STRATEGIC ENVIRONMENTAL ASSESSMENT FOR EXPANSION OF ELECTRICITY GRID INFRASTRUCTURE IN SOUTH AFRICA

Biodiversity and Ecological Impacts (Aquatic Ecosystems and Species) - Wetlands and Rivers

STRATEGIC ENVIRONMENTAL ASSESSMENT FOR THE EXPANSION OF ELECTRICITY GRID INFRASTRUCTURE IN SOUTH AFRICA

Draft v3 Specialist Assessment Report for Stakeholder Review

FRESHWATER ECOSYSTEMS

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ABBREVIATIONS AND ACRONYMS

ADU	Animal Demographic Unit
ASPT	Average Score Per Taxon
BSP	Biodiversity Sector Plan
CBA	Critical Biodiversity Area
C-Plan	Conservation Plan
CR	Critically Endangered
CSIR	Council for Scientific and Industrial Research
DEA	Department of Environmental Affairs
DWS	Department of Water and Sanitation
ECO	Environmental Control Officer
EGI	Electrical Grid Infrastructure
EI	Ecological Importance
EMPr	Environmental Management Programme
EN	Endangered
ES	Ecological Sensitivity
GBIF	Global Biodiversity Information Facility
GIS	Geographic Information System
HGM	Hydrogeomorphic
IHI	Index of Habitat Integrity
IUCN	International Union for Conservation of Nature
LC	Least Concern
NBA	National Biodiversity Assessment (2011)
NFEPA	National Freshwater Ecosystem Priority Areas
PA	Protected Area - statutory
PES	Present Ecological State
QV	Quality Value
SA	South Africa
SAIAB	South African Institute for Aquatic Biodiversity
SANBI	South African National Biodiversity Institute
SASS	South African Scoring System
SEA	Strategic Environmental Assessment
Spp	Species
SQ4	Sub-quaternary catchment
ToPs	Threatened or Protected Species
TSP	Threatened Species Programme
VU	Vulnerable
WULA	Water Use License Application

1 SUMMARY

This assessment aims to identify the potential impacts of constructing and maintaining Electricity Grid Infrastructure (EGI) to freshwater ecosystems and biodiversity in two proposed Expanded EGI corridors the North Eastern and North Western coasts of South Africa.

The proposed Western Expanded EGI corridor is characterised by a drier climate and resultantly more ephemeral / non-perennial aquatic systems, thus with an anticipated lower sensitivity to EGI development. Conversely the proposed Western Expanded EGI corridor contains permanent aquatic features and is anticipated to be overall more sensitive to EGI development.

The key risks to freshwater ecosystems associated with EGI development includes:

- Direct loss of riparian and wetland vegetation;
- Fragmentation of freshwater ecosystems and flow patterns;
- Waste pollution and contamination of aquatic environments;
- Compaction of soils and creation of preferential flow paths with and adjacent to wetland and river habitats;
- Increased erosion;
- Infestation of alien invasive plants in aquatic systems; and
- Disturbance to and mortality of fauna.

In order to reduce potential impacts of EGI development on freshwater ecosystems (including habitat and biodiversity), sub-quaternary catchments classified with a very high or high sensitivity should be avoided as far as possible. Where avoidance of sensitive sub-quaternary catchments is not possible, detailed desktop investigations should be conducted, followed by specialist in-field assessments and verification. This will determine whether the fine-scale, micro-sited EGI alignment and development footprints can avoid the freshwater ecosystems (i.e. wetland and river habitats) and associated buffers within identified sensitive sub-quaternary catchments. Following this assessment, appropriate management actions may be determined and implemented as required.

2 INTRODUCTION

In January 2014 the Department of Environmental Affairs (DEA), mandated by Ministers and Members of the Executive Council (MinMec), commissioned the Council for Scientific and Industrial Research (CSIR) to undertake a Strategic Environmental Assessment (SEA) linked to SIP 10: Electricity Transmission and Distribution for all. The SEA, entitled "the national Department of Environmental Affairs Electricity Grid Infrastructure Strategic Environmental Assessment" was aimed primarily at establishing routing corridors to enable the efficient and effective expansion of key strategic transmission infrastructure designed to satisfy national transmission requirements up to the 2040 planning horizon. Preliminary Eskom corridors were assessed collaboratively in 2016 (DEA, 2016) by a number of specialists and institutions, however, since then refinements have been made to the routing/corridors. The CSIR together with Eskom, the South African National Biodiversity Institute (SANBI) and a number of experts worked collaboratively to undertake high impact assessments of key biophysical factors related to the refined routing corridors. The SEA process also provides a platform for coordination between the various authorities responsible for issuing authorisations, permits or consents and thereby will further contribute to a more streamlined environmental authorisation process (DEA, 2016).

Construction of Electricity Grid Infrastructure(EGI) including transmission lines, interconnections, substations and road networks have both positive and negative impacts at varying scales and at different stages of the power supply chain life cycle from extraction of fuels to construction and operation phases (Von Hippel and Williams, 2003). Evaluating potential impacts for the entire supply chain of EGI is important for optimising EGI interconnection opportunities and routing. Typically the environmental considerations of EGI development have received less emphasis than economic, technical and political issues, especially in developing regions, highlighting the importance of considering environmental impacts at an early stage (e.g. through conducting SEA's) and identifying potential problems (e.g. routing of transmission lines through/over sensitive ecosystems, difficult terrain) (Von Hippel and Williams, 2003).

While a variety of environmental issues have been identified with the full life cycle of EGI including amongst others: air pollutant emissions (local and regional), both particulate and the precursors of acid precipitation, water pollution, solid waste generation, land use impacts, disturbance to wildlife, loss of biodiversity and habitat and also human health; those related to impacts on freshwater ecosystems are the focus of this study and are discussed in detail in the following sections.

3 SCOPE OF THIS STRATEGIC ISSUE

This strategic issue focuses on impacts/threats to freshwater ecosystems, specifically the assessment of biodiversity and ecological impacts linked to rivers and wetlands as part of the SEA for the identification of energy corridors, as well as to provide management measures for the expansion of EGI for South Africa.

The primary objective of this study will be to provide an assessment of freshwater ecosystems (i.e. rivers and wetlands) and associated biodiversity within pre-identified corridors as supplied by the CSIR (Figure 1). The assessments will inform the SEA through identification of constraints (e.g. sensitive rivers and wetland ecosystems, critical areas for aquatic fauna and flora, etc.) and opportunities for the EGI development.

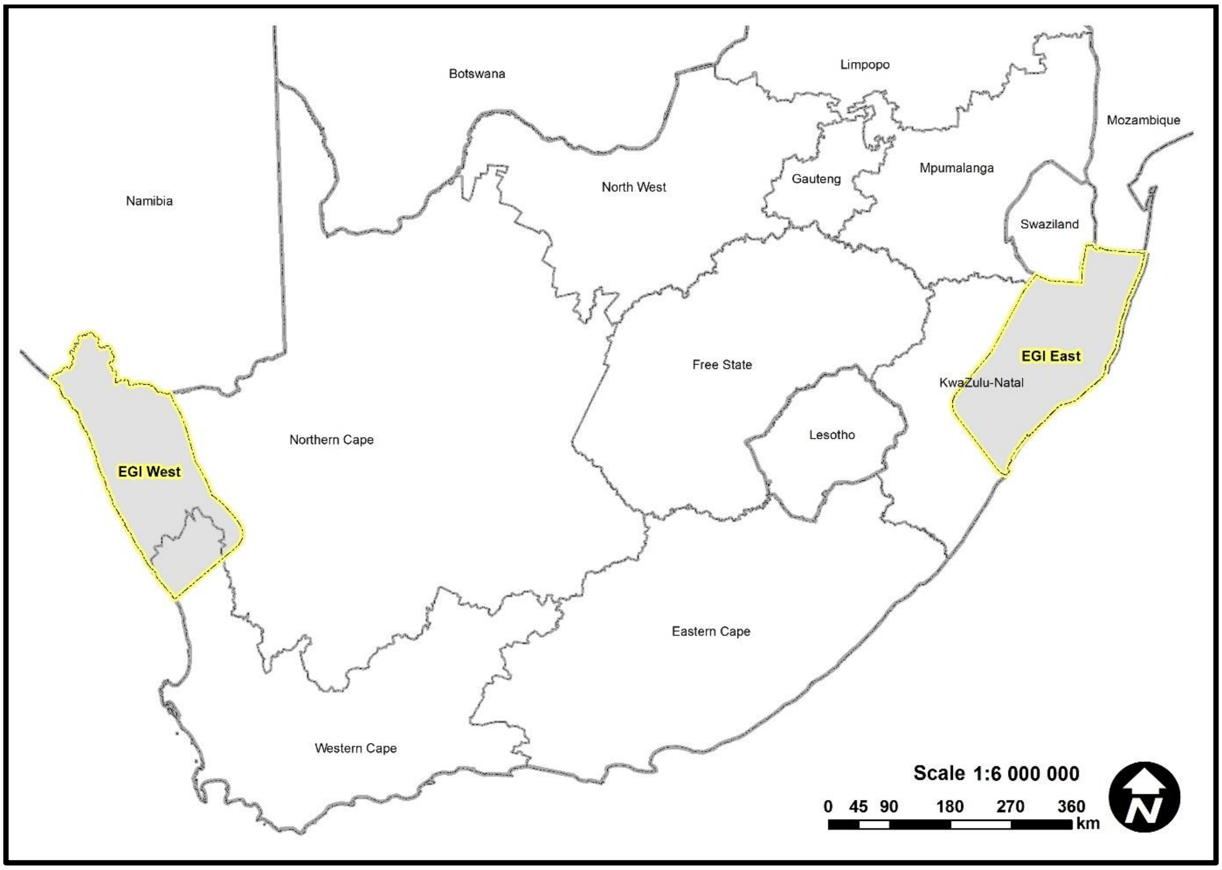

Figure 1: Overview of the proposed EGI corridors (East and West).

This assessment is focused primarily on the interpretation of existing data and is based on defensible and, if available, standardised and recognised methodologies. The focus is primarily to review the environmental wall to wall mapping outputs produced by the CSIR and SANBI (specifically relating to the additional EGI corridors), and to discuss the direct, indirect and cumulative impacts. Any gaps in information linked to aquatic biodiversity associated with rivers and wetlands with respect to the expanded EGI were identified as potential shortcomings needing to be addressed through further screening and ground-truthing assessments.

The study methodology developed as part of this project is intended to inform future SEAs in terms of specialist assessment methodologies. The study also incorporates a review of available data and information (e.g. the CSIR environmental wall to wall mapping, SANBI datasets, etc.), and builds on discussions with the relevant organisations related to aquatic ecosystems and biodiversity (e.g. SANBI, National Department of Water and Sanitation (DWS), etc.). This is to ensure that the outcomes of the study are accepted by these agencies, and will be taken into consideration for future authorisation and commenting within the areas assessed.

The assessment of freshwater ecosystems and biodiversity includes the following:

- Review of existing literature (including the latest research undertaken both locally, nationally and internationally), mapping/aerial photographs, and habitat and species data to compile a baseline description applicable to each corridor;
- Identification of any additional features of interest (large waterfalls, spray zones, etc.) or any gaps in information within the corridors not identified in the existing sensitivity analysis, making use of datasets made available through the draft environmental constraints map and additional information sourced by the specialist;
- High level distribution mapping for sensitive aquatic species occurring within South Africa;
- Review and update, where required, the environmental sensitivity/attribute map for the proposed additional EGI corridors provided by the CSIR and SANBI and develop/verify the approach for classing each sensitivity feature according to a four-tiered sensitivity rating system (i.e. very high, high, medium or low);
- Assess the proposed corridors in terms of the potential impacts associated with the construction and operation of EGI, taking cognisance of the relative sensitivity of areas, and outline proposed management actions to enhance benefits and avoid/reduce/offset negative impacts – this was done as per the impact assessment methodology provided by the CSIR Project Team;
- Based on the findings of the assessment, provide the relevant information and produce an updated four-tiered sensitivity map related to the field of expertise and the relevant corridors.
- Provide input to the pre-construction site specific environmental assessment protocol (e.g. additional information and level of assessment required in each sensitivity category before an authorisation with respect to aquatic biodiversity impacts), checklist, norms or standards, and Environmental Management Programme (EMPr) for the development of the expanded EGI.

Further to the above scope of work, the following information and data was considered as a minimum as part of the study, with more recent data consulted as appropriate:

- The latest Systematic Biodiversity Plans relevant to the study area, including input layers where applicable, as well as relevant land-use and impact assessment guidelines associated with these plans, e.g. the National Freshwater Ecosystem Priority Areas (NFEPA) technical report (Nel *et al.* 2011), and its associated implementation manual (Driver *et al.*, 2011).
- The 2011 National Biodiversity Assessment (NBA), including its spatial layers (specifically layers that were not used for the environmental constraints map), but that are relevant at a finer scale (Nel and Driver, 2012).
- The latest species information available for the study area in particular, but not limited to sensitive species that are dependent on these riparian zones, including specific Red Listed plants (Raimondo *et al.*, 2009), butterflies, (Mecenero *et al.*, 2013), reptiles (Bates *et al.*, 2014).
- Fine-scale spatial biodiversity information, e.g. additional wetland or species information that may not have been included in a systematic biodiversity plan.

It is important to note that the outputs from this study will form the basis of a planning and decision-support document for EGI development in the respective corridors. The aim of the planning document will be to inform and focus further aquatic project-level assessments (as they relate to rivers and wetlands) with respect to EGI development in the respective corridors (i.e. serve as a scoping exercise).

The key deliverables and reporting requirements of this project include:

- Specialist Assessment Report based on a specialist report template provided by the CSIR for the SEA, for review and comment, but covering the following:
    - Summary of key points, including degree-of-certainty terms;
    - Introduction – brief discussion of the essential background on the Strategic Issue;
    - Definition of issue scope and key terms;
    - Key attributes and sensitivities of the study areas towards the development of powerlines and associated infrastructure within the additional EGI corridors - baseline description of each proposed corridor (study area) relating to the issue topic and spatial sensitivity analysis (for spatially explicit topics), inclusive of a literature review in line with the strategic issue;
    - Description of methodology and approach to the study;
    - Description of the key potential impacts (positive and negative, including direct, indirect and cumulative) that are associated with EGI activities relating to the issue topic (inferred and distilled from the Project Description document provided to Authors), and their spatial and temporal distributions, including required mitigation measures;
    - The sensitivity delineation should be undertaken in the context of the development of EGI including transmission lines, distribution lines and substations
    - The results of a structured risk and opportunity assessment which evaluates the impacts, with and without mitigation, for each study area, and clearly defines consequence terms;
    - Updated four-tiers sensitivity map;
    - Outline proposed mitigation measures and management actions to enhance benefits and avoid/reduce/offset negative impacts for construction and operation phase. This will form part of the EMPr;
    - Best practice and management guidelines for EGI development (including inputs in the norms or standards, and the Site Specific Environmental Assessment Protocols and Checklist), monitoring requirements and recommendations for future site-specific assessment in relation to the Strategic Issue;
    - Gaps in knowledge; and
    - References.
- Geographic Information System (GIS) Assessment Dataset and additional information sourced by the specialist;
- Metadata for the Assessment Dataset (DEA metadata template, must be used - template will be provided upon appointment);
- GIS based four-tiered consolidated sensitivity map of all sensitivity features identified through the assessment showing the location and spatial extent for each sensitivity feature and associated buffering. The sensitivity rating should be illustrated according to the following coloration scheme: Dark Red/Very High, Red/High, Orange/Medium, Green/Low; and
- A guideline on the interpretation and implementation of the four tier maps as well as permit requirements (where applicable) for each corridor. This section should also make recommendations on requirements for additional terrestrial and aquatic biodiversity specialist studies (if any) within the different tiers of sensitivity specialist before an authorisation can be considered. Recommendations should be focused around the objective of streamlining without compromising environmental protection. This information will be incorporated into the Decision-Making tools that will ultimately govern development in the corridors.

4 APPROACH AND METHODOLOGY

4.1 Study Methodology

The study was based on a combination of desktop assessments building on strengths of GIS mapping and geospatial analyses, and builds on meetings and discussions with relevant authorities and experts. This ensured a thorough interpretation of existing data incorporating defensible and rigorous methodologies. The following steps outlined below were followed.

4.1.1 Briefing session

A representative from the GroundTruth team attended a one-day briefing session at the CSIR in Stellenbosch to meet the Integrating Authors and Contributing Authors to discuss and define the assessment phase of the project. The briefing session served to refine/agree on the scope of work, deliverables and timing, as well as to make sure all available data and information from the CSIR could be obtained upfront and as timeously as possible.

4.1.2 Literature review and data collation

The accuracy of information generated for the SEA is only as good as the information on which they are derived. Thus, as far as possible, the quality and validity of data obtained for the assessment of aquatic biota and ecosystems has been reviewed and refined to allow for integration to an appropriate scale/resolution. This process included the collation of datasets from a variety of sources, which were subsequently reviewed and assessed for suitability/relevance for the spatial assessments associated with freshwater rivers and wetlands. The datasets used in this component of the SEA, and sources where the data was obtained are indicated in Section 4.2.

4.1.3 Assigning a suitable spatial scale for analysis

All spatial data obtained for the freshwater ecosystem component were considered in terms of a suitable spatial unit/scale of measurement deemed practical for the purpose of assessing the expanded EGI corridors, as well as the alignment of associated infrastructure within the corridors. The sub-quaternary (SQ4) catchments for South Africa was decided as the most appropriate scale for the spatial analyses and assessment of freshwater ecosystems within the SEA corridors. This allowed for the scaling up of data to assess the corridors relative to each other.

4.1.4 Analysis and integration of GIS data

All spatial/GIS data obtained for the freshwater component were assessed firstly in terms of applicability/suitability, then merged/joined with other layers, then clipped according to the relevant EGI corridors as provided by the CSIR in order to assess the sensitivity-level of the corridors. All spatial analyses were undertaken using ArcGIS 10 software (version 10.4.1).

4.1.5 Application of metrics for sensitivity analyses

<u>River threat status and sensitivity:</u>
Threat status has been applied to river ecosystems as per thresholds defined in the Freshwater Component of the 2011 South African NBA (Nel and Driver, 2012), but using updated Present Ecological State (PES) information. The 2011 NBA used PES data from 2000 (Kleynhans, 2000) whereas the report here draws on the more recent PES, EI (Ecological Importance) and ES (Ecological Sensitivity) data from DWS (2014).

In addition to the threat status calculation, a metric was developed to integrate EI and ES component scores from the 2014 DWS study, the derived threat status (as above), as well as stream order. EI and ES scores represent ecological importance and sensitivity scores for freshwater ecosystems as separate, yet complimentary, components of PES. They are not currently accounted for in the threat status calculation, which uses river length and overall PES category/river health condition, but nevertheless provide valuable information regarding ecological sustainability. EI refers to biophysical aspects in the reach that relates to its capacity to function sustainably, whereas ES considers reach attributes that relate to the sensitivity of biophysical components to general environmental changes such as flow, physico-chemical and geomorphic modifications. EI and ES categories were ranked as scores from one to four (i.e. very low and Low = 1, moderate = 2, high = 3, and very high = 4), along with threat status (i.e. Critically Endangered or CR = 4, Endangered or EN = 3, Vulnerable or VU = 2, Least Concern or LC = 1). These scores were then considered in relation to stream order as per the following equation, such that the higher the score, the higher the overall sensitivity of the river ecosystem:

River Sensitivity = Threat Score + (EI Score + ES Score / Stream Order)

In basic terms, the higher the score the more sensitive the freshwater system. In addition, the metric favours higher order streams in the catchment which feed downstream systems.

<u>Wetlands threat status and sensitivity:</u>
The extent and distribution of wetland ecosystems (and their importance and sensitivity) was defined using a variety of available wetland datasets. These datasets cover a range of scales (i.e. national and provincial, down to fine-scale mapping for certain local municipalities), and include a variety of information pertaining to wetland habitats, such as wetland types, condition and conservation importance. The objective of the wetland mapping was to define areas containing wetland habitat in terms of sensitivity and importance based on the information available. A composite wetland layer was developed with this in mind, and followed a systematic process of sourcing, reviewing/analysing, cleaning and collating relevant datasets for each province. Provincial datasets were then collated, and routinely cleaned of any redundant data. Field attributes contained in the combined wetland coverage were categorised using four sensitivity classes as summarised in Table 1. A hierarchical selection process was followed to assign the highest sensitivity to each wetland feature contained in combined coverage.

Table 1: Criteria for assigning sensitivity classes for wetland attributes

Sensitivity class/value	Wetland attribute
Low sensitivity (sensitivity value = 1)	Wetland probability, non-NFEPA wetlands, least threatened wetlands, other natural areas (ONAs) as aquatic features, protected aquatic features.
Medium sensitivity (sensitivity value = 2)	NFEPA wetlands, nearly threatened wetlands, ecological support areas (ESAs) as aquatic features.
High sensitivity (sensitivity value = 3)	Ramsar site wetlands, KZN priority wetlands, Endangered or Vulnerable wetlands, optimal critical biodiversity areas (CBA2s) as aquatic features.
Very high sensitivity (sensitivity value = 4)	Critically Endangered wetlands, irreplaceable critical biodiversity areas (CBA1s) as aquatic features.

Due to large size of the combined wetland coverage, it was deemed practical to remove wetland features smaller than 0.50 and 0.25 hectares for the low and medium sensitivity classed wetlands. For the Western Cape, a more rigorous cleaning process was required due to the impractical file sizes that were created as a result of combining multiple fine-scale datasets. Thus for the Western Cape, aquatic CBA features less than one hectare, and aquatic ESA features less than two hectares were removed. Furthermore, it was found that the ESA layers were particularly cumbers, so only ESA features that are connected to CBAs were included in the final wetland layer for the Western Cape.

The threat status of wetlands was defined using the national wetland vegetation groups (Nel and Driver, 2012). Wetlands occurring within a particular wetland vegetation group (or region) were assigned the threat category of that region, and then allocated a threat score (i.e. CR = 4, EN = 3, VU = 2, LC = 1). The threat scores were combined with the initial wetland sensitivity values (based on Table 1) by adding the scores and values together to produce an overall risk/sensitivity score of wetlands within the study area.

In order to account for the aerial extent of wetland habitat, the risk/sensitivity scores for each wetland feature were multiplied by the proportion of wetland (of a particular risk/sensitivity) within each SQ4 catchment. These area-weighted risk/sensitivity scores were then summed together for each SQ4 catchment, and then collapsed into the four sensitivity classes using a quantile data split.

The final result of the wetland integration and spatial analysis was a SQ4 coverage showing areas of low, medium, high and very high sensitivity taking into account threat status, and importance/sensitivity and extent of wetland habitat. However, it is also prudent to consult the combined wetland feature map, which displays the actual sensitivity scores for each wetland feature.

Freshwater biota (species and families):
Information of freshwater biota was used as an additional level of detail in order to assess the sensitivity/importance of SQ4 catchments within the EGI corridors. To achieve this, taxonomic groups that are representative of freshwater ecosystems were considered, especially where data of known localities was found to be sufficiently detailed and accessible. These groups include: freshwater plants, aquatic macro-invertebrates, dragonflies/damselflies (i.e. Family: Odonata), freshwater fish, amphibians, obligate reptiles and obligate mammals. Information of the conservation status/importance of species from these taxonomic groups was considered particularly important in terms of being able to establish the sensitivity of areas. To achieve this, data of Red Listed species was sourced to obtain the latest available assessments (global and national) of species done according to the International Union for Conservation of Nature (IUCN) criteria and Red Listing requirements (IUCN, 2012). Species selected primarily for this study included freshwater species of conservation importance, i.e. species listed as Threatened (i.e. Critically Endangered, Endangered and Vulnerable), Near Threatened and Data Deficient.

Freshwater plants (Kingdom: Plantae):
The conservation status of a large number of plants occurring within South Africa has been assessed by Raimondo *et al.* (2009). As with the other taxa, freshwater plants listed as Threatened, Near Threatened and Data Deficient were selected for this study, which includes 40 species of plants (Appendix 1) that inhabit a range of freshwater habitats, broadly including wetlands, rivers and riparian areas. Point localities (approximately 661 records) for the selected plant species were obtained from the SANBI Threatened Species Programme (TSP) database (SANBI, 2018). As with the other taxonomic groups, these point records were assigned to SQ4 catchments to derive a presence/absence coverage, which were then classified into the four sensitivity classes (i.e. low, medium, high, very high).

Aquatic macro-invertebrates (Class: Insecta):
Species-level data for invertebrates is generally limited or biased toward certain groups (e.g. butterflies and dragonflies/damselflies), however, family-level data is more obtainable. Furthermore, families of most macro-invertebrates (94 families) have variable tolerances to water quality and quantity impacts with specific Quality Values (QV - an indication of their sensitivity to land use and water quality/quantity impacts ranging from 1 to 15) - this is the basis of river health biomonitoring.

Point localities for the 94 macro-invertebrate families recorded from a total of 4 350 river sites in South Africa, of which 11 (or 0.2%) and 348 (or 8%) are located within the western and eastern EGI corridors respectively, were assigned to a 1:10 000 grid vector. For each grid cell the total diversity was calculated from which two separate but complementary indices were then derived, namely:

- South African Scoring System (SASS) Score - sum of all families multiplied by their respective QV as occurring within a particular grid cell; and
- Average Score Per Taxon (ASPT) - the SASS Score divided by the total number of recorded families for a particular grid cell.

SASS Scores and ASPT values were then assigned to a river ecoregion (Level 2) by selecting grid cells where more than half of the grid cell falls within a particular ecoregion. Average SASS Scores and ASPT values was calculated for each river ecoregion using all grid cell data within each ecoregion. Average ASPT values were then classified into four sensitivity classes (i.e. low, medium, high, very high) using a Quantile split in the dataset using ArcGIS 10 software (version 10.4.1).

Dragonflies and Damselflies (Family: Odonata):
All species of Odonata (i.e. dragonflies and damselflies) have been assessed in terms of their conservation status/importance within South Africa (IUCN, 2017; Samways and Simaika, 2016). Species listed as Threatened, Near Threatened and Data Deficient, were selected for this study, which includes 13 listed species (Appendix 2). Point localities (approximately 164 records) where these conservation important dragonflies and damselflies have been recorded were obtained from the SANBI (TSP) database (SANBI, 2018). Point records were assigned to SQ4 catchments to derive a presence/absence coverage of each species per catchment. The SQ4 catchments were then classified into four sensitivity classes (i.e. low, medium, high, very high) based on the presence/absence of conservation important dragonflies and damselflies where catchments supporting Critically Endangered species have a “very high” sensitivity, Endangered and Vulnerable species have a “high” sensitivity, Near Threatened and Data Deficient species have a “medium” sensitivity, and all remaining catchments not known to support conservation important species have a “low” sensitivity.

Freshwater Fish (Class: Actinopterygii):
Most of the freshwater fish that occur within South Africa have been recently assessed and are now Red Listed, with only a few species still requiring assessments (Coetzer, 2017). Twelve species of conservation importance were selected for this study (Appendix 2). Point localities (approximately 233 records) for nine of these selected species were obtained from the Global Biodiversity Information Facility (GBIF) database via the South African Institute for Aquatic Biodiversity (SAIAB). These point records were assigned to SQ4 catchments to derive a coverage of presence or absence of each species per catchment based on known point locations. Distribution data for the other three selected fish species was spatially defined by selecting SQ4 catchments where each species occurs as inferred from the IUCN Red List of Threatened Species Map Viewer (IUCN, 2017). As with dragonflies and damselflies, all SQ4 catchments were then classified into four sensitivity classes (i.e. low, medium, high, very high) based on the presence/absence of conservation important freshwater fish.

Amphibians (Order: Anura):
The conservation status of most amphibians occurring within South Africa has been assessed by Minter *et al.* (2004). As with the other freshwater taxa, amphibians listed as Threatened, Near Threatened and Data Deficient selected for this study includes eight listed species (Appendix 2). Point localities (approximately 2 248 records) for these selected species were obtained from the SANBI (TSP) database (SANBI, 2018). These point records were assigned to SQ4 catchments to derive a coverage of presence or absence of each species per catchment based on the known point locations. The SQ4 catchments were then classified into four sensitivity classes (i.e. low, medium, high, very high) based on the presence/absence as done for the other freshwater taxonomic groups.

Reptiles (Order: Reptilia):
The conservation status of most reptiles (i.e. terrapins, geckos, lizards, chameleons, and snakes) that occur within South Africa have been assessed by Bates *et al.* (2014). Reptiles listed as Threatened, Near Threatened and Data Deficient selected for this study includes four listed species (Appendix 2). In addition, only those reptiles that are defined as freshwater ecosystem obligates (i.e. species that is entirely or mostly dependent on aquatic, wetland and riparian habitats to exist) were considered. Point localities (approximately 1 477 records) for these selected species were obtained from the SANBI (TSP) database (SANBI, 2018). These point records were assigned to SQ4 catchments to derive a coverage of presence or absence of each species per catchment based on the known point locations. The SQ4 catchments were then classified into four sensitivity classes (i.e. low, medium, high, very high) based on the presence/absence as done for the other freshwater taxonomic groups.

Mammals (Order: Mammalia):
The conservation status of most mammals that occur within South Africa have been assessed by Child *et al.* (2016). As with the other taxa, only mammals listed as Threatened, Near Threatened and Data Deficient were selected for this study, which includes eight listed species (Appendix 2). In addition, only those mammals that are defined as freshwater ecosystem obligates (i.e. species that is entirely or mostly dependent on aquatic, wetland and riparian habitats to exist) were considered. Point localities

(approximately 494 records) for these selected species were obtained from the SANBI (TSP) database (SANBI, 2018). These point records were assigned to SQ4 catchments to derive a coverage of presence or absence of each species per catchment based on the known point locations. The SQ4 catchments were then classified into four sensitivity classes (i.e. low, medium, high, very high) based on the presence/absence as done for the other freshwater taxonomic groups.

4.1.6 Integration of taxonomic groups

Sensitivity values of the aforementioned taxonomic groups, ranging from one to four (i.e. low to very high sensitivity), were combined into a single layer in order to calculate overall biotic sensitivity for each SQ4 catchment. Linear weightings were applied to each of the groups based on the ability of respective species being able to escape/disperse away from disturbance and impacts to habitats. Plants being sedentary were thus given the highest weighting of five, followed by amphibians (weighting of four), fish (weighting of three), dragonflies and damselflies (weighting of two), and macro-invertebrates (weighting of one). The weighted sensitivity values were summed together to produce a total score for each SQ4 catchment, which were then collapsed into the four sensitivity classes using a quantile data split.

4.1.7 Producing integrated four tier sensitivity maps

The sensitivity maps produced for rivers, wetlands and combined freshwater biota were also integrated into a single layer by summing the sensitivity values for each component. The total score for each SQ4 catchment were collapsed into the four sensitivity classes using a quantile data split. This coverage provides an integration of all data pertaining to freshwater biodiversity and ecosystems, and is particularly useful for identifying preferred alignments for electrical infrastructure in order to reduce impacts on freshwater ecosystems and associated biodiversity.

4.2 Data Sources

Table 2: Data used in this assessment.

Data title	Source and date of publication	Data Description
SQ4 sub-quaternary drainage regions (referred to as SQ4 catchments)	DWS (2009)	Catchment areas that define the drainage regions of the NEFPA river reaches, which include 9 433 catchments ranging from 0.25 to 400 000 hectares. The proposed Expanded EGI corridors include 761 SQ4 catchments ranging from 0.25 to 115 000 hectares. These catchment areas are used as the primary spatial unit for analysis in the freshwater component.
River Ecoregions (Level 1 and 2)	Kleynhans *et al.* (2005)	A delineation of ecoregions for South Africa as derived from terrain, vegetation, altitude, geomorphology, rainfall, runoff variability, air temperature, geology and soil. There are 31 Level 1 and 219 Level 2 River Ecoregions in South Africa, of which 12 Level 1 and 29 Level 2 River Ecoregions occur within the proposed Expanded EGI corridors.
River Present Ecological State (PES), Ecological Importance (EI) and Ecological Sensitivity (ES)	DWS (2014)	A Desktop Assessment of the Present Ecological State, Ecological Importance and Ecological Sensitivity per Sub Quaternary Reaches for Secondary Catchments in South Africa conducted in 2013.
NFEPA rivers and wetlands	Nel *et al.* (2011)	The NFEPA coverages provide specific spatial information for rivers according to the DWS 1:500 000 rivers coverage, including river condition, river ecosystem types, fish sanctuaries, and flagship/free-flowing rivers. The NFEPA coverages also provide specific information for wetlands such as wetland ecosystem types and condition (note: wetland delineations were based largely on remotely-sensed imagery and therefore did not include historic wetlands lost through transformation and land use activities).
Ramsar Sites	Ramsar (2018)	Distribution and extent of areas that contain wetlands of international importance in South Africa.
National Wetland Vegetation Groups	Nel and Driver (2012)	A vector layer developed during the 2011 NBA to define wetland vegetation groups to classify wetlands according to Level 2 of the national wetland classification system (SANBI, 2010). The wetland vegetation groups provide the regional context within which wetlands occur, and is the latest available classification of threat status of wetlands that are broadly defined by the associated wetland vegetation group. This is considered more practical level of classification to the Level 4 wetland types owing to the inherent low confidence in the desktop classification of hydrogeomorphic units (HGM) that was used at the time of the 2011 NBA.

Data title	Source and date of publication	Data Description
Provincial Wetland Probability Mapping	Collins (2017)	Mapping of wetland areas based on a concept of water accumulation in the lowest position of the landscape, which is likely to support wetlands assuming sufficient availability water to allow for the development of the indicators and criteria used for identifying and delineating wetlands. This method of predicting wetlands in a landscape setting is more suitable for certain regions of the country than in others.
KwaZulu-Natal Freshwater Systematic Conservation Plan	Ezemvelo KZN Wildlife (2007)	This is the freshwater planning unit surface for KZN based on the 2007 Freshwater Systematic Conservation Plan (FSCP) run by Dr. Nick Rivers-Moore using MARXAN using catchment planning units. Catchments “earmarked” for freshwater conservation were selected as CBAs for this study as these areas represent optimal biodiversity areas required to meet biodiversity targets.
KwaZulu-Natal Vegetation Types	Scott-Shaw and Escott (2011)	This coverage represents an update of the KZN vegetation map as completed in September 2009. Several additions have been made which is represented in the Appendix 1 of the KwaZulu-Natal Vegetation Type Description Document for Vegetation Map 2011. These additions were made based on data that was received in an effort to make the map more current and representative of KZN’s vegetation. The coverage includes a variety of wetland types with conservation statuses that are specific to KZN conservation planning.
Western Cape Biodiversity Spatial Plans (fine-scale mapping)	CapeNature (2017)	The Western Cape Biodiversity Spatial Plans (WCBSP) are products of a systematic biodiversity planning process that maps terrestrial and aquatic CBAs and ESAs that require safeguarding to ensure the continued existence and functioning of species and ecosystems, including the delivery of ecosystem services. These spatial priorities are used to inform sustainable development in the Western Cape Province. Mapping regions for the BSPs include: Beaufort West, Berg River, Bitou, Breede Valley, Cape Agulhas, Cederberg, City of Cape Town, Drakenstein, George, Kannaland, Knysna, Laingsburg, Langeberg, Mossel Bay, Oudtshoorn, Overstrand, Prince Albert, Saldanha Bay, Swellendam, Theewaterskloof and Witzenberg. Aquatic CBAs and ESAs were selected for all the BSPs and merged together to create a complete BSP for the Western Cape.
Northern Cape Critical Biodiversity Areas	Northern Cape Department of Environment and Nature Conservation (2016)	Coverage of Aquatic Critical Biodiversity Areas as obtained from the Northern Cape Biodiversity Conservation Plan (BCP). Coverage of CBAs for the Northern Cape based on a Systematic Conservation Planning approach that incorporates data on biodiversity features (incorporating both pattern and process, and covering terrestrial and inland aquatic realms), condition, current Protected Areas and Conservation Areas, and opportunities and constraints for effective conservation.
Northern Cape District Municipality Aquatic Critical Biodiversity Areas	Botanical Society of South Africa (2007; 2008)	Identified and mapped aquatic CBAs for selected municipalities within the Northern Cape namely, Hantam District Municipality (2007) and Namakwa District Municipality (2008). CBAs are derived from one are many biodiversity features used in the mapping. Aquatic CBAs were selected and integrated with the more recent provincial mapping.

Data title	Source and date of publication	Data Description
Freshwater aquatic plants	Raimondo *et al.* (2009), with spatial data provided by SANBI (2018)	Point locations (from a total of 661 records) of conservation important plant species (40 species) that inhabit wetland, river and riparian habitats.
Dragonflies and damselflies (Odonata)	IUCN (2017) and Samways and Simaika (2016), with spatial data provided by SANBI (2018)	Point locations of dragonflies and damselflies taken from a total of 164 records for these selected species within South Africa for the EGI Corridors. This data includes records of the conservation important Odonata selected for this assessment.
Aquatic macro-invertebrates	DWS (2015)	Point shapefiles of 94 aquatic macro-invertebrate families recorded from 359 monitoring sites on rivers within South Africa, of which 11 (or 0.2%) and 348 (or 8%) are located within the western and eastern EGI corridors respectively.
Freshwater fish	Coetzer (2017)	Point locations for freshwater fish for South Africa taken from a total of 233 records. This data includes records for approximately half of the conservation important fish in South Africa.
Fish distributions	International Union for the Conservation of Nature (2017)	Distribution data for selected fish species where point data was found to be lacking/insufficient was obtained from the IUCN Red List of Threatened Species Map Viewer with data presented as catchment distributions. The IUCN distributions were spatially inferred using the SQ4 catchments for three of the selected fish species.
Amphibians	Minter *et al.* (2004), with spatial data provided by SANBI (2018)	Point locations of amphibians was taken from a total of 2 248 records for these selected species within South Africa for the EGI Corridors.
Reptiles	Bates *et al.* (2014), with spatial data provided by SANBI (2018)	Point locations of reptiles was taken from a total of 1 477 records for these selected species within South Africa for the EGI Corridors.
Mammals	Child *et al.* (2016), with spatial data provided by SANBI (2018)	Point locations of mammals was taken from a total of 494 records for these selected species within South Africa for the EGI Corridors.

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4.3 Assumptions and Limitations

Table 3: Assumptions and limitations.

Limitation	Included in the scope of this study	Excluded from the scope of this study	Assumption
This is a desktop assessment of biodiversity sensitivity based largely on existing datasets, with some expert review and input from the consultant team.			
Suitable spatial scale and unit for analysis	Sub-Quaternary Catchments were used as the primary unit of scale for analyses allowing for integration of multiple datasets (e.g. points, lines, polygons) to ensure continuity in the output that are also comparable.	Data outputs as points or grid cells.	Data representing freshwater ecosystems and biota are contained and displayed using sub-quaternary catchments units. The integration of all data according to a suitable scale will be undertaken by CSIR.
Data accuracy and reliability	Use of existing datasets that have been verified, with some datasets further refined at the desktop level.	Ground-truthing and further infield verification of datasets.	Existing datasets are assumed accurate until such a time as they have been accurately verified.
Potential species-level data sampling bias	Available species datasets, including freshwater plants, aquatic invertebrates, dragonflies and damselflies, fish, amphibians, reptiles (freshwater obligates) and mammals (freshwater obligates)	Ground-truthing and further infield verification of datasets.	Species-level datasets are inherently biased by sampling effort. Datasets used in this study are likely to contain such bias and this has not been adjusted for or improved.
Wetland classification according to HGM units not available for all wetlands layers	The conservation importance/threat status of wetlands was determined using the national wetland vegetation groups.	Verification of HGM units and determination of wetland conservation/ threat status according to HGM type.	The spatial resolution of characterising the threat status of wetland is considered sufficient for the scale of study and ensures that the output layers are contiguous.
Occurrence of species, including Critically Endangered, Endangered, Vulnerable and other species of conservation concern is not exhaustive	Only point data for species of conservation concern was used based on current availability and sources.	Ground-truthing/ verification of species presence/absence from all areas, as well as modelled distribution data.	The latest available conservation assessments for species is considered conservative as additional records/localities overtime tend to reduce the threat status of a particular species. Added precaution is included in the GIS layers whereby point data has been assigned to sub-quaternary catchments.

Limitation	Included in the scope of this study	Excluded from the scope of this study	Assumption
Protected Areas layers	No protected areas layer data was included	Protected Areas layers were not used in this study.	Aquatic ecosystems and features are inherently less sensitive given the levels of protection. Protected areas will be accounted for in the main integration of all data layers and development of the cost surface - in this regard all freshwater ecosystems and features will be treated with a high sensitivity.
Working with large datasets, particularly fine-scale plans	The fine-scale GIS layers have been thinned out to make processing more efficient - allowing a suitable fine scale resolution for strategic planning, whilst ensuring efficient processing.	Small wetland fragments from fine-scale GIS data layers were excluded, and scaled according to sensitivity.	Site specific studies will utilise all information available (SEA threat and sensitivity layers) as well as the detailed fine-scale GIS layers. Such fine-scale detail is potentially excessive at the strategic planning phase.

4.4 Relevant Regulatory Instruments

A detailed list and description of all relevant regulatory instruments associated with freshwater ecosystems at an international, national scale, as well as provincial scale as per the compendium of South African Environmental Legislation (van der Linde, 2006) for each focus area is provided in Table 4.

Table 4: International, national and provincial regulatory instruments relevant to freshwater ecosystems.

Instrument	Key objective	Feature
International Instrument		
Ramsar Convention (The Convention of Wetlands of International Importance (1971 and amendments)	Protection and conservation of wetlands, particularly those of importance to waterfowl and waterfowl habitat. South Africa is a signatory to the Ramsar Convention and is thus obliged to promote the conservation of listed wetlands and the 'wise management' of all others.	Ramsar Wetlands
IUCN Red List of threatened species	Provides the most comprehensive inventory of the global conservation status of plant and animal species. Uses a set of criteria to evaluate the extinction risk of thousands of species and subspecies. The criteria used are relevant to all species and all regions of the world.	Species diversity
The Convention on Biological Diversity (1992)	Focused on the conservation of biological diversity, the sustainable use of its components, the fair and equitable sharing of the benefits from the use of genetic resources	Species diversity
Regional Instrument		
SADC Protocol on Shared Watercourse Systems (1995)	The protocol provides for the utilisation of a shared watercourse system for the purpose of agricultural, domestic and industrial use and navigation within the SADC region. The protocol established river basin management institutions for shared watercourse systems and provides for all matters relating to the regulation of shared watercourse systems	Transboundary Rivers
National Instrument		
National Environmental Management Act (Act 107 of 1998), as amended	NEMA sets out the fundamental principles that apply to environmental decision making, some of which derive from international environmental law and others from the constitution.	Relevant to rivers and wetlands during all phases

Instrument	Key objective	Feature
	The National Environmental Management Act of 1998 (NEMA), outlines measures that….”prevent pollution and ecological degradation; promote conservation; and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.” Of particular relevance to this assessment is Chapter1(4r), which states that sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands, and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure.	
NEMA EIA 2014 Regulations, as amended April 2017 (Government Gazette 40772)	These regulations provide listed activities that require environmental authorisation prior to development because they are identified as having a potentially detrimental effect on natural ecosystems, including freshwater ecosystems. Different sorts of activities are listed as environmental triggers that determine different levels of impact assessment and planning required. The regulations detail the procedures and timeframes to be followed for a basic or full scoping and environmental impact assessment.	Relevant for planned EGI construction/ development in proximity to wetlands, rivers and critical biodiversity areas
Water Research Act (Act 34 of 1971)	Promotes water related research	All water resources, and associated ecosystems
National Water Act (Act 36, 1998)	This act provides the legal framework for the effect and sustainable management of water resources. It provides for the protection, use, development, conservation, management and control of water resources as a whole. Water use pertains to the consumption of water and activities that may affect water quality and condition of the resource such as alteration of a watercourse. Water use requires authorisation in terms of a Water use licence (WULA) or General Authorisation (GA), irrespective of the condition of the affected watercourse. Includes international management of water.	Relevant to rivers and wetlands during all phases
National Water Resource Strategy (NWRS) 2004 and NWRS2 2013	Facilitate the proper management of the nation’s water resources; provide a framework for the protection, use, development, conservation, management and control of water resources for the country as a whole; provide a framework within which water will be managed at regional or catchment level, in defined water management areas; provide information about all aspects of water resource management; identify water-related development opportunities and constraints	All rivers, wetlands and freshwater resources
The Water Services Act, (No. 108 of 1997 (RSA, 1997a)	The right of access to basic water supply and the right to basic sanitation necessary to secure sufficient water and an environment not harmful to human health or well-being; the setting of national standards and norms and standards for tariffs in respect of water	Water resource allocation to EGI infrastructure - during construction and operation phases. Relevant to water

Instrument	Key objective	Feature
	services; the preparation and adoption of water services development plans by water services authorities; a regulatory framework for water services institutions and water services intermediaries; the establishment and disestablishment of water boards and water services committees and their duties and powers; the monitoring of water services and intervention by the Minister or by the 5 relevant Province; financial assistance to water services institutions; the gathering of information in a national information system and the distribution of that information; the accountability of water services providers: and the promotion of effective water resource management and conservation. Water supply services in an efficient equitable manner, as well as measures to promote water conservation and demand management which through Water Conservation and Water Demand Management (WC/WDM) strategies	resources in the vicinity of EGI.
National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004)	The National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004) provides for listing threatened or protected ecosystems, in one of four categories: critically endangered (CR), endangered (EN), vulnerable (VU) or protected. Activity 12 in Listing Notice 3 (of the 2014 EIA Regulations (as amended) in Government Notice R324 of 2017) relates to the clearance of 300 m^2 or more of vegetation, within Critical Biodiversity Areas.	Relevant to rivers and wetlands, critical biodiversity areas, threatened ecosystems and endangered species during all phases
Draft biodiversity offset policy	A Draft National Biodiversity Offset Policy was recently gazetted in March 2017 (NEMBA, 2017), and is in the process of being finalised. The offset policy is intended to establish the foundation for establishing an offset for biodiversity (including river and wetland ecosystems), ensuring that offset procedures are properly integrated into the EIA process to make sure that the mitigation hierarchy is exhausted. Should it be determined in the EIA that there will be residual impact that cannot be avoided and/or mitigate, then an offset will need to be established to account for the loss of biodiversity. The core principles for offsetting, as set out in the policy, should be used to guide the process of evaluating, designing and implementing an offset. It is essential that the offset process is introduced from the outset of the EIA.	River and wetland ecosystems and associated fauna and flora
National Environmental Management: Protected Areas Act (No. 57 of 2003 as amended) {NEM:PPA}	To provide, within the framework of national legislation, including the National Environmental Management Act, for the declaration and management of protected areas; to provide for co-operative governance in the declaration and management of protected areas; to effect a national system of protected areas in South Africa as part of a strategy to manage and conserve its biodiversity; to provide for a representative network of protected areas on state land, private land and communal land; to promote sustainable	Any protected areas - and related freshwater ecosystems affected by EGI development

Instrument	Key objective	Feature
	utilisation of protected areas for the benefit of people, in a manner that would preserve the ecological character of such areas; and to promote participation of local communities in the management of protected areas, where appropriate.	
Resource Directed Measures including: the Ecological Reserve, National Water Resource Classification System (NWRCS) and Resource Quality Objectives (RQO's)	The main objective of the Chief Directorate: Resource Directed Measures (RDM) is to ensure protection of water resources, as described in Chapter 3 of the South African National Water Act - 1998 (No. 36 of 1998) and other related water management legislation and policies. The role of RDM is to provide a framework to ensure sustainable utilization of water resources to meet ecological, social and economic objectives and to audit the state of South Africa's water resources against these objectives The aim of Water Resource Quality Objectives is to delineate units of analysis and describe the status quo of water resources, initiate stakeholder process and catchment visioning, quantify EWR's and changes in ecosystem services, identify scenarios within IWRM, draft management classes, produce RQO's (EcoSpecs, water quality), Gazette class configuration	Benchmark used for monitoring and evaluation of freshwater resources especially rivers in relation to the Reserve.
National Environmental Management Waste Act (No. 59 of 2008)	Minimising the consumption of natural resources; avoiding and minimising the generation of waste; reducing, re-using, recycling and recovering waste; treating and safely disposing of waste as a last resort; preventing pollution and ecological degradation; securing ecologically sustainable development while promoting justifiable economic and social development; promoting and ensuring the effective delivery of waste services; remediating land where contamination presents, or may present, a significant risk of harm to health or the environment: and achieving integrated waste management reporting and planning; to ensure that people are aware of the impact of waste on their health, well-being and the environment; to provide for compliance with the measures set out in paragraph (a) and generally, to give effect to section 24 of the Constitution in order to secure an environment that is not harmful to health and well-being.	Relevant to construction and operation phase of EGI which may impact rivers and wetlands
Conservation of Agricultural Resources Act (CARA, Act 43 of 1983).	Key aspects include legislation that allows for: Section 6: Prescription of control measures relating to the utilisation and protection of vleis, marshes, water sponges and water courses. These measures are described in regulations promulgated in terms of the Act, as follows; Regulation 7(1): Subject to the Water Act of 1956 (since amended to the Water Act 36 of 1998), no land user shall utilise the vegetation of a vlei, marsh or water sponge or within the flood area of a water course or within 10 m horizontally outside such flood area in a manner that causes or may cause the deterioration or damage to the natural agricultural resources. Regulation 7(3) and (4): Unless written permission is obtained, no	Rivers and wetlands

Instrument	Key objective	Feature
	land user may drain or cultivate any vlei, marsh or water sponge or cultivate any land within the flood area or 10 m outside this area (unless already under cultivation).	
Provincial Instrument		
Catchment Management Strategies applicable to all provinces	Progressively develop a catchment management strategy for the water resources within its water management area. Catchment management strategies must be in harmony with the national water resource strategy. CMA must seek cooperation and agreement on water -related matters from the various stakeholders and interested persons. CMA must be reviewed and include a water allocation plan, set principles for allocating water to existing and prospective users, taking into account all matters relevant to the protection use, development conservation, management and control of resources	Rivers and wetlands
Western Cape		
Nature and Environmental Conservation Ordinance (Ordinance 19 of 1974; amended in 2000).	This ordinance is applicable in the Western Cape, Eastern Cape, Northern Cape and parts of the North West Province. This ordinance provides measures to protect the natural flora and fauna, as well as listing nature reserves in these provinces. This ordinance was amended in 2000 to become the Nature Conservation Laws Amendment Act. Lists of endangered flora and fauna can be found in this act.	Species diversity
KwaZulu-Natal		
KwaZulu-Natal Nature Conservation Act, 1992 (Act 29 of 1992) as an amendment to the Natal Nature Conservation Ordinance (No. 15 of 1974)	According to the Natal Nature Conservation Ordinance No. 15 of 1974 and the KwaZulu-Natal Nature Conservation Act, 1992 (Act 29 of 1992), no person shall, among others: damage, destroy, or relocate any specially protected indigenous plant, except under the authority and in accordance with a permit from Ezemvelo KZN Wildlife (EKZNW).	Species diversity
Ezemvelo KZN Wildlife Guideline: Biodiversity Impact Assessment in KwaZulu-Natal	Provides guidelines for developers, applicants, environmental consultants and specialists to ensure that projects investigation timeframes are accurately determined, that feasibility studies accurately determine fatal flaws regarding biodiversity, and that the scope and reporting requirements of specialist studies allow for informed and sustained decisions to be made in terms of biodiversity.	Conservation and protection of river and wetland habitats and associated fauna and flora
South Barrow Loan and Ext Powers Ordinance 12 of 1920	Regulates water pollution	Rivers and wetlands

Instrument	Key objective	Feature
South Shepstone Loan and Extended Powers Ordinance 20 of 1920	Regulates water pollution and other pollutants	Rivers and wetlands
Water Services Ordinance 27 of 1963	Regulates matters relating to water , water pollution and sewage	Rivers and wetlands
Kloof Loan and Extended Powers Ordinance 16 of 1967	Regulates water pollution and other pollutants	Rivers and wetlands
Umhlanga Extended Powers and Loan Ordinance 17 of 1975	Regulates water pollution within Umhlanga and surrounding areas	Rivers and wetlands
Durban Extended Powers Cons Ordinance 18 of 1976	Regulates water pollution and other pollutants	Rivers and wetlands
Kwa-Zulu and Natal Joint Services Act 84 of 1990	Regulates pollution of land water and waste management	Rivers and wetlands
Northern Cape Province		
Divisional Councils Ordinance 18 of 1976	Provides for the regulation and control of effluents refuse and storm water	EGI development affecting rivers and wetlands
Nature and Environmental Conservation Ordinance (Ordinance 19 of 1974; amended in 2000).	This ordinance is applicable in the Western Cape, Eastern Cape, Northern Cape and parts of the North West Province. This ordinance provides measures to protect the natural flora and fauna, as well as listing nature reserves in these provinces. This ordinance was amended in 2000 to become the Nature Conservation Laws Amendment Act. Lists of endangered flora and fauna can be found in this act.	Species diversity

5 IMPACT CHARACTERISATION

The impacts associated with EGI range from those that are direct (e.g. pylon construction and clearing areas for servitudes) to those that are more subtle (indirect) and which occur over longer timeframes (e.g. vegetation compositional changes from continued disturbance/clearing, habitat fragmentation, hydrological alteration, and alien plant infestation). The main impacts to freshwater ecosystems associated with EGI were identified and discussed in detail in the freshwater specialist component of the 2016 EGI SEA (Todd *et al.*, 2016). The majority of the impacts identified in this assessment are relevant to the scope of the present study, and have been contextualised here in relation to the following activities and their associated impacts to aquatic ecosystems and biota.

- **Activity: Construction of substations and pylons and powerline servitudes** – The direct clearing and/or removal of vegetation to allow for the construction of substations and pylons, as well as to establish servitudes to access the pylons and powerlines for on-going maintenance.
- Impacts:
  - Similar impacts to the development of access roads (as below), but differing in terms of extent, duration and intensity.
  - The direct footprint of single pylon supporting a 765 kV powerline is 1 ha (including excavation, assembly and raising), while the development footprint for a substations extends up to 70 ha (including temporary construction camps, borrow pits, vehicle parking, stock piles, etc.).
  - Servitudes for accessing pylons/powerlines will require ongoing vegetation clearing to maintain an eight-metre strip wherein grass/herbaceous vegetation regrowth is cut to a height of 20 cm, and trees in most cases are removed (DEA, 2016).

- **Activity: Developing access roads** – Development of new access roads to enable construction, as well as ongoing maintenance during the operational phase may result in the following impacts:
- Impacts:
  - Direct loss of riparian and wetland vegetation (and associated buffers), including potentially sensitive/important freshwater ecosystems and/or habitat supporting species of conservation concern;
  - Fragmentation of freshwater ecosystems and flow patterns, resulting in an indirect loss of ecological patterns and processes such as species movement and dispersal, habitat connectivity, increased edge effects and disturbance, establishment of invasive alien vegetation, etc.;
  - Stormwater runoff resulting in increased flows (hydrological alteration) within receiving aquatic environments, particularly in relation to runoff discharge points, which in turn has a number of indirect issues such as bank erosion and collapse, scouring and channel incision, headcut erosion, desiccation of wetland/riparian soils and vegetation, increased turbidity, sedimentation and smothering of benthos. The combined effects will negatively affect the ecological integrity and ability of the freshwater ecosystems to function properly;
  - Waste pollution and contamination of aquatic environments from foreign materials (e.g. fuels/hydrocarbons, cement, and building materials) being dumped and/or carried into aquatic environments;
  - Compaction of soils and creation of preferential flow paths with and adjacent to wetland and river habitats; and
  - Direct loss of flora and fauna (including Threatened or other species of conservation concern) that inhabit wetland/river ecosystems and adjacent buffer/fringe habitats, including accidental road kills caused by increased traffic on both existing and new roads.

In addition to the main activities and key impacts resulting from EGI development and operation, other **more specific impacts** that may occur as a result include:

- **Habitat fragmentation** – one of the more concerning issues of linear developments such as transmission lines is the fragmentation of freshwater ecosystems and associated buffers, especially where areas are permanently impacted. This presents a serious issue particularly to fauna, and leads to populations becoming more isolated, resulting in a reduction of inter-population connectivity and compromised genetic viability. For example, inappropriately designed and constructed river crossings could prevent fish from moving/migrating freely within a river system. Habitat fragmentation also has the potential to exacerbate impacts to freshwater ecosystems, such as through altering micro-climatic conditions (e.g. fire, wind, desiccation, etc.). These alterations in turn affect the perimeter of wetland and riparian habitats resulting in edge effects and development of transitional habitats. This presents a favourable situation for invasive alien plants (IAPs) to establish, with knock-on effects for freshwater ecosystem and associated fauna and flora (as discussed in the following point).

- **Habitat alteration and knock-on effects caused by IAPs** – IAPs that already occur in the area are likely to invade newly disturbed areas, by gradual (or even rapid) encroachment into disturbed areas (e.g. temporary construction camps, borrow pits, vehicle parking, stock pile areas, etc.), transitional habitats, as well as around pylons/substations and along access roads. The spread of existing, and the introduction of new problem, plant species may be facilitated by movement of people and construction vehicles. IAP infestation within freshwater ecosystems will further degrade habitats and habitat availability for associated biota. Secondary impacts (or caused by IAPs) include, but are not limited to:
  - Competition with native plant species, especially when considering the severity of allelopathic influences caused by certain IAP (e.g. *Acacia mearnsii*);
  - Shading of banks and instream habitats, which in turn impacts on water temperatures and freshwater fauna and flora that are intolerant;
  - Shift in allochthonous and autochthonous organic compounds within wetland and river ecosystems;
  - Bank instability, erosion and collapse, with exacerbated deposition of sediments and debris; and
  - In more severe cases, reduced water availability due to excessive water consumption from most IAPs (in particular, deep-rooted tree species such as *Eucalyptus* species *(spp.)*).
- **Mortality of fauna** – Earthworks and excavations would mainly affect fossorial fauna (i.e. animal adapted to living underground), as well as small, less-mobile fauna (e.g. amphibians, as well as freshwater obligate reptiles and shrews/rodents). Mortality of fauna from accidental collisions due to the movement of vehicles/machinery across the site would also be an issue for smaller, less mobile species of fauna. Illegal hunting/poaching could also present a significant impact during the construction phase whereby certain personnel/contractors engage in such activities.
- **Disturbance of fauna** – Certain fauna are more susceptible to impacts from increased noise and/or artificial lighting. Artificial lighting in and around substations may for example have a significant impact on normal life cycles of adult forms of aquatic macro-invertebrates, as well as increased mortality rate. Noise impacts will affect noise-sensitive mammals, particularly larger mammals such as Otter species and Servals. Noise and light impacts ultimately result in the displacement of fauna away from the noise impact area, but is expected to be temporary, and restricted to the construction phase.

Rudman *et al.* (2017) highlights additional freshwater impacts associated with concentrated solar power construction sites, which are relevant in this case in terms of the construction of EGI (e.g. pylons, substations, etc.). Main impacts identified by the authors stem from the lack of stormwater management at construction sites leading to erosion and runoff, the use of water for construction and dust suppression, concrete/oil/hydraulic spills, and an overall need for strategic planning of water resource allocation.

Overall, in this study impacts are characterised at the broadest scale in relation to the corridors as a means to identify preferred routings that will have the least possible impact on freshwater ecosystems and/or associated biota. Nevertheless, an inadequately positioned alignment through a particular corridor could potentially impact areas with severe consequences for freshwater biodiversity. Taking this into consideration, it is thus important to acknowledge impacts at a finer scale (i.e. sub-quaternary catchment) in order to identify preferred alignments/positions of EGI within the two respective corridors. Lastly, data within the catchments at a site specific/habitat scale have been interrogated to guide the finer alignment of infrastructure, as well as inform the specialist assessments required and the mitigation measures.

6 CORRIDORS DESCRIPTION

A description of the freshwater ecosystems within corridors that stand to be impacted by the development of EGI in South Africa are presented in Table 5. These descriptions are provided together with a summary of the existing drivers and pressures, relating primarily to land use, within these corridors.

Table 5: Description of freshwater ecosystems and species of the proposed Expanded EGI corridors, including existing drivers and pressures.

Site	Brief description	Existing drivers and pressures
Expansion of Western Corridor	**Rivers** are predominantly non-perennial/ephemeral in character. A small proportion (~10%) of the rivers are classified as perennial/permanently - flowing rivers, largely the Orange River and other smaller rivers (e.g. Doring, Olifants and Sout Rivers). Non-perennial systems that dominate the corridor include the Holgat, Kamma, Buffels Swartlintjies, Groen and Goergap. Most of the river habitats fall within the Namaqua Highland Ecoregion (48%), followed by the Western Coastal Belt (26%), and the Orange River Gorge (16%). Only 4% of the river habitat is considered to be Threatened (i.e. Endangered and Vulnerable). The Doring River and the lower Olifants River are the only flagship/free-flowing rivers in the corridor. The PES of rivers is generally good, with less than 25% of the rivers assessed to be in either a fair, poor or very poor state. **Overall river sensitivity for the Western EGI Corridor is as follows: very high (1%), high (31%), medium (26%), and low (42%).** **Wetland habitats** occupy a low proportion of the corridor (~1%) owing to the xeric climatic conditions of the Succulent Karoo. Nevertheless, the area supports up to 57 wetland types dominated by floodplain wetland habitat along the lower Gariep River and channelled-valley bottom wetlands within the Namaqualand Hardeveld region, as well as a number of endorheic pans that are more unique to the region. One Ramsar wetland occurs within the corridor, and is located at the mouth of the Gariep River. A small proportion of the wetlands in the corridor are characterised as NFEPA wetlands, which predominantly include floodplain wetlands along the Gariep River and seeps within the Namaqualand Hardeveld region. **Overall wetland sensitivity for the Western EGI Corridor is as follows: very high (3%), high (22%), medium (46%), and low (29%).** **Threatened aquatic biota:** One Endangered fish, *Pseudobarbus phlegethon* occurs in the Olifants River, which flows through the extreme south-western corner of the Western EGI Corridor. There are also two Near Threatened fish (i.e. *Labeobarbus seeberi* and *Pseudobarbus serra*) that occur in the corridor. Two notable amphibians occur in the north western parts of the corridor, namely *Breviceps macrops* (Near Threatened), which inhabits sandy habitats along	Approximately 95% of the Western Corridor comprises land that is largely natural, thus only a small proportion is transformed through urbanisation, agricultural and mining developments. Impacts on freshwater ecosystems from associated land use activities of the transformed landscape are relatively localised within the corridor context. More widespread impacts to freshwater systems tend to be linked to livestock farming practices and infestation of IAPs. The combined effect of anthropogenic pressures results in both localised and widespread impacts that affect functioning and integrity of freshwater ecosystems. Key impacts include: • Pollution from application of fertilizers, herbicides and pesticides, as well as point-source discharges from urban centres (e.g. Bitterfontein, Springbok and Vioolsdrif); • Grazing by livestock, particularly high/concentrated levels of along watercourses, causing overgrazing and trampling within and adjacent to river and wetland systems, which in turn leads to increased erosion and changes in vegetation structure (notably, the loss of riparian habitat); • Increases in woody vegetation along rivers, in particular by *Acacia karoo*, as well as infestations of invasive alien species (e.g. *Tamarix* spp. and *Prosopis glandulosa*). These deep-rooted species are able to readily consume groundwater. Heavily infested areas have a significant impact on the hydrology of catchments, as well as outcompeting indigenous species; • More localised, yet severe impacts, linked to sand mining and other mining activities (e.g. alluvial diamond mining at the mouth of the Gariep River and along the west coast); • Groundwater utilisation both for domestic and agricultural

Site	Brief description	Existing drivers and pressures
	Namaqualand coast, and *Breviceps branchi* (Data Deficient), which is only known from a single specimen collected near the Holgat River. One Critically Endangered reptile, *Pachydactylus rangei*, inhabits dry river beds and surrounding dunes/sanding environments in the north western corner of the corridor. The Spotted-necked Otter *Hydrictis maculicollis* (Vulnerable) has been recorded near the mouth Gariep River. Two Vulnerable plants, *Isoetes eludens* and *Oxalis dines*, and four Near Threatened plants occur as a few isolated populations in the corridor. **Overall species sensitivity for the Western EGI Corridor is as follows: very high (0%), high (6%), medium (36%), and low (58%).**	uses; • Construction of weirs and dams along river systems, which alters the natural hydrological flows, which is most notable for the Gariep River as a consequence of numerous, large dams/impoundments in the catchment; and • Road crossings, which cause concentration of surface runoff and localised sheet and gulley erosion in proximity to rivers and wetlands.
Expansion of Eastern Corridor	**Rivers within the Eastern EGI Corridor** are predominantly perennial/permanently-flowing (87%), majority of which occur in the North Eastern Uplands, Lowveld and North Eastern Coastal Belt ecoregions. Major river systems include the Mkuze, Phongolo, Mfolozi, Thukela, Mhlatuze and Mvoti Rivers that drain across the width of the corridor into the Indian Ocean. Up to 16% of the river habitat is considered to be Threatened (i.e. Critically Endangered, Endangered and Vulnerable). This corridor contains the following remaining flagship/free-flowing rivers in the country, namely: the Mfolozi and Thukela River systems, and the Mkuze River and one of its tributaries, the Msunduzi. The PES of rivers is fairly good, with 50% of the rivers assessed to be in a natural/good condition, while 35% are in a fair condition and 15% are in a poor/very poor condition. **Overall river sensitivity for the Eastern EGI Corridor is as follows: very high (21%), high (38%), medium (39%), and low (2%).** **Wetland habitats within the Eastern EGI Corridor** occupy a notable proportion of the corridor (~10%) comprising up to 83 different wetland types dominated by channelled-valley bottom wetlands and floodplain wetlands, particularly within the Indian Ocean Coastal Belt region. The corridor boasts four Ramsar wetlands covering up to 185 000 ha, namely Ndumo Game Reserve, Kosi Bay, Lake Sibaya, and the St. Lucia System. A large proportion (~65%) of the wetlands in the corridor are characterised as NFEPA wetlands, a third of which is made up of channelled-valley bottoms, floodplains, seeps and valley-head seeps within the Indian Ocean Coastal Belt region. **Overall wetland sensitivity for the Eastern EGI Corridor is as follows: very high (3%), high (22%), medium (54%), and low (21%).** **Threatened aquatic biota:** The only Critically Endangered Odonata for South Africa occurs along the Phongolo River in the north-western corner of the Eastern EGI Corridor, namely *Chlorocypha consueta*. The Endangered *Diplacodes pumila* also occurs in the corridor along with seven species listed as Vulnerable and four species listed as Near Threatened. Two Endangered fish,	Approximately 65% of the Eastern Corridor comprises land that is largely natural, with a significant proportion of the area protected by existing conservation areas (e.g. Isimangaliso Wetland Park, Hluhluwe-Imfolozi Game Reserve, Tembe Elephant Park, Ndumo Game Reserve, Ithala Game Reserve). The remaining area has been transformed largely by cultivation, plantations, urbanisation and rural settlements. Impacts on freshwater ecosystems caused by land use activities associated within these transformed areas vary across the landscape, however, combined effect has had a significant effect on freshwater ecosystem functioning and integrity. Key impacts include: • Extensive urbanisation causing transformation and degradation of freshwater ecosystems, notably in the greater Durban region, which continues to expand up along the coast, as well as Richards Bay; • Water quality impacts and pollution associated with urban areas (e.g. domestic and industrial effluents, failing water treatment infrastructure, etc.) and agriculture (e.g. pesticides, herbicides and fertiliser applications) all of which are contaminating receiving aquatic environments; • Flow alteration caused by large impoundments (e.g. Inanda, Hazelmere and Goedertrouw and Pongolapoort Dams), inter-basin transfers, WWTW return flows, and stormwater runoff from hardened surfaces and sewer reticulation, all of which affect downstream aquatic systems (e.g. channel characteristics, riparian vegetation, and instream and floodplain habitats) as well as river continuity;

Site	Brief description	Existing drivers and pressures
	Marcusenius caudisquamatus and *Silhouettea sibayi*, occur predominantly within coastal rivers within the corridor, as well as two species listed as Vulnerable, including the widespread *Oreochromis mossambicus*. The corridor also supports three Near Threatened and two Data Deficient fish species. Two Endangered amphibians, *Hyperolius pickersgilli* and *Natalobatrachus bonebergi*, also occur along the coastal areas, while the Endangered *Leptopelis xenodactylus* occurs more inland at isolated localities. Threatened reptiles include *Bradypodion melanocephalum*, which often occurs in vegetation along rivers and adjacent to wetlands, and *Pelusios rhodesianus*, which is known from a few water bodies along the coastal region – both are listed as Vulnerable. Up to eight Red Listed mammals occur within the Eastern Corridor, including five rodents/shrews, as well as Spotted-necked Otter *Hydrictis maculicollis* and Cape Otter *Aonyx capensis*. One Critically Endangered plant, *Kniphofia leucocephala*, occurs in isolation in the Richards Bay area. There are also five Endangered, 16 Vulnerable, 12 Near Threatened freshwater plants occurring within the corridor. **Overall species sensitivity for the Eastern EGI Corridor is as follows: very high (23%), high (11%), medium (30%), and low (36%).**	• Cultivation of wetlands and floodplains (notably sugarcane), especially along the coastal region; • Illegal sand mining, as well as and other mining activities, particularly in the Richards Bay region; • Transformation and alteration of watercourses through canals, diversion structures, weirs, road crossings, flood control berms; • Abstraction of water for irrigation and extensive forestry, which has a significant impact on groundwater and linked wetlands in the Maputaland region; • Erosion and degradation, especially linked to overgrazing, which is notable in the more rural areas; and • Excessive infestation of numerous IAPs, particularly along rivers and around wetlands, as well as instream (e.g. Water Hyacinth).

7 FEATURE SENSITIVITY MAPPING

7.1 Identification of feature sensitivity criteria

Table 6 provides a list and description of the sensitivity criteria considered during this assessment for the proposed Expanded EGI corridors.

Table 6: Data and criteria used to assign sensitivity to freshwater ecosystems within the proposed Expanded EGI corridors.

Category	Feature Class	Data Source + Date of Publications	Data Description, Preparation and Processing
Freshwater ecosystems	Wetlands	Combined wetlands layer comprising: NFEPA (2011); Provincial Wetland Probability Mapping (2017); Fine scale planning - Western Cape (2017); Conservation Plans, Biodiversity Sector Plans (BSP's), and Critical Biodiversity Areas (CBA's) and Ecological Support Areas (ESAs) - KZN (2007) and Northern Cape (2016); National wetland vegetation groups (2012); KZN wetlands/vegetation types (2011); KZN Priority Wetlands; Ramsar Sites.	The combined wetland layer was processed according to two metrics as described in more detail in Section 4.1. **Threat:** National Wetland Vegetation Groups (2012) **Sensitivity:** Ramsar wetlands, Threatened wetlands, Irreplaceable and Optimal CBAs as aquatic features, KZN priority wetlands, NFEPA wetlands, ESAs as aquatic features, wetland probability mapping, and ONAs as aquatic features.
	Rivers	PES, EI and ES DWS Resource Quality Information Services (2014), using the NFEPA rivers coverage (2011)	Metrics were applied that integrate data pertaining to river ecosystems to define river threat status and river importance/sensitivity (as described in Section 4.1). PES, river types and river length were used to derive river threat using updated PES data (2014) based on thresholds defined in the 2011 NBA. River sensitivity/importance was based on the 2014 EI and ES dataset. Overall river sensitivity scores were determined as: Threat Score (PES score and river length as per NBA) + (EI+ES score/ Stream Order)
Freshwater biota	Flora: Plants	Raimondo *et al.* (2009), with spatial data provided by SANBI (2018) as part of the TSP database	Species of conservation concern, and their respective conservation status (i.e. CR, EN, VU, NT, DD and rare), that inhabit freshwater ecosystems and adjacent fringe habitats/ buffers were selected based on known point localities, and assigned to sub-quaternary (SQ4) catchments. The SQ4
	Fauna: Aquatic macro-invertebrates	DWS Resource Quality Information Services (2015)	

Category	Feature Class	Data Source + Date of Publications	Data Description, Preparation and Processing
	Fauna: Odonata	IUCN (2017) and Samways and Simaika (2016), with spatial data provided by SANBI (2018) as part of the TSP database	catchments were then classified into four sensitivity classes based on presence/ absence of selected freshwater fauna and flora (i.e. low = no occurrence, medium = rare or NT, high = VU or EN, very high = CR or DD). See approach and methodology section for more details pertaining to data preparation and processing applied to each of the taxonomic groups. ASPT values for aquatic macro-invertebrate families as recorded from various river sampling sites was used to defined importance/sensitivity of DWS Level 2 Ecoregions.
	Fauna: Fish	Coetzer (2017), with spatial data provided from the SAIAB, and International Union for the Conservation of Nature (2017).	
	Fauna: Amphibians	Minter *et al.* (2004), with spatial data provided by SANBI (2018) as part of the TSP database	
	Fauna: Reptiles (freshwater ecosystem obligate)	Bates *et al.* (2014), with spatial data provided by SANBI (2018) as part of the TSP database	
	Fauna: Mammals (freshwater ecosystem obligate)	Child *et al.* (2016), with spatial data provided by SANBI (2018) as part of the TSP database	

The feature types considered in the sensitivity analysis and the rating given to each feature and buffered area is indicated in the table below.

Table 7: Sensitivity ratings assigned to freshwater ecosystem features in both the proposed Expanded EGI corridors.

Feature Class	Feature Class Sensitivity	Buffer Distance Sensitivity
Wetlands: Critically Endangered wetlands and Irreplaceable CBAs (aquatic)	Very High	200 m
Wetlands: Ramsar wetlands, KZN priority wetlands, Endangered or Vulnerable wetlands, Optimal CBA (aquatic)	High	100 m
Wetlands: NFEPA wetlands, Near Threatened wetlands and ESA (aquatic)	Medium	50 m
Wetlands: probable wetland, non-NFEPA wetlands, least threatened wetlands, ONA (aquatic), formally protected aquatic features	Low	32 m
River ecosystems (including instream and riparian habitats)	Very High	200 m
	High	100 m
	Medium	50 m
	Low	32 m
Freshwater fauna and flora: Critically Endangered or Data Deficient species	Very High	N/A – all species of conservation concern localities are assigned to sub-quaternary (SQ4) catchments, thereby presenting a variable buffer.
Freshwater fauna and flora: Endangered or Vulnerable species	High	
Freshwater fauna and flora: Near Threatened or Rare species	Medium	
Freshwater fauna and flora: Least Threatened species	Low	

7.2 Feature maps

7.2.1 Expanded Western Corridor

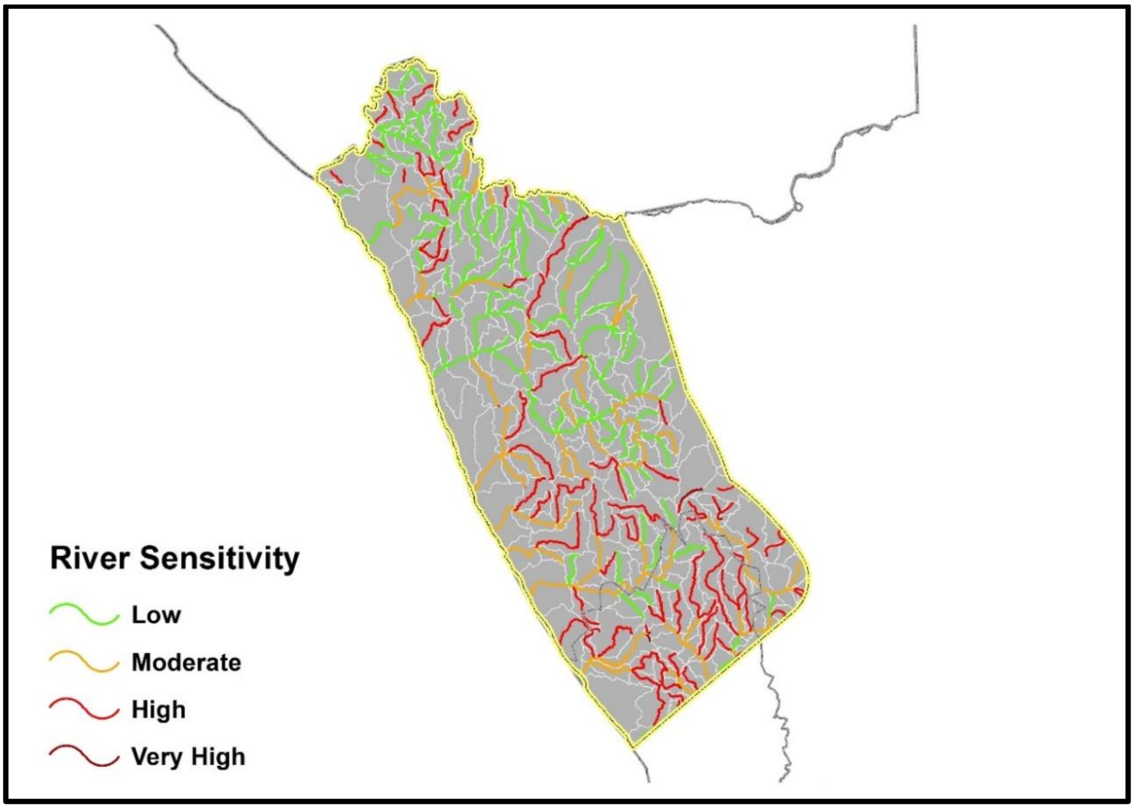

Figure 2: River threat status and sensitivity calculated for the expanded western EGI corridor using PES, EI and ES data from DWS (2014).

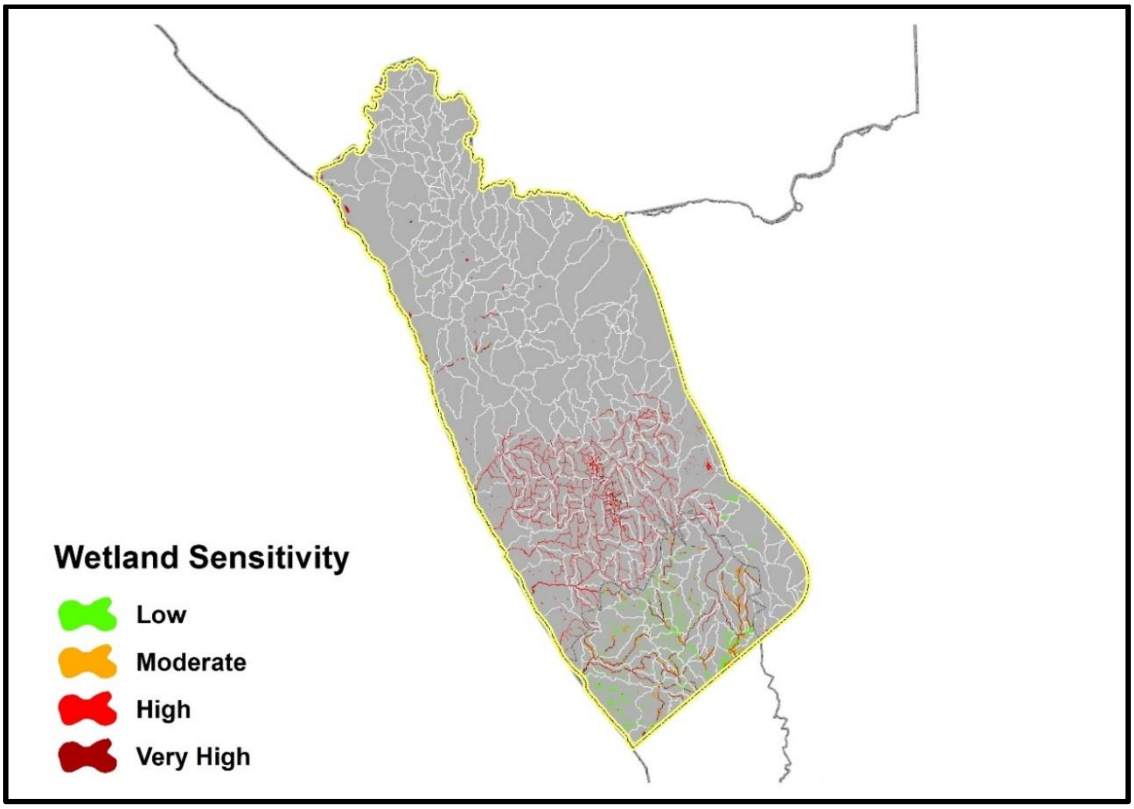

Figure 3: Wetland threat status and sensitivity calculated for wetland features in the expanded western EGI corridor.

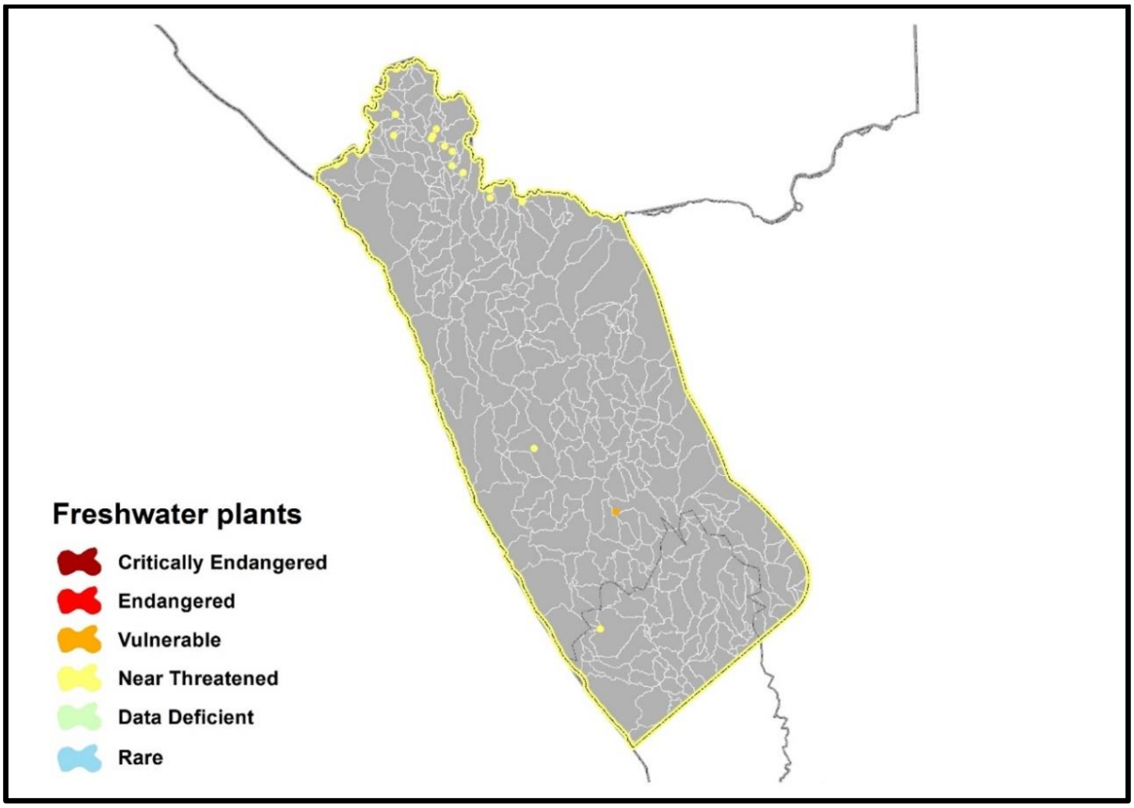

Figure 4: Occurrence of freshwater plants of conservation concern in the expanded western EGI corridor.

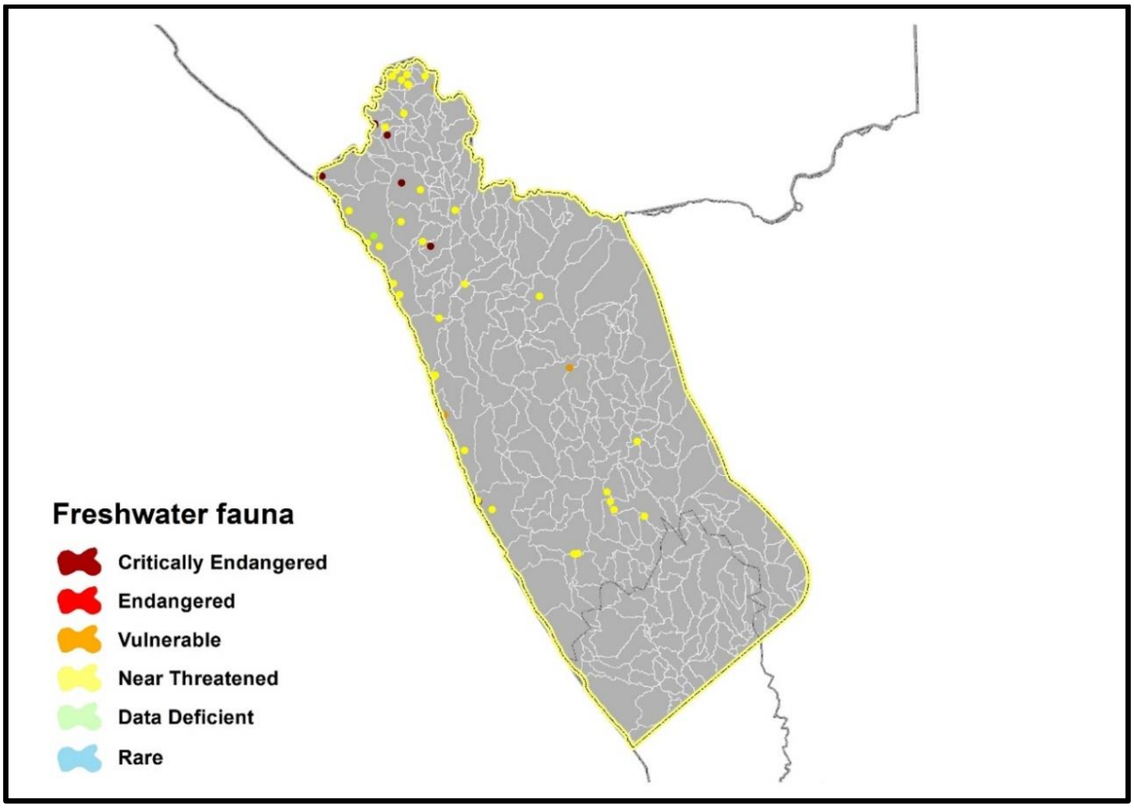

Figure 5: Occurrence of freshwater fauna (dragonflies, damselflies, fish, amphibians, reptiles and mammals) of conservation concern in the expanded western EGI Corridor.

7.2.2 Expanded Eastern Corridor

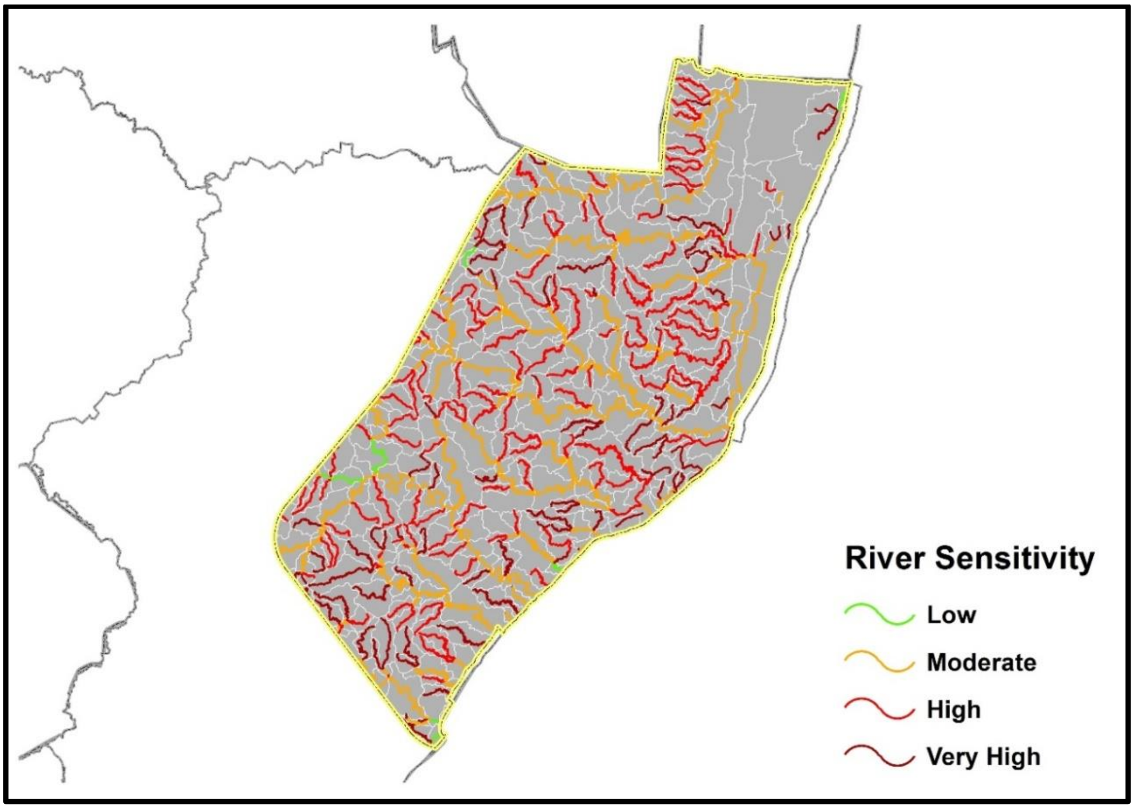

Figure 6: River threat status and sensitivity of river features calculated for the expanded eastern EGI corridor using PES, EI and ES data from DWS (2014).

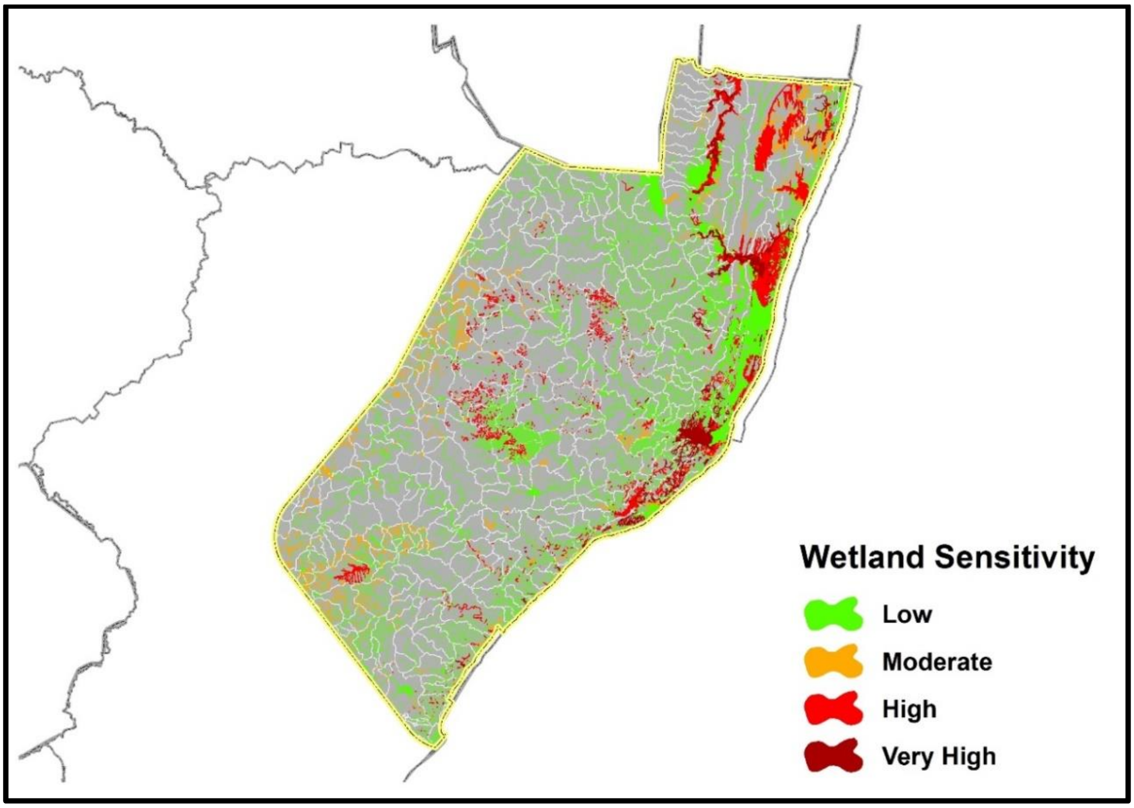

Figure 7: Wetland threat status and sensitivity calculated for wetland features in the expanded eastern EGI corridor.

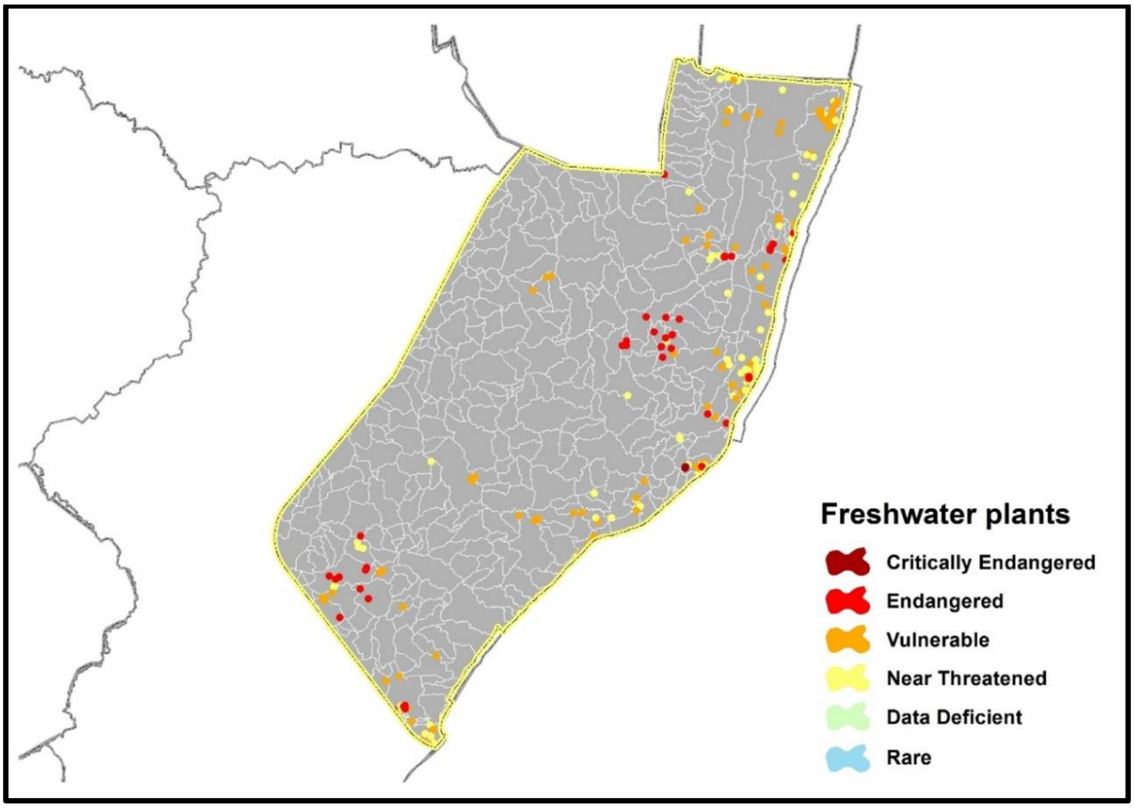

Figure 8: Occurrence of freshwater plants of conservation concern in the expanded eastern EGI corridor.

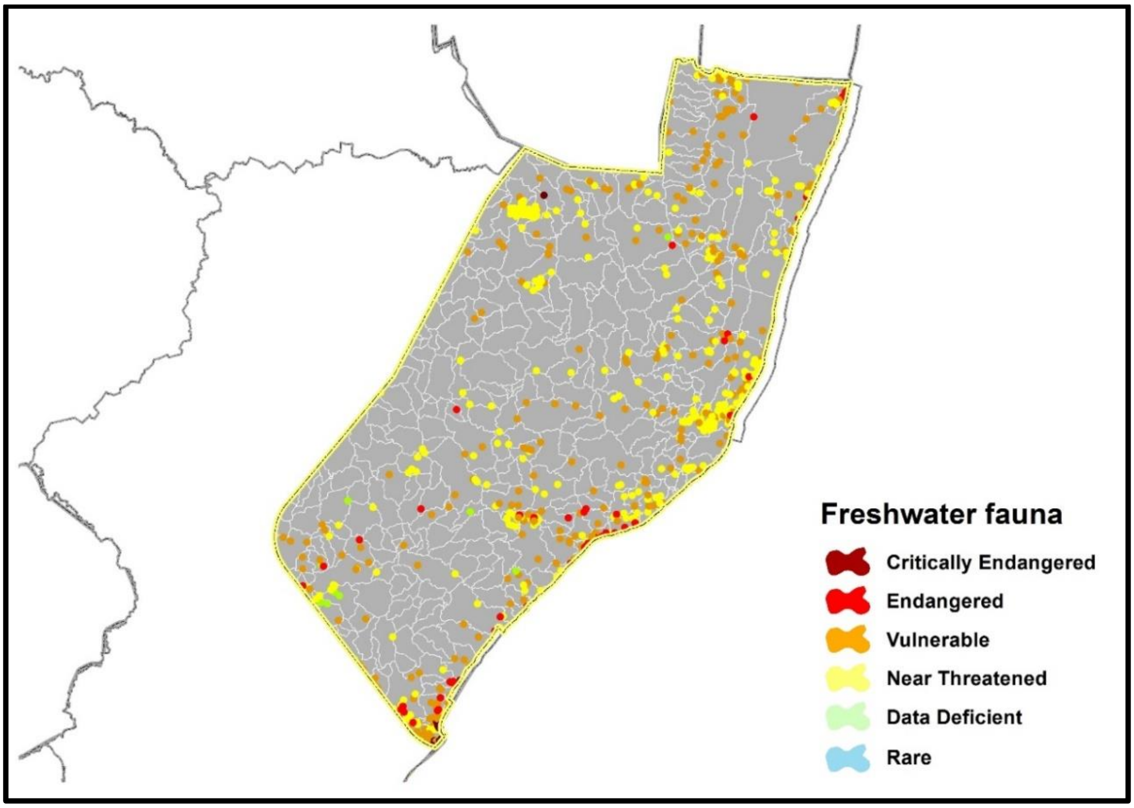

Figure 9: Occurrence of freshwater fauna (dragonflies, damselflies, fish, amphibians, reptiles and mammals) of conservation concern in the expanded eastern EGI Corridor.

8 FOUR-TIER SENSITIVITY MAPPING

8.1 Expanded Western Corridor

8.1.1 Rivers

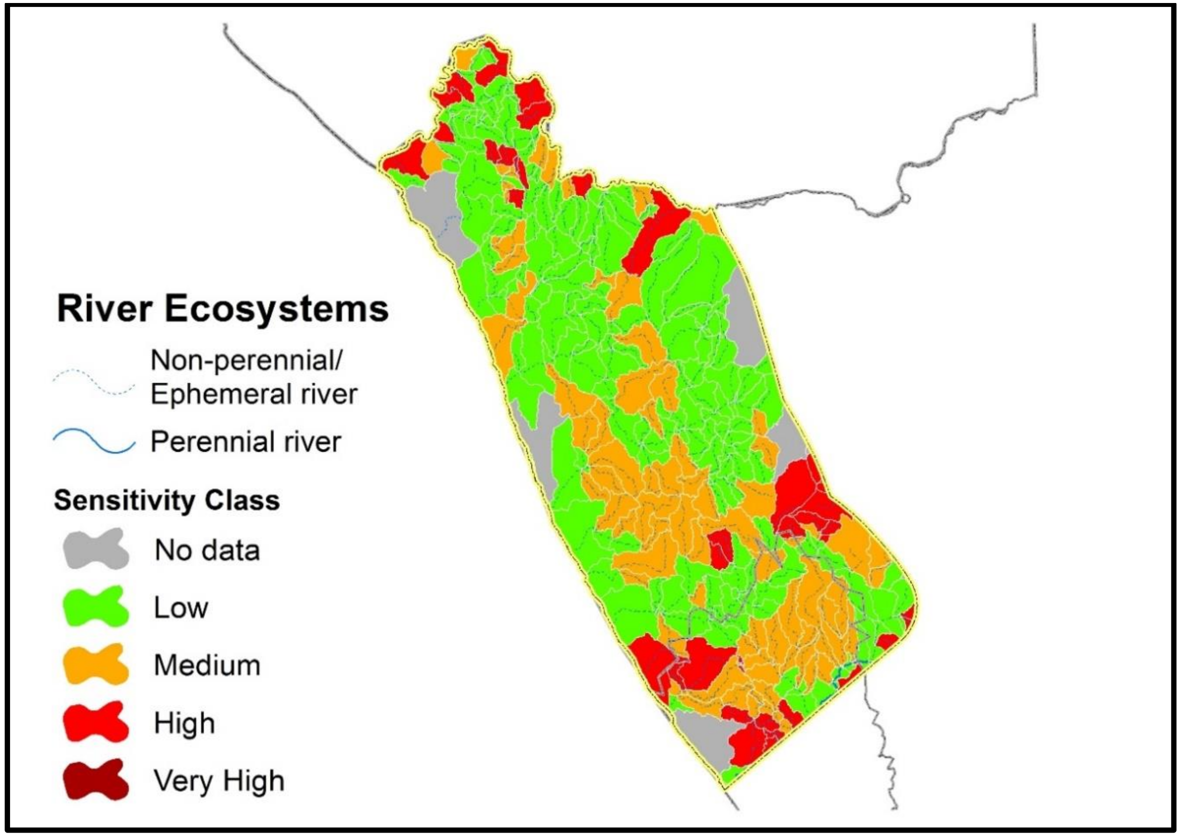

Figure 10: River threat status and sensitivity calculated for sub-quaternary catchments in the expanded western EGI corridor using PES, EI and ES data from DWS (2014).

8.1.2 Wetlands

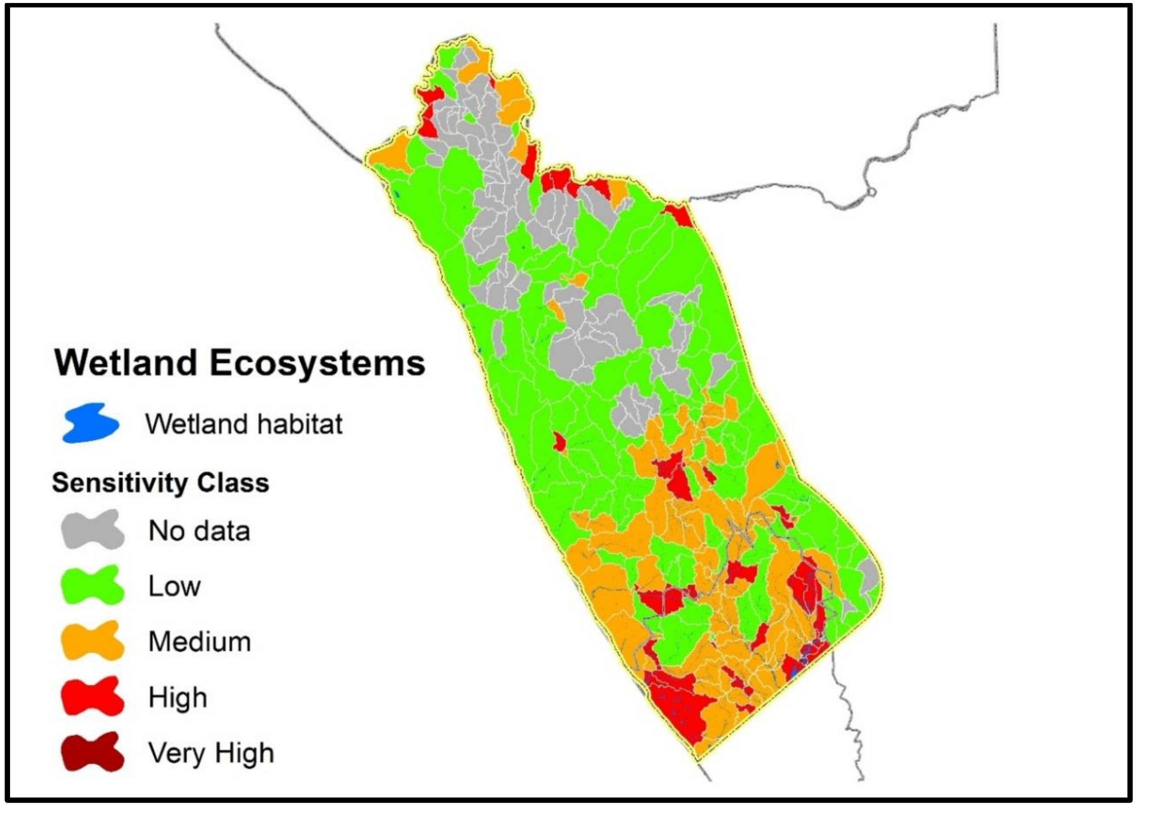

Figure 11: Wetland threat status and sensitivity calculated in relation to areas of sub-quaternary catchments in the expanded western EGI corridor.

8.1.3 Freshwater biota (fauna and flora)

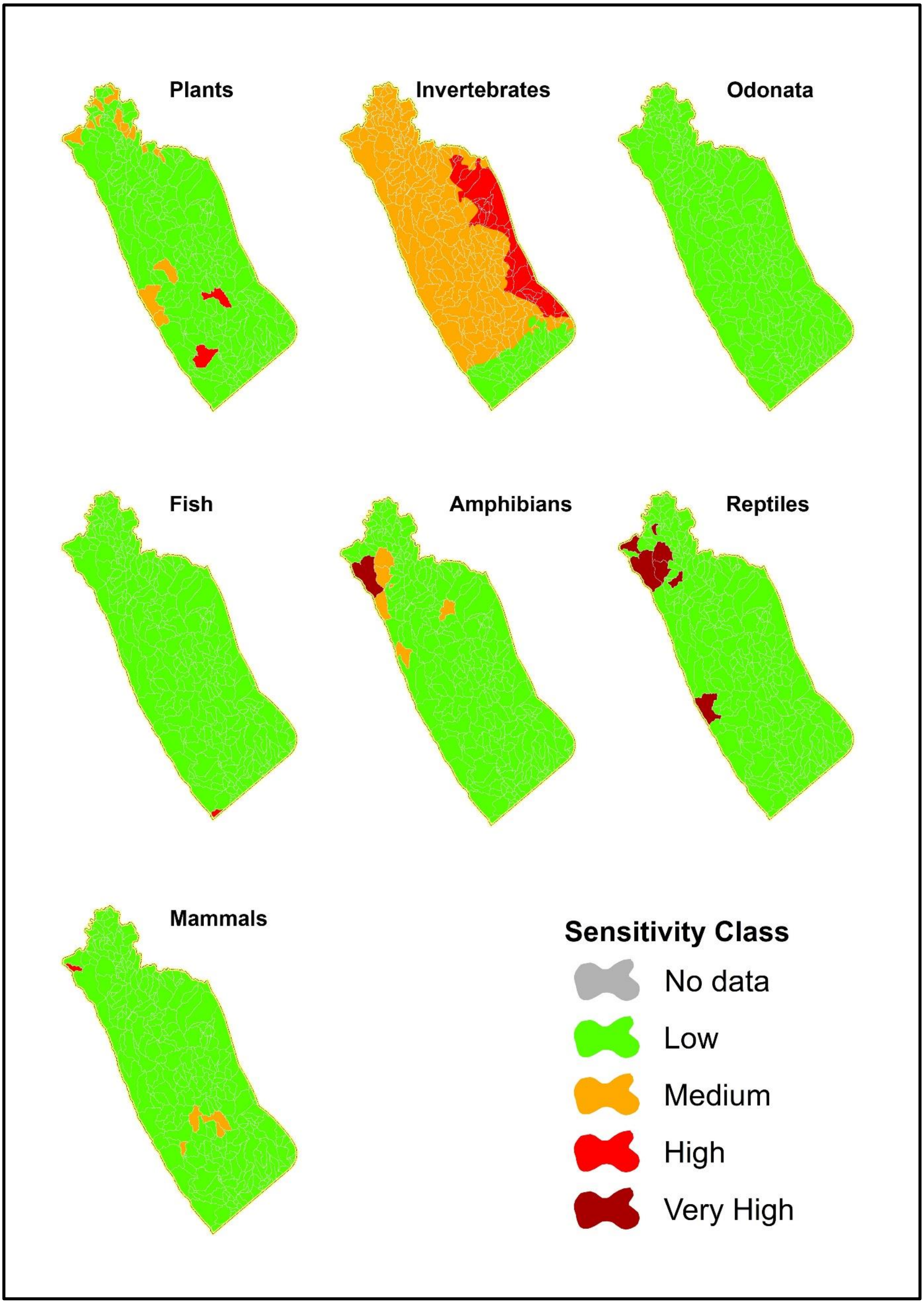

Figure 12: Threat and sensitivity status calculated for different freshwater taxonomic groups (flora and fauna) in the expanded western EGI corridor in relation to sub-quaternary catchments.

8.1.4 Freshwater ecosystems and biota (combined)

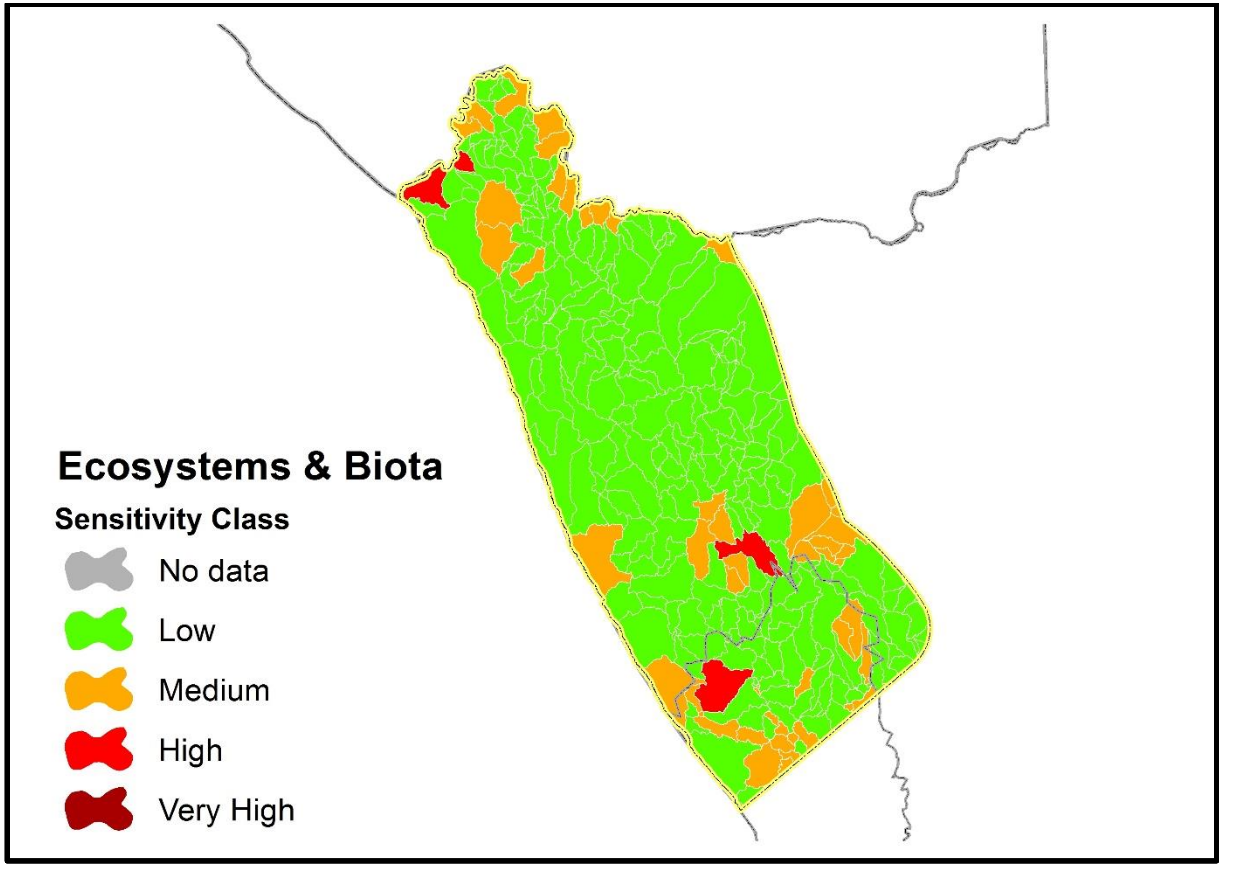

Figure 13: Integrated sensitivity and threat status map for freshwater ecosystems and biota in the expanded western EGI corridor.

8.2 Expanded Eastern Corridor

8.2.1 Rivers

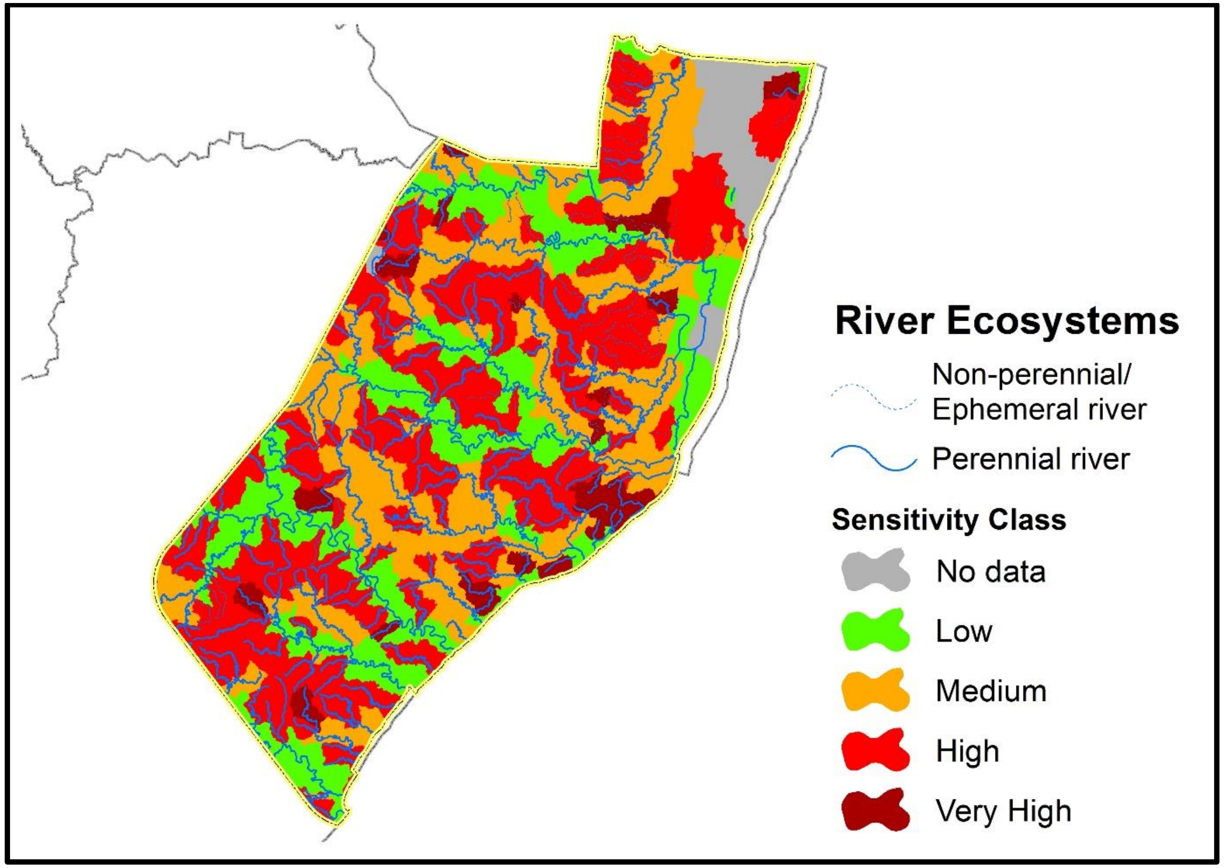

Figure 14: River threat status and sensitivity calculated for sub-quaternary catchments in the expanded eastern EGI corridor using PES, EI and ES data from DWS (2014).

8.2.2 Wetlands

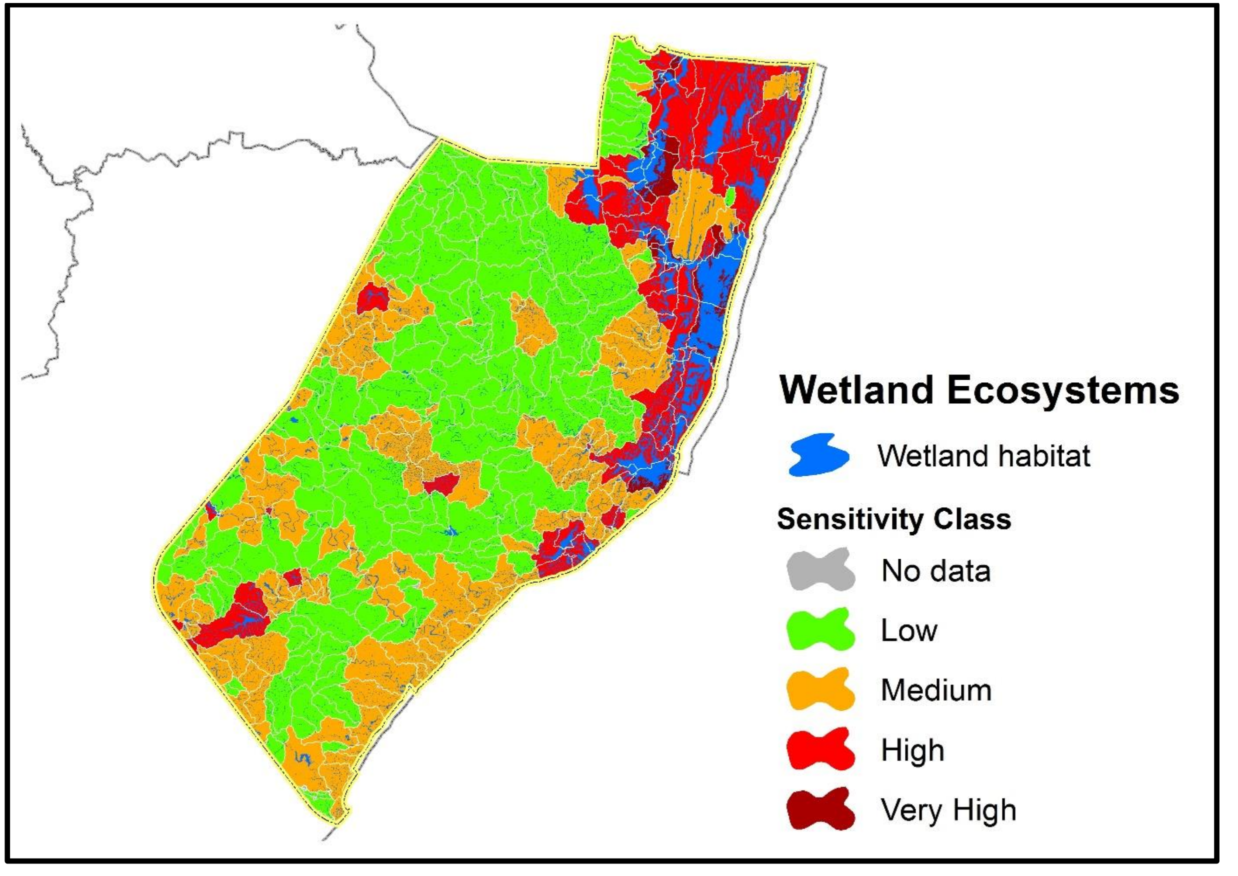

Figure 15: Wetland threat status and sensitivity calculated in relation to areas of sub-quaternary catchments in the expanded eastern EGI corridor.

8.2.3 Freshwater biota (fauna and flora)

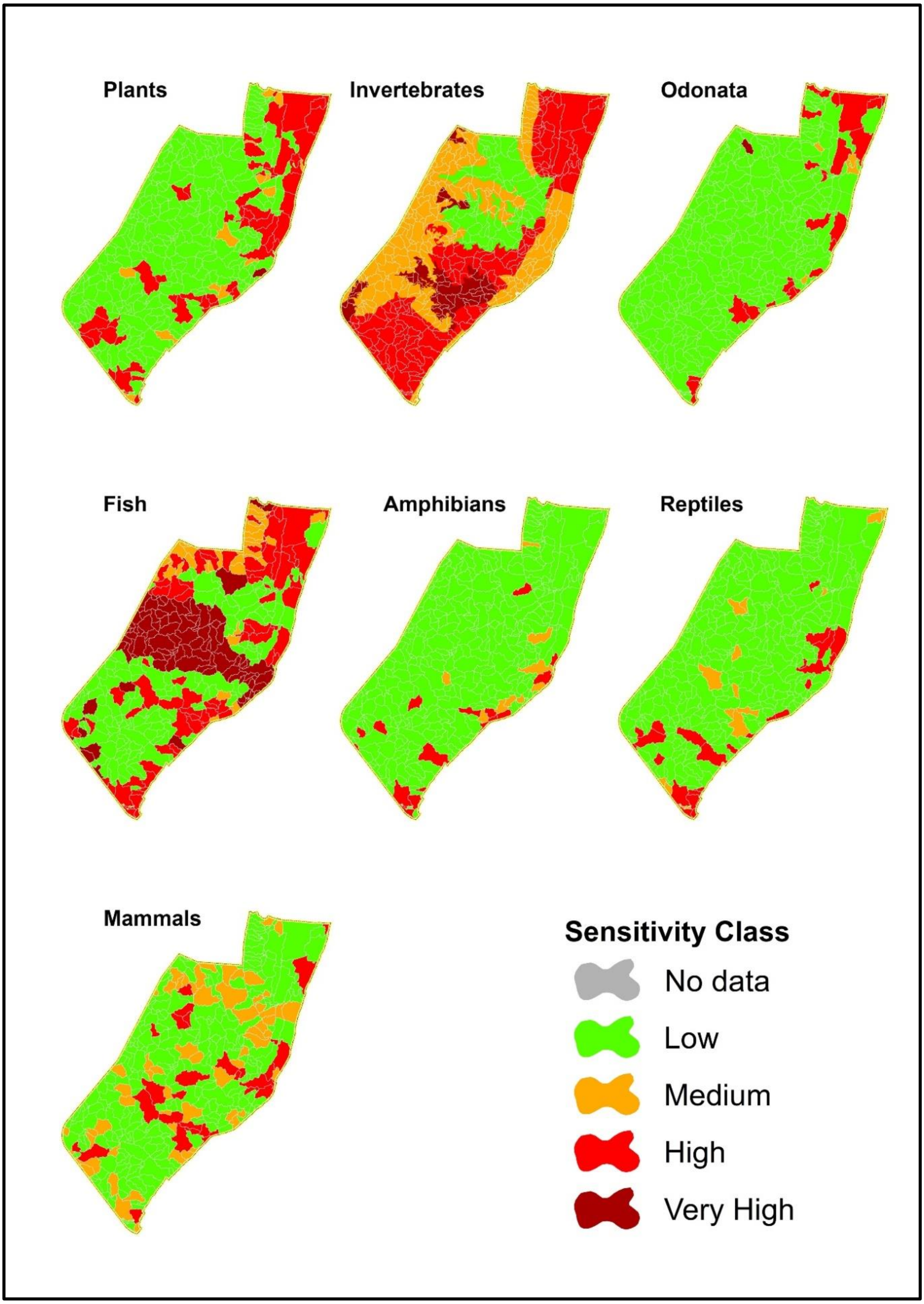

Figure 16: Threat and sensitivity status calculated for different freshwater taxonomic groups (flora and fauna) in the expanded eastern EGI corridor in relation to sub-quaternary catchments.

8.2.4 Freshwater ecosystems and biota (combined)

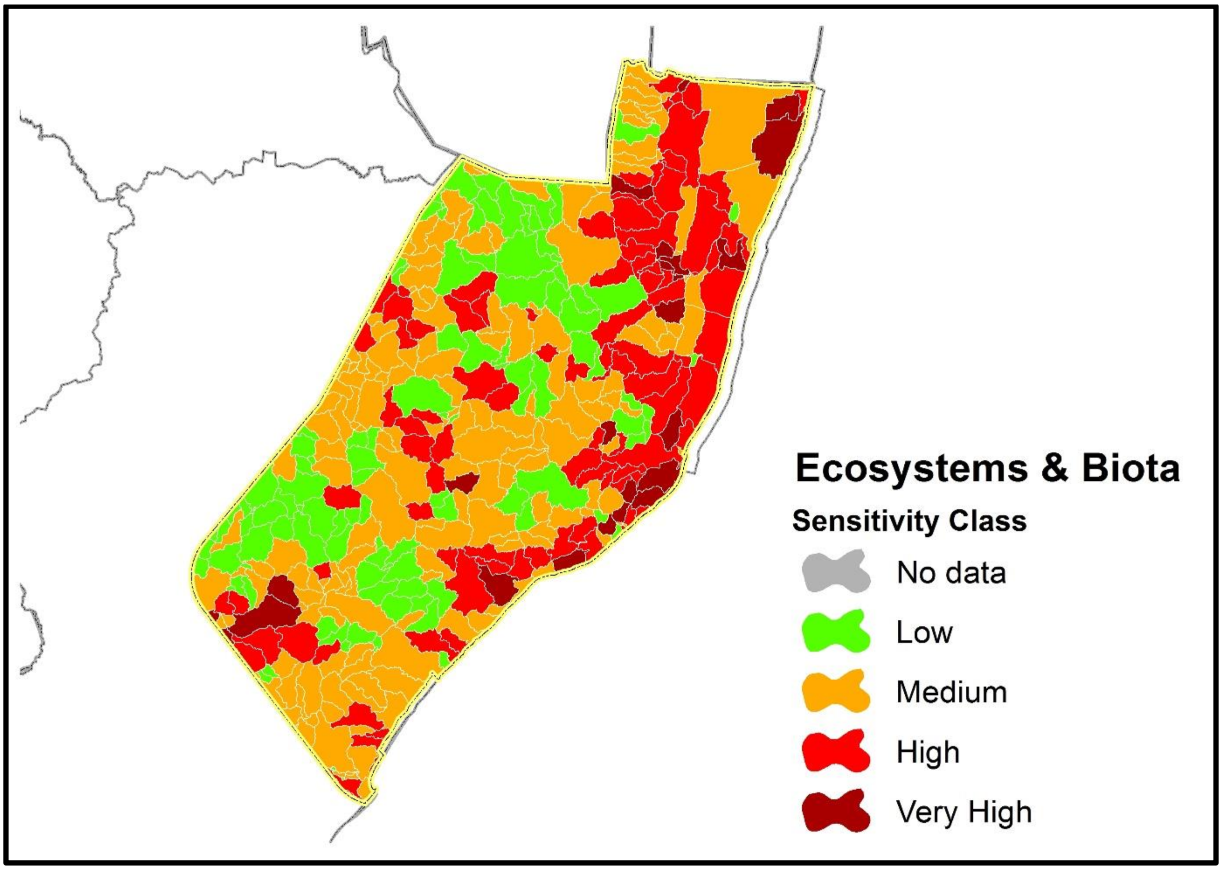

Figure 17: Integrated sensitivity and threat status map for freshwater ecosystems and biota in the expanded eastern EGI corridor

9 KEY POTENTIAL IMPACTS AND MITIGATION

The following table provides detail in terms of key impacts and possible effects on freshwater ecosystems and associated fauna and flora that are linked to Expanded EGI project phases and developmental activities. Mitigation measures are included to ensure that impacts are avoided where necessary and/or minimised in terms of mitigation hierarchy. Site-specific concerns regarding freshwater biodiversity that is of particular importance/sensitivity are also provided according to each corridor as a summary of the sensitivity maps as presented in Sections 7 and 8.

Table 8: Key potential impacts to freshwater ecosystems by EGI development and respective mitigation measures.

Project Phase	Activity	Key Impact	Possible Effect	Site Specific Description Summary	Mitigation
Design phase	Placement of substations, foundations for pylons, construction camps and access roads within or close to wetlands or rivers (including associated buffer habitat).	Loss of freshwater habitat through clearing/ infilling of wetlands and rivers and associated buffer habitat, potentially including threatened/ sensitive ecosystems.	Removal of wetland and riparian vegetation, instream habitat, as well as adjacent terrestrial buffer habitat which could result in a loss of ecological functions and processes, freshwater biota (i.e. fauna and flora), and valuable ecosystem services.	Western Corridor: In terms of freshwater ecosystems the Western Corridor is dominated by non-perennial (or ephemeral) river systems, some of which are Endangered on the basis that they are represent a specific type of river habitat that is in a natural/near-natural condition. These are largely along the eastern sections of the corridor (e.g. the Kirrie and Saraip se Laagte). Other notable rivers include sections of the Brak, Buffels, Groen, Skaap and Swartlintjies, located roughly in the centre of the corridor and currently in a natural condition. Only a very small proportion of the Western Corridor supports wetland habitat. Nevertheless this includes isolated occurrences of highly sensitive endorheic pans along the western boundary of the corridor that are associated with the Critically Endangered Northwest Sand Fynbos, as well as floodplain wetlands along the Gariep River that are part of the Endangered Gariep Desert. One Ramsar wetland occurs just upstream of the mouth of the Gariep River, and a small proportion of wetlands are characterised as NFEPAs, predominantly in the form of the floodplain wetland along the Gariep River and seeps within the Namaqualand Hardeveld region.	Sub-corridors to avoid catchments with very high sensitivity, and try to avoid catchments with a medium to high sensitivity. However, where this is unavoidable, placement of pylons and infrastructure within these catchments (as well as catchments with a low sensitivity) should as far as possible avoid freshwater ecosystems or areas of these systems that are deemed to be sensitive or of concern (as a result of separate groundtruthing/assessments) as well as their associated buffers.. Other mitigation measures can include specific design features, reduced development footprints, options for specific placement of infrastructure relative to the identified threat.(i.e. a sensitive frog species may have a specific habitat requirement in a small area which can be worked around). Sub-corridor screening, validation and walk-throughs may be required to determine buffer areas, sensitivity etc.
		Fragmentation of aquatic habitat (which may result from clearance due to road construction, and	Loss of ecosystem resilience and integrity through the disruption of		Avoid and/or minimise road crossings through wetlands and rivers. Where this is not

Project Phase	Activity	Key Impact	Possible Effect	Site Specific Description Summary	Mitigation
		other activities).	biodiversity patterns and processes (e.g. fish movement/ migration)	There are no known freshwater flora occurring within the Western Corridor that are either Critically Endangered, Endangered or Data Deficient. Only two exceptional freshwater fauna occur in the corridor, namely the Data Deficient amphibian, *Breviceps branchi*, and the Critically Endangered reptile, *Pachydactylus rangei*. Eastern Corridor: Extensive areas of the Eastern Corridor support wetlands of international, national and regional significance, including four Ramsar wetlands, KZN priority wetlands, Critically Endangered wetlands (e.g. Swamp Forests, Lowveld Riverine Forest, and Lowveld Floodplain Grasslands).	possible, ensure that appropriate crossings are constructed to minimise impacts, as well as to ensure connectivity and avoid fragmentation of ecosystems, especially where systems are linked to a river channel. Designs to consider use of riprap, gabion mattresses, with pipe crossings or culverts. As far as possible ensure access roads are linked to existing river crossings (e.g. bridges) to minimise disturbance from additional crossings.
		Hydrological alteration largely through interrupted surface and/or subsurface water flows, as well as the concentration of water flows due to roads traversing wetlands or rivers.	Flow changes result in degradation of the ecological functioning of aquatic ecosystems that rely on a specific hydrological regime to maintain their integrity. This also leads to geomorphologic impacts within systems.	The Eastern Corridor also contains a number of river systems that generally flow in an easterly direction into the Indian Ocean. Included is the Nsuze River, a pristine/near-natural system that flows through the central parts of the corridor. Other notable rivers include several NFEPA rivers, which are nationally recognised as “flagship” rivers (e.g. Thukela, Black Mfolozi and Mkuze Rivers). Exceptional freshwater flora that occur within the Eastern Corridor include the only known population of the Critically Endangered *Kniphofia leucocephala* at Langepan Vlei near Richards Bay, as well as several Endangered species such as *Albizia suluensis, Asclepias*	Avoid and/or minimise road crossings through wetlands and rivers. Minimise the number of watercourse crossings for access roads. Ensure adequate watercourse crossings (i.e. culverts of the correct specification) are designed and constructed where roads traverse these areas so that the concentration of flow (particularly during high flow conditions) is minimised as far as possible.
		Erosion caused by loss of vegetation cover through site	Alterations in moisture availability and soil		Avoid clearing of indigenous vegetation where possible Bank

Project Phase	Activity	Key Impact	Possible Effect	Site Specific Description Summary	Mitigation
		clearing and consequent sedimentation of aquatic ecosystems. Erosion is particularly a high risk in steep systems, and in drainage lines that lack channel features and are naturally adapted to lower energy runoff with dispersed surface flows (such as unchannelled valley-bottom wetlands).	structure can promote the invasion of weedy and/or alien species at the expense of more natural vegetation and thus a loss of habitat integrity and/or biodiversity.	*gordon-grayae, Geranium ornithopodioides, Kniphofia latifolia* and *Mondia whitei.* Exceptional freshwater fauna that occur within the Eastern Corridor include the only Critically Endangered dragonfly for South Africa, *Chlorocypha consueta*, which occurs along the Phongolo River in the north-western corner of the corridor. Other notable freshwater fauna include the Endangered dragonfly, *Diplacodes pumila*, the Endangered fish, *Marcusenius caudisquamatus* and *Silhouettea sibayi*, and the Endangered amphibians, *Hyperolius pickersgilli, Natalobatrachus bonebergi,* and *Leptopelis xenodactylus.*	stabilisation measures (gabions, eco logs, geofabric, sediment fences) are required when wetland or watercourse banks steeper than 1:5 are denuded during construction. Appropriate rehabilitation procedures/measures should be planned which may include relocation of sensitive plant species.
Construction phase	Establishment of construction camps or temporary laydown areas within or in close proximity to wetlands or rivers	Physical destruction or damage of freshwater ecosystems by workers and machinery operating within or in close proximity to wetlands or drainage lines, and through the establishment of construction camps or temporary laydown areas within or in close proximity to wetlands or watercourses.	Loss of both faunal and floral biodiversity and the ecosystem services provided by these habitats directly through clearing, and indirectly through poaching/hunting.		All wetlands and watercourses should generally be treated as "no-go" areas and appropriately demarcated as such. However, with additional screening/groundtruthing assessments there may be an opportunity to apply for special permits to work in and around these areas if avoidance is not possible. No vehicles, machinery, personnel, construction materials, cement, fuel, oil or waste should be allowed into these areas without the express permission of and supervision by an on-site Environmental Control Officer (ECO). All construction activities (including establishment of construction camps, temporary

Project Phase	Activity	Key Impact	Possible Effect	Site Specific Description Summary	Mitigation
					lay-down areas, construction of haul roads and operation of heavy machinery), should take place during the dry season to reduce potential impacts to freshwater ecosystems, if possible. Furthermore, construction camps, toilets, temporary laydown areas and haul roads should be located outside of the recommended buffer areas around wetlands and watercourses, and should be rehabilitated following construction.
	Stockpiling of materials and washing of equipment within or in close proximity to wetlands or watercourses	Pollution (water quality deterioration) of freshwater ecosystems through the runoff of contaminants such as fuel, oil, concrete, wash-water, sediment and sewage into these ecosystems.	Habitat degradation which results in the loss of resilience of ecosystems through the disruption of ecological processes and thus a loss of ecosystem integrity		Stockpiling and washing areas should be clearly demarcated and sign posted. These areas should be set back outside of the buffer zone of freshwater ecosystems - 30 m of the edge of any wetlands or drainage lines/rivers. No vehicles, machinery, personnel, construction material, cement, fuel, soap/detergents, oil or waste should be allowed outside of the demarcated stockpiling/washing areas.
	Construction of haul roads for movement of machinery and	Reduction in habitat quality through erosion and sedimentation of wetlands and rivers			There should be as little disturbance to surrounding vegetation as possible when construction activities are

Project Phase	Activity	Key Impact	Possible Effect	Site Specific Description Summary	Mitigation
	materials	Excessive dust generation from road construction and vehicle traffic/haulage leading to impact on surrounding vegetation health and suspended solids/sediment entering nearby watercourses			undertaken, as intact vegetation adjacent to construction areas will assist in the control of sediment dispersal from exposed areas. Furthermore dust suppression methods (e.g. spraying surfaces with water) should be used to minimise the transport of wind-blown dust
	Excavation of borrow pits for road construction	Can act as pitfall traps for amphibians and other terrestrial species leading to unnecessary death of species.			Excavations and construction of borrow pits for road construction should be located outside of the recommended buffer areas around wetlands and watercourses and should be rehabilitated following construction. Pits or excavations should be checked regularly by the on-site ECO and plans put in place for species rescue and relocation.
	Operation of heavy machinery within or in close proximity to wetlands or watercourses and placement of associated vehicle maintenance/ refuelling depots	Disturbance of aquatic and semi-aquatic fauna, as a result of the noise from construction teams and their machinery working within or in close proximity to wetlands and rivers. Damage to vegetation from operating heavy machinery			As far as possible heavy machinery should not be operated in wetlands / water course and their associated buffers. If this is unavoidable then all operations should be managed by an on-site ECO, with further screening/ groundtruthing assessments conducted on an ad-hoc basis. Relocation of sensitive flora and fauna may be required prior to

Project Phase	Activity	Key Impact	Possible Effect	Site Specific Description Summary	Mitigation
					operation.
					No fuel storage, refuelling, vehicle maintenance or vehicle depots should be allowed within 30 m of the edge of any wetlands or drainage lines. Refuelling and fuel storage areas, and areas used for the servicing or parking of vehicles and machinery, should be located on impervious bases and should have bunds around them. Bunds should be sufficiently high to ensure that all the fuel kept in the area will be captured in the event of a major spillage
					Vehicles and machinery should not be washed within 30 m of the edge of any wetland or watercourse.
					No effluents or polluted water should be discharged directly into any watercourse or wetland areas.
					If construction areas are to be pumped of water (e.g. after rains), this water should be pumped into an appropriate settlement area, and not allowed to flow straight into any

Project Phase	Activity	Key Impact	Possible Effect	Site Specific Description Summary	Mitigation
					watercourses or wetland areas.
					No spoil material, including stripped topsoil, should be temporarily stockpiled within 30 m of the edge of any wetland or drainage line. Freshwater ecosystems located in close proximity to construction areas (i.e. within ~30 m) should be inspected on a regular basis by the ECO for signs of disturbance from construction activities, and for signs of sedimentation or pollution. If signs of disturbance, sedimentation or pollution are noted, immediate action should be taken to remedy the situation and, if necessary, a freshwater ecologist should be consulted for advice on the most suitable remediation measures.
					Workers should be made aware of the importance of not destroying or damaging the vegetation along watercourses and in wetland areas, of not undertaking activities that could result in the pollution of drainage lines or wetlands, and of not killing or harming any animals that they encounter. This awareness should be promoted throughout the

Project Phase	Activity	Key Impact	Possible Effect	Site Specific Description Summary	Mitigation
					construction phase and can be assisted through erecting appropriate signage
					Fixed point photography to monitor vegetation changes and potential site impacts occurring during construction phase
Operational Phase	Clearing or trimming of natural wetland or riparian vegetation	Loss and/or reduction in habitat quality Growth stimulation of alien vegetation/invasive species	Degradation of ecological integrity and changes to species community composition as well as habitat structure		One of the options that could be explored to mitigate against the potential vegetation clearing/trimming impacts would be to consider constructing taller pylons in certain areas that are high enough to allow for the growth of relatively tall vegetation. Fixed point photography could be used to monitor long-term vegetation changes and potential site impacts
	Application of herbicides	Pollution (water quality deterioration) of freshwater ecosystems and potential contamination of groundwater/subsurface drainage			Avoid the use of herbicides in close proximity (close than 50 m) to wetlands or rivers and do not disturb riparian/or wetland buffer areas
	Operation of high-voltage transmission lines above freshwater ecosystems.	Disturbance to aquatic fauna due to the noise and electromagnetic field (EMF) from the transmission line.			There is no way to mitigate against the noise- and EMF-related disturbance to aquatic and semiaquatic fauna potentially associated with the operation of the proposed power

Project Phase	Activity	Key Impact	Possible Effect	Site Specific Description Summary	Mitigation
					line and associated substations and switching stations, and it is difficult to predict how significant this potential impact could be. The light-related disturbance from the substations and switching station could be mitigated to some degree by minimising the amount of lighting at these facilities and by using low intensity lights that are directed exclusively to the areas where night-time lighting is required.

10 BEST PRACTICE GUIDELINES AND MONITORING REQUIREMENTS

This section provides "best practice" (or "good practice") guidelines and management actions (including relevant standards and protocols) that cover the following development stages, and include practical, target-directed recommendations for monitoring of specified aspects raised in previous sections: During planning, construction, operations, rehabilitation. These guidelines and monitoring requirements must also take into consideration mitigation measures provided in Section 9.

10.1 Planning phase

The planning phase for EGI development through firstly establishing preferred powerline alignments, then determining sites for substations, placement of pylons, and needs for ancillary infrastructure (e.g. access roads, water abstraction points, etc.) has the potential to greatly reduce impacts on freshwater ecosystems and associated fauna and flora through simply avoiding areas of very high sensitivity, and as far as possible avoiding areas of high sensitivity. In order to significantly reduce potential impacts on freshwater biodiversity, sub-quaternary catchments classified with a very high or high sensitivity should be avoided. Where these areas cannot be avoided, a detailed desktop investigation should be followed to determine whether the EGI alignment and development footprint can avoid the actual freshwater ecosystems (i.e. wetland and river habitats) and associated buffers (as per Section 7.1). This process should also be followed for all other sub-quaternary catchments (including medium and low sensitivities).

Where it is impossible to avoid freshwater ecosystems (i.e. wetland and river habitats) and associated buffers altogether, it will be necessary to undertake more detailed specialist studies, impacts assessments, and if necessary investigate needs and opportunities for offsets. Preference should be given to position EGI within already disturbed/degraded areas (e.g. freshwater ecosystems and buffers that are already invaded by IAPs). Mitigation specific to impact significance should be considered that is cognisant of the mitigation hierarchy, where very high significance impacts are avoided, while high and medium significance impacts are mitigated as far as possible. Offsets should only be considered once alternatives and mitigation measures have been exhausted, and in instances where it is provided that there are significant residual impacts due to the proposed development. Any freshwater ecosystems that will be affected by EGI development must be subject to a project level assessment.

10.2 Construction phase

This phase may include the construction of pylons and substations, and stringing of transmission lines, and will thus include a number of impacts typical of construction activities, such as disturbance to wildlife through noise/light pollution, creation of dust, erosion and degradation/disturbance of habitats and vegetation (including areas for access via roads and servitudes and movement of heavy machinery), and bulldozing and vegetation/habitat clearing. Specific measures and actions required during the construction phase are presented in Section 9, but key to the process to include:

- Timing of construction activities to occur in the dry season as much as possible;
- Appointment and involvement of an ECO to provide oversight and guidance to all construction activities, as well as ensure full consideration and implementation of the EMPr; and
- Environmental monitoring (or biomonitoring) required for pre-construction, during construction and post construction at strategically selected monitoring sites based on additional detail specified in Section 10.5 below.

10.3 Operations phase

This phase will predominantly include activities typical of routine maintenance, such as clearing/trimming of natural wetland or riparian vegetation (to maintain required height clearance of transmission lines over vegetation), IAP control and application of herbicides, and operation of high-voltage transmission lines. Specific measures to be considered are provided in in Section 9.

10.4 Rehabilitation and post closure

Rehabilitation and post-closure measures would most likely be required for areas in and around pylons within or in proximity to freshwater ecosystems, as well as for areas degraded by access routes, operation of vehicles/heavy machinery, and infestation of servitudes by IAPs. In general, the following processes/procedures as recommended by James and King (2010):

- Initiation – to assemble the rehabilitation project team/specialists, identify problem/target areas, establish reference condition and desired states, and define rehabilitation targets and objectives;
- Planning - to account for constraints, budgeting and timeframes;
- Analysis – evaluation of alternatives and strategies to achieve the objectives, and to develop preliminary designs and inform feasibility;
- Implementation – a including detailed engineering designs, construction and inspections; and
- Monitoring – to establish need for maintenance and repair of interventions, as well as provide feedback regarding success and failure.

Additional points to be considered regarding rehabilitation of degraded areas within and adjacent to freshwater ecosystems include:

- IAP clearing and control – an IAP control programme should be developed and implemented based on site-specific details, including, but not limited to, types of IAPs, growth forms, densities and levels of infestation, potential dispersal mechanisms, knock-on impacts to freshwater ecosystems caused during implementation (e.g. herbicide drift and contamination), etc.;
- Erosion control and re-vegetation – the objective should be to establish indigenous vegetation cover as soon as possible, as well as to control and limit secondary impacts caused by rainfall-runoff. Where necessary geotextile fabrics, brush mattresses/bundles, geocells, and hydroseeding with a suitable grass seed mix should be considered, while more severe cases of erosion/bank collapse will require more advanced stabilisation methods (e.g. reshaping, planting, concrete blocks, riprap, gabions/reno mattresses, etc.).

10.5 Monitoring requirements

Sites/areas where freshwater ecosystems are likely to be affected by EGI development, according to the various phases of development (including rehabilitation), appropriate measures of monitoring should be considered, including:

- Upstream and downstream biomonitoring to include appropriate indicators/measures of assessing rivers (e.g. diatoms, water quality/clarity, macro-invertebrates using the SASS5 method, instream and riparian habitat using the Index of Habitat Integrity (IHI) method) and wetland habitats (e.g. WET-Health and WET-EcoServices) of a potential impact is recommended at suitable sites to be determined in-field by a specialist.
- Monitoring/sampling is to be conducted by suitably qualified specialists (e.g. DWS accredited SASS 5 practitioners) with sufficient experience in assessing aquatic ecology and water quality;
- A single sampling event is recommended prior to construction taking place to serve as a reference condition;
- Monthly monitoring is recommended for the duration of construction to evaluate trends;
- Biannual monitoring is recommended thereafter during the operation phase (biannual monitoring during the operational phase is not necessary for transmission lines or pylons);
- A single sample can be collected at closure, with additional sampling events 3 and 6 months post closure; and
- Fixed point photography to monitor changes and long term impacts.

11 CONCLUSIONS AND FURTHER RECOMMENDATIONS

Biodiversity impacts, unfortunately, are unavoidable when developing large-scale projects such as national-scale EGI. This is particularly the case when considering that these linear developments need to avoid human settlement (and other areas with anthropogenic significance, e.g. large/viable agricultural areas) as much as possible to prevent socio-economic impacts. Despite this, impacts to local and regional biodiversity assets can be substantially reduced through careful strategic level planning and design which consider areas of concern.

The sensitivity maps presented herein are based on specifically developed methods that enabled spatial integration of a broad suite of data depicting freshwater ecosystems and associated fauna and flora. Outputs include a series of four-tiered sensitivity maps that are intended to be used proactively in terms of planning EGI development footprint areas and pathways for transmission lines, including servitude negotiations and potential land acquisitions, such that environmental impacts to freshwater ecosystems are minimised. The sensitivity maps provided in this SEA, are seen as an improvement from those provided in the 2016 EGI SEA in that they provide sensitivity assessments using a greater suite of data sets, the most up-to-date data, and assessments at higher resolutions (through the inclusion of fine-scale mapping across the country and at the catchment scale). The maps also indicate those areas where development is likely to be able to proceed with minimal risk and needs for project level assessments.

The sensitivity maps and desktop analyses can also be used for any other planned development within the corridors that may impact freshwater ecosystems. Potential impacts and associated mitigation measures identified in this SEA are related specifically to EGI and are not generally applicable to other types of development.

Transmission line routing will need to include an integration of all specialist studies and GIS layers to develop something akin to a Marxan cost surface. It is assumed that a measure of slope will be factored in the routing optimisation, as it is applicable across a number of specialist fields. Specialist input will still be required to aid in the identification of the preferred option and refine the final powerline route through the identified corridor/s based on more detailed desktop and infield assessments. Ultimately, transmission line routing and development should avoid areas of very high sensitivity, and as far as possible avoid areas a high sensitivity. Where this is not possible, more site-specific specialist studies will need to be conducted to include further desktop verification with ground-truthing. Specific considerations for additional specialist studies include:

- Details for more sensitive areas, and
- Catchment-scale evaluation and oversight;
- Confirmation of occurrence of species conservation concern through range/habitat modelling and field surveys;
- Identify primary receivers, major impacts and most effective site-specific mitigation measures along with sensitivity specific mitigation measure; and
- Undertake pre-construction walk-throughs.

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Appendices

Appendix 1: Selected flora used in the assessment of freshwater biota

Family	Species	Conservation status
Fabaceae	*Albizia suluensis*	EN
Apocynaceae	*Asclepias gordon-grayae*	EN
Apocynaceae	*Aspidonepsis cognata*	NT
Salviniaceae	*Azolla pinnata subsp. africana*	NT
Plantaginaceae	*Bacopa monnieri*	NT
Rhizophoraceae	*Cassipourea gummiflua var. verticillata*	VU
Asteraceae	*Cotula filifolia*	NT
Amaryllidaceae	*Crinum moorei*	VU
Cyperaceae	*Cyathocoma bachmannii*	VU
Cyperaceae	*Cyperus sensilis*	NT
Apocynaceae	*Ectadium virgatum*	NT
Eriocaulaceae	*Eriocaulon mutatum var. angustisepalum*	VU
Zygophyllaceae	*Fagonia rangei*	NT
Cyperaceae	*Fimbristylis aphylla*	VU
Geraniaceae	*Geranium ornithopodioides*	EN
Hydrostachyaceae	*Hydrostachys polymorpha*	VU
Isoetaceae	*Isoetes eludens*	VU
Asphodelaceae	*Kniphofia latifolia*	EN
Asphodelaceae	*Kniphofia leucocephala*	CR
Hydrocharitaceae	*Lagarosiphon cordofanus*	VU
Alismataceae	*Limnophyton obtusifolium*	NT
Onagraceae	*Ludwigia leptocarpa*	NT
Marsileaceae	*Marsilea fenestrata*	NT
Apocynaceae	*Mondia whitei*	EN
Najadaceae	*Najas setacea*	VU
Amaryllidaceae	*Nerine pancratioides*	NT
Lythraceae	*Nesaea crassicaulis*	NT
Lythraceae	*Nesaea wardii*	VU
Lamiaceae	*Ocimum reclinatum*	VU
Hydrocharitaceae	*Ottelia exserta*	NT
Oxalidaceae	*Oxalis dines*	VU
Oxalidaceae	*Oxalis disticha*	NT
Poaceae	*Panicum sancta-luciense*	Rare
Arecaceae	*Raphia australis*	VU
Santalaceae	*Thesium polygaloides*	VU
Scrophulariaceae	*Torenia thouarsii*	VU
Lentibulariaceae	*Utricularia benjaminiana*	NT
Lentibulariaceae	*Utricularia foliosa*	VU
Lemnaceae	*Wolffiella denticulata*	VU
Xyridaceae	*Xyris natalensis*	NT

Appendix 2: Selected fauna according the taxonomic groups used in the assessment of freshwater biota

Family	Species name	Common name	Conservation status
Dragonflies and Damselflies (Odonata)			
Coenagrionidae	*Aciagrion gracile*	Graceful Slim	VU
Coenagrionidae	*Agriocnemis gratiosa*	Gracious Wisp	VU
Chlorocyphidae	*Chlorocypha consueta*	Ruby Jewel	CR
Libellulidae	*Diplacodes pumila*	Dwarf Percher	EN
Aeshnidae	*Gynacantha villosa*	Brown Duskhawker	VU
Corduliidae	*Hemicordulia africana*	African Emerald	NT
Lestidae	*Lestes dissimulans*	Cryptic Spreadwing	VU
Lestidae	*Lestes ictericus*	Tawny Spreadwing	VU
Lestidae	*Lestes uncifer*	Sickle Spreadwing	VU
Libellulidae	*Olpogastra lugubris*	Bottletail	NT
Libellulidae	*Orthetrum robustum*	Robust Skimmer	NT
Libellulidae	*Parazyxomma flavicans*	Banded Duskdarter	VU
Libellulidae	*Trithemis werneri*	Elegant Dropwing	NT
Fish			
Amphiliidae	*Amphilius natalensis*	*Natal Mountain Catfish*	DD
Poeciliidae	*Aplocheilichthys myaposae*	*Natal Topminnow*	NT
Cyprinidae	*Barbus eutaenia*	*Orangefin Barb*	DD
Cyprinidae	*Engraulicypris gariepenus*		NT
Cyprinidae	*Labeo rubromaculatus*	*Tugela Labeo*	VU
Cyprinidae	*Labeo seeberi*	Clanwilliam Sandfish	EN
Cyprinidae	*Labeobarbus nelspruitensis*	*Incomati Chiselmouth*	NT
Mormyridae	*Marcusenius caudisquamatus*		EN
Cichlidae	*Oreochromis mossambicus*	Mozambique Tilapia	VU
Cyprinidae	*Pseudobarbus phlegethon*	*Fiery Redfin*	EN
Cyprinidae	*Pseudobarbus serra*	*Clanwilliam Sawfi*	NT
Gobiidae	*Silhouettea sibayi*	*Sibayi Goby*	EN
Amphibians			
Brevicipitidae	*Breviceps bagginsi*	Bilbo's Rain Frog	NT
Brevicipitidae	*Breviceps branchi*	Branch's Rain Frog	DD
Brevicipitidae	*Breviceps macrops*	Desert Rain Frog	NT
Bufonidae	*Capensibufo deceptus*	Deception Peak Mountain Toadlet	DD
Hemisotidae	*Hemisus guttatus*	Spotted Shovel-nosed Frog	NT
Hyperoliidae	*Hyperolius pickersgilli*	Pickersgill's Reed Frog	EN
Arthroleptidae	*Leptopelis xenodactylus*	Long-toed Tree Frog	EN
Pyxicephalidae	*Natalobatrachus bonebergi*	Kloof Frog	EN
Reptiles			
Chamaeleondidae	*Bradypodion melanocephalum*	KwaZulu Dwarf Chamaeleon	VU
Lamprophiidae	*Macrelaps microlepidotus*	KwaZulu-Natal Black Snake	NT
Gekkonidae	*Pachydactylus rangei*	Namib Web-footed Gecko	CR
Pelomedusidae	*Pelusios rhodesianus*	Variable Hinged Terrapin	VU
Mammals			
Carnivora	*Aonyx capensis*	Cape Clawless Otter	NT
Carnivora	*Leptailurus serval*	Serval	NT
Carnivora	*Hydrictis maculicollis*	Spotted-necked Otter	VU
Eulipotyphla	*Crocidura mariquensis*	Swamp Musk Shrew	VU
Eulipotyphla	*Myosorex sclateri*	Sclater's Forest Shrew	VU
Rodentia	*Dasymys incomtus*	African Marsh Rat	NT
Rodentia	*Otomys auratus*	Vlei Rat	NT
Rodentia	*Otomys laminatus*	Laminate Vlei Rat	NT