

A series of *A. cf. basalis* was collected from terrestrial habitat at night (see Figure 12 and Figure 13). It was fairly abundant and widespread in medium to tall forest habitat, with several stridulating males observed during the nocturnal surveys (acoustic recordings were also taken to be disseminated at a later stage to relevant taxonomists and expert specialists). Therefore, *Arytropteris cf. basalis* was **confirmed** from the project area (from four localities) and the terrestrial medium to tall coastal belt forest patches in the area appears to be important habitat for this threatened species.

It is recommended that the terrestrial medium to tall coastal belt forest patches be retained as a corridor for this species to maintain genetic cohesion with populations occurring to the north and the south of the project area. In addition, all suitable habitat (mainly terrestrial medium to tall coastal belt forest) of *Arytropteris cf. basalis* should be buffered by 50m (see Figure 13) and must be designated as sensitive habitat. The 50m buffer was chosen based on the surrounding habitat comprising mainly of *Eucalyptus* plantations which is not considered as optimal habitat for *A. basalis*. Buffer size (with emphasis on larger buffers) is most probably likely to remain indifferent due to the monotony of the surrounding habitat (being Eucalyptus plantations).

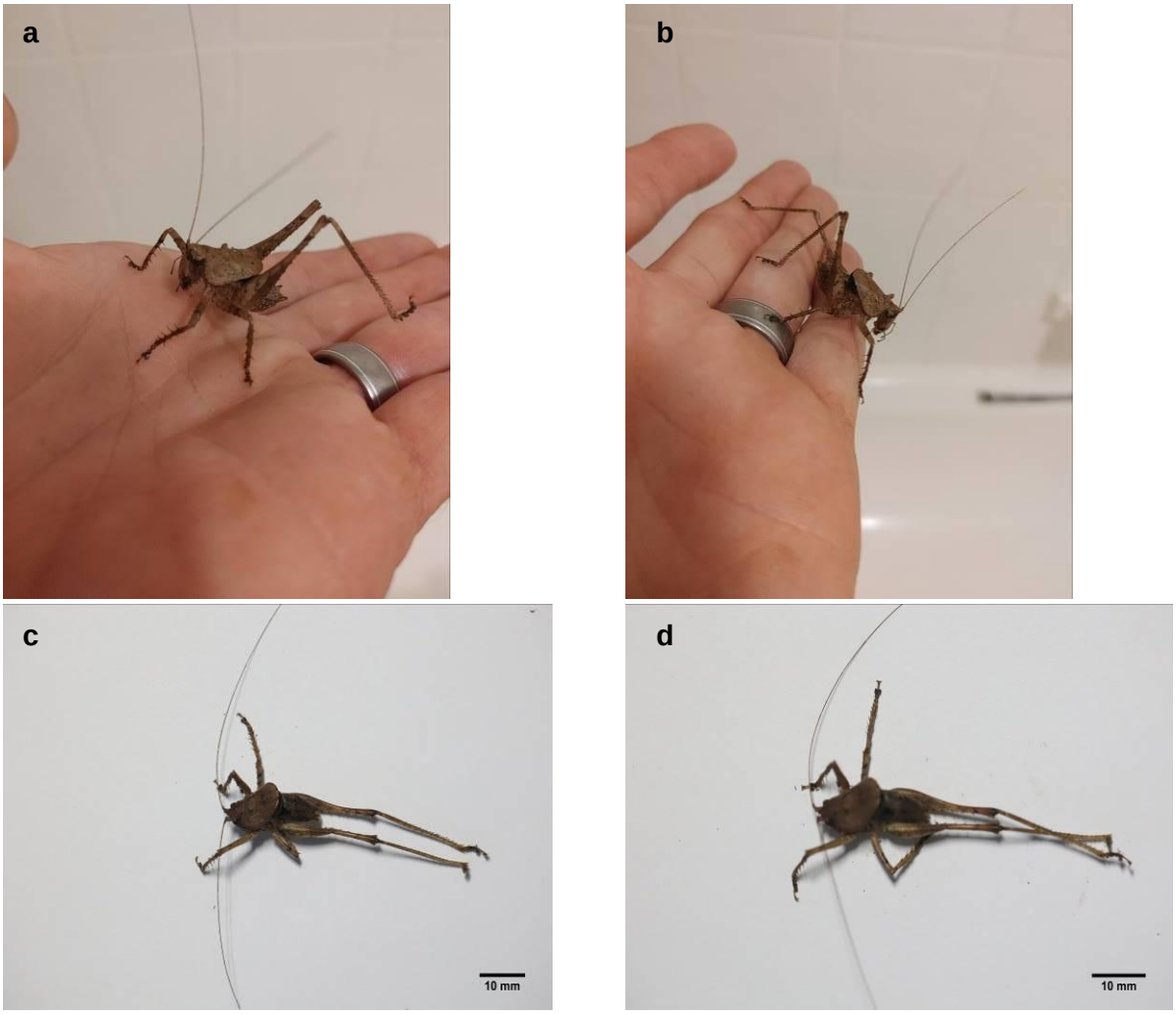


Figure 12: Images illustrating the morphological aspects of *Arytropteris cf. basalis* collected from the project area.

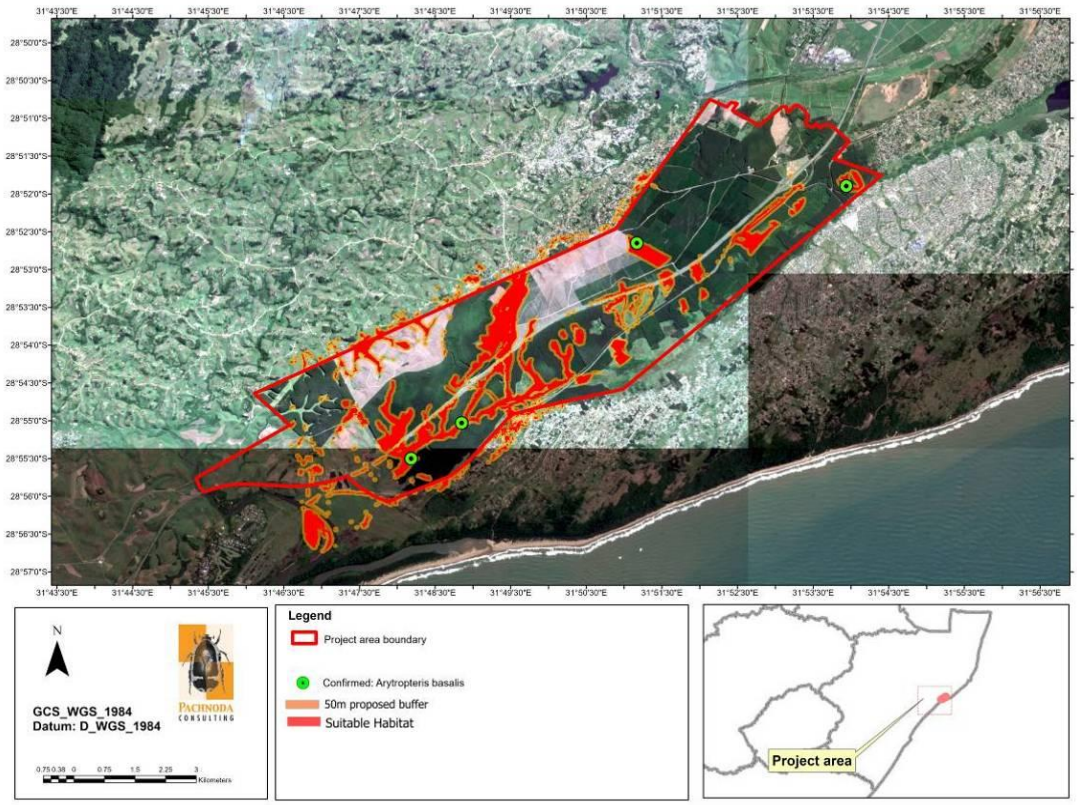


Figure 13: A satellite image of the project area illustrating the extent of occurrence of the globally vulnerable *Arytropteris cf. basalis* (Flat-necked Shieldback) and suitable habitat.

4.1.3 East Coast Katydid (East Coast Katydid)

Pomatonota dregeii is a katydid belonging to the Mecopodinae (Tribe: Pomatonotini), with the national population being severely fragmented owing to the loss of forest habitat and forest degradation (according to Bazelet and Naskrecki, 2014). The conservation status of *P. dregeii* is listed as globally Vulnerable [B1ab(iii,iv)] because its extent of occurrence is small (approx. 800km^2) corresponding to coastal forest in the Eastern Cape and KwaZulu-Natal provinces.

It is a distinctive species with a prominent dark line extending from the eyes across the lateral margin of the pronotum, and most specimens bear a characteristic yellowish line along the ventral margin of the wings (Figure 14). It feeds on a variety of tree species, with a preference for *Vachellia* and *Senegalia* species (Bazelet and Naskrecki, 2014).

4.1.4 The occurrence of Pomatonota dregeii on the study site

Pomatonota dregeii was not observed on the project area even after intensive nocturnal searching. However, it is possible that suitable habitat is present as provided by the terrestrial mid to tall coastal belt forest. It's absence during the site survey cannot be rules out based on the occurrence of suitable habitat since this species is often overlooked species. Therefore, it is of the opinion that the probability that this species could occur on the project area is **moderate**. The nearest recent documented locality of this species was at forest habitat near Yellow Wood Park in Durban (approx. 135 km south of the project area) during 2025 (sensu iNaturalist).

Figure 14: An example of *Pomatonota dregeii* photographed from the Silaka Nature Reserve near Port St. John's, Eastern Cape (photograph courtesy and the copyright of Piotr Naskrecki, Minden and Nature Picture Library).

4.1.5 Physophorina livingstonii (bladder grasshopper)

Physophorina livingstonii is a bladder grasshopper belonging to the Pneumoroidae, which is distributed along the east coast of Africa from Uganda to South Africa (according to Couldridge & Bazelet, 2018; Figure 15). Despite its widespread distribution, it has an estimated area of occupancy of which is likely to be below 500 km^2. The conservation status of *P. livingstonii* is listed as globally Endangered [B2ab(iii,v)] because the patchiness of its preferred habitat and it is likely to be extremely rare and declining in at least part of its range.

4.1.6 The occurrence of Physophorina livingstonii on the study site

Physophorina livingstonii was not observed on the project area even after intensive nocturnal searching. However, it is possible that suitable habitat is present (e.g. terrestrial mid to tall coastal belt forest) on the project area which cannot exclude the

absence of this species which is often overlooked. Therefore, it is of the opinion that the probability that this species could occur on the project area is **moderate**.

Figure 15: An example of *Physophorina livingstonii* (photograph courtesy www.orthoptera.speciesfile.org).

4.1.7 Deloneura millari millari (Millar's Buff) and Teriomima zuluana (Yellow Zulu Buff)

Both species are highly localised and occur in low densities throughout their distribution range. They are both highly specialised species that often occur on the tree stems of certain trees species (in particular *Vachellia* and *Senegalia* species for *D. millari*) whereby they are often associated with certain Stenorrhyncha coccids and cyanobacteria.

4.1.8 The occurrence of Deloneura millari millari (Millar's Buff) and Teriomima zuluana (Yellow Zulu Buff) on the study site

Teriomima zuluana is currently only known from a limited distribution range corresponding to the Makhatini Flats and from False Bay north to Kosi Bay and inland to Tembe Elephant Park. Therefore, the probability that this species could occur on the project area is **low**.

Deloneura millari millari has a distribution range that is sympatric with that of the project area, since it occurs from Port Alfred in the Eastern Cape northwards to the coastal belt of KwaZulu-Natal (KZN). Although not encountered during the survey, the mid- to tall coastal belt forest patches provide ephemeral foraging habitat for this species. Therefore, it is of the opinion that the probability that this species could occur on the project area is **moderate.**

4.1.9 Iolaus diametra natalica (Natal Yellow-banded Sapphire)

Iolaus diametra natalica has a fairly wide distribution range along the east coast of South Africa, where it is regarded as a rare species that occur at low densities. It breeds on *Actinanthella whyliei*.

4.1.10 The occurrence of Iolaus diametra natalica on the study site

Iolaus diametra natalica has been recorded in the Richard's Bay area from similar habitat corresponding to the edges of tall coastal belt forest (pers. comm). Therefore, it is of the opinion that the probability that this species could occur on the project area is **high.** It is likely to be associated with the medium to tall coastal belt forest patches on the project area. In addition, a total of 19 records of this species exists for the quarter degree grid cell that overlaps with the project area (sensu LepiMap, 2831DC) with the most recent records obtained during 2020. These emphases the high probability for this species to be present on the project area.

4.2 Forest floor sampling results (for millipedes and molluscs)[1]

4.2.1 Millipedes

Nine millipede morpho-types were recorded on the project area during the February survey (Table 2 and Figure 16). These correspond to terrestrial forest habitat, even though the observed millipede richness was considered to be of low-moderate richness and more taxa were expected. The main reason for the poor observed richness is probably an artefact of unfavourable environmental conditions and extreme wet and cold conditions (see section 3.3 above).

Centrobolus richardii was prominent and widespread in the forest leaf litter, and is regarded as a common species on the project area. The occurrence of both *Centrobolus richardi* and *C. sp. nr fulgidus* is considered to be significant since both these species are considered to be narrow-endemic taxa to the KZN coastal region which is vulnerable towards habitat loss and habitat degradation.

[1] The collected specimens are pending determination (identification) from experts from high resolution images. However, it is often difficult to obtain species-level identifications and in most instances dissection of the genitalia is required to acquire positive identification which were not possible during the compilation of the report. The specimens will be donated to taxonomic experts for further determination at a later stage.

Table 2: An inventory of millipede taxa recorded on the project area during February 2023.

Taxa	Quadrate																	Frequency of occurrence
	1A	1B	2A	2B	3A	4A	5A	6A	7A	8A	9A	10A	11A	12A	13A	14A	15A	
Orthoporoides cf. corrugatus	1																	1
Centrobolus cf..*richardi*	1								3	6				1	1	1		6
cf. Orthoporus sp.		1																1
cf. Ulodesmus cf. biconus.		3																1
Spinotarsus cf. *anguliferus*				5										3				2
Sphaerotherium sp. "giganteum"	1																	1
Sphaerotherium sp.1				1														1
Centrobolus cf. fulgidus				1											1			2
Sphaerotherium cf. *dorsale*																		0
Number of species	**3**	**4**	**0**	**7**	**0**	**0**	**0**	**0**	**3**	**6**	**0**	**0**	**0**	**4**	**2**	**1**	**0**	

Spinotarsus cf. *anguliferus*

cf. Ulodesmus cf. biconus.

Orthoporoides cf. corrugatus

cf. Orthoporus sp.

Centrobolus cf. *richardi*

Sphaerotherium cf. *dorsale*

Sphaerotherium sp.1

Sphaerotherium sp. "giganteum"

Figure 16: Examples of millipede taxa observed on the project area.

4.2.2 Molluscs

Six mollusc taxa were recorded from the forest habitat (mainly terrestrial forest) on the project area represented by *Kerkophorus cf. vitttarubra*, *Cochlitoma cf. granulata*, cf. *Sheldonia* sp., cf. *Laevicaulis natalensis*, cf. *Elisolimax flavescens* and *cf. Chlamydephorus sp.* (Figure 17). These taxa are relatively widespread and are not threatened or near threatened.

Kerkophorus cf. vitttarubra

Cochlitoma cf. granulata

cf. Sheldonia sp.

cf. Laevicaulis natalensis

cf. Elisolimax flavescens (colour morph)

cf. Elisolimax flavescens.

cf. Chlamydephorus sp.

Figure 17: Examples of mollusc taxa observed on the project area.

4.3 Site Ecological Importance

The Site Ecological Importance will follow the methods described in the species protocol guideline (SANBI, 2020). It is a “standardised" metric which take into account the biodiversity importance of a particular habitat and its resilience to impacts. The biodiversity importance of an area is again a function of the Conservation Importance and the Functional Integrity of a particular habitat, whereby the Conservation Importance is evaluated in accordance with recognised established internationally acceptable principles and criteria for the determination of biodiversity-

related values (as per the IUCN criteria; please refer to the SANBI species protocol guideline for more information, SANBI, 2020).

The SEI was evaluated for each of the natural broad-scale habitat units on the project area (Figure 18) as per the species protocol guidelines, and the results are presented in Table 3. It is evident that most of the untransformed and tall to medium forested habitat units have a high to very high site ecological importance.

4.3.1 Buffers

Section 4.1.2 provides a conspectus of buffer widths (50m) applied to suitable habitat where *Arytropteris cf. basalis* could occur, including localities where it was confirmed during the 2023 surveys (Figure 13).

Table 3: An evaluation of Site Ecological Importance (SEI) of invertebrate habitat units in the project area. BI = Biodiversity Importance.

Habitat	Conservation Importance	Functional Integrity	Receptor Resilience	Site Ecological Importance
Secondary coastal belt forest & savanna	Low - No confirmed or highly likely populations of Species of Conservation Concern	Low - Almost no habitat connectivity but dispersal still possible	Medium - Will recover slowly (~more than 10 years) to restore > 75 % of the original species composition and functionality	Medium (BI = Low)
Transformed Eucalyptus plantations	Low - No confirmed or highly likely populations of Species of Conservation Concern	Low - Almost no habitat connectivity but migrations still possible across some modified natural habitat	Low - Habitat will recover very slowly because it is in a degraded state	Very Low (BI = Low)
Terrestrial Forest (mid- to tall coastal belt forest)	High - Confirmed or highly likely occurrence of VU species (*Arytropteris basalis*).	Very High - High habitat connectivity serving as functional ecological corridors	Medium - Will recover slowly (~more than 10 years) to restore > 75 % of the original species composition and functionality	Very High (BI = Very High)
Swamp Forest	High - Confirmed or highly likely occurrence of VU species (*Arytropteris basalis*) that have a global Extent of Occurrence of > 10 km².	Very High - High habitat connectivity serving as functional ecological corridors	Medium - Will recover slowly (~more than 10 years) to restore > 75 % of the original species composition and functionality	Very High (BI = Very High)
Wetlands and open water	Low - No confirmed or highly likely populations of Species of Conservation Concern	Medium - Only narrow corridors of good habitat connectivity or larger areas of poor habitat connectivity for terrestrial taxa	Medium - Will recover slowly (~more than 10 years) to restore > 75 % of the original species composition and functionality	Low (BI = Low)

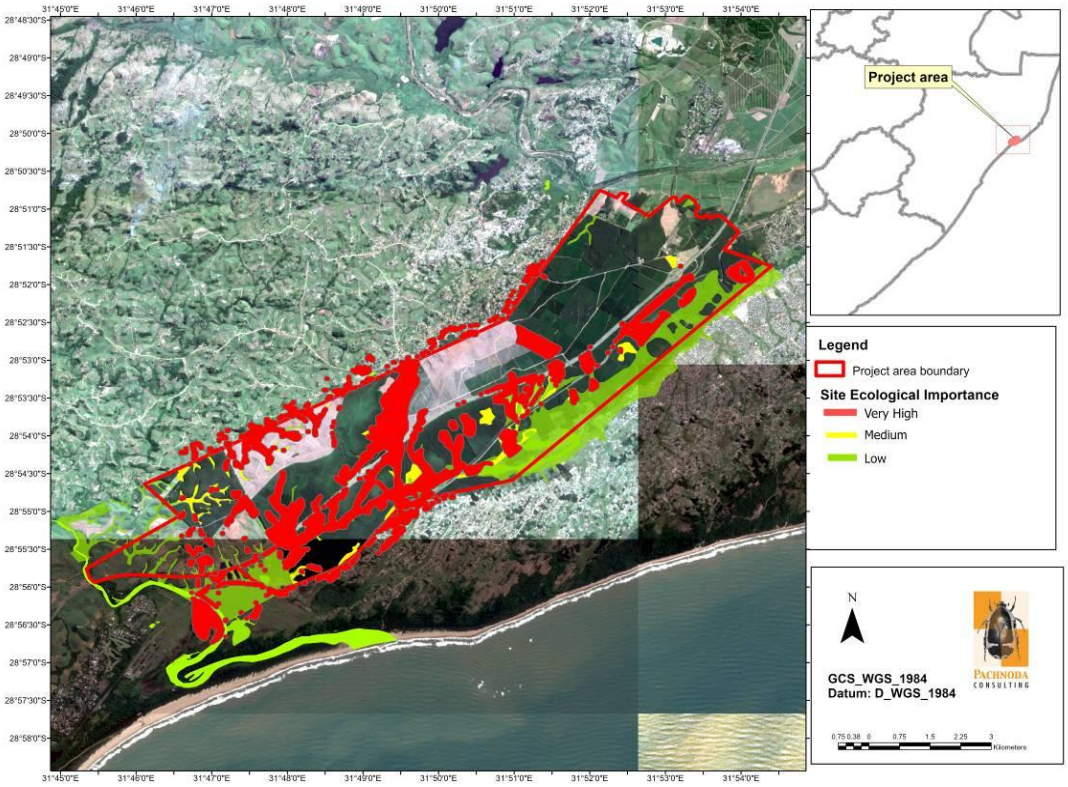


Figure 18: Site Ecological Importance (SEI) of invertebrate habitat units in relation to the project area (the remaining transformed habitat consisting of *Eucalyptus* plantations have a very low SEI).

4.4 Impacts and Proposed Recommendations

The project consists of three distinct stages, of which there are two phases of mining development. The intended assessment will be undertaken for the following stages of the project (Figure 19 and Figure 20):

- Phase 1 – Operation;
  - Mining of small surface area (block 2025)
  - Site establishment/Construction of infrastructure for Phase 2

- Phase 2 – Operation;
  - Full scale mining (full extent as indicated in Figure 19)
  - On site processing (Primary Wet Plant)
  - Backfilling
  - Waste management (Residual Storage Facility)

- Decommissioning and Closure.
  - Topsoil redistribution and rehabilitation.

Please note that these stages are combined in the impact assessment according to the following reasons:

- The construction and operation phases are expected to have the same impacts on the invertebrate taxa of conservation concern, thereby resulting in the loss of habitat and displacement of taxa.
- The impacts associated with the decommission phase are also similar to the construction and operation (impacts associated with earthworks during rehabilitation are similar in most respects to that of mining activities);
- There are no phase-specific mitigation measures to avoid/minimise impacts. Therefore, a single suit of management guidelines will be included in the management plan for all phases.

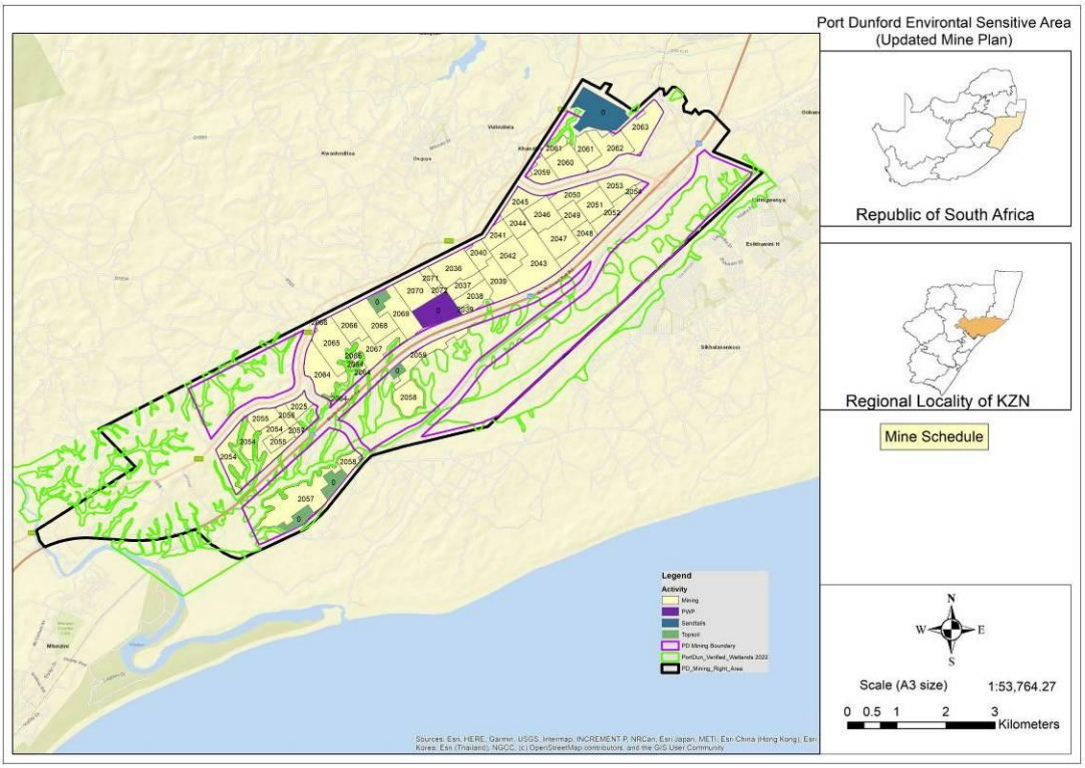
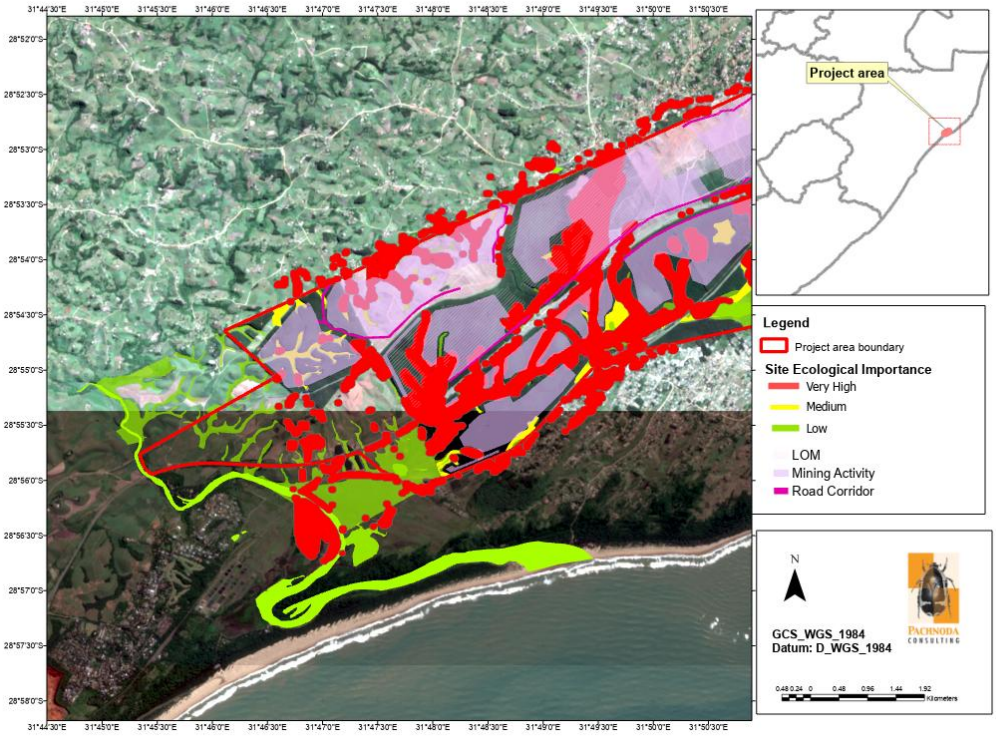
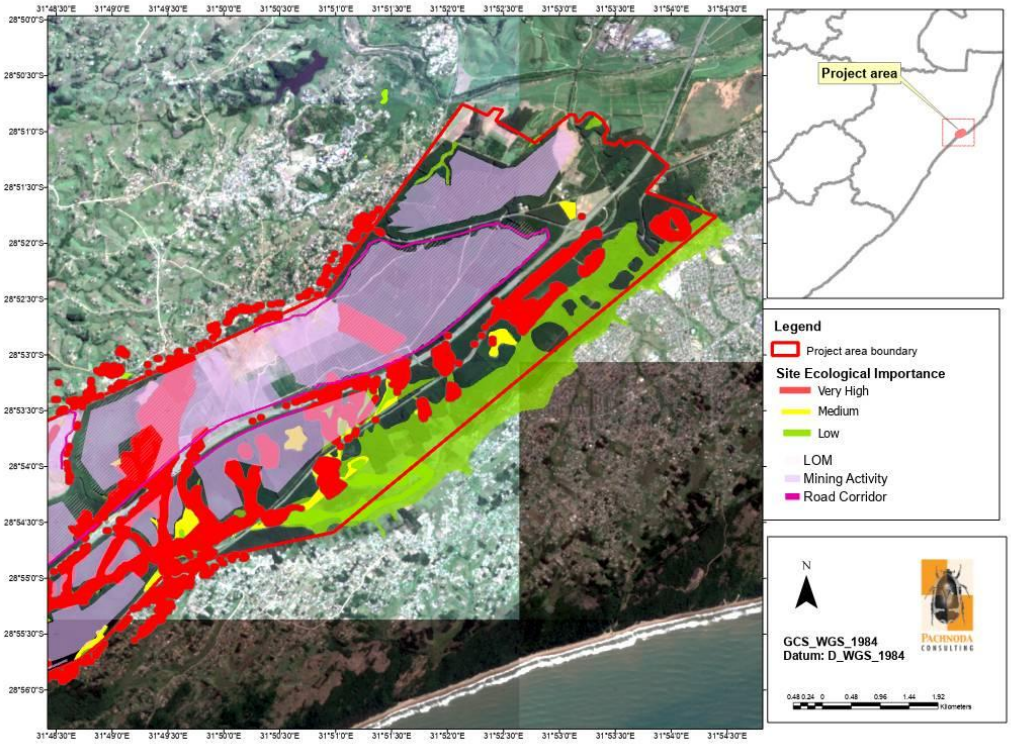


Figure 19: The mine schedule and related activities on the project area.

Impacts are summarised in Table 4 below.



(a) Western Extent



(b) Eastern Extent

Figure 20: The proposed mine layout in relation to the Site Ecological Importance for invertebrate taxa on the (a) western extent and (b) eastern extent of the project area.

Table 4: Impact assessment significance rating table for Phases 1 and 2.

ACTIVITY whether listed or not listed	POTENTIAL IMPACT	ASPECTS AFFECTED	PHASE in which impact is anticipated	Size and Scale of Disturbance	Magnitude	Duration	Physical Extent	Probability	Reversibility	Significance	Significance wihtout Mitigation	Magnitude	Duration	Scale	Probability	Reversibility	Significance	Significance with Mitigation	Detailed Mitigation Measures	Mitigation Type	Standards to be Achieved
Vegetation clearing, construction of infrastructure, excavation, stockpiling and dumping	Loss of habitat and loss and displacement of invertebrate species of conservation concern	Natural Habitat	Phase 1	All mining activities	2	3	1	3	3	27	Low	2	3	1	3	3	27	Low	See Section 4.4.1 – 4.4.4	Apply " best practice" mitigation & prevent overspill of mining activities into natural habitat	Avoid the loss of Sensitive/Very High/High SEI habitat

Vegetation clearing, construction of infrastructure, excavation, stockpiling and dumping	Loss of habitat and loss and displacement of invertebrate species of conservation concern	Natural Habitat: Med- to tall coastal belt forest	Phase 2	All mining activities	5	5	1	5	5	80	High	4	5	1	5	5	75	High	See Section 4.4.1 – 4.4.4	Avoidance	Avoid the loss of Sensitive/Very High/High SEI habitat
Clearing of vegetation and physical mining procedures	Loss of ecological connectivity and subsequent loss of dispersal (resulting genetic isolation, fragmentation and sink meta-populations)	Natural Habitat: Med- to tall coastal belt	Phase 2	Terrestrial forest habitat	4	5	2	4	5	64	High	4	5	2	4	5	64	High	See Section 4.4.1 – 4.4.4	Avoidance, minimise	Maintain ecological connectivity and natural forest corridors - not only wetlands but also terrestrial forest corridors

Mining operations, hauling of material and noise generation	Disorientation of invertebrates, poor intra-specific communication and displacement during vibrations	Disturbances caused by noise, vibration and air pollution	Phase 1 & 2	Mainly terrestrial forest habitat	4	4	1	3	2	33	Medium	3	4	1	3	2	30	Low	See Section 4.4.1 – 4.4.4	Minimise	Reduce noise and vibrations to acceptable levels; implement best practice guidelines
Job-seeking population and "urbanization"	Illegal utilisation of resources and displacement of invertebrate species of concern	Natural habitat	Phase 1 & 2	Mainly terrestrial forest habitat	4	4	2	3	5	45	Medium	3	3	2	3	3	33	Low	See Section 4.4.1 – 4.4.4	Minimise	Prevent illegal "squatting" by applying access control to the area

4.4.1 Loss of habitat and loss/displacement of invertebrate species of conservation concern

The proposed mining of sand and ancillary activities during Phase 2 will result in the loss and clearing of approximately 146.07 ha of terrestrial forest habitat, which were identified as habitat with a Very High SEI. This habitat includes medium to tall coastal belt forest consisting of a very high SEI. This loss of habitat equals to approximately 25% of Very High SEI habitat (without any buffers applied). With the recommended 50m buffer applied, the loss of Very high habitat will be approximately 339.575 ha of forest habitat

The impact caused by mining and the loss of forest habitat will be of high significance on habitat with high or very high sensitivities. The loss of these habitat units will result in the associated loss of invertebrate taxa, which are in general less mobile than other taxonomic groups (e.g. mammals and birds), which are invariably habitat specific (e.g. *Arytropteris basalis*). This habitat, even though only a small percentage are represented on the project area, are the only remaining intact forest habitat in the area. The only option within the mitigation hierarchy that could reduce the impact significance would be Avoidance, which would reduce the impact significance to Medium-High.

Recommended Mitigation measures

No plausible mitigation is possible to prevent the direct loss of habitat and subsequent loss and/or displacement of invertebrate species of conservation concern. The only viable option within the Mitigation Hierarchy is Avoidance. Applying the Minimize option would be in conflict with the KZN Conservation Plan, since mining could disrupt an integral terrestrial forest corridor linking similar forest types between Richard's Bay in the north with Mtunzini in the south. Offsets are often proposed as a mitigation measure, but this option will only be viable adjacent or nearby relevant habitat inclusive of the relevant SCCs is available for purchase for formal conservation.

Please note that the applicant/client proposes the implementation of a "corridor offset" which will include the retainment of some of the existing forest habitat but also the rehabilitation of post-mined habitat to reinstate natural forest habitat (see Figure 21). However, the impacts associated with the loss of habitat and displacement of invertebrate taxa of conservation concern as assessed in this document will remain unchanged until the feasibility of the proposed "corridor offset and rehabilitation plan" is "tested" during detailed specialist investigations and by means of input from local conservation authorities **prior to the commencement of mining**. If deemed achievable according to results obtained from pre-mining specialist studies and surveys, in conjunction with dedicated long-term management approval, such an undertaking could potentially benefit invertebrate taxa of conservation concern in the area, including ecological connectivity along natural forest corridors.

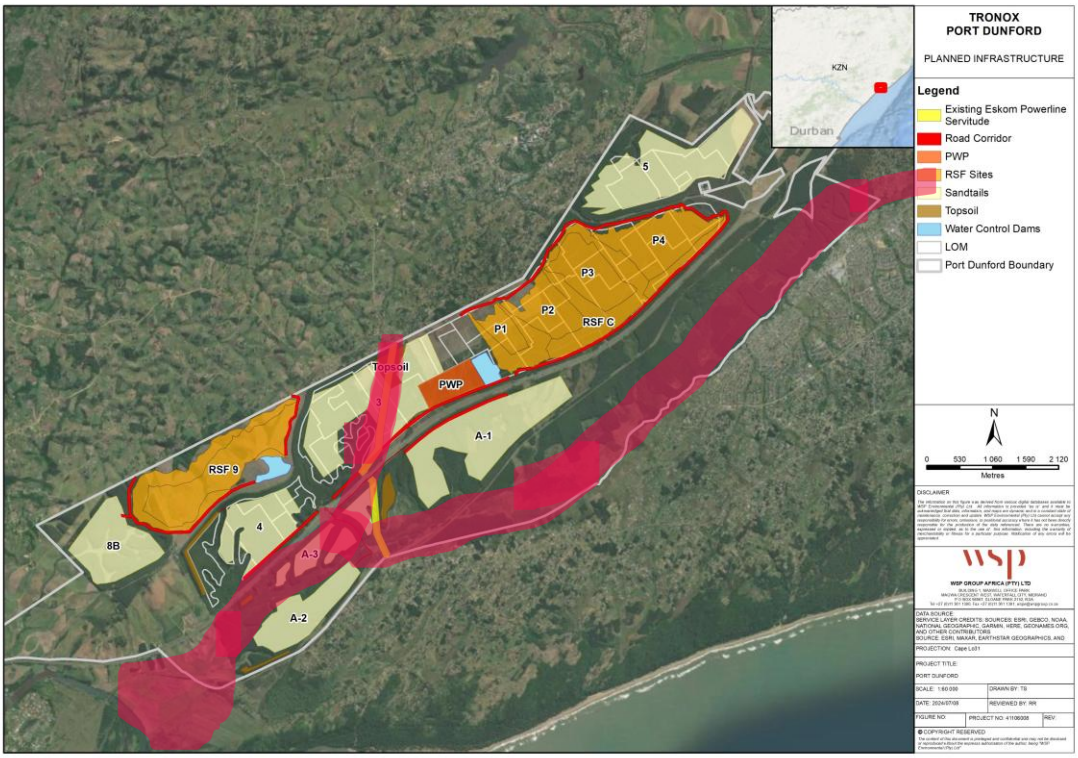


Figure 21: The proposed "corridor offset and rehabilitation" plan which will require detailed specialist research and scientific input prior to the commencement of mining.

4.4.2 Disruption of ecological connectivity and invertebrate dispersal

Mining activities and mine expansion are anticipated in the project area, whereby such activities will aggravate fragmentation and the disruption of natural ecological corridors in the area (see discussions above), thereby impeding the dispersal and genetic cohesion of invertebrate sub-populations of the same species, as well as the potential for re-colonisation and recruitment of taxa to the project area during rehabilitation. It is especially sub-populations of habitat specialists and apterous (wingless) taxa such as *Arytropteris basalis*, millipedes and land snails that are at risk of becoming fragmented if natural connectivity is disrupted. It is especially forest patches located on the north-central section and north of the N2 highway of the project area that will be affected by mining operations. Many of these species are slow moving or wingless, and therefore poor dispersers. The pre-mitigation significance of the impact is assessed as High.

Recommended Mitigation measures

No plausible mitigation is possible to prevent the direct loss of habitat and subsequent loss and/or displacement of invertebrate species of conservation concern. The only viable option within the Mitigation Hierarchy is Avoidance. However, the following mitigation measures are recommended:

- Ensure that construction and mining activities do not overspill onto adjacent natural habitat in order to provide displaced invertebrate taxa the opportunity to disperse into suitable habitat (although potential dispersal by apterous and stenotopic taxa is highly limited).
- Access to the mining areas should be controlled by fencing. The practice of excavating trenches as a form of access control should be prohibited as such trenches act as 'pitfall and death traps' and barrier to dispersal of less mobile invertebrates and are regarded as an unnecessary and severe impact to such fauna occurring within the project area and its immediate surrounds. This recommendation should be included in the EMP.
- Minimize the area to be cleared during construction activities. This includes the area used by personnel and labour during construction activities.
- Retain and or maintain all natural forest habitat within the project area to counter negative edge effects along the corridor. In addition, all linear features (e.g. drainage lines and wetlands) must be retained irrespective of their floristic condition or composition to facilitate the movement of entomofauna when a high rate of natural disruption is expected.

4.4.3 Illegal utilization of resources and potential "urbanization"

Although there is currently no restriction on the local community to access the area, it is possible that mining activities could elevate the influx of people to the area with the increased risk of illegal utilization of natural resources, such the collection of firewood resulting in deforestation resulting in a change to the floristic structure of the coastal habitat units.

In addition, the project may also result in increased utilisation of natural resources due to potential human encroachment and accessibility to the project area owing to people seeking jobs. This could result in settlement encroachment in areas consisting of natural habitat on the project area where active mining is absent. The pre-mitigation significance of the impact is assessed as Medium. Implementation of the measures recommended below could reduce the significance to Low.

Recommended Mitigation measures

- Contractors and labour should be accommodated off-site (in order words NOT on the project area), reducing the risk of illegal harvesting of natural resources. This recommendation should be included in the EMP.
- Labour supervisors and SHE officials should monitor the activities of labourers when working away from infrastructure in natural habitat.
- Personnel and staff should be advised by means of environmental awareness training on the biodiversity importance of the area. The intentional killing of any faunal species, in particular invertebrates should

be avoided by means of awareness programmes presented to the labour force. The labour force should be made aware of conservation issues pertaining to the taxa occurring on the project area.

4.4.4 Disturbances caused by noise, vibration and air pollution and displacement during operation

The proposed mining operations are expected to increase noise and vibrations, while air pollution resulting from truck and shovel mining could lead to increased combustion and evaporation of exposed hydrocarbons. These impacts are reproduced through air and ground and may result in the disorientation of invertebrates. The impact will be particularly higher for less mobile species or taxa with low intrinsic mobility (whereby fragmentation could lower the long-term viability of such populations and result in genetic "bottlenecks"), including species that are habitat specific (e.g. with high terrestrial forest affinities) and disperse seasonally from the coastal escarpment down towards the coastal plain. In addition, noise pollution, especially at night, could also interfere with invertebrate communication such as stridulating males of *Arytropteris basalis* and making it difficult for females to locate partners.

Road mortalities could occur during the hauling of material owing to oncoming traffic of small-bodied and low-flying invertebrates, which pose a higher risk than for large-bodied or high-flying taxa.

Poorly constructed, or designed, storm water infrastructure not only facilitates erosion, but the excess run-off may initiate changes to the floristic composition along mined areas and roads. Therefore, storm water run-off into the surrounding vegetation is likely to alter the vegetation structure and composition, which could also elicit "barrier" effects for dispersing invertebrates.

Recommended Mitigation measures

- Assist with a strategy and develop an adaptive management guideline for veld management (and burning – where applicable) practices in the area with the intent to optimise the ecological condition of remaining natural habitat units within the project area. Typical examples would include the development of a comprehensive and practical Veld Management Plan Plan.

- In most instances the mining of *Eucalyptus* forests will return to plantations after mining. However, it is recommended that mined land that was originally covered by natural vegetation be rehabilitated making use of indigenous plant species (as opposed to *Eucalyptus* plantations), and preferably of species native to the project area and immediate surroundings. The plant species selected should strive to represent habitat types typical of the ecological landscape prior to construction.

- If any invertebrate SCC (as indicated in this report) are encountered during the construction/mining phase, the ECO shall be informed, who shall then issue instructions for its capture, translocation and safe release to nearby suitable habitat with the relevant permits obtained from the authority. This recommendation should be included in the EMP.

- It is assumed that generated waste will be disposed at registered offsite facilities. However, waste generated (especially domestic waste) during construction and mining operations should be removed as soon as possible to reduce the risk of colonization by feral mammals, scavengers or competitively superior faunal species (e.g. Pied Crows *Corvus albus*) which may prey on the native invertebrate population.

- Minimize outside/security lighting at relevant infrastructure. Outside lighting should be replaced with bulbs of longer wave lengths (550nm), for example low-pressure yellow sodium vapour bulbs or yellow LEDs. Where possible, outside lighting should not make use of fluorescent lights since these emit significant amounts of UV which will attract invertebrates. Apply UV filters to high pressure mercury vapour lamps as an alternative to yellow sodium lamps. In addition, lights should be directed downwards, and internal lights should be shielded by blinds/curtains.

4.5 Cumulative Impacts

The following projects/mining operations were considered as being relevant for the inclusion of evaluation of cumulative impacts (these are approved or in progress of obtaining authorisation, refer Figure 22):

- Current Tronox Fairbreeze mine (will conclude its life of mine in 2037).

- Tronox Hillendale Mine (currently in closure phase).
- Richards Bay Minerals – Zulti South project.
- Adjacent mining leases for heavy mineral sands (status of these and details remaining to be confirmed) – to SW, south and west of the project area:

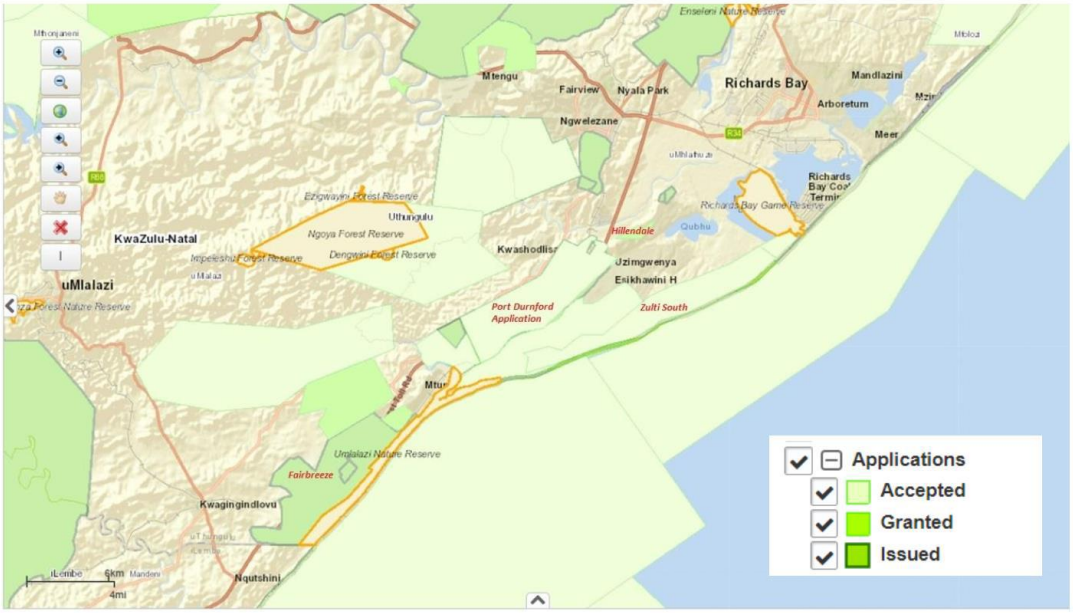


Figure 22: Relevant projects and mine operations in close proximity to the project area (DFFE Screening Tool, 2024).

Cumulative impacts are defined as impacts that result from additional or incremental activities caused by past or present actions together with the current project. Therefore, cumulative impacts are those that will affect the general invertebrate community on the project area due to other planned mined projects in the region.

When considering that that most of the coastal belt forests are already highly fragmented and, in a sense, also patchy, additional fragmentation of these habitat units will increase the disruption of one of the KZN Landscape Corridors (Ezemvelo KZN Wildlife, 2010) which traverses the central and western extent of the project area (Figure 23). Currently, the terrestrial forest units on the project area are the only main dispersal route and “stepping stones” for many faunal taxa along these corridors, but also provides and extension along the coastal corridor between Richard’s Bay and Mtunzini. Therefore, the mining of these corridors will impede on the extant distribution ranges of many invertebrate species, especially forest-dependant species, which may even result in the local extinction of certain species that are less mobile due to genetic isolation.

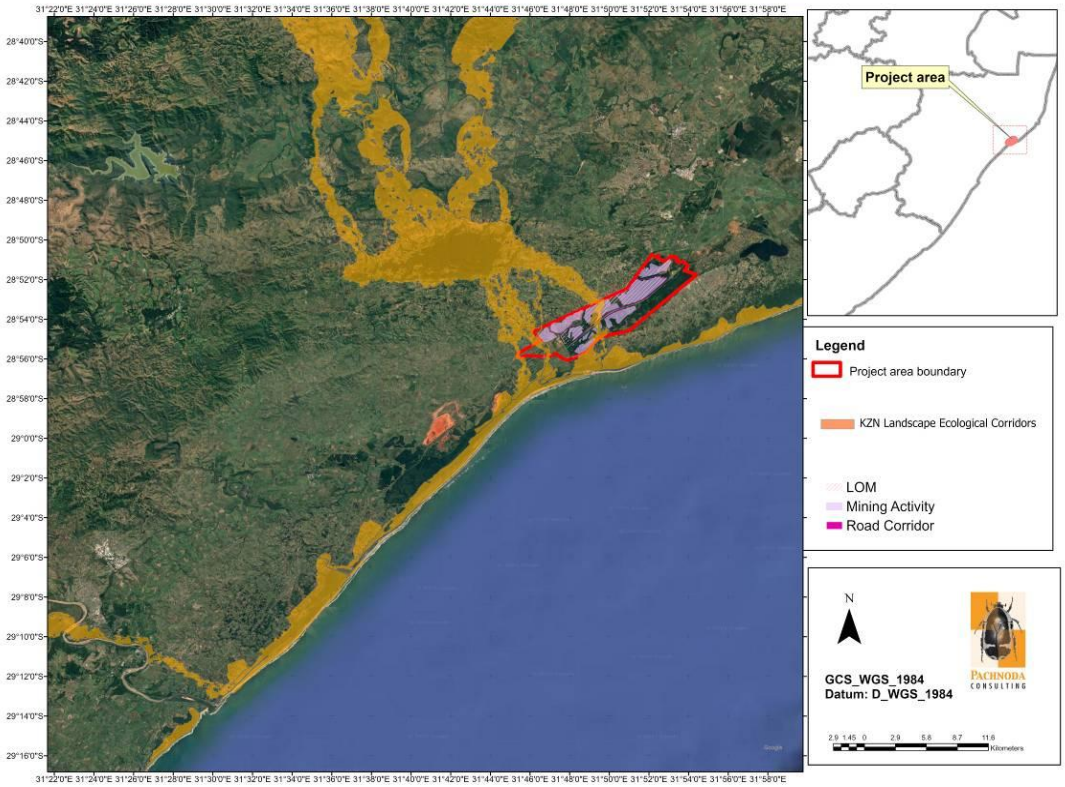


Figure 23: The proposed KZN landscape ecological corridors located within the project area and surroundings (Ezemvelo KZN Wildlife, 2010).

However, the applicant/client proposes the implementation of a “corridor offset and rehabilitation plan” which will include the retainment of some of the existing forest habitat but also the rehabilitation of post-mined habitat to reinstate natural forest habitat. Please note that the cumulative impacts associated with the loss of habitat as assessed in this document will remain unchanged until the feasibility of the proposed “corridor offset and rehabilitation plan” is “tested” during detailed specialist investigations and by means of input from local conservation authorities **prior to the commencement of mining**. If deemed achievable according to results obtained from pre-mining specialist studies and surveys, along with the approval from conservation authorities, such an undertaking could potentially preserve at least some of the remaining ecological corridors in the region (Figure 24).

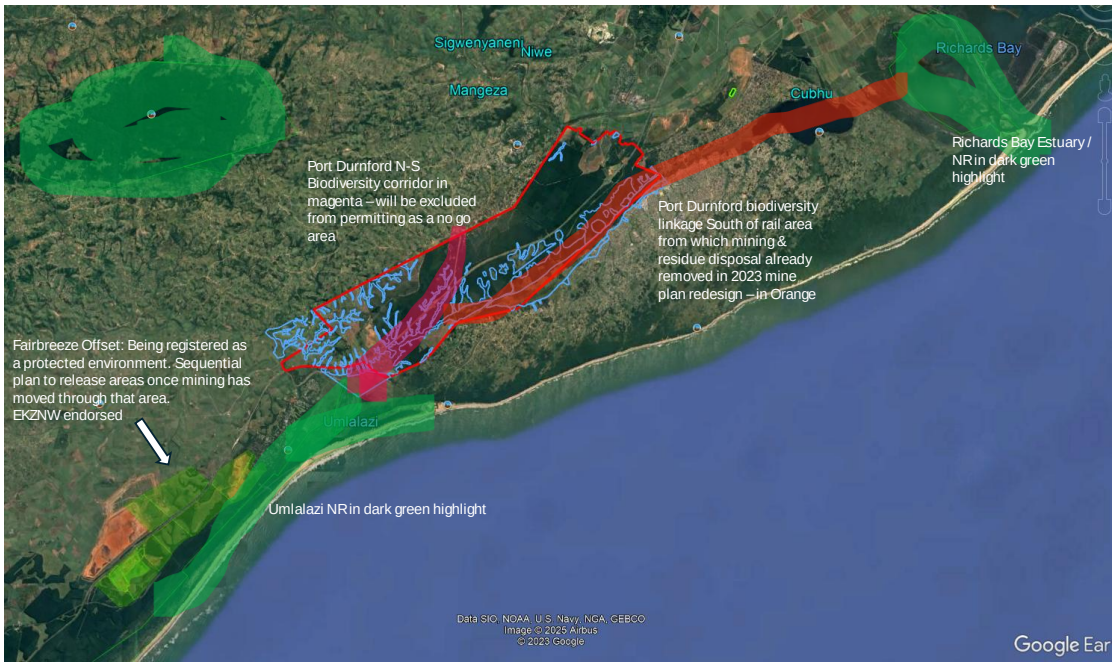


Figure 24: The proposed "corridor offset and rehabilitation" plan which will require detailed specialist research and scientific input prior to the commencement of mining – landscape perspective.

The cumulative impacts are summarised in Table 5 below.

Table 5: Cumulative impact assessment significance rating table.

ACTIVITY whether listed or not listed	POTENTIAL IMPACT	ASPECTS AFFECTED	PHASE in which impact is anticipated	Size and Scale of Disturbance	Magnitude	Duration	Physical Extent	Probability	Reversibility	Significance	Significance wihtout Mitigation	Magnitude	Duration	Scale	Probability	Reversibility	Significance	Significance with Mitigation	Detailed Mitigation Measures	Mitigation Type	Standards to be Achieved
Vegetation clearing, construction of infrastructure, excavation, stockpiling and dumping	Loss of habitat and loss and displacement of invertebrate species of conservation concern	Natural Habitat: coastal belt forest	Phase 1 & 2	All mining activities	5	5	3	5	5	90	High	4	5	3	5	5	85	High	n/a	n/a	n/a

Clearing of vegetation and physical mining procedures	Loss of ecological connectivity and subsequent loss of dispersal (resulting genetic isolation, fragmentation and sink meta-populations)	Natural Habitat: along the coastal littoral	Phase 1 & 2	Mainly terrestrial forest habitat	5	5	3	4	5	72	High	4	5	3	4	5	68	High	n/a	n/a	n/a
Potential increase in population and "urbanization" of the wider area	Illegal utilisation of resources and displacement of invertebrate species of concern	Natural habitat	Phase 1 & 2	Mainly terrestrial forest habitat	4	5	3	3	5	51	Medium	4	5	2	3	5	48	Medium	n/a	n/a	n/a

5. CONCLUSION

The project area comprised of a diversity of habitat types located within the Maputaland Coastal Belt. Although many of these forest habitat units appeared pertubated by past anthropogenic activities and afforestation by timber plantations, it was regarded as a critical important habitat for invertebrate SCC and also act as “stepping stones” for invertebrate sub-populations along the coastal littoral and inland habitat as presented by the KZN landscape ecological corridors (Ezemvelo KZN Wildlife, 2010). Disruption of the terrestriaal forest units located within the project area will most definitely result in changes in the distribution ranges of species that are confined or restricted.

In addition, the project area was also evaluated in terms of its potential to provide habitat for a series of invertebrate species of conservation concern. Surveys found that the mid- to tall forest remnants sustained a healthy population of the Vulnerable katydid *Arytropteris basalis* while the potential occurrence for *Iolaus diametra natalica* was found to be high. All mid to tall forest remnants were identified with a Very High SEI in accordance with the Species Environmental Assessment Guidelines (SANBI, 2020).

Avoidance mitigation is required for all habitat of a Very High SEI of which it is anticipated, based on the current mine layout, that the mining infrastructure will overlap with 25 % of Very High SEI habitat. Although a suite of mitigation measures was proposed to minimize various anticipated impacts for which many are more likely to be costly or ineffective, the most practicable means and risk averse approach to avoid disturbance or transformation of the terrestrial forested environments is a re-evaluation of the layout of the proposed mining plan to avoid habitat with a Very High SEI.

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APPENDIX 1: CV OF SPECIALIST.

Name:	**LUKAS JURIE NIEMAND**
Company:	Pachnoda Consulting cc (Director)
Date of Birth:	1974-03-12
Nationality:	South African
Languages:	English and Afrikaans

EDUCATIONAL QUALIFICATIONS

1992	Hoërskool Hartbeespoort, Hartbeespoort - Senior Certificate.
1996	University of Pretoria, Pretoria - B.Sc. (Zoology and Entomology).
1997	University of Pretoria, Pretoria - B.Sc. (Hons) (Entomology).
2001	University of Pretoria, Pretoria - M.Sc. (Restoration Ecology/Zoology).

MEMBERSHIP IN PROFESSIONAL SOCIETY

- Professional Natural Scientist (Pr. Sci. Nat.) (Reg. no. 400095/06)
- BirdLife South Africa
- Hartbeespoort Natural Heritage Society

EXPERIENCE

A. Work conducted in South Africa

1. General Ecological Assessments:

- Belvedere Trust, Proposed retirement village on Amorosa Agricultural Holdings, Roodepoort, Gauteng (2004);
- City of Joburg Property Development Company, Proposed upgrade and development of the Orlando Dam Intersection, Soweto, Gauteng (2004);
- PDNA, Proposed NASREC development, Johannesburg, Gauteng (2004);
- 17 Shaft Conference and Education Centre, Proposed establishment of the Veteran's Heritage Education Centre, Crown Mines, Gauteng (2004);
- GAUTRANS, Proposed re-alignment of Road D781 and construction of a road bridge over the Rietvleispruit, Kempton Park, Gauteng (2004);
- Mr. N. Lang, Ecological Opinion on the proposed establishment of a township, Muldersdrift, Gauteng (2004);
- AGES, Proposed Equestrian Centre, Leeufontein 299 IR, Gauteng (2004);
- PDNA, Proposed new bridge and re-alignment of a portion of provincial road P101-2 (R51), Laversburg, Gauteng (2004);
- Blenneerville Investment (Pty) Ltd, Proposed construction of a residential and commercial development on of Paradiso Estate, Tweefontein 372 JR, Gauteng (2004);
- Les Roches (Pty) Ltd, Proposed zoning of holdings 1, 2 & 3 of Hyde Park Agricultural Holdings, Gauteng (2004);

- Transnet Limited, Terrestrial Faunal Ecological Opinion: Phase 1B expansion of the Sishen-Saldanha Iron ore export corridor, Saldanha Bay, Western Cape (2005);
- Celebration North Riding (Pty) Ltd, Proposed mixed land-use development, North Riding, Gauteng (2005);
- Wilderness Safaris, Proposed upgrade of the Manzengwenya Dive Camp, Greater St. Lucia Wetlands Park, KwaZulu-Natal (2005);
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- GAEA Projects, Corridor Assessment for the proposed Sibaya Precinct, KwaZulu-Natal (2005);
- Computer Domain Holdings (Pty) Ltd, Red Data Floral Scan on portion 3 of the farm Elandshoek, portions 12 & 27 of the farm Groot Suikerboschkop, and portions 5 & 10 of the farm Palmietfontein, Dullstroom (2005);
- Zong's Property Investments, Proposed establishment of a residential development on a portion of Pomona Estates Agricultural Holdings, Pomona, Gauteng (2005);
- GJ van Zyl Trust, Proposed development of a resort on the Farm Witpoort 216 JS, Mpumalanga (2005);
- Mr. Howard Walker, Proposed subdivision of the Farm Lunsklip 105 JT, and the Farm Morgenzon 122 JT, for the establishment of a private resort, Dullstroom, Mpumalanga (2005);
- Lavender Manor cc, Proposed establishment of a retail, commercial and Lavender Manor Township on part of farm Rietfontein 189 IQ, Muldersdrift, Gauteng (2005);
- Geo Pollution Technologies, Proposed establishment of a residential development: Noordwyk Ext 65 & 80 on Erand Agricultural Holdings, Midrand, Gauteng (2005);
- Mr. A. Le Roux, Proposed Cradle View Country Estate, Muldersdrift, Gauteng (2006);
- Viking Bay Development Company (Pty) Ltd, Proposed Viking Bay freshwater marina and hotel development, Vaal Dam, Gauteng (2006);
- Land for Africa (Pty) Ltd, Ecological Opinion for the proposed establishment of a residential township on holding 122 Erand Agricultural Holding Extension 1, Halfway House, Midrand, Gauteng (2006);
- Brickot Developments cc, Ecological opinion for the proposed Bethal Retirement Village on the remainder of portion 3 of the farm Mooifontein 108 IS, Bethal, Mpumalanga (2006);
- Brawild (Pty) Ltd, Red Data Scan for the proposed Annlin Ex 117, Pretoria, Gauteng (2006);
- Mbombela Local Municipality, Ecological Opinion for the proposed extension of the Lowveld Botanical Gardens, Nelspruit, Mpumalanga (2006);

- Natural Scientific Services cc, Botanical survey for the SASOL Mafutha coal project near Lephalale, Limpopo Province, RSA (2008);
- SRK Consulting, Ecological assessment on Vlakfontein area, NW of Ogies, Mpumalanga. Report compiled in association with EkoInfo (2009); and
- Aurecon, Desktop biodiversity assessment and wetland scan: upgrade of the River View waste water treatment works, eMalahleni, Mpumalanga province. Report compiled in association with Imperata Consulting (2009).
- 2. Mining and Industrial related projects (ecological):
- Lonmin Platinum (Western Platinum Limited), Ecological Assessment for the proposed MK3 Shaft Complex on the farm Wonderkop 400 JQ, Rustenburg, North West Province (2004);
- Impala Platinum Limited, Ecological Assessment for prospecting SEMPs on the farms Buffelshoek 386 KT, Kalkfontein 367 KT, Spitskop 333 KT, Steelpoortpark 366 Kt and Tweefontein 360 KT and Hackney 116 KT (all Sekhukhuneland), Mpumalanga and Limpopo Province (2004);
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- Ekurhuleni Metropolitan Municipality, Ecological Assessment Report for the proposed GLB Landfill Site on the farm Zesfontein 27 IR, Benoni, Gauteng (peer reviewed, 2006);
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- ENVASS, An ecological evaluation (vertebrate & avifaunal component) for the proposed alternative energy plant on Portion 3, 4 & 5 of the Farm Groenwater 453, Northern cape (2012); and

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3. Avifaunal and Invertebrate Assessments:

- Lavender Manor cc, Red Data Bird Assessment for the proposed establishment of a retail, commercial and Lavender Manor Township on part of the farm Rietfontein 189 IQ, Muldersdrift, Gauteng (2004);

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- Eskom/Baagi Environmental, An environmental management plan (avifaunal component) for the proposed Gromis - Oranjemund 400 kV transmission line, Northern Cape (2013);

4. Other Assessments:

- Facilitation, project management and conduction of environmental scoping exercises, Environmental Impact Assessments, Environmental Management Plans, Feasibility Reports, for a range of projects and issues such as:
    - Housing Projects (West Rand Housing Projects) for the Gauteng Department of Housing;
    - Planning and facilitation of environmental awareness workshops (Winterveltd Workshops for the Department of Environmental Affairs and Tourism);
    - Compilation and evaluation of EIA reports and Environmental Management Plans (EMPs) for both the private and public sector (e.g. Scoping Report for the relocation of oxidation ponds for the Moqhaka Local Municipality and the installation of an underground additive tank for Sasol Oil (Pty) Ltd).
    - Urban Renewal Projects: Bekkersdal Urban Renewal Project and the Greater Evaton Urban Renewal Project for the Gauteng Department of Housing.
- Douglas Collieries (Inkwe Collieries), Biodiversity Assessment and database compilation of the Douglas Collieries (2005);
- Orion Group, Ecological Sensitivity Map for the proposed golf course and related facilities, Mont-Aux-Sources (2005);
- City of Joburg Property Development Company, Specialist *Lepidium mossii* assessment for the proposed upgrade and development of the Orlando Dam intersection, Soweto, Gauteng (2005);
- Johannesburg Roads Agency, Alien Eradication and Rehabilitation Programme for the proposed upgrade of 14th Avenue, Randburg, Gauteng (2006);
- City of Joburg Property Development Company, Ecological Management Plan for the Orlando Dam intersection, Soweto, Gauteng (2006);
- GJ van Zyl Trust, Alien Eradication Programme for the proposed development of a resort on the Farm Witpoort 216 JS, Mpumalanga (2006);
- GJ van Zyl Trust, Fire Management Plan for the proposed development of a resort on the Farm Witpoort 216 JS, Mpumalanga (2006); and

  Khutala Collieries (Inkwe Collieries), Biodiversity Assessment and database compilation (2006)

5. Linear Assessments:

- Johannesburg Roads Agency, Ecological Assessment for the Proposed upgrade of 14th Avenue, Randburg, Gauteng (2004).
- Trans-Caledon Tunnel Authority (TCTA), Proposed Vaal River Eastern Sub-Augmentation (VRESAP) pipeline from Vaal Marina to Secunda (2005);
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- Bohlweki Environmental (in association with Bathusi EC), Ecological Scoping Report for the proposed Eskom Malelane-Boulders 132 kV Distribution line (2007);
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- Natural Scientific Services cc, Botanical survey for the proposed upgrade of the Transnet railway line between Hotazel, Northern Cape and the Port of Ngqura, Eastern Cape, RSA (2008);
- Envirolution Consulting (Pty) Ltd, Ecological Report for the proposed Eskom Apollo-Lepini 400kV transmission line (2009);
- Arcus Gibb, An ecological investigation for the Tumelo 132 kV distribution line and power line near Kagiso, Gauteng (2010);
- Ekoinfo/SANRAL, Faunal investigation for the upgrade of the N3 highway (2011); and
- Aurecon (Pty) Ltd, Baseline vegetation survey for the Mokolo – Crocodile River Augmentation Project (MCWAP) pipeline from Mokolo Dam to Thabazimbi (2011).

B. Work Conducted in other African countries:

- Rural Maintenance, Invertebrate study for four mini-hydroelectric generation plants, Northern Malawi, Africa (2010);
- Impacto, An avifaunal study (Phase 1) for the proposed Mpanda Nkwua Dam in the Zambezi River, Mozambique, Tete Province (2010);
- Conseil Régional des Pays de la Loire, An avifaunal investigation of the Rusizi and Ruvubu National Parks (Burundi), and the feasibility of establishing an avi-tourism network with specific emphasis on the protection of important flyways used by Palearctic birds - of - prey (2010);
- Impacto, An avifaunal study (Phase 2) for the proposed Mpanda Nkwua Dam in the Zambezi River, Mozambique, Tete Province (2011);
- Rural Maintenance, Invertebrate scan for the expansion of coal mining activities at Kayelekera, Northern Malawi, Africa (2011);
- Rural Maintenance, Invertebrate study for a mini-hydroelectric plant at the Chisanga Falls, Nyika National Park, Malawi (2011);
- Impacto/ERM/Enviro-Insight, Avifaunal investigation for the proposed Ncondezi Coal Mine, Tete Province, Mozambique (2011);
- Enviro-Insight, Avifaunal investigation for the Riversdale Coal Mine complex, Tete Province, Monzambique (2011);
- Anadarko Petroleum/ERM/Enviro-Insight, Avifaunal investigation for the proposed Anadarko Mozambique Area 1 Liquefied Natural Gas plant in northern Mozambique, Cabo Delgado Province, Mozambique (2012);
- Coffey Environments/EkoInfo, Avifaunal investigation for the mining of iron ore by Baobab Resources, Tete Province, Mozambique (a scoping-level assessment); and
- SRK/Flora, Fauna and Man Ecological Services, An avifaunal and invertebrate assessment for the establishment of a potash mine at Konkoati, Republic of the Congo (2012);
- China Union/ERM/Enviro-Insight, Avifaunal investigation for the proposed mining of iron ore in Bong County, Liberia (2012);
- SRK/Flora, Fauna and Man Ecological Services, An invertebrate assessment for the mining of iron ore by DMC Congo Mining/Exxaro at Mayoko, Republic of the Congo (2012);

- Western Cluster/ERM/Enviro-Insight, Avifaunal investigation for the proposed mining of iron ore at Bomi Hills, ,Bomi County, Liberia (2013);
- SRK/Flora, Fauna and Man Ecological Services, An invertebrate assessment for the establishment of an ecological offset for the DMC Congo Mining/Exxaro Iron Ore Mine at Mayoko, Republic of the Congo (2013);
- Western Cluster/ERM/Enviro-Insight, Avifaunal investigation for the proposed mining of iron ore at Bea Mountain, Grand Cape Mount County, Liberia (2013);
- Western Cluster/ERM/Enviro-Insight, Avifaunal investigation for the proposed mining of iron ore at Mano River, Grand Cape Mount County, Liberia (2013); and
- WSP/Flora, Fauna and Man Ecological Services, An invertebrate assessment for the establishment of a phosphate mine, Hinda Phosphate Project, Republic of the Congo (current); and
- Aureus Mine/Enviro-Insight, An avifaunal investigation for the proposed mining of gold at the New Liberty Gold Mine, Liberia (current)

C. Additional Experience:

- Monitoring and evaluation of the rehabilitation programme for the mining company Richards Bay Minerals (RBM) with special reference to vegetation, bird, small mammal and millipede assemblages.
- Other responsibilities include assessment of the ecological standard operating procedures (SOP) according to RBM's environmental management programme in compliance with ISO 14001 environmental standards accreditation process.
- Participated in the annual relief programme on the S.A Agulhas voyage to Sub-antarctic Marion Island (Prins Edward group). Took part in the research to estimate the population dynamics and demography of the alien house mouse (*Mus musculus*) on the island (under supervision of the University of Pretoria).
- Participated in the preparation of a conservation management plan for a game and trout farm in conjunction with Mpumalanga Parks Board (in charge of the bird section) for the farm Nu-Scotland Bavaria.
- Lead a successful professional bird tour (party of 12) to the Eastern Zimbabwean highlands and adjacent Mashonaland Plato (10 days).
- Lead a successful professional bird tour (party of 9) to the Cape Peninsula, Karoo and West Coast (10 days).
- Lead a successful professional bird tour (party of 12) to the Swaziland and Northern Zululand (10 days).
- Lead a successful professional bird tour (party of 15) to the Namibia (10 days).
- Lead a successful professional bird tour (party of 14) to the Eastern Drakensberg and Lesotho (10 days).

EMPLOYMENT HISTORY:

March 2007 – Current: of Director of Pachnoda Consulting cc

2004- January 2007: Strategic Environmental Focus (Pty) - Terrestrial Ecologist

2003 – 2004: Enviro-Afrik (Pty) Ltd– Environmental Consultant

2001 – 2003: University of Pretoria - Research Assistant

PUBLICATIONS:

- McEWAN, K.L., ALEXANDER, G.J., NIEMAND, L.J. & BREDIN, I.P. 2007. The effect of land transformation on diversity and abundance of reptiles. Paper presented at the 50th Anniversary Conference of the Zoological Society of Southern Africa.
- NIEMAND, L. 1997. Distribution and consumption of a rust fungus *Ravenelia macowaniana* by micro-lepidopteran larvae across an urban gradient: spatial autocorrelation and impact assessment. Hons publication, University of Pretoria, Pretoria
- NIEMAND, L. 2001. The contribution of the bird community of the regenerating coastal dunes at Richards Bay to regional diversity. MSc Thesis, University of Pretoria, Pretoria.
- VAN AARDE, R.J., WASSENAAR, T.D., NIEMAND, L., KNOWLES, T., FERREIRA, S. 2004. Coastal dune forest rehabilitation: a case study on small mammal and bird assemblages in northern KwaZulu-Natal, South Africa. In: Martínez, M.L. & Psuty, N. (Eds.) *Coastal sand dunes: Ecology and Restoration*. Springer-Verlag, Heidelberg.
- VAN AARDE, R., DELPORT, J. & NIEMAND, L. 1999. Of frogs and men. *Mechanical Technology,* June: 32-33.
- VAN AARDE, R., DELPORT, J. & NIEMAND, L. 1999. Gone Frogging. *Getaway,* January: 80-83.

PRESENTATIONS:

- Co-presenter at the Wetland Training Course (30 July – 3 August 2007) entitled: “Wetland-associated fauna”. University of Pretoria, Pretoria.
- Co-presenter and lecturer of the pre-conference training course (entitled "Can rehabilitation contribute towards biodiversity?") at the 3rd Annual LaRSSA (Land Rehabilitation Society of Southern Africa) Conference (8-11 September 2015), Glenburn Lodge, Muldersdrift, Gauteng.