Msunduzi Municipality

Final Draft Environmental Services Plan

Report Prepared for

Department of Environmental Affairs,

Department of Agriculture, Environmental Affairs and Rural Development, and

Msunduzi Municipality

Report No 376998/2DESP

May 2010

SRK Consulting
Engineers and Scientists

Msunduzi Municipality

Final Draft Environmental Services Plan

Department of Environmental Affairs,

Department of Agriculture, Environmental Affairs and Rural Development, and

Msunduzi Municipality

SRK Project Number 376998

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Executive Summary

The Msunduzi Municipality (Msunduzi), in partnership with the national Department of Environmental Affairs (DEA) and the KwaZulu-Natal Department of Agriculture and Environmental Affairs and Rural Development (DAEA&RD), has recognised that to support sustainable social, economic and environmental development within the municipal area of Msunduzi, the adoption and implementation of an appropriate policy that informs both development planning and approval is required. To address these requirements, the preparation of an Environmental Management Framework (EMF) is being undertaken by SRK Consulting (SRK). The Msunduzi EMF includes a Status Quo Analysis, a Strategic Environmental Assessment (SEA), a Municipal Open Space System (MOSS), a Strategic Environmental Management Plan (SEMP) and a GIS based Spatial Decision Support Tool (SDST) in respect of the municipal are of Msunduzi.

During the development of the MOSS document it was recognised that the MOSS should focus on identifying areas to be set aside to maintain ecosystem goods and services as the process of identifying areas for social use value would require extensive public consultation which was outside of the scope of work for this study. It was however recognised that protection of areas of biodiversity importance achieves both biophysical and social objectives. Due to this shift in thinking and approach it was decided that the product would be more aptly named the **Msunduzi Environmental Services Plan (ESP).**

To meet the requirements of the terms of reference the Institute for Natural Resources (INR) was appointed to identify areas for inclusion in the ESP from a biophysical perspective, while SRK undertook to identify social criteria. The remainder of the report was therefore split into two components namely:

- Environmental Services Plan – Areas required to maintain ecosystem goods and services; and
- Environmental Services Plan – Identification of Social Criteria.

These reports are elaborated on further below.

During public involvement many requests where received to include additional areas, most notably, conservancy areas and proposed protected areas identified in terms of the Ezemvelo Stewardship program in the ESP. The purpose of the Draft ESP was to identify untransformed areas of biodiversity significance. It was agreed that in the development of the ESP no consideration was to be given to land ownership, current use, or zoning other than those areas already formally proclaimed as open space, conservation areas or nature reserves. It was agreed that the extensive public involvement process, required to identify areas of social significance, aesthetic appeal, landscape quality and critical for the maintenance of sense of place would be undertaken as a next step. To this end Action Plan E4 Implementation of the ESP with associated land ownership options was included as part of the SEMP. The action plan includes tasks associated with identifying additional areas for inclusion in the ESP and land ownership and use models that will be used to implement the ESP. Part of this process will be the consideration of the conservancies and proposed protected areas identified in terms of the Ezemvelo Stewardship program for inclusion in the ESP.

Environmental Services Plan – Areas required to maintain ecosystem goods and services

The "Environmental Services Plan – Areas required maintaining ecosystem goods and services" report produced by INR, set out to design a system that maximizes the ecological viability of the ecosystems contained within Msunduzi to ensure the persistence of biodiversity over the long term.

A stepwise approach was followed in drafting the ESP for biodiversity persistence, and relied heavily on work previously undertaken by the INR in developing a fine-scale systematic conservation plan for the Municipality. Protected areas were identified as the first building blocks of the ESP as these areas have already been set aside for biodiversity protection. Key areas for protection of biodiversity attributes were then incorporated by including irreplaceable sites identified in the systematic conservation plan. A review of relevant literature was then undertaken to inform the identification of linkages to maintain and restore connectivity. This process highlighted the importance of riparian corridors which were therefore mapped and included in the areas required to maintain ecosystem goods and services. A review of important species and the need for additional terrestrial corridors was then undertaken and used to identify additional terrestrial corridors for inclusion. Mapping of areas required to maintain ecosystem goods and services was then combined with the existing Public Open Space (POS) system to produce the Environmental Services Plan Map of areas required to maintain ecosystem goods and services. This also helped to identify areas within the existing POS that contribute to biodiversity objectives and those areas that are of strictly social importance.

The mapping was presented at a key stakeholder workshop for discussion and approval. This was particularly useful in drafting recommendations for further refinement and implementation of the ESP at a Municipal level. These recommendations are included in the report attached at Appendix 1 and will facilitate further refinement and development of an implementation plan for the ESP in the Msunduzi Municipal area.

Environmental Services Plan – Identification of Social Criteria

The Terms of Reference for the preparation of the ESP include the following: "*Classify and rate vacant land in terms of the goods and services provided at the level of ecosystem, social and cultural importance*"

To ensure that social use values were duly taken into account, SRK undertook to identify social criteria that may be used to identify areas of social importance for inclusion in the ESP and then rank areas identified by INR in terms of their social importance.

Social Criteria where identified through literature review and include the following:

- Function;
- Usage Frequency;
- Social Services
- Economic Value;
- Visual Absorption Capacity (VAC); and
- Heritage Values;

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Msunduzi Final Draft Environmental Services Plan

1 Introduction

The Msunduzi Municipality (Msunduzi), in partnership with the national Department of Environmental Affairs (DEA), formerly the Department of Environmental Affairs and Tourism (DEAT) and the KwaZulu-Natal Department of Agriculture and Environmental Affairs and Rural Development (DAEA&RD) formerly the Department of Agriculture and Environmental Affairs (DAEA), has recognised that to support sustainable social, economic and environmental development in Msunduzi, the adoption and implementation of an appropriate policy to inform development planning and approval is required. To address these requirements, the preparation of an Environmental Management Framework (EMF) is being undertaken by SRK Consulting (SRK). The Msunduzi EMF includes a Status Quo Analysis, a Strategic Environmental Assessment (SEA), a Municipal Open Space System (MOSS), a Strategic Environmental Management Plan (SEMP) and a GIS based Spatial Decision Support Tool (SDST) for Msunduzi.

During the process of developing the MOSS it was recognised that the MOSS should focus on identifying areas to be set aside to maintain ecosystem goods and services. The process of identifying areas for social use value requires extensive public consultation and as such would be undertaken by Msunduzi as part of the implementation of the MOSS.

It was however acknowledged that while areas may have been identified specifically to maintain ecosystem goods and services these goods and services, these areas also provided the social use values associated with open spaces such as recreation and aesthetics. The protection of these areas therefore achieved both biophysical and social objectives. There had however been a shift to a more

ecosystem based approach. It was therefore decided that the product would be more aptly named the **Msunduzi Environmental Services Plan (ESP).**

The intention of the plan is to build awareness of ecosystem goods and services, and highlight the fact that areas designated for management under this plan, need not be sterilised from other types of development but rather be managed to ensure that the ecosystem goods and services they supply are not compromised. From this point forward, therefore, the report is referred to as the Msunduzi ESP.

1.1 The Msunduzi ESP as part of the greater environmental planning initiative (EMF)

The Msunduzi EMF consists of three phases as indicated in Figure 1.1. The ESP forms part of Phase three of the Msunduzi EMF project.

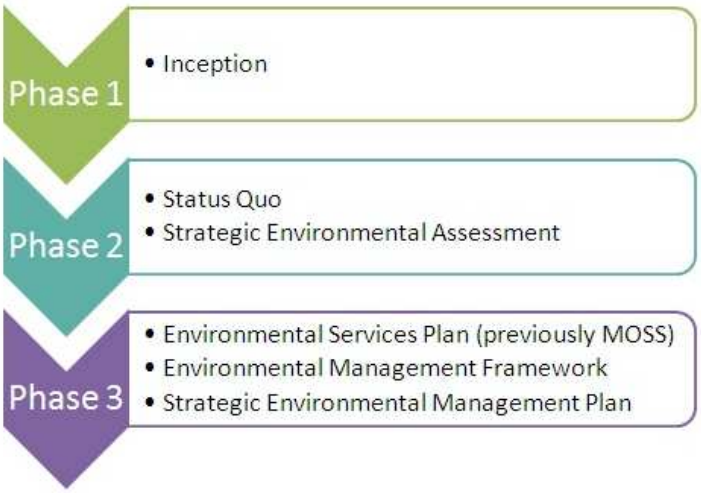

Figure 1.1: Phases of the Msunduzi EMF

Phase One, the Inception Phase, required and included consultation to finalise the approach to the remainder of the study. Phase Two included the Status Quo where the current state of the environment was described and was spatially represented, based on environmental sensitivity. Finally Phase Three includes the preparation of the ESP, SEMP and EMF. The SEA consolidated the findings of the Status Quo phase and used these findings to develop a Sustainability Framework. The SEMP looked the implementation and operalisation of recommendations from the SEA while the ESP aimed to spatially identify areas required to maintain ecosystem goods and services

This report constitutes the product of the ESP component undertaken as part of Phase Three of the greater Msunduzi EMF project.

1.2 Understanding of the Terms of Reference

The terms of reference for the MOSS component of the project originally included the following:

- Develop and refine the open space system for the study area;
- Identify and evaluate the goods and services provided by natural areas;
- Classify and rate vacant land in terms of the goods and services provided, at the levesl of ecosystem, social and cultural importance; and

- Identify areas that could or should be included in the open space system to promote ecological linkages and connectivity and enhance the provision of environmental goods and services.

During the preceding phases of the greater Msunduzi EMF project however the Terms of Reference for the MOSS component of the project were revised through a process of workshops and the consolidation of comments received from the DAEA&RD, Msunduzi, Ezemvelo KZN Wildlife, INR and various other stakeholders. The approach proposed therefore included the following:

- Development of design criteria
  - Review of approach to developing Durban MOSS;
  - Define design criteria for identification of priority conservation areas;
  - Review literature on corridors, island biogeography, connectivity and climate change considerations & define design criteria for biological corridor design;
    - Biological aspects (biological functionality, flood lines, sensitive features, climate change, water quality etc.)
  - Review literature on social use values for open space& define criteria for inclusion of these area for uses such as education, scenic/aesthetic considerations, recreational use, trails, buffers (i.e. between industrial and residential areas); and
  - Define design criteria for identification of priority areas in terms of their social use / values (incl. developed parks) as part of the implementation of the Msunduzi MOSS.
- Development of classification system
  - Apply a simple classification system for areas that have been included in the MOSS from a biological perspective; and
  - Protected areas and priority public open space to be identified as well.
- Mapping of priority conservation areas
  - Use conservation plan outputs to identify, map and classify priority biodiversity areas for inclusion in the MOSS (wetlands, forest, grassland, flood plain etc).
- Mapping of ecological corridors
  - Mapping of riparian corridors based on areas of flood risk identified during the status quo phase of the project; and
  - Mapping of preliminary biological corridors based on biological criteria to link priority conservation areas and priority open space areas identified by the Municipality.

INR was appointed to identify areas for inclusion in the ESP from a biological perspective, while SRK undertook to identify social criteria. The remainder of the report is therefore split into two components namely:

- Environmental Services Plan – Areas required to maintain ecosystem goods and services; and
- Environmental Services Plan – Identification of Social Criteria.

This is elaborated on in the following section that deals with the structure of the report.

1.3 Structure of the Report

As stated above the report is split into two components. Table 1.1 below provides an outline of the INR Report (Appendix 1) entitled "*Environmental Services Plan - Areas required to maintain ecosystem goods and services*", and details the identification of areas for their inclusion in the ESP from an ecosystems goods and services perspective. Table 1.2 outlines the SRK Report (Appendix 2) entitled "*Environmental Services Plan – Identification of Social Criteria*" that identifies criteria that Msunduzi may use during implementation to prioritise areas identified in the INR Report or identify additional areas for inclusion in the ESP to meet purely social needs.

Table 1.1: Outline of the INR Report identifying areas required to maintain ecosystem goods and services

Section	Title	Content
Section 1	Introduction	Background to the project, study area and specialist team.
Section 2	Methodology	Outlines the criteria used to identify areas for inclusion in the ESP to include areas of biodiversity significance, corridors and linkages and existing open space areas.
Section 3	Results	Identification of the areas and extent of the proposed draft ESP together with land cover classes.
Section 4	Recommendations and Way Forward	Outline of steps to be taken to refine, integrate and implement the ESP.

Table 1.2: Outline of the SRK Report identifying social criteria

Section	Title	Content
Section 1	Introduction	An introduction to this report, outlining the differences between a MOSS, ESP and Public Open Space. This section explains the role of a MOSS within the Msunduzi EMF.
Section 2	Methodology	Outlines the methodology used in this report.
Section 3	Literature Review	Review of other relevant MOSSes and studies to include: the eThekwini Environmental Services Management Plan 2001 and 2003; Gauteng Open Space Project: Phase 3 and the uMhlathuze Crime Prevention Study.
Section 4	Design criteria for identification of priority social use / values	Details social criteria that could be used in the Msunduzi Municipality to prioritise or include areas in the ESP
Section 5	Conclusions and Way forward	Outlines recommended actions for implementation of the ESP.
Appendix	INR Draft MOSS for the Msunduzi Municipality	Detailed further in Table 1.1 below.

2 Way Forward

The draft ESP was prepared using the biodiversity value of untransformed land as the basis, with no consideration being given to land ownership, current use, and zoning other than in respect of those areas already formally proclaimed as conservation areas or nature reserves. The terms of reference included the preparation of a draft ESP that would inform the extensive consultation process required to identify areas of social significance, aesthetic appeal, landscape quality and critical for the maintenance of sense of place. To assist this process Social criteria where identified that Msunduzi may use during implementation to prioritise areas identified in the INR Report or identify additional areas for inclusion in the ESP to meet purely social needs. The Report is included at Appendix 1.

Neither Conservancies nor proposed protected areas in terms of the Ezemvelo KZN Wildlife stewardship program have any legal status. Urban Conservancy boundaries have to a large extent not been established using biodiversity value as the criteria. There are substantial areas falling within conservancy boundaries which could be deemed to have very little or no biodiversity value at all although it must be acknowledged that in the more rural or undeveloped parts of the City, Conservancies are likely to encompass areas of biodiversity value.

Land ownership and use models still need to be developed and will include a range of options (of which Land stewardship and conservancies are but two) to be presented to landowners when the public process of formally adopting the ESP begins. Clearly the ESP needs to be developed further using a broad range of ecosystem services rather than the current “narrow” focus on biodiversity value only.

Action Plan E4-Implementation of the ESP with associated land ownership models,is included in the SEMP and outlines how this will be achieved. Conservancies and land stewardship status clearly needs to be acknowledged and addressed during this process and it certainly is not and never was the intention to ignore or downplay the importance of these areas.

Tasks proposed in terms of Action Plan E4- Implementation of the ESP with associated land ownership models are as follows:

- Undertake a public involvement process to identify additional areas for inclusion in the ESP. The public involvement process should include all land owners of areas currently identified for inclusion in the ESP, all conservancies, and all IAP’s identified during the grater Msunduzi EMF process. Areas that should be given careful consideration during the public consultation process include the following:
  - Ezemvelo KZN Wildlife Stewardship program proposed protected areas;
  - Conservancies to include:
    - Upper Mpushini
    - Lower Mpushini
    - Cleland, Mkondeni
    - Wembly, Clarendon
    - Ferncliff Catchment

- Use the social criteria identified in Annexure 2 of the ESP to rate and prioritise the areas of environmental value to the municipality.
- Develop a rates rebate policy to include identification of alternative land use and land ownership options and associated rebates.
- Amend the Town Planning scheme to incorporate priority open space areas and areas subject to rebates
- Notify all property owners (particularly those in areas of high environmental value) through the rates system of potential rebates and the rates rebate policy.

For further information regarding timing, responsibility and budgets, please refer to the Action Plan included in Section 4.1.3 of the SEMP.

To ensure that these areas are considered in the next step towards adopting the ESP the proposed protected areas in terms of the Ezemvelo KZN Wildlife stewardship program, Figure 2.1provides a map of the location of these areas.

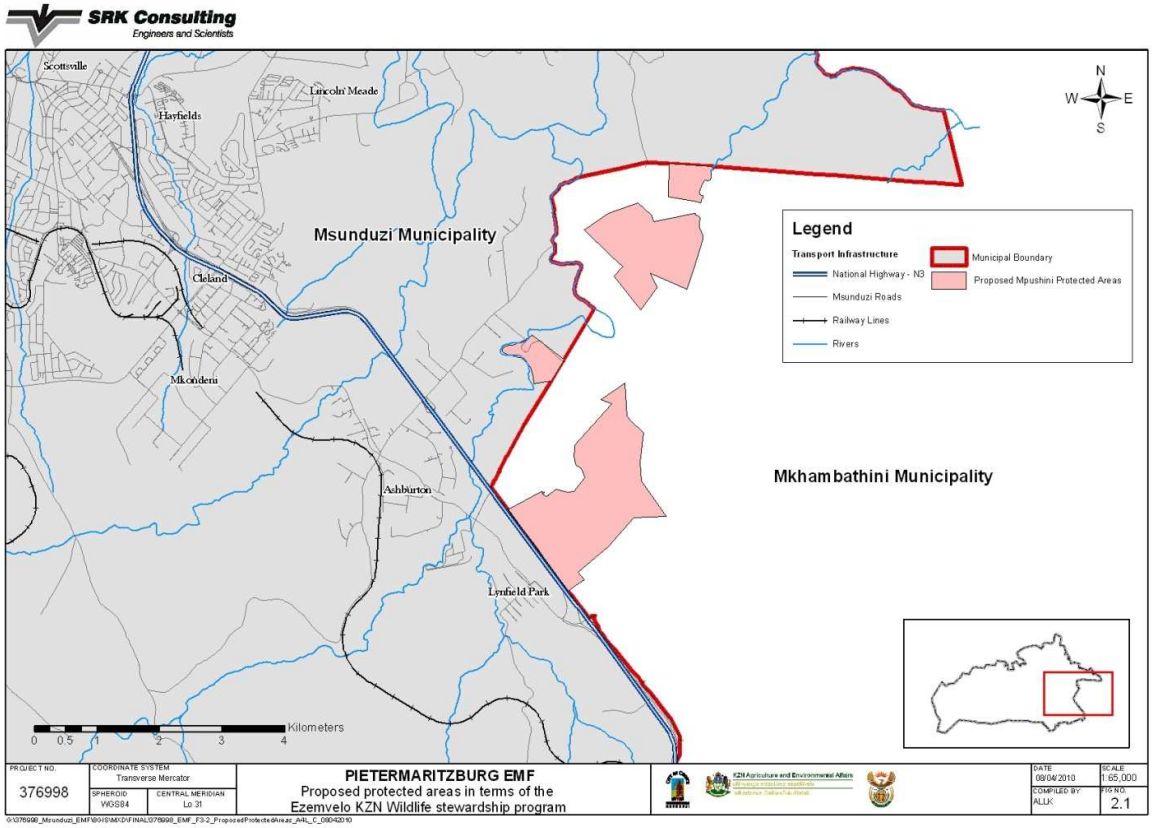

Figure 2.1: Proposed protected areas in terms of the Ezemvelo KZN Wildlife stewardship program

It is notable that only one small area of 36. 44 Ha falls within Msunduzi the remainder of the areas fall within the neighbouring Mkambathini Municipality.

3 Public Involvement

A public consultation process was undertaken to support the preparation of the draft ESP. This included an initial planning workshop with key stakeholders, two public meetings to discuss the desired state of environment and the Draft ESP Report, notices to IAP's and newspaper advertisements.

SRK in partnership with Msunduzi Municipality Environmental Branch made every effort to ensure that the Draft ESP was informed by public input and that a wide range of public sectors gained access to the documentation and participated in the process.

It is however acknowledged that further public consultation will be required to identify areas to identify areas of social significance, aesthetic appeal, landscape quality and critical for the maintenance of sense of place. Land ownership and use models still need to be developed and will be presented to landowners when the public process of formally adopting the ESP begins.

A detailed account of the public consultation process undertaken, together with all notices, representations received, notices issued and a copy of the IAP database, is included in the Public Consultation Record which has been produced as a separate document as it relates to all the products produced in terms of the Greater Msunduzi EMF project. In addition the Final Draft ESP will be presented to council for adoption as a Final Draft. The document will remain as a final draft until the extensive public consultation process as discussed above has been undertaken.

Table 3.1 includes all comments received on the Draft ESP Report during the public consultation and associated resultant responses.

Table 3.1: Comments received in the SEA and associated Responses

Date	Individual	Company / Organisation	Comment / Issue / Concern	Response
ESP				
18 March 2010 Public Meeting	Mr. D. Johnson	Private	How were the limits for the C-Plan exercise determined? Thornveld habitat in the Mpushini area warrants greater conservation.	Provincial limits were used to inform the setting of limits for specific to Msunduzi in consultation with a number of experts and Ezemvelo KZN Wildlife (EKZNW).

Date	Individual	Company / Organisation	Comment / Issue / Concern	Response
18 March 2010 Public Meeting	Ms. S. Schutte	Upper Mpushini Conservancy	What level of ground truthing was undertaken as part of the C-Plan process? Additional information (species lists) for the Mpushini area was available.	The C-Plan process relied on input from experts that had undertaken primary data collection in various parts of the Msunduzi municipal area. Additional information should be provided and will be used in the review of the C-Plan.
18 March 2010 Public Meeting	Ms. P. Long	Preservation of Mpushini and Mkhondeni Biodiversity (PMMB) Trust	Why are the areas identified in the Msunduzi C-Plan different from those identified by EKZNW in the provincial C-Plan?	The C-Plan for Msunduzi was undertaken at a far greater scale and included additional information and therefore produced different results.

Date	Individual	Company / Organisation	Comment / Issue / Concern	Response
18 March 2010 Public Meeting & in writing on the 25 March 2010	Ms. S. Schutte Ms. P. Long Mr. N. Durow	Upper Mpushini Conservancy Upper Mpushini Conservancy	Areas set aside for conservation in terms of the EKZNW stewardship program and the Upper and Lower Mpushini Conservancy should be included in the Environmental Services Plan (ESP). Further the following linkages between the Upper and Lower Mpushini Conservancy are proposed. 30 m buffers on both sides of the watercourses (Mpushini and Malkop Spruits). Where the linkage is blocked through existing properties at the bridge of the R103 over the Mpushini an additional buffer should be put in place on the eastern side of the river on the (as yet) undeveloped land. Should the R103 be widened at a later state, a suitable undercut should be provided.	During the public meeting it was agreed that if a spatial representation of these areas could be provided within the time frame for comments their inclusion in the ESP would be considered. The draft ESP was prepared using the biodiversity value of untransformed land as the basis, with no consideration being given to land ownership, current use, and zoning other than those areas already formally proclaimed as conservation areas or nature reserves. The terms of reference included the preparation of a draft ESP that would then inform the extensive consultation process required to identify areas of social significance, aesthetic appeal, landscape quality and critical for the maintenance of sense of place. Neither Conservancies nor land currently being put forward in terms of the "Stewardship" program have any legal status. Urban Conservancy boundaries have to a large extent not been established using biodiversity value as the criteria. There are substantial areas falling within conservancy boundaries which would be deemed to have very little or no biodiversity value at all although it must be acknowledged that in the more rural or undeveloped parts of the City, Conservancies are likely to encompass areas having biodiversity value. Land ownership and use models still need to be developed and will include a range of options (of which Land stewardship and conservancies are but two) to be presented to landowners when the public process of formally adopting the ESP begins. Clearly the ESP needs to be developed further using a broad range of ecosystem services rather than the current "narrow" focus on biodiversity value only. Action Plan E4 Implementation of the ESP with associated land ownership models outlines how this will be achieved. Conservancies and land stewardship status clearly needs to be acknowledged and addressed during this process and it certainly was never the intention to ignore or downplay the importance of these areas. Action Plan E4 has been amended to ensure that these areas are included in the next step towards finalising the ESP.
25 March 2010 Email Comments	Ms. P. Long	PMMB Trust	Of what value are the community conservation initiatives with respect to the design and implementation of an Environmental Management Framework that seeks to ensure the sustainability of the Municipality of Msunduzi?	Response as above

Date	Individual	Company / Organisation	Comment / Issue / Concern	Response
18 March 2010 Public Meeting	Ms. P. Long	PMMB Trust	Raised concern that all areas outside the boundaries of the ESP would be made available for transformation and stressed that these areas have a role to play in the delivery of Ecosystem Goods and Services.	Areas outside the ESP also have conservation significance in terms of the EMF. Areas of development constraint identified in terms of the EMF also require further investigation in terms of their biodiversity value
18 March 2010 Public Meeting	R. Fincham	MIDI	Suggested an annual review for the C-Plan.	Msunduzi has agreed to work together with EKZNW in order to achieve this. A six month review period has been proposed but will be assessed based on capacity during implementation.
18 March 2010 Public Meeting	Mr. L. Ngobo	Greater Edendale Development Initiative (GEDI)	How much of Edendale was included in the ESP?	The ESP had focused on untransformed areas and therefore areas set aside within Edendale where limited by the level of transformation in the area. Mr. A. Goddard however was able to identify areas within Edendale that form part of the ESP and contribute to Msunduzi's Ecosystem Goods and Services. Criteria for the identification of additional areas from a social perspective have been proposed and will be used to identify additional areas. In addition Action Plan S1: Urban Greening Program identifies the steps towards the development of an Urban Greening Program for Msunduzi.
18 March 2010 Public Meeting	Ms. P. Long	PMMB Trust	How will the ESP affect the public's ability to conserve their areas?	Areas excluded from the ESP may still become private protected areas. These areas should however be included in the ESP as a next step as outlined in Action Plan E4 Implementation of the ESP.
18 March 2010 Public Meeting	Mr. N. Masikane	Greater Edendale Development Initiative (GEDI)	Without appropriate management of Open Space areas they become a burden and can pose the threat to community safety.	Action Plan S1: Urban Greening Program identifies the steps towards the development of an Urban Greening Program for Msunduzi. Action Plan E4 also addresses implementation of the ESP and development of land management options.
18 March 2010 Public Meeting	Mr. N. Masikane	Greater Edendale Developmnet Initiative (GEDI)	How would the EMF affect the timing of EIA applications?	The EMF does not negate the need for EIA's but rather provides information to developers and authorities to ensure that the EIA process and decision making is facilitated.

Date	Individual	Company / Organisation	Comment / Issue / Concern	Response
25 March 2010 Written Comments	Ms. S. Schutte Mr. N. Durow	Upper Mpushini Conservancy Lower Mpushini Conservancy	The term 'irreplaceable' is questioned. Much of Mpushini is identified as being outside the irreplaceable areas but has conservation significance. Not many on-the-ground studies have been done in this area and we would like to encourage research studies within the conservancy. Rare species seen include amongst others serval, caracal and African python. Further information has been provided. According to Dr Bonkewitzz, a butterfly expert that studied the Mkhondeni valley, the Mpushini area is data deficient when it comes to butterflies, but certainly warrants more studies. We certainly see the need to a more detailed study at ground level that will proof that the area is not replaceable.	Noted – further investigation of the area and information supplied will be included in the next iteration of the C-Plan.
25 March 2010 Written Comments	Ms. S. Schutte	Upper Mpushini Conservancy	Hinterland Thornveld and Valley Bushveld are important in giving the Eastern areas the sense of place and African feel and therefore making PMB the "City of Choice" for many to live in.	Agreed – the criteria and limits identified in the SEMP aim to ensure that the sense of place is not lost.
23 March 2010 Written Comments	Dr. D. Johnson	Private	The terms irreplaceability originated in the GIS section of KZN Wildlife about 15 years ago. Its starting point was to tot up what remains of each habitat or landscape (not exactly the same thing) within reserves in KZN. I don't think it took account of what was conserved elsewhere in South Africa, nor further afield, a relevant point to which we will return. Habitats which were well conserved formally were then deemed "replaceable" outside the reserves, the degree depending roughly upon pro-rata arithmetic.	The use of the same system as EKZNW was intentional. This was done specifically so that it made it easier to align the local planning to district and provincial conservation planning as it occurred and/ or was refined.
23 March 2010 Written Comments	Dr. D. Johnson	Private	To pick up these threads nearer home. Valley Bushveld occupies only a small part of our area. The idea that it is replaceable can only be on the basis that it is well enough conserved elsewhere in KZN. It is not well conserved within our area, and indeed occupies only a small part of it. If it were excluded altogether from development plans it would hardly make any difference at all to the greater whole.	It is important to define "our area" as the conservation planning that was taken into account considered / targeted habitat conservation for the Msunduzi Area.

Date	Individual	Company / Organisation	Comment / Issue / Concern	Response
23 March 2010 Written Comments	Dr. D. Johnson	Private	The dangerous ground, specifically avoided in the KZN Wildlife exercise, is to assume that conservation outside the area under jurisdiction will continue indefinitely at an adequate level. There can be no better illustration of this wisdom than the White Rhino saga. In about 1950 when KZN had about 40 left. The only other population in the world was the "thriving" one in eastern Zaire. I can't remember the exact figure but there were certainly hundreds at least, and all in a proclaimed national park. Why bother with ours? We all now know the answer. The KZN stock grew to over 1000, with the surplus going to restock dozens of other (now) safe areas, while the Zaire population is down to single figures and undoubtedly doomed. Moral: look after your own immediate neighbourhood.	The Biodiversity report recognises that while the focus of the study was on Msunduzi there is a potential to relax targets in Msunduzi if they are strengthened in other municipalities. At this stage however the targets set for conservation are based solely on Msunduzi's responsibility and does not allow for habitats to be protected in other municipalities.
23 March 2010 Written Comments	Dr. D. Johnson	Private	Apart from anything else, Valley Bushveld is the only local habitat that looks like "real Africa"; to be unkind to make the point, the rest of our area looks much like many other places in the world.	Sense of place and other social aspects like aesthetics will be addressed in the public consultation process required to finalise the ESP prior to adoption.

Date	Individual	Company / Organisation	Comment / Issue / Concern	Response
25 March 2010	Ms. D. Dold	WESSA	It must be ensured that the upper valley, and catchment area are kept in a natural state to ensure that the valley systems below, especially the river system, have sustainability. This aspect will become more and more important in terms of resource economics in the future. As far back at 1970 WESSA was appealing for this area to be kept intact due to its archeological and heritage significance, the sense of place and landscape considerations for the greater Pietermaritzburg area. WESSA also believes that the inclusion of informally and formally conserved areas should be in place in the EMF from the outset regardless whether this was in the terms of reference or not. This is simply common sense. We support the premise that alternative technologies for all development must work in a new paradigm otherwise we will just repeat the degradation of the past.	The draft ESP was prepared using the biodiversity value of untransformed land as the basis, with no consideration being given to land ownership, current use, and zoning other than those areas already formally proclaimed as conservation areas or nature reserves. The terms of reference included the preparation of a draft ESP that would then inform the extensive consultation process required to identify areas of social significance, aesthetic appeal, landscape quality and critical for the maintenance of sense of place. Neither Conservancies nor land currently being put forward in terms of the "Stewardship" program have any legal status. Urban Conservancy boundaries have to a large extent not been established using biodiversity value as the criteria. There are substantial areas falling within conservancy boundaries which would be deemed to have very little or no biodiversity value at all, although it must be acknowledged that in the more rural or undeveloped parts of the City, Conservancies are likely to encompass areas of biodiversity value. Land ownership and use models still need to be developed and will include a range of options (of which Land stewardship and conservancies are but two) to be presented to landowners when the public process of formally adopting the ESP begins. Clearly the ESP needs to be developed further using a broad range of ecosystem services rather than the current "narrow" focus on biodiversity value only. Action Plan E4 Implementation of the ESP with associated land ownership models outlines how this will be achieved. Conservancies and land stewardship status clearly need to be acknowledged and addressed during this process and it certainly was never the intention to ignore or downplay the importance of these areas. Action Plan E4 has been amended to ensure that these areas are included in the next step towards finalising the ESP.

Date	Individual	Company / Organisation	Comment / Issue / Concern	Response
25 March 2010	Ms. D. Dold	WESSA	Concerns in the Lower Mpushini Valley area are the Lynfieldpark Sewage Works; damming of the river, alien vegetation; mining operations, and the large number of development proposals for the catchment area (industry, commerce and high density residential) which will result in serious negative implications for the river system and provision of environmental goods and services for the protected area. The problem is that no-one seems to be looking at the cumulative impact that these developments are going to have on the river system which is going to mean that our water becomes more and more expensive to treat to potable standards in the future. Bear in mind that we are talking here not only of the Msunduzi Municipality but of the greater eThekwini area as well. Therefore Msunduzi are the custodians of this water supply and need to look after it properly.	Noted. The management priorities for Water Quality particularly related to land use have been amended in line with comments received.
25 March 2010	Ms. D. Dold	WESSA	Lower Mpushini Valley forms a valuable contribution to the Provincial biodiversity targets which form part of the National Biodiversity targets, in the respective vegetation types which occur here in good condition, and this is why it is being proposed and going through the formal channels of becoming a Provincial Protected Area Environment. The area has a wilderness feel to it and will become more and more important to city dwellers in the future as a refuge to escape the trials of city life and is an asset to the City or Pietermaritzburg.	As above, sense of place and other social aspects like aesthetics, will be addressed in the public consultation process required to finalise the ESP prior to adoption as detailed in Action Plan E4.
25 March 2010	Ms. D. Dold	WESSA	The air quality is excellent in the Lower Mpushini Valley and a further asset to PMB in terms of free goods and services. The area is not suitable for extensive agriculture, but its value lies in the free goods and services it supplies. The entire Mkondeni/Mpushini area is rich in heritage and is currently being researched in this regard.	Action Plan AMAFA 1 Cultural Heritage Resource Assessment aims to extend the cultural heritage study undertaken as part of this EMF process and information gathered for this area should be included in the extended study. The action plan has been amended to reflect this.
25 March 2010	Ms. D. Dold	WESSA	Ad hoc development proposals not aligned to SDF developed for Ashburton area. Unscrupulous marketing of N3 intersection at Lionpark as development node (this is not in accordance with PEDS or LUMS) Other development applications undermining the stability of the area include-; the area is zoned as agricultural and eco-tourism; protection of ecological goods and services and ecological integrity; conceptual development plan that is truly sustainable for these valleys; degradation of the environment; development over/through drainage lines; threats to river and riverine area; provision of extensive conservation corridors throughout the area bulldozing of natural vegetation; protection of fauna and flora.	The SDF process was undertaken separately to the EMF process. However Action Plan E1 Integrates EMF into SDF Review and preparation of the LUMS highlights tasks to be undertaken to ensure that the environmental planning undertaken as part of the EMF process is included in future planning for Msunduzi.

Date	Individual	Company / Organisation	Comment / Issue / Concern	Response
30 March 2010	Ms. M. Ngotho	GREEN	Public participation is fundamental to the production and implementation of the EMF. Concerns have been expressed by some Civil Sector organizations (CSO's on whom and how the public have been engaged in the process. Low participation in meetings may attest to this concern. Now that the EMF is almost complete my concern is, 'if the public were not widely engaged, then what will be the implications on the implementation of the EMF?' For example, Section 1.1paragraph one on page 2 of the Environmental Services Plan (ESP) reads, '*It was agreed that this level of public involvement fell outside of the scope of the ESP and that the public involvement required would be undertaken during the implementation of the ESP"* (ESP report, Pg 2). Environmental goods and services are at the heart of all development processes, sometimes access, lack of access and distribution thereof may lead to conflict and fuel irresponsible behaviour towards the environment. Though the Strategic Environmental Management Plans (SEMP) alludes to some actions, I think there should be more explicit recommendations which enhance ownership and commitment during implementation.	The draft ESP was prepared using the biodiversity value of untransformed land as the basis, with no consideration given to land ownership, current use, and zoning other than those areas already formally proclaimed as conservation areas or nature reserves. The terms of reference included the preparation of a draft ESP that would then inform the extensive consultation process required to identify areas of social significance, aesthetic appeal, landscape quality and critical for the maintenance of sense of place. Given the number of products that were to come from the EMF process it was agreed that the second step, namely the public consultation, would fall outside the terms of reference and would be undertaken by the municipality as part of the implementation. Action Plan E4 has been amended to include more specific recommendations as to how this process will be undertaken.
30 March 2010	Ms. M. Ngotho	GREEN	The EMF processes has been promoted through various media-newspapers, internet, public meetings and access to outputs (documents). Whereas this media has reached residents, why then is there low participation of the public? Given the low participation, strategies should be thought through to tackle this challenge and possibly change the approach or media used. Yes, public participation processes are sometimes problematic and gatherings poorly attended. If stakeholders are informed appropriately, it will enable the municipality to actualize the EMF.	Great effort was made to ensure that the public, councillors and municipal officials were made aware of the EMF process and its implications.
30 March 2010	Ms. M. Ngotho	GREEN	Civil sector organizations (CSO's) play and can play a vital role in engaging communities in environmental initiatives and contribute towards good environmental governance. Their inputs should be duly recognised and not be clustered under the term 'public'? Some sections of CSO's expressed concerns and inadequate knowledge of the EMF/process. Whereas there is no way to redo the process, I think the report should be explicit about this inadequacy and make recommendations on possible initiatives to engage CSO's in implementation, updating and the review process of the EMF.	The report has been amended and Action Plan G2 looks at increasing participation of the public and organisations in municipal decision making.

Date	Individual	Company / Organisation	Comment / Issue / Concern	Response
30 March 2010	Ms. M. Ngotho	GREEN	The Msunduzi municipality will be the lead implementing body of EMF. However, experience reveals that the environment department has inadequate capacity and human resources to tackle environmental concerns in the municipality. Enhancing capacity and collaboration of actors need to be a top priority to actualise the EMF. Complements to the team for using and delivering the EMF products with a state-of- the- art technology. Considerations should focus on the capacity of the municipal decision makers to use and sustain the technology. There should be provisions to extend these skills and knowledge to the public to enable it to engage actively in implementation and review of the EMF. The SEMP has wonderful actions to achieve. All stakeholders need to engage actively in identifying and setting the indicators and targets. Hopefully, this will enhance the implementation, monitoring and evaluation process.	Action Plan G1 Environmental Capacity Assessment looks at ensuring that Msunduzi has sufficient capacity to implement the EMF and all action plans identified in the SEMP.

Appendices

Appendix 1: Environmental Services Plan – Areas required to maintain ecosystem goods and services

Msunduzi Municipality

Environmental Services Plan – Areas of biophysical importance

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Institute of Natural Resources

INR Report No:

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Prepared for:

SRK Consulting

July 2009

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1. INTRODUCTION

1.1. Background to assessment

The Msunduzi Municipality (Msunduzi)in conjunction with the national Department of Environmental Affairs and Tourism (DEAT) and the provincial Department of Agriculture and Environmental Affairs (DAEA) have appointed SRK Consulting (SRK) and their proposed Team to prepare an Environmental Management Framework (EMF) for the Msunduzi Municipal Area. As part of this project, the Institute of Natural Resources was appointed to assist in identifying areas required to maintain ecosystem goods and services in Msunduzi as part of the development of an Environmental Services Plan (ESP).

1.2. Description of study area

Msunduzi covers an area of approximately 640 km^2 and covers a wide range and diversity of land uses from urban, industrial and residential to large areas of afforestation and agriculture. Seven vegetation types occur within the study area (Figure 1) ranging from Drakensberg Foothill Moist Grasslands and indigenous forests in the west and north to dry eastern valley bushveld in the east of the Municipality (Figure 1).

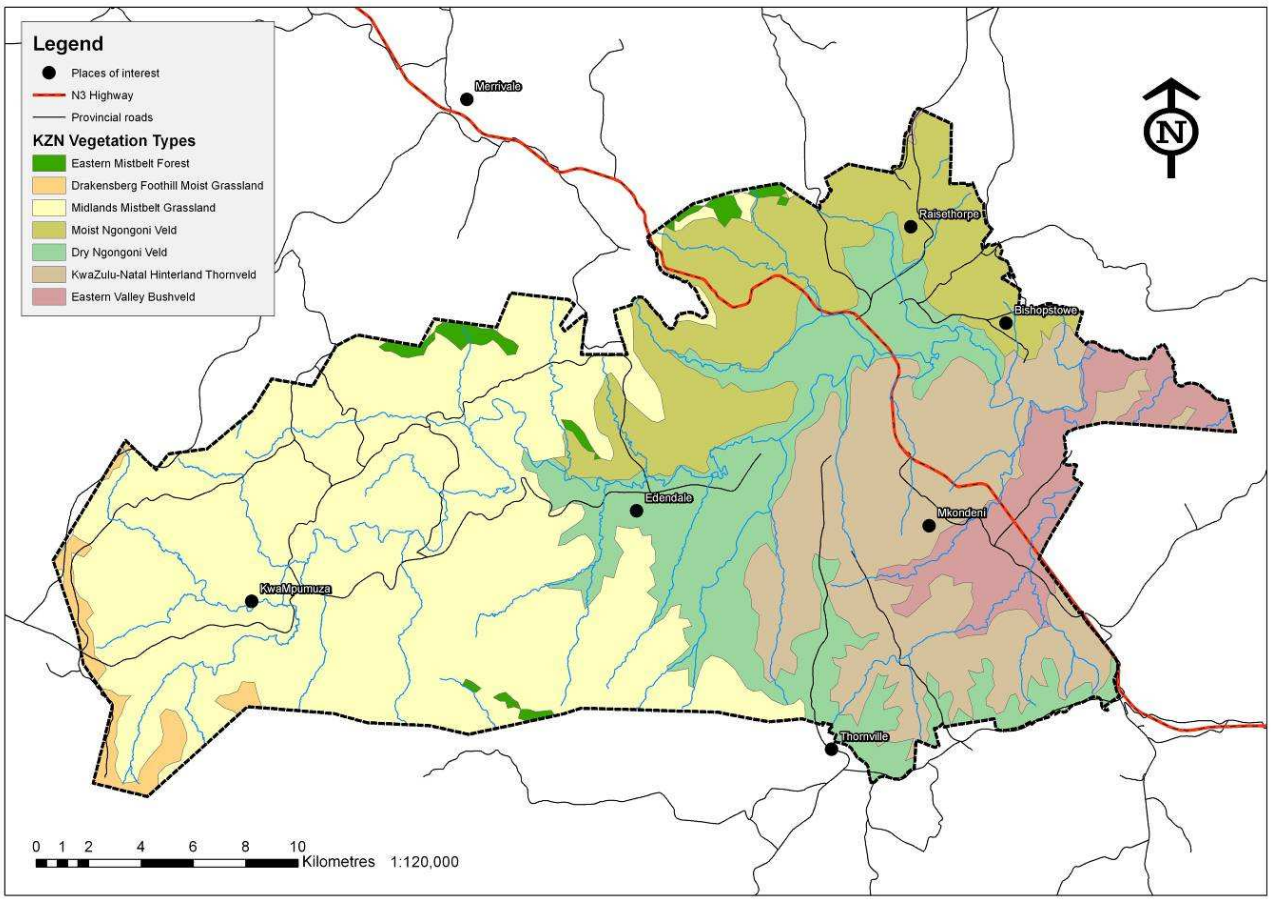


Figure 1. Map of the study area showing vegetation types occurring within Msunduzi.

As with many built up landscapes, large natural tracts of undeveloped land in Msunduziare limited and are becoming scarcer over time. Remnants of the natural environment increasingly occur as a mosaic of large and small patches, survivors of environments that have been carved up to develop new forms of productive land use for humans. This is particularly evident within the basin in which Pietermaritzburg town is situated with very little natural habitat remaining in these areas (Figure 2). Remaining natural fragments range from large blocks (such as those occurring on the hills around KwaMpumuza and the valley east of Mkondeni), to tiny remnants surrounded by intensive land use. Together they provide for the habitats upon which the conservation of much of the flora and fauna in the Municipality now ultimately depends.

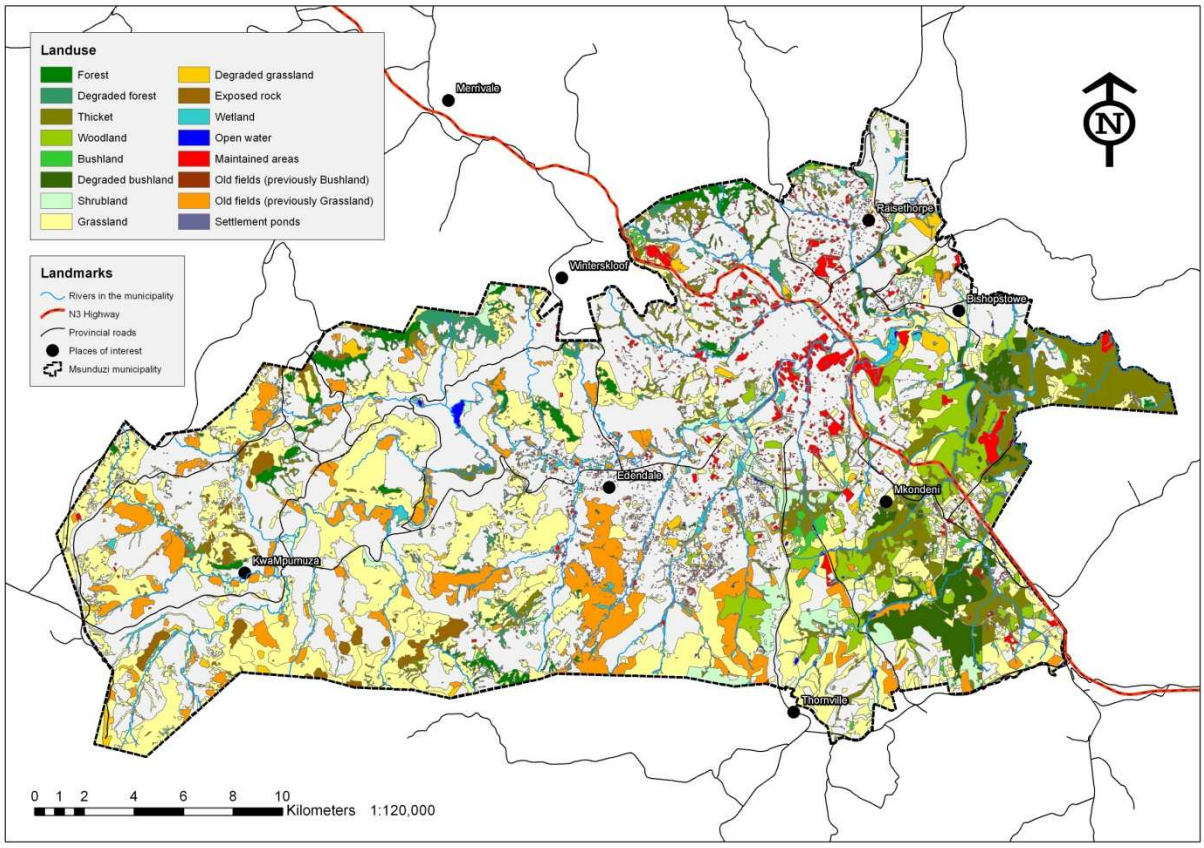


Figure 2. Map of Msunduziindicating the extent of untransformed landuse classes in the municipality (Macfarlane, 2008).

This transformation and fragmentation of the landscape has a major consequence for biodiversity conservation which includes a loss of species from fragments and entire landscapes, changes in the composition of faunal assemblages, and changes to ecological processes involving plant and animal species. Isolation of habitats, a fundamental consequence of the process of fragmentation, also influences the status of animal populations and communities in developed landscapes, making them more susceptible to natural and anthropogenic disturbances.

Despite current levels of fragmentation and transformation, sufficient habitat still remains to allow conservation targets for all but two vegetation types (Dry Ngongoni Veld and Moist Ngongoni Veld) and two plant species (*Dierama nixonianum* and *Senecio burnensis*) to be achieved. The high levels of current transformation does however mean that much of the remaining habitat is required to meet conservation targets as reflected by the dominance of high levels of irreplaceability for important biodiversity attributes across much of the municipality (Figure 3). Focussed interventions

and careful decisions around land use zoning and management is therefore essential to prevent further loss of species and to ensure that biodiversity targets can be achieved.

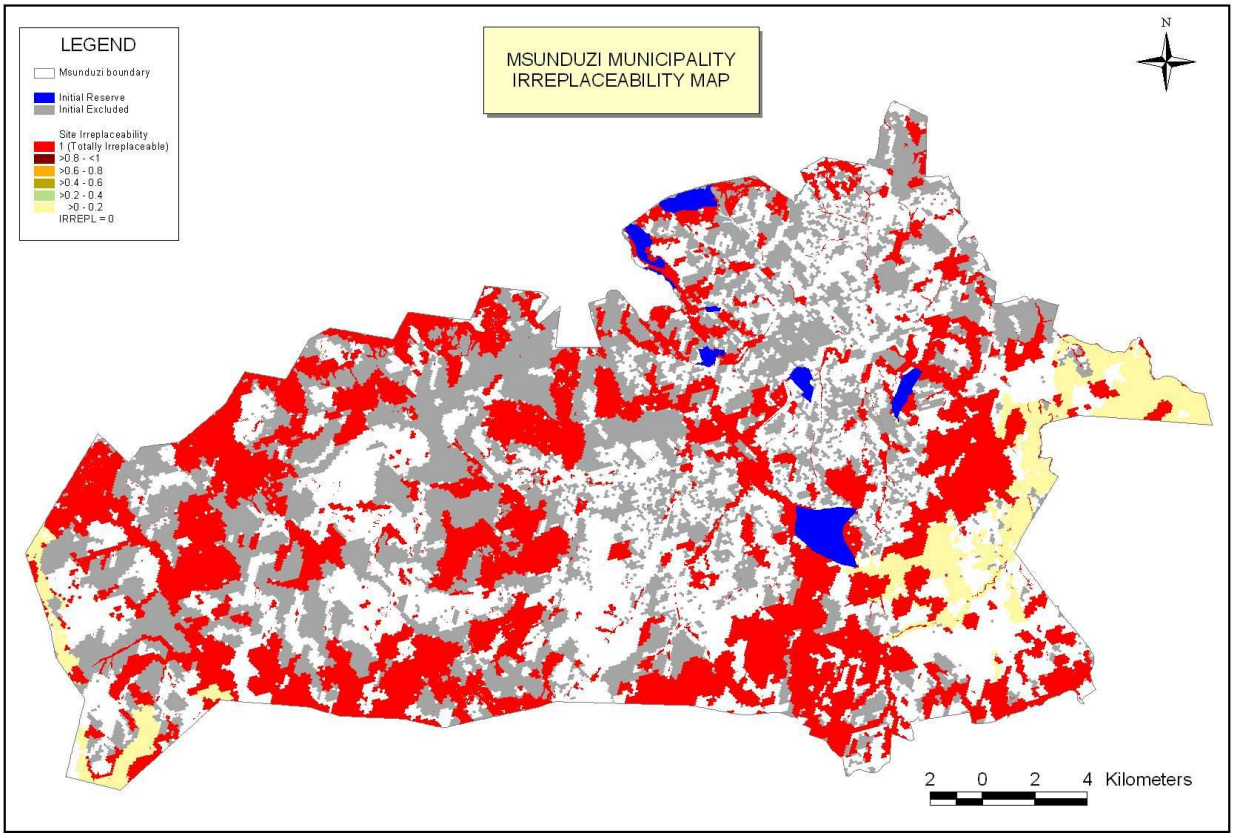


Figure 3. Map of Msunduzi indicating irreplaceability values of untransformed land (Macfarlane, 2008).

1.3. Scope of Work

Given the context in which the municipality finds itself, a real challenge remains to design and implement land-use strategies that will ensure the conservation of natural resources in the face of competing demands for land use. One strategy is to design and implement an ESP aimed at supporting the conservation and maintenance of threatened biodiversity within the municipality. The focus of this assessment was therefore to build on the work undertaken as part of the specialist biodiversity report (Macfarlane, 2008) to develop an input to the ESP which identifies priority areas for biodiversity conservation.

It is important to note that other social factors that should be considered in designing the ESP such as recreational and educational opportunities, aesthetic value and other practical considerations

such as mechanisms to manage such areas has not been specifically addressed as part of this study but should be considered during planned refinement of the proposed open space system.

1.4. Specialist team

Mr. Douglas Macfarlane was responsible for project conceptualization, coordination, management and report compilation. He was supported by Mr. Leo Quayle who provided technical GIS support required to draft the ESP mapping.

2. METHODOLOGY

2.1. Clarifying objectives

Although the Municipality currently has no clear requirements for an ESP, they do recognize the role that such a system can play in sustainably managing natural resources in the Municipality. In this regard, Mr. Rodney Bartholomew (Municipal Manager: Conservation and Environment, Development Services), when questioned about the specific objectives relating to the development of an ESP, made reference to the IUCN definition of nature conservation which is 'the management of human use of the biosphere so that it may yield the greatest sustainable benefit to present generations, while maintaining its potential, to meet the needs and aspirations of future generations'. This definition acknowledges that conservation is far more complex and comprehensive than simply preserving wildlife and "natural" areas and that the human habitat is now the biosphere as a whole.

The provision, protection and management of urban open space essentially talks to the quality of the urban environment and unfortunately if this is provided on an ad hoc basis the result is likely to be space lacking any meaningful functional, physical and visual integration into the urban structure. **A key objective in drafting an ESP for the Municipality has therefore been to design an open space system that maximizes the ecological viability of the ecosystems contained within the Municipality to ensure the persistence of biodiversity over the long term.** This is particularly important in a developing country with scarce resources such as South Africa where the open space system also provides an alternative source of many urban services to the costly engineering solutions so often adopted in developed countries that have greater resources (eThekwini Municipality, 2003).

In developing an ESP, it was also agreed that a broad-brush approach would be used during this first phase, so as to limit the risk of excluding potentially valuable areas. The intention is then , through a process of consultation with I&AP's, to define more detailed evaluation criteria (including social issues) to prioritise and if necessary eliminate areas deemed to be of lesser importance.

2.2. Prioritizing untransformed areas for biodiversity conservation

The first step in drafting the ESP was to identify a suite of priority areas to act as the backbone of the ESP. This was done by including existing protected areas and key areas for biodiversity conservation based on their importance for meeting conservation targets. The approach used to identify and classify priority areas is discussed in more detail below.

2.2.1. Incorporating protected areas

Protected areas form the logical first step in developing an ESP for the Municipality. A map indicating the location of existing protected areas in the municipality thus formed the first building block in the process. This includes two types of protected areas i.e. formal (Type 1) protected areas – those underpinned by strong legislation and effective management and Type 2 protected areas, i.e. those underpinned by weak or non-existent legislation. Given the current protection measures implemented in these areas, it makes sense that these areas be identified as starting point for developing an ESP for the Municipality. Those protected areas occurring within the municipality are summarized in Table 1 and distribution reflected in Figure 4.

Table 1. Protected areas (Type 1 & 2) occurring in the Msunduzi Municipality.

Name	Type	Extent (Ha)	Description
Queen Elizabeth Park	1	93.5	This park is managed by Ezemvelo KZN Wildlife on 99 year lease but the land is owned by Msunduzi Municipality. The park was proclaimed under the Provincial ordinance as a park and provides important habitat for a range of important species such as the Natal leaf-folding frog, Black-headed dwarf chameleon and Hilton Daisy. The park also acts as the headquarters for Ezemvelo KZN Wildlife and is used as a recreational area by the general public.
Bisley Valley Nature Reserve	2	358.4	This reserve was proclaimed in terms of the town planning scheme as a Nature Reserve in 1986. The reserve is owned by Msunduziwho are responsible for management of the reserve. The nature reserve was initially proclaimed to preserve and protect biodiversity and to provide recreational opportunities to Pietermaritzburg residents. Important species known from this reserve include the modest millipede, Shaw's earthworm, the javelin flat-backed millipede, and corn crake. There are a number of walking trails, bird hides and a resource centre for day visitors and basic overnight accommodation for 16 visitors.
Ferncliff Nature Reserve	2	147.6	This reserve was proclaimed in terms of the town planning scheme as a Nature Reserve in 1986. The reserve is owned

Name	Type	Extent (Ha)	Description
			by Msunduziwho are responsible for management of the reserve. The reserve was established largely due to conservation significance of the site, representing one of last remaining remnants of Mistbelt Forest in the Pietermaritzburg area. This forest also represents the type locality for a range of invertebrate species. The nature reserve offers a number of trails, picnic sites and an education resource centre for day visitors. Cannot accommodate overnight visitors.
Worlds View Conservation Area	2	31.7	This conservation area was proclaimed in terms of the town planning scheme as a Conservation Area in 1995. The site encompasses indigenous Mistbelt grasslands between worlds view road and old Howick road. The site was proclaimed largely because of its biological diversity and presence of rare and endangered species such as the Hilton Daisy. Only a portion of this site falls within the demarcated Msunduzi Municipal boundary.
Hesketh Conservation Area	2	92.5	This conservation area has been proclaimed in terms of the town planning scheme as a Conservation Area. The site represents an area of Southern Tall grassveld, located above the Maritzburg Golf Course in the Scottsville area. The site was proclaimed largely due to the need to protect areas of this veld type. The site is particularly well known for its ground orchids and other plant species.
Alexandra Park	2	71.4	This park was donated to the Municipality by a resident for the management as a park for urban residents. Protection of this area is written into the title deeds. The park is widely used for recreational use – there are few environmental components of any value.
Wylie Park	2	10.6	This park was also donated to the Municipality by a resident for the management as a park for urban residents. The site is perhaps most important for its horticultural value as an arboretum which is also used for passive recreation.
Pietermaritzburg National Botanical Gardens	2	47.7	The botanical gardens are managed and owned by National government. The area is an important arboretum and used for passive recreation but does have some untransformed land with some biodiversity value.

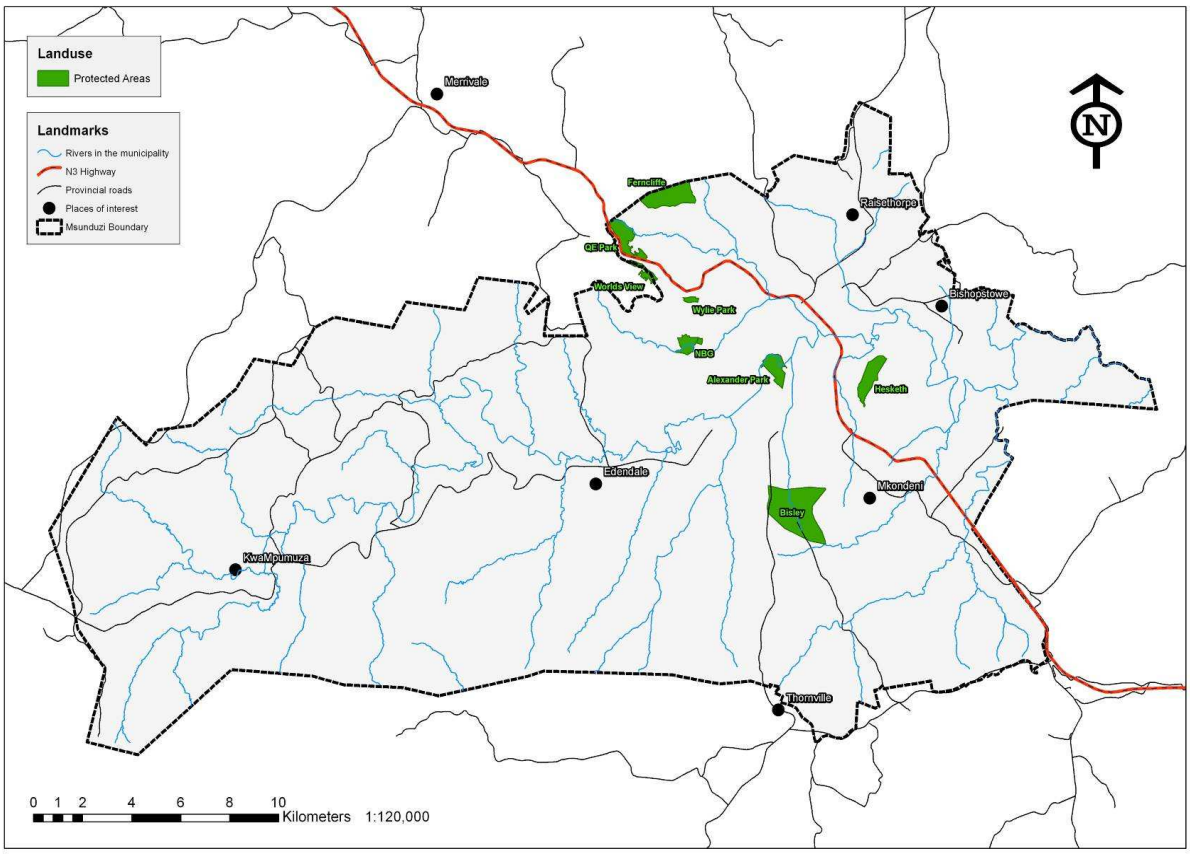


Figure 4. Location and extent of protected areas in the Msunduzi Municipality.

2.2.2. Identifying key areas of natural habitat

Protection of a representative set of natural areas that are regarded as high priority for biodiversity protection should be included as part of the 'backbone' of the ESP. Ideally, these areas would include large, intact blocks of representative habitat, but in a largely transformed landscape, such as that occurring within the municipal boundary, many small remaining areas are now essential to meet biodiversity targets for a range of species.

The systematic conservation plan developed for the Municipality was used as the basis for identifying key areas of natural habitat for inclusion in the ESP (Macfarlane *et al,* 2008). One of the primary outputs of the systematic conservation plan was a map indicating the irreplaceability of untransformed land in the Municipality (Figure 3). This map is divided primarily into 1 ha hexagonal grid cells called 'planning units' with additional planning units based on the extent of natural forest and wetland systems, as well as the protected areas. Each cell has an associated 'Irreplaceability Value' which is a reflection of the planning unit's importance with respect to the conservation of

biodiversity. Irreplaceability reflects the planning unit's ability to meet set 'targets' [1]for selected biodiversity 'features'. The irreplaceability value is scaled between 0 and 1.

Irreplaceability value – 0. A planning unit with an irreplaceability value of 0 indicates that a planning unit is not required to meet any biodiversity feature target, and thus there is unlikely to be a biodiversity concern with the development of the site. There is no need from a biodiversity perspective to include such areas in the ESP, unless they can form part of a linkage between areas of key habitat (See Section 2.3.2).

Irreplaceability value – 1. These planning units are referred to as totally irreplaceable, for without the protection of these units, the conservation target of the feature(s) within its extent will not be met.

Irreplaceability value > 0 but < 1. Some of these planning units are required to meet biodiversity conservation targets. If the value is high (e.g. 0.9) then most units are required (few options available for alternative choices). If the value is low, then many options are available for meeting the biodiversity targets. It must be remembered though, that the development of one of these sites affects the irreplaceability value of all of the remaining negotiated sites within the planning domain as a whole. Although not identified as key habitats, these areas are potentially important linkages between key habitats (See Section 2.3.2)

A simple classification system was therefore applied to the outputs of the conservation plan to specifically identify key habitats for biodiversity conservation. Given that all features with an irreplaceability value of 1 are required to meet conservation targets, all mapped units with scores = 1 were earmarked for inclusion in the ESP by classifying them as "**Key Areas**". The distribution of these areas is presented in Figure 5, below.

[1] Area-based targets for habitat conservation are set for important biodiversity features including vegetation types and species habitats. Targets reflect the area of suitable habitat that is required to help ensure the conservation of biodiversity attributes within the study area.

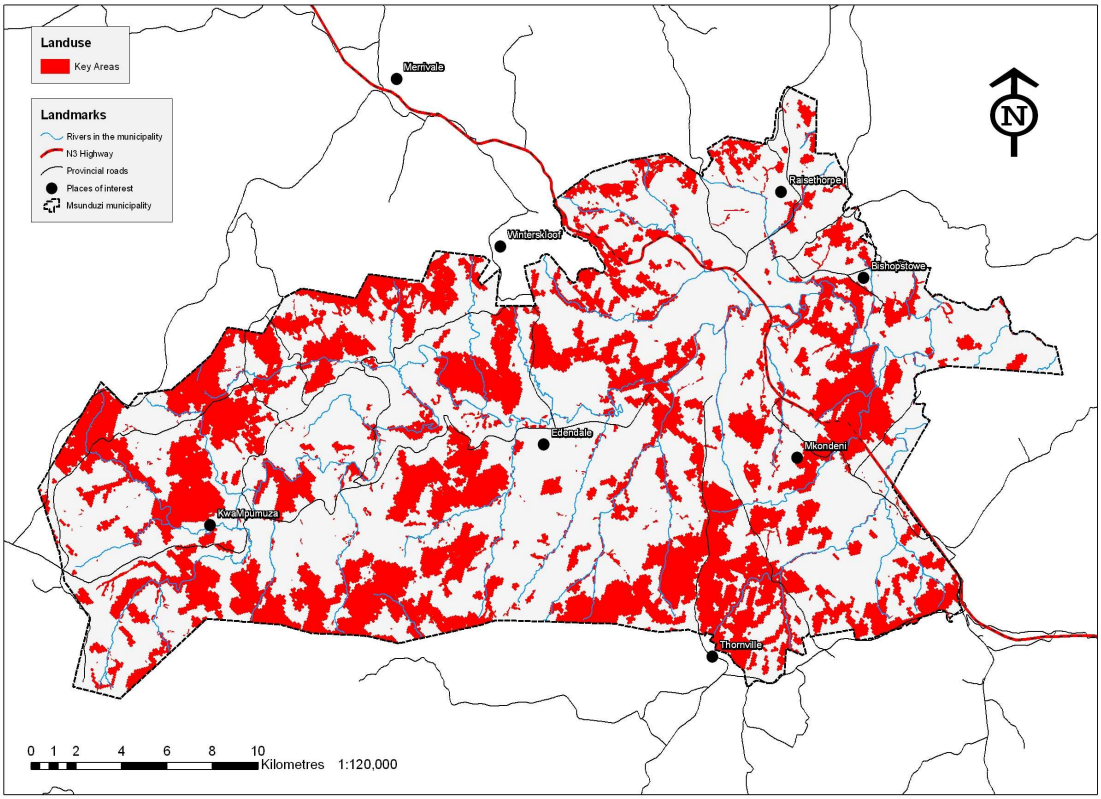


Figure 5. Distribution and extent of key areas for biodiversity conservation in the Msunduzi Municipality.

In order to provide additional information for planning and prioritization, sites were further ranked from 1 to 5 by averaging summed irreplaceability values calculated using Marxan for each feature (Macfarlane, 2008). These values represent the frequency with which planning units were selected by the conservation planning software in order to meet biodiversity targets. The following ranking system was applied:

1. Priority 1: Top 1% of planning units;
2. Priority 2: Next 4% of planning units;
3. Priority 3: Next 15% of planning units;
4. Priority 4: Next 30% of planning units.
5. Priority 5: Remaining 50% of planning units (not specifically required to meet targets)

This approach helps to highlight those sites that are more important than others in maintaining biodiversity within the Municipality that could be prioritized for acquisition or management. The result of this classification is indicated in Figure 6 below.

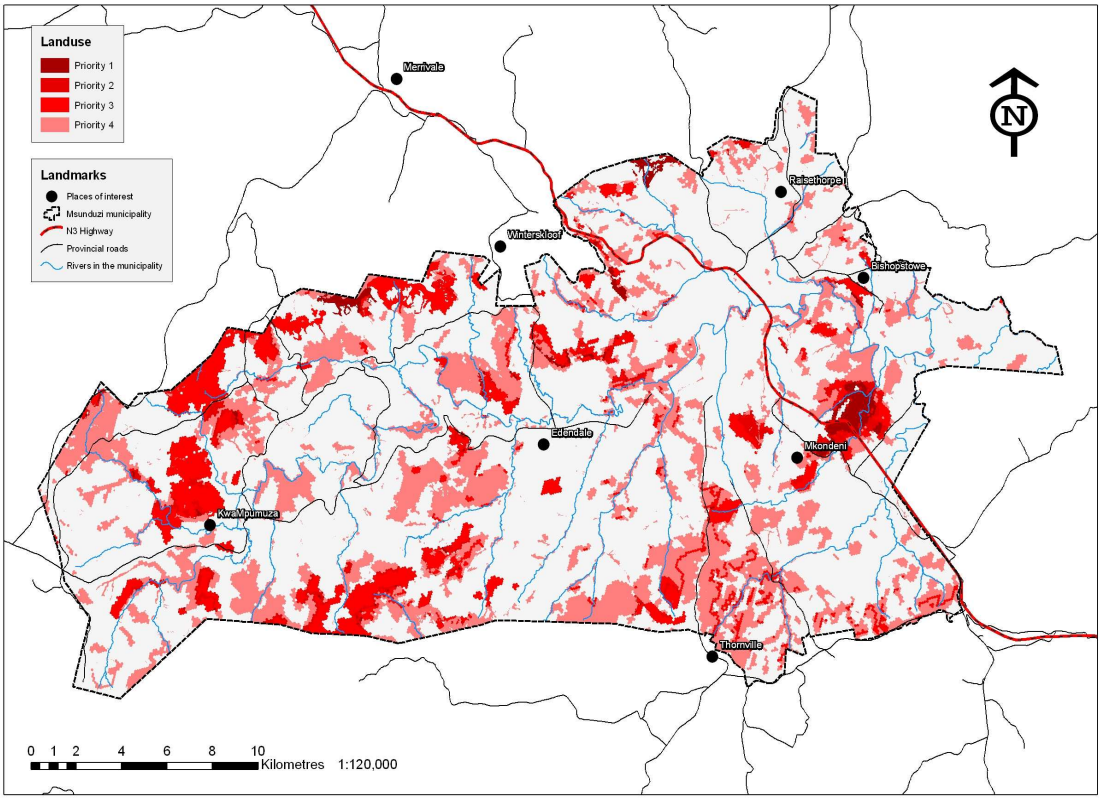


Figure 6. Classification and ranking of natural habitat based on the necessity for meeting conservation targets.

Remaining areas of untransformed land may still play an important role in (i) meeting conservation targets or (ii) acting as linkages between priority conservation areas. Although not identified as key habitats, these areas are potentially important linkages between key habitats and were considered further in Section 2.3.

2.3. Identification of linkages to maintain and restore connectivity

Once priority habitats had been identified, the next step involved identifying appropriate linkages to maintain and restore connectivity and increase the resilience of the proposed ESP. A review of relevant literature was undertaken to define design criteria that were then used to identify a suite of appropriate linkages.

2.3.1. Review of scientific literature

Bennet, (1998, 2003) in the book entitled "Linkages in the Landscape: The Role of Corridors and Connectivity in Wildlife Conservation" provides a synthesis of available science and current thinking on linkages for biodiversity conservation. This reference formed the primary reference used to

inform this study. A summary of pertinent points provided in the text, and supported by a range of other sources is summarized below:

2.3.1.1. The importance of connectivity

Maintenance of connectivity within and between ecosystems in the landscape is well recognized as contributing significantly to biodiversity conservation, particularly in highly transformed landscapes (Bennet, 1998, 2003). Connectivity, in this context, can be defined as 'the degree to which the landscape facilitates or impedes movement among resource patches' (Taylor *et al*. 1993 in Bennet, 1998, 2003). Various authors have demonstrated the importance of maintaining connectivity, with close correlations having been demonstrated between the extent of unbroken surface and species richness within ecosystems as well as the population viability of these species (Bond *et al.*, 1988).

Maintaining connectivity is important for maintaining the viability of existing populations for a number of reasons. Firstly, increased connectivity increases immigration rates to isolated habitats. This can contribute to the maintenance of higher species richness and diversity by supplementing declining populations and reducing their risk of extinction (Bennet, 1998, 2003). Increased movement also facilitates genetic mixing and prevents inbreeding, which decreases the genetic diversity and thus contributes to the long-term survival of the species (Williams *et al.*, 2005). Corridors may also allow the re-establishment of areas following local extinctions (Bennet, 1998, 2003). This is demonstrated by Samways and Taylor (2004) who found that newly rehabilitated riparian buffer zones enabled dragonflies to re-colonize previously isolated habitats and to reconnect with isolated populations, within as little as one year.

Within populations, corridors allow the connection of breeding, feeding and refuge sites crucial to maintain the population viability of many species (Sheldon *et al.*, 2003). For many semi-aquatic reptile species, such as the Nile crocodile, Nile monitor and Cape terrapin for example, connectivity between aquatic habitats is regarded as vital as these species often cross land in order to find suitable hibernating spots or patches of permanent water in the dry season (Cowan, 1995). A range of snake species, such as *Lycodonomorphus rufulu*, *Lamprophis aurora* and *Psammophylax rhombeatus* hibernate in aggregations, thus requiring connectivity in order for individuals to congregate (Cowan, 1995).

Although fine scale corridors enable short distance or regional movements, they also play a role in sustaining long distance migrations. Many birds, for example, including little bitterns, ringed plover, common sandpiper and greenshanks, use riparian vegetation (in buffers) as migratory routes

(Cowan, 1995). This is likely to be particularly important in urban areas, which are major obstacles in a bird's migration route. In such areas, corridors, such as those created by establishing buffers along water courses may provide the only suitable pathway through these obstacles along which these species can travel (Biohabitats Inc., 2007).

Despite the numerous reported advantages of corridors, it is worth noting that there are also a range of reported disadvantages. These range from facilitating the spread of unwanted species and abiotic disturbances, to high management costs that may reduce funds available for alternative conservation actions. A summary of reported advantages and disadvantages of corridors is presented in Table x below.

Table 2. Reported advantages and disadvantages of linkages for biodiversity conservation (Bennet, 1998, 2003).

Reported Advantages	Reported disadvantages
Assist in the movement of individuals through disturbed landscapes, including • Wide ranging species that move between habitats on a regular basis; • Nomadic or migratory species that move between irregular or seasonally varying resources; • Species that move between habitats at different stages of their life cycles	Increase immigration rates to isolated habitats which could: • Facilitate the spread of unwanted species such a pests, weeds and exotic species; • Facilitate the spread of disease; • Introduce new genes which could disrupt local adaptations
Increase immigration rates to isolated habitats which could: • Maintain higher species richness and diversity; • Supplement declining populations, thus reducing their risk of extinction; • Allow re-establishment following local extinction; • Enhance genetic variation and reduce the risk of inbreeding occurring.	Increase exposure of animals to: • Predators, hunting or poaching by human or other sources of mortality • Competition or parasites.
Facilitate the continuity of natural ecological processes in developed landscapes.	Act as 'sink habitats' in which mortality exceeds reproduction, and thus functions as a 'drain' on the regional population.
Provide habitat for many species including: • Refuge and shelter for animals moving through the landscape; • Plants and animals living within linkages.	Facilitate the spread of fire or other abiotic disturbances.
Provide ecosystem services such as maintenance of water quality, reduction of erosion, and stability of hydrological cycles.	Establishment and management costs could reduce the resources available for more effective conservation measures, such as the purchase of habitats for endangered species.

Despite the possible disadvantages, it is worth noting that many of these would apply equally to large intact landscapes. Indeed, habitat connectivity is a characteristic of natural environments. As such, protection or restoration of connectivity is not an artificial change in landscape: rather, it is the loss of connectivity and isolation of natural environments that is a result of human interference. There is also clear evidence that isolation of populations and communities through the loss of intervening habitat has a detrimental effect. Following the 'precautionary principle' therefore demands that where knowledge is limited, **the prudent approach is to retain existing natural linkages due to the large range of potential benefits they provide**.

2.3.1.2. Corridors and climate change

The importance of maintaining connectivity has also been highlighted in the face of climate change and in response; corridors are being increasingly incorporated in a range of strategic conservation planning initiatives (2009 Biodiversity Planning Forum). This is because the distribution ranges of many species will change, challenging the ability of our present fixed conservation areas to protect them (Williams *et al.*, 2005). For example two-thirds of the 330 endemic *Proteaceae* species of the fynbos biome are projected to experience complete range dislocation by 2050 (Midgley *et al.*, 2002). The critically endangered riverine rabbit, endemic to the central Karoo, is another species likely to be significantly affected by climate change, with an expected 96% loss of its current suitable habitat due to climate change (Hughes *et al.*, 2008). Although no specific information is available on the susceptibility of species with the Msunduzi Municipality, climate change will undoubtedly affect the potential viability of local species populations.

Bennet, (1998, 2003) highlights a number of reasons why linkages may play an important role in safeguarding against climate change that includes:

1. Assisting plants and animals to extend their geographic range to track suitable climatic conditions. Linkages most likely to be suited to help plants and animals extend their geographic ranges are those that link habitats across an elevational gradient to facilitate range shifts.

2. Helping to maintain the continuity of species populations through their present geographic range, thus maximizing a species ability to persist within those parts of its range where climatic conditions may remain suitable. This recognizes that redistribution of plants and animals within an existing range is more feasible than range shifts to new areas.

3. By interconnecting existing protected areas, they may help to maximize the resilience of the present conservation network. In this regard, linkages that maintain large continuous

habitats or that maintain connectivity between a number of protected areas along an environmental gradient is likely to be most valuable.

Maintenance of corridors is therefore likely to be one of the most important strategies for biodiversity conservation in response to climate change.

2.3.1.3. Factors to consider when designing linkages

When designing and prioritizing corridor networks, there are a range of factors that affect the functionality of the corridor and should be considered (Bennet, 1998, 2003). These are briefly described below in order to provide guidance on corridor design criteria to be used in this study.

Spatial scale at which linkage maintains ecological processes

Linkages can be established at a range of scales from local; operating over metres (e.g. streams, roadsides, underpasses etc) to landscape scale; operating over kilometers (e.g. rivers & associated riparian vegetation, broad links between reserves etc) and regional or biogeographic scales; operating over hundreds of kilometers (e.g. major river systems; mountain ranges etc).

While linkages that maintain natural ecological processes and continuity of species distributions at the biogeographic and regional scale are likely to be most important at a national level, such linkages can usually not be established at a local (e.g. Municipal) scale. Within the study area, opportunities for establishing corridors at the landscape and local scale should therefore be considered.

Level of redundancy of the linkage and associated habitat

Highest priority should be given to those situations where there are no feasible alternatives for maintaining connectivity, where the loss of existing linkages would be essentially irreplaceable, or where no other habitat systems conserve a particular community of animals (Bennet, 1998, 2003). Corridors are therefore likely to be most important in situations where large parts of the landscape has been modified and is inhospitable to native species ((e.g. within built-up areas).

Degree of threat to species or communities in the habitats to be linked

Priority should be given to developing linkages that connect species or communities that warrant special conservation attention. Decisions should however be informed by known causes of species declines, mobility of species concerned and habitat requirements of the species concerned.

Present condition of the linkage

Tracts of natural vegetation have greater conservation potential as linkages than comparable areas of land that require partial or major restoration. Priority should therefore be given to largely undisturbed areas of natural vegetation.

Range of species that the linkage will benefit

In general, links that enhance the conservation status of a group of species, or entire communities of animals should receive higher priority than those that function for one, or only a few species. This is partially related to the size of the linkage as discussed further in this document.

Capacity of the linkage to provide other ecological and environmental benefits

Linkages that provide a range of environmental benefits, without compromising their role of ensuring connectivity of wildlife, should be prioritized over those that only have a single purpose. Streamside corridors are particularly important in this regard, as discussed further in section 2.3.1.5.

2.3.1.4. Determining appropriate widths of linkages

The width of linkages is particularly important as it influences most of the aspects that affect the functionality of the corridor. Indeed, maximizing width is regarded as one of the most effective options to increase the effectiveness of corridors for wildlife conservation (Bennet, 1998, 2003). There are no generic widths that can be easily applied in the design of linkages in the Municipality however. Some generic principles should however be considered in corridor design and include:

- Reduction in edge effects can be most effectively minimized by increasing the width or size of corridors;
- Increased width typically incorporates a large area with potential greater diversity of habitats that is likely to act as a useful link for a wider variety of species and;
- Larger widths increase the likelihood of the corridor providing appropriate requirements for species requiring large amounts of space or specialized feeding and habitat requirements.

The following 'rules of thumb' have been proposed by Harris and Scheck for deciding on an appropriate corridor width (1991 in Bennet, 1998, 2003):

- *'for the movement of individual animals where much is known of their behavior and the corridor is tended to function over weeks or months, the appropriate width can be measured in metres;*
- *For the movement of a species, when much is known of its biology and when the corridor is expected to function over years, the width should be measured in 100's of metres;*
- *When the movement of entire assemblages is considered and / or when little is known of the biology of the species concerned, and/or the corridor is intended to function over decades, the appropriate width must be measured in kilometres'*

There is therefore no generic solution for a linkage that will meet the requirements of all species. A link for one species may be ineffective for others that move at different scales. Different widths of ecological linkages are therefore required to promote movements at different scales to cater for the full range of species occurring in a landscape (Bennet, 1998, 2003).

2.3.1.5. Importance and design of riparian corridors

Riparian vegetation along stream lines forms a natural hierarchical system of natural linear habitats through the landscape that represent a natural choice for corridor selection. Such areas typically persist even in highly developed areas due to factors such as flood risk that reduce their utility for alternative land uses. Selecting riparian corridors as linkages is a useful approach for biodiversity conservation for a number of reasons:

- Riparian vegetation is well known to be a rich habitat for fauna, being an interface between aquatic and terrestrial environments;
- Adjacency of aquatic and terrestrial environments is important for species that require both habitats for their life cycles (e.g. frogs and dragonflies);
- Riparian ecosystems frequently support species adapted to streamside habitats that are not found in terrestrial habitats (e.g. otters);
- Fertile alluvial soils and greater availability of water contributes to higher productivity on riparian zones. This typically leads to greater structural diversity and volume of vegetation which may support greater numbers of species and individual populations than terrestrial areas (Bennet, 1998, 2003).

Apart from their value as wildlife corridors, buffer zones established along stream lines have a range of other important ecological functions and values in the landscape that add to their importance. For example:

- Vegetation slows runoff into streams and increases the rate at which water infiltrates the soil;
- Riparian vegetation and wetlands can moderate flood levels by providing floodwater storage;
- Filtration of sediments from adjoining landuses that can reduce the loss of storage capacity of downstream dams;
- Trapping of nutrients before they reach the stream, thus improving water quality;
- Stabilizing stream banks and preventing erosion;
- Shading rivers and streams thereby reducing water temperature, thereby increasing the levels of dissolved oxygen, thereby influencing the capacity of water resources to support aquatic biodiversity.

The effectiveness of riparian buffer zones on providing a range of services is dependent on a range of characteristics such as vegetation structure and density, slope of the buffer and soil characteristics. Perhaps the most important variable affecting functioning however is the width of the buffer applied, with some functions adequately performed by narrow buffers while others require extremely wide buffers. Recommended buffer widths for a range of recognized buffer functions are illustrated in Figure 7 below.

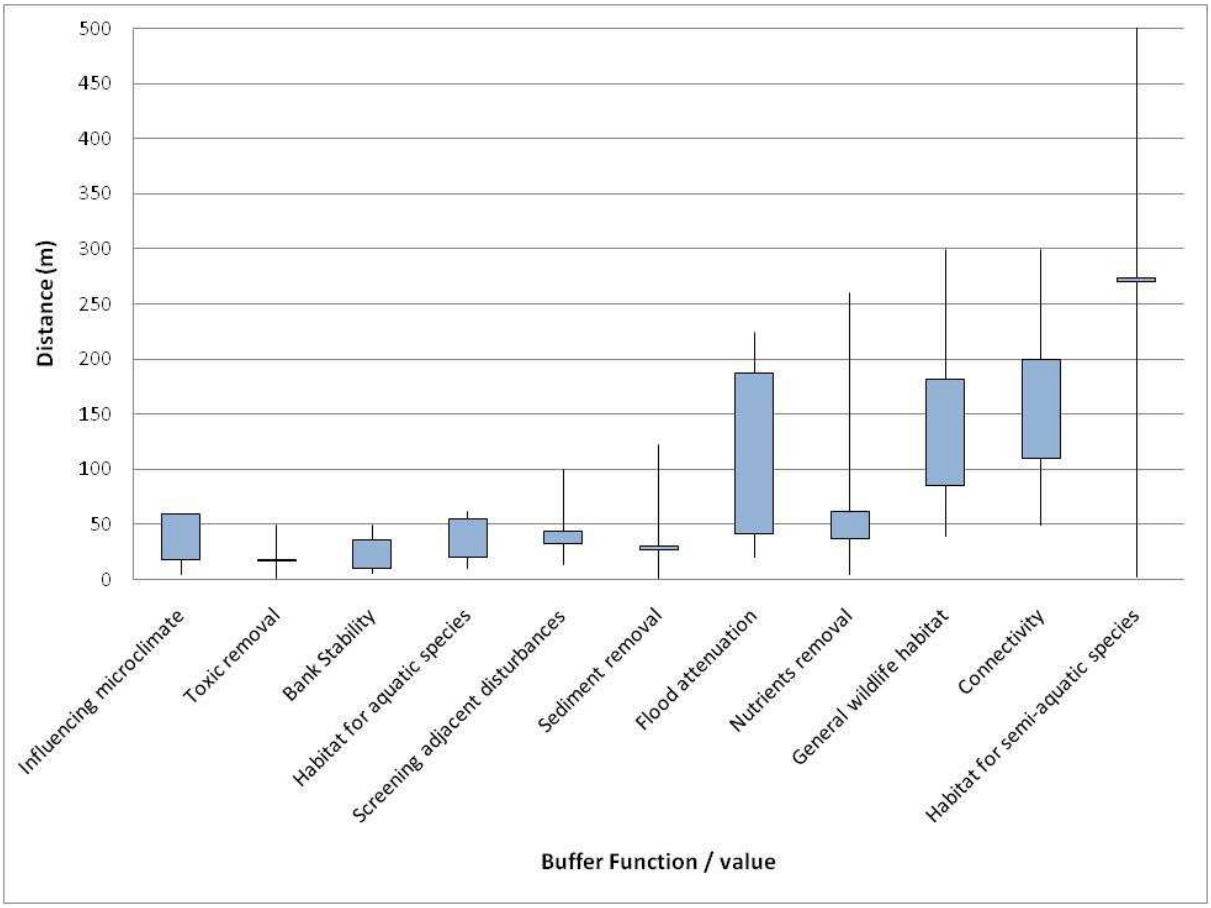


Figure 7. Summary of recommended buffer widths for the provision of different buffer functions and values. Boxes represent average upper and lower recommended widths while lines represent upper and lower ranges (note that upper range for habitat for semi-aquatic species is 2200m). (Source: Macfarlane *et al.*, 2009)

This figure shows that buffer widths of between 90 and 200m are typically required to provide appropriate habitat for general wildlife and to maintain connectivity while larger buffers may be required to cater for specific needs of important semi-aquatic species. Widths required to reduce water quality impacts on the other hand are typically far smaller, typically ranging from 10 – 60m. The effect of increasing buffer width on pollutant levels and wildlife habitat value is elegantly presented by Desbonnet *et al.* (1993, 1994) as illustrated in Table 3 below.

Table 3. Summary of sediment and pollutant removal effectiveness and wildlife habitat value based on buffer width (Desbonnet et al 1993, 1994)

Buffer Width	Pollutant Removal Effectiveness	Wildlife Habitat Value
5m	Approximately 50% or greater sediment and pollutant removal	Poor habitat value, useful for temporary activity of wildlife.
10m	Approximately 60% or greater	Minimally protects stream habitat, poor wetland habitat, useful for

Buffer Width	Pollutant Removal Effectiveness	Wildlife Habitat Value
	sediment and pollutant removal	temporary activity of wildlife.
15m	Greater than 60% sediment and pollutant removal	Minimum general wildlife and avian habitat value.
20m	Greater than 70% sediment and pollutant removal	May have use as a wildlife travel corridor for some species as well as minimal to fair wildlife habitat.
30m	Approximately 70% or greater sediment and pollutant removal	May have use as a wildlife travel corridor for some species as well as minimal to fair wildlife habitat.
50m	Approximately 75% or greater sediment and pollutant removal	Minimum to fair general wildlife habitat value.
75m	Approximately 80% or greater sediment and pollutant removal	Fair to good general wildlife and avian habitat value.
100m	Approximately 80% or greater sediment and pollutant removal	Good general wildlife and avian habitat value; may protect significant wildlife habitat value.
200m	Approximately 90% or greater sediment and pollutant removal	Excellent general wildlife and avian habitat value; likely to support diverse community.
600m	Approximately 99% or greater sediment and pollutant removal	Excellent general wildlife and avian habitat value; likely to support diverse community; protection of significant species.

2.3.2. Methodology applied in identifying and mapping linkages

Riparian vegetation along stream lines forms a natural hierarchical system of natural linear habitats through the landscape that represent a natural choice for corridor selection. Such areas typically persist even in highly developed areas due to factors such as flood risk that reduce their utility for alternative land uses. These zones also provide a range of functions other than those necessary for biodiversity persistence and maintenance which provides additional incentives for protecting such areas.

The first step in developing an appropriate network of linkages was therefore to identify riparian corridors for inclusion in the ESP. Once these had been defined, the suitability of these linkages in maintaining connectivity between key areas of natural habitat was reviewed and used to update and improve the proposed corridor network based on species-specific requirements. The process followed in identifying and mapping these linkages is described in more detail below.

2.3.2.1. Identification and mapping minimum riparian corridors

The key question in mapping preliminary riparian corridors was: What width should be applied? As illustrated in Table 3, widths of buffers have implications for both water quality and wildlife habitat value, together with a range of other functions and values provided. Buffers of 20m provide a reasonable level of protection for water quality while providing a minimum width for wildlife movement. These buffers, together with an accuracy buffer for mapped wetlands were therefore identified as minimum riparian corridors around mapped wetlands and streamlines in the study area.

Development within areas prone to flooding is also typically restricted, with the National Water Act requiring 1:100 year flood lines to be established and shown on township development plans to inform development planning (SRK Consulting, 2009). In discussion with Mr. Rodney Bartholomew it was agreed that, due to the constraints to development in these areas and potential benefits associated with wider corridors for wildlife species, that such areas should be included in the ESP. The indicative flood buffer zone coverage for a 1:100 year recurrence interval flood (SRK Consulting, 2009) was therefore combined with the preliminary buffers applied to refine minimum riparian corridors for the study area. Minimum riparian corridors delineated through this process are classified in Figure 8 and presented together with Key areas in Figure 9.

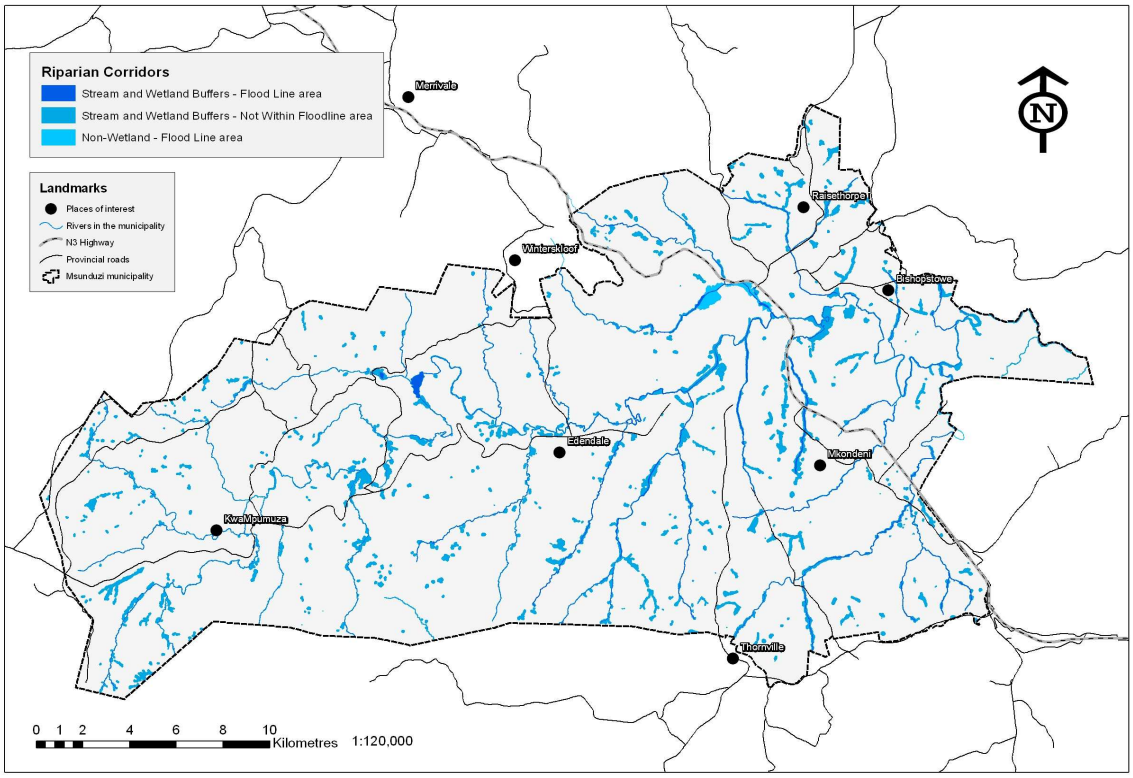


Figure 8. Map indicating different classes of riparian corridors included in the ESP mapping.

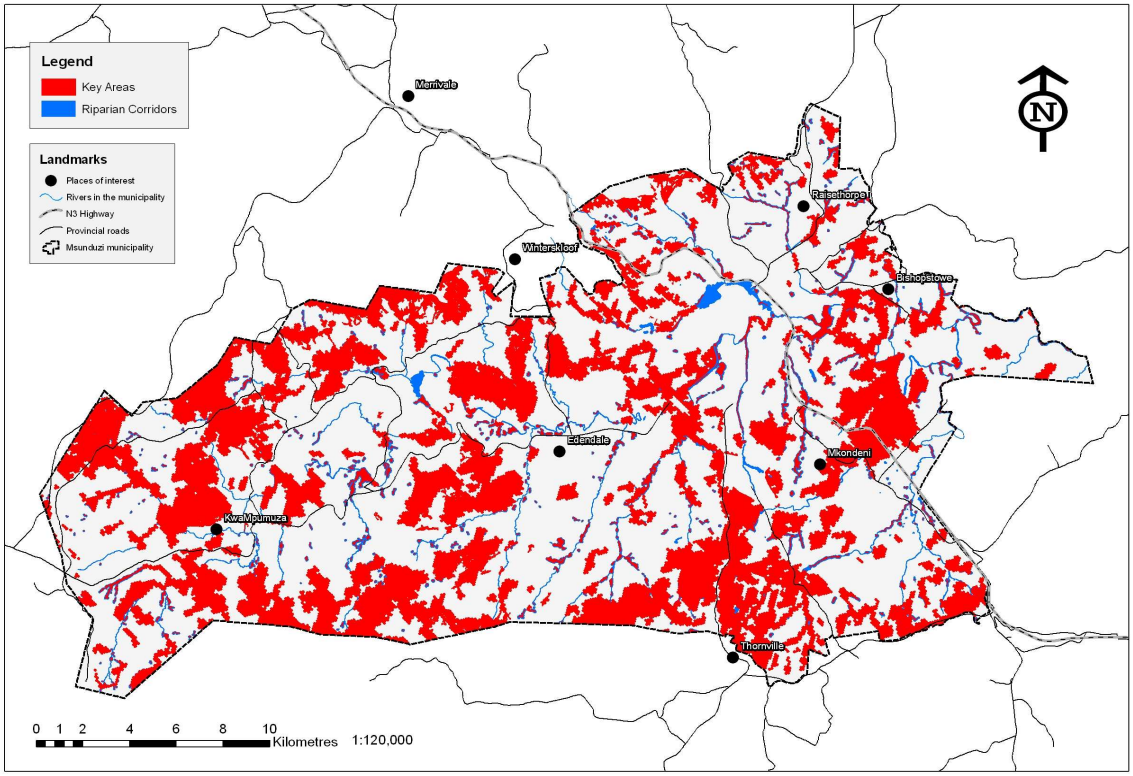


Figure 9. Map indicating key areas together with minimum riparian corridors defined for the study area.

These corridors include both transformed and untransformed areas and serve to highlight areas where existing and future development should be carefully managed to limit impacts on aquatic systems and help maintain natural vegetation as corridors for indigenous species.

2.3.3. Identification and mapping of additional terrestrial corridors to meet specific species requirements

Once initial riparian corridors had been established, the need for establishing additional terrestrial corridors was evaluated. This involved systematically assessing the importance of (i) proposed riparian corridors and (ii) additional terrestrial corridors as linkages between areas of priority habitat where the species were recorded. While it is recognized that connectivity may be important for plant species, this has been partially addressed through the identification of minimal critical patch size used to identify priority areas during the systematic conservation planning process. The assessment was therefore limited to animal species. The following criteria were used to identify priority species for the creation of terrestrial corridors:

- Mobility of the species – corridors are likely to be more important for mobile species that move over kilometers than for species that move over metres during their lifetime;
- The ability of the species to disperse through mechanisms other than terrestrial habitats (e.g. via stepping stones of suitable habitat, along a waterway);
- The relative restrictions to movement in transformed areas (e.g. ability to move through residential lots / agricultural fields)

The results of this assessment is presented in Annexure 1 and helped to identify species where incorporation of additional terrestrial corridors was required. For each of the priority species, the distribution of priority habitats was overlaid in GIS over the draft ESP to help determine the need for additional terrestrial corridors. This was informed by:

- The degree to which core areas were already linked through the ESP;
- Availability of suitable habitat to link core areas (level of transformation, available habitat);
- Presence of restrictive barriers (e.g. N3) that could affect the effectiveness of proposed corridors;
- Distance of separation between core areas.

Where linkages were deemed adequate, no additional terrestrial corridors were proposed. In the few instances where linkages between existing key areas was inadequate, and the creation of additional corridors was feasible (suitable habitat still available; distance between areas limited), additional terrestrial corridors were created. A brief summary of the assessment and any new corridors included is presented in Table 4, below.

It should be noted that the N3 and other major roads do act as a significant barriers to many species. This assessment has not specifically looked at how restrictions to movement associated with road networks can be overcome. This should however potentially be a focus in key areas such as the Mkondeni Valley, where the N3 acts as a significant barrier between important biodiversity areas on either side of the highway.

Consideration was also given to the need to introduce additional linkages in response to pressures from Climate Change. Given the large extent of areas covered by the ESP mapping, reasonable level of connectivity and inclusion of some large areas with good altitudinal variation, no additional areas were specifically identified to increase resilience in response to the threat of climate change.

Table 4. Species for which terrestrial corridors were identified as important and steps taken to improve linkages between identified core areas.

Scientific name	English Name	Corridor design considerations	Riparian corridors	Terrestrial corridors	Map reference – See Annexure 2	Adequacy of preliminary network?	Modifications to preliminary ESP Mapping
Bradypodion melanocephalum	Black-headed dwarf chameleon	Although slow moving, corridors would be useful in promoting the maintenance of remaining populations of this species. Given the species ability to use a range of habitat types, even somewhat degraded areas (e.g. areas infested by alien plants) may act as suitable corridors for this species. Riparian corridors may also be effective in maintaining connectivity between remnant habitat patches.	Y	Y	Map 1	The preliminary ESP already provides good connectivity between QE Park (Priority area) and other potential habitat for the species in Ferncliff Nature Reserve (See point 1). A number of the secondary areas identified as important for this species are also already included in the ESP Mapping, many of which are already adequately connected (e.g. areas along the South-facing slopes of the Edendale valley – See Point 2). Areas of potential habitat are also reasonably well connected in the hills along the northern borders of the Edendale area (See point 3).	No additional terrestrial corridors required
Crocidura maquassiensis	Makwassie musk shrew	Corridors are potentially important for this species, although habitat characteristics of the corridor are likely to affect use by this small shrew. Given the species preference for wetland areas and moist grassland, maintenance of riparian corridors may provide a reasonable level of connectivity between areas of suitable habitat.	N	Y	Map 2	The preliminary ESP already caters for the protection of much more habitat than is required to meet conservation targets (7% of priority 2 areas). Areas of potential habitat just north of Edendale are already well connected (See point 1). Suitable habitat near QE Park is also reasonably well connected, with no additional terrestrial corridors required in this area (See point 2). Potential habitat also occurs near Raisthorpe & Bishopstowe (See point 3). The preliminary ESP does not adequately cater for the species in this area but the preliminary ESP already caters for most habitat requirements of this species. No further corridors were therefore considered in this area.	No additional terrestrial corridors required

Scientific name	English Name	Corridor design considerations	Riparian corridors	Terrestrial corridors	Map reference – See Annexure 2	Adequacy of preliminary network?	Modifications to preliminary ESP Mapping
Dasophrys natalensis	Natal robberfly	Given the mobility of this species, corridors between forest patches are likely to contribute to the conservation of this species.	N	Y	Map 3	Priority habitat for this Mistbelt forest margin species was identified as the Ferncliff Nature Reserve (See point 1). This habitat is connected in the upper reaches but is separated to a large degree by timber plantations. This connectivity can be improved by including a narrow, wooded riparian corridor to connect these two areas.	Narrow wooded riparian habitat through commercial plantations added to ESP network.
Dasophrys umbripennis	Shaded-winged robberfly	Given the mobility of this species, fine-scale corridors between forest patches are likely to contribute to the conservation of this species.	N	Y	Map 4	Priority habitat for this Mistbelt forest margin species was identified as the Ferncliff Nature Reserve (See point 1). This habitat is connected in the upper reaches but is separated to a large degree by timber plantations. This connectivity has already been improved through the inclusion of the corridor for *D. natalensis.*	See above
Ischiolobos mesotopos	Midlands robberfly	Given the mobility of this species, fine-scale corridors between grassland patches are likely to contribute to the conservation of this species.	N	Y	Map 5	Only a very small area (30Ha) of the nearly 3000Ha of suitable habitat identified for this species. Large areas of suitable habitat will already be protected by the preliminary ESP. Most areas are already well connected, such as grasslands in the upper reaches of the Edendale Valley (See point 1). Some areas are less well connected (See point 2) but already represent large areas of intact habitat for the species.	No additional terrestrial corridors required
Microchaetus caementerii	Large Pietermaritzburg earthworm	Connectivity is likely to be important for the persistence of this species.	N	Y	Map 6	All areas of priority habitat for this species have been incorporated into the planned ESP (See point 1). These areas are well connected with no need for additional terrestrial corridors.	No additional terrestrial corridors required

Scientific name	English Name	Corridor design considerations	Riparian corridors	Terrestrial corridors	Map reference – See Annexure 2	Adequacy of preliminary network?	Modifications to preliminary ESP Mapping
Microchaetus papillatus	Green giant earthworm	Connectivity is likely to be important for the persistence of this species although corridors may include agricultural lands (rather than only pristine areas).	N	Y	Map 7	Priority habitat occurs as three priority areas near Mkondeni. Existing levels of transformation and the presence of a highway between two of these sites suggests that little can be done to improve levels of connectivity between these priority areas.	No additional terrestrial corridors required
Orycteropus afer	Aardvark	Maintenance of corridors between areas of suitable habitat (open grassland areas) is regarded as very important for this species. Corridors would however need to be of suitable habitat as this species is unlikely to move through heavily transformed areas (other than agricultural lands).	N	Y	Map 8	This species is predicted to occur primarily in the grassland areas in the upper reaches of the Edendale valley. Most of the large intact grassland areas that remain have been incorporated into the preliminary ESP (E.g. See Point 1). These already adequately meet habitat targets for the species. Although the addition of additional habitat could improve connectivity (E.g. Points 2 & 3), the addition of additional corridors cannot be adequately justified.	No additional terrestrial corridors required
Philantomba monticola bicolor	Blue duiker	Corridors may be potentially beneficial for this species. It should be noted however that management considerations (controlling snaring, dog poaching etc) are likely to be more important in maintaining habitat populations than linking suitable habitats with terrestrial corridors. Riparian corridors typically include woody vegetation and may also act as useful links between areas of suitable habitat.	Y	Y	Map 9	The preliminary ESP already makes adequate provision for connectivity between areas of priority habitat for this species (E.g. points 1 & 2). No additional terrestrial corridors were therefore required.	No additional terrestrial corridors required
Poecilogale albinucha	Striped weasel	Maintenance of corridors may be potentially beneficial for this mobile species.	Y	Y	Map 10	As with *Orycteropus afer*, this species is predicated to occur primarily in the upper reaches of the Edendale valley. Large areas of intact habitat have already been	No additional terrestrial corridors required

Scientific name	English Name	Corridor design considerations	Riparian corridors	Terrestrial corridors	Map reference – See Annexure 2	Adequacy of preliminary network?	Modifications to preliminary ESP Mapping
						included in the preliminary ESP with reasonably high connectivity (E.g. areas 1 & 2). There is no clear need to introduce additional corridors to improve connectivity for this species.	
Pronolagus crassicaudatus	Natal red hare	Connectivity is likely to be important for the maintenance of isolated populations of this species. Habitat should however be of suitable habitat (grassland / rocky grassland) to facilitate movement between populations.	N	Y	Map 11	The preliminary ESP already includes the most suitable rocky outcrops for this species. Connectivity between priority habitat is already reasonably good (E.g. point 1), with no need for further terrestrial corridors.	No additional terrestrial corridors required
Stagira purpurea	Purple cicada	Given the mobility of this species, corridors between forest patches are likely to contribute to the conservation of this species.	N	Y	Map 12	This species is known to occur in Swartkop Forest, an area included in the preliminary ESP (See point 1). The other known locality is in Doreen Clark Nature Reserve, just outside the Municipality and within a residential area. No viable corridors exist between these two areas. Management should rather focus on managing these two important sites.	No additional terrestrial corridors required
Tritogenia shawi	Shaw's earthworm	Connectivity is likely to be important for the persistence of this species.	N	Y	Map 13	Priority 1 habitat for this species has been highlighted as Bisley nature reserve (See point 1). This species is also predicted to occur across much of the areas around Mkondeni. Connectivity for this species, together with a range of other species occurring in both Bisley and in priority areas below Mkondeni could be substantially improved by maintaining a corridor of untransformed habitat between these two key areas (Point 2).	A small section of untransformed habitat between Bisley Nature Reserve and the Mkondeni area was included to improve connectivity for this species and a range of other species using this

Scientific name	English Name	Corridor design considerations	Riparian corridors	Terrestrial corridors	Map reference – See Annexure 2	Adequacy of preliminary network?	Modifications to preliminary ESP Mapping
							area.

2.3.4. Inclusion of existing public open space (POS)

The existing POS system only covers a small portion of the Msunduzi Municipality, having previously been limited to the extents of the old city boundary. This POS consists of a range of different POS categories which includes:

- Conservation areas: POS designated for conservation purposes;
- Passive POS: Areas designated for passive social activities such as walks, picnicking, etc;
- Active POS: Areas designated for active social and recreational activities such as golf courses, sports fields and children's parks;
- Private POS: Areas designated as POS but under private ownership;
- Afforestation: Timber plantations owned by the Municipality but used for a range of recreational activities such as walking and mountain biking.

The existing extent of these areas, together with the different classes of POS is presented in Figures 10 and 11. It is worth noting that nearly half of the current POS is transformed with only 16% designated with conservation as the primary use (Table 5)

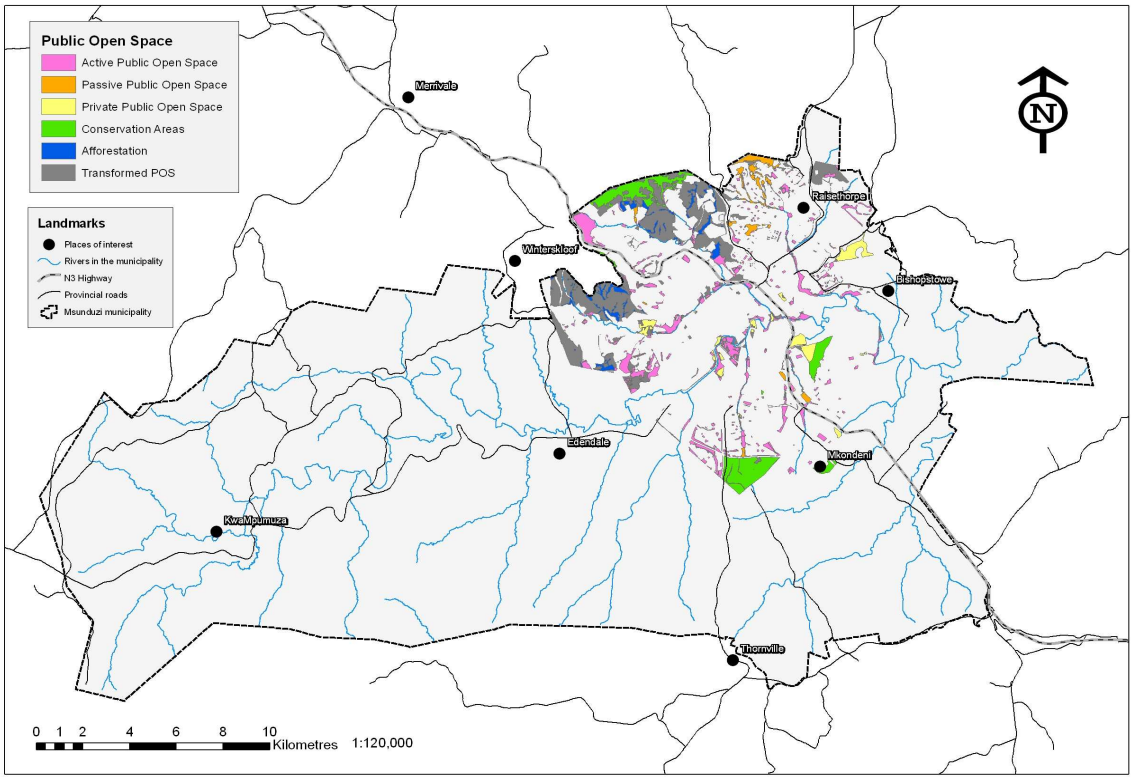


Figure 10. Location and extent of mapped public open spaces in the Msunduzi Municipality.

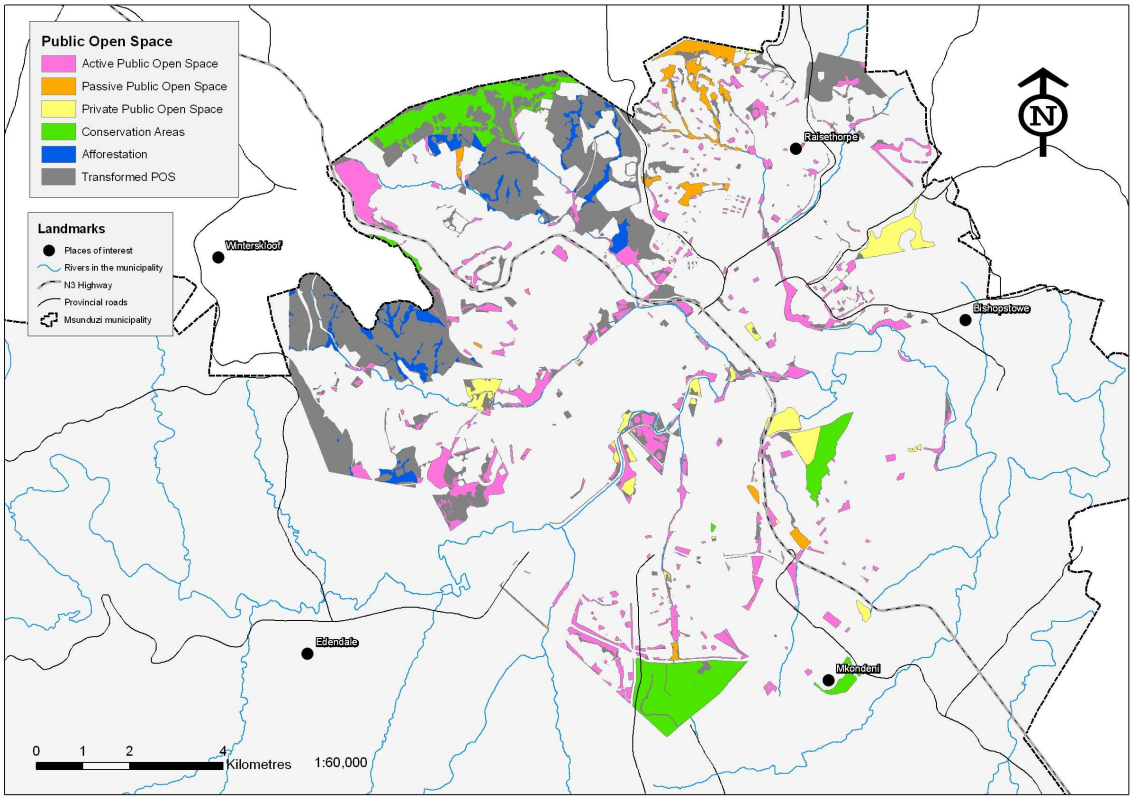


Figure 11. Close-up view indicating the types of POS in the portion of the Municipality in which POS areas have been defined.

Table 5. Relative proportion of different POS categories in the existing POS network.

POS Category	Area (Ha)	Area (%)
Afforestation	213.9	6%
Active POS	770.9	22%
Conservation	547.5	16%
Passive POS	142.8	4%
Private POS	211.1	6%
Transformed	1644.6	47%
Total	**3531.0**	

From a biodiversity perspective, only untransformed areas are likely to contribute meaningfully to biodiversity conservation in the Municipality. The existing POS coverage was therefore combined with a map of untransformed land to differentiate between transformed and untransformed POS to

help highlight POS of greater value for biodiversity conservation. It should however be noted that some areas of transformed habitat (e.g. areas currently infested by alien invasive plants) could be rehabilitated to provide suitable linkages for biodiversity.

The ESP mapping and associated classification is presented in Figure 13, and formed the basis for discussions with key stakeholders.

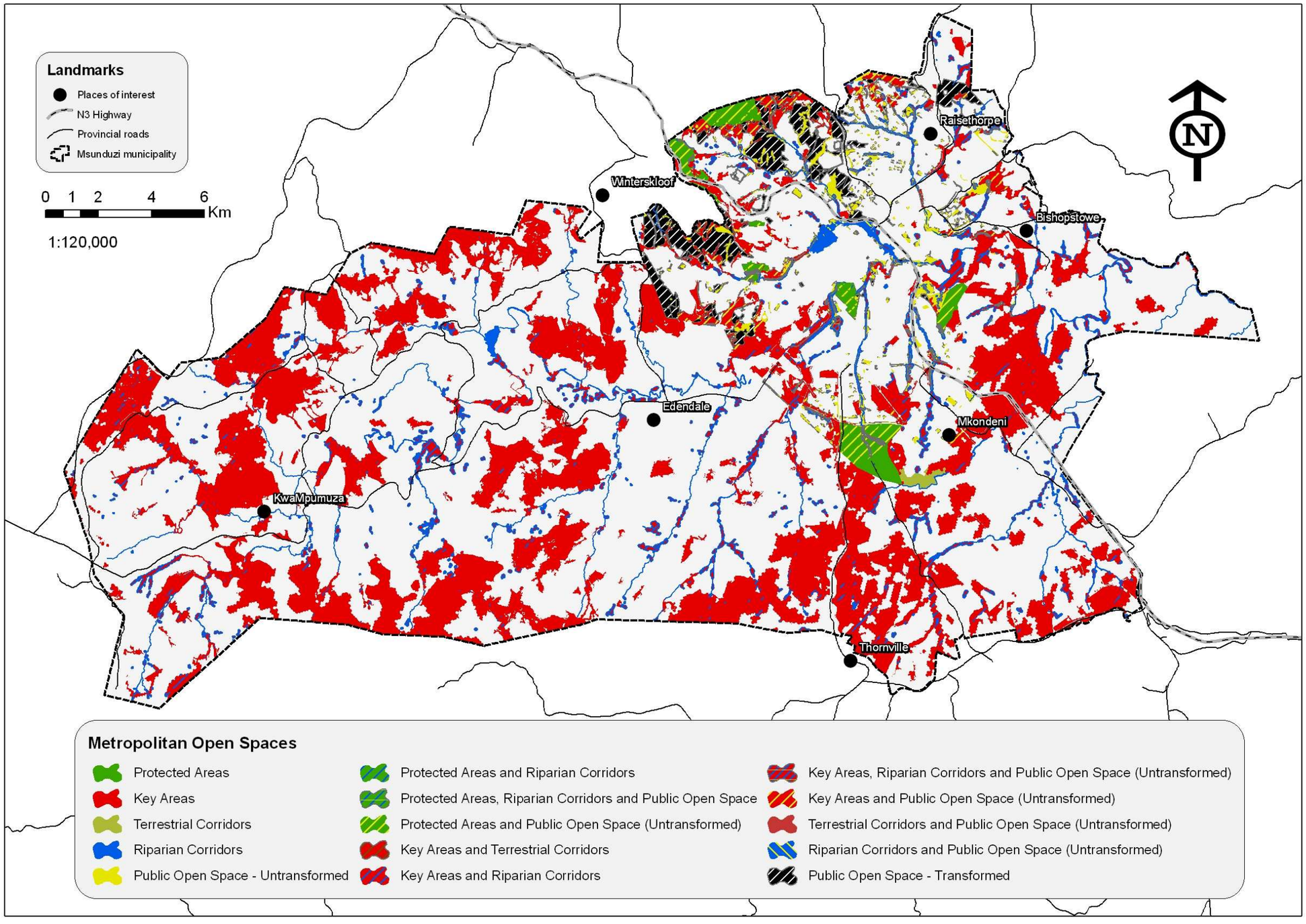


Figure 12. Proposed ESP mapping for biodiversity protection in the Msunduzi Municipality. Areas of existing public open space that are currently transformed are also indicated but have not been included in the ESP mapping as they are unlikely to contribute towards biodiversity objectives.

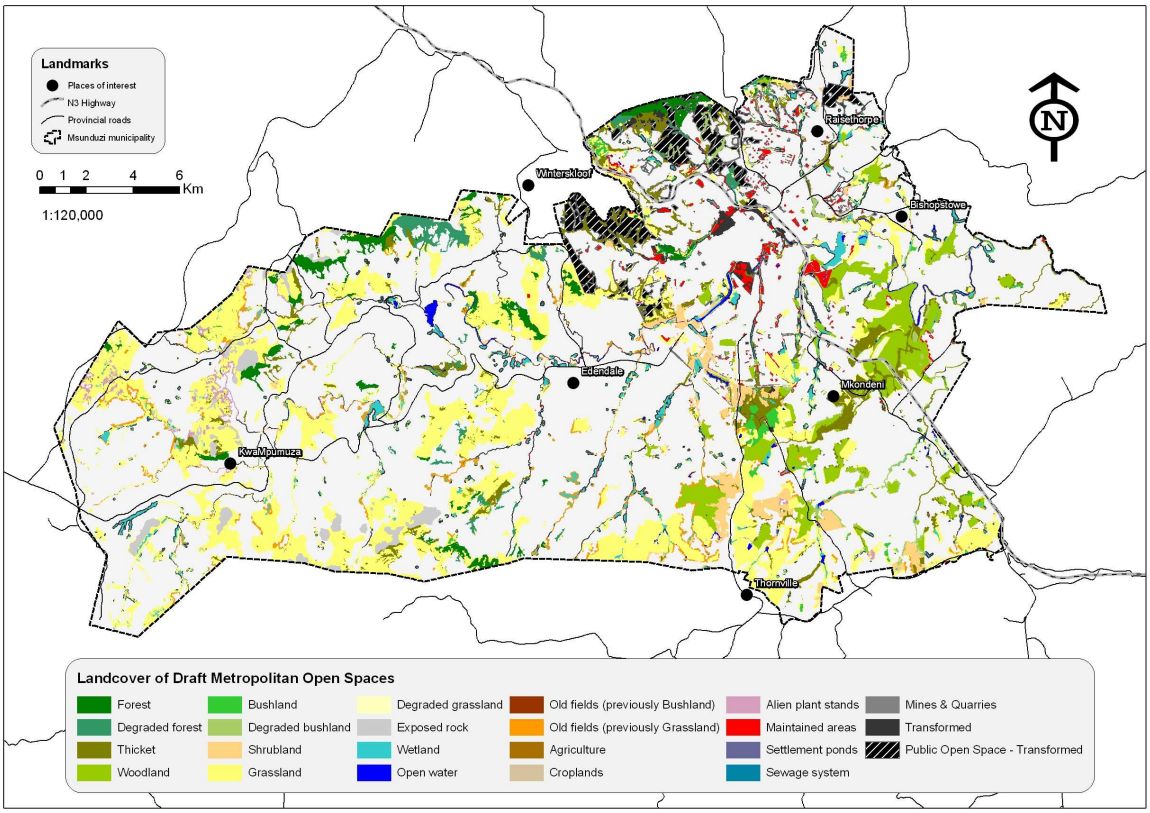
2.4. Stakeholder workshop to present inputs to the ESP

Once the inputs to the ESP had been developed, a workshop was held with representatives of the Msunduzi Municipaliy, DAEA, Ezemvelo KZN-Wildlife and SRK to present the draft coverage and to discuss actions required to refine and implement the ESP. Recommendations made at this meeting were used to help inform the recommendations provided in section 4 of this report.

2.5. Allocating landcover classes to areas incorporated in the ESP mapping

Once the spatial extent of the areas for inclusion in the ESP had been agreed, this map was intersected with the map of landcover classes (Figure 13) to ensure that attributes of landcover type were included as attributes in the ESP mapping. This therefore provides further information on vegetation characteristics of the proposed ESP.

Figure 13. Map indicating landcover of areas included as part of the ESP mapping.



2.6. Incorporation of indicative land values

Since land values are likely to affect actions required to ensure that priority components of the ESPare safeguarded, indicative values of untransformed land within the Municipality were calculated. This was based on the 2008 valuation role provided by the Msunduzi Municipality. A brief explanation of the process followed to develop a land valuation coverage is outlined below.

Step 1: The Municipality was broken down into 60 different principalities that reflected areas of broadly similar economic status. This was based on a planning unit coverage provided by the Municipality.

Step 2: Market values of areas of untransformed land were extracted from the valuation role as a basis for estimating the value of untransformed land within each principality.

Step 3: Average values (R/Ha) were calculated for each principality based on the information available in the valuation role.

Step 4: Availability of data was rated within each principality to provide an indication of the accuracy of estimates given. These ranged from good (large number of properties with values used) to Poor (few values available).

Step 5: A meeting was held with Mr. J.S. Zwart, (Manager: Real Estate and Valuations for the Msunduzi Municipality) to review and refine average values for each principality based on his understanding of relative property values (rated according to development potential) in the Municipality. These values were then used to create a map (Figure 14) illustrating indicative values of untransformed land within different principalities.

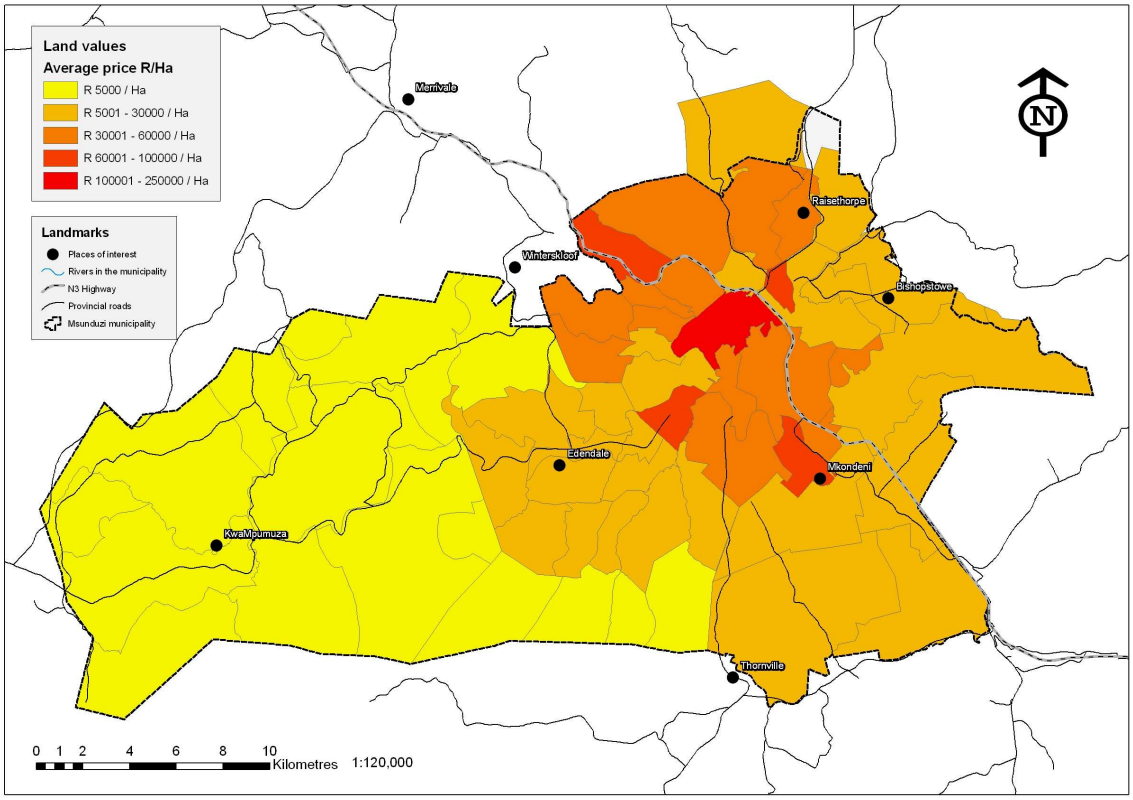


Figure 14. Relative indicative rateable values of untransformed land within each principality.

Note: While this map provides an indication of land prices, it does not take a range of factors into consideration. For example, land values are likely to vary according to slope, vegetation type, development constraints (e.g. environmental importance, ecosystem goods and services) and access to services, which have not been factored into this assessment.

3. RESULTS

3.1. Area of Open Space Assets in ESP Mapping

The ESP mapping developed as part of this study is presented in Figure 10. The areas for inclusion in the ESP cover an area of 20 723.5 Ha, that represents approximately 32.7 % of the Msunduzi Municipality. This consists of a number of different features, ranging from protected areas through to riparian and terrestrial corridors. The extent covered by each of these features is presented in Table 6 below.

Table 6. Extent of features included in the ESP Mapping.

Feature	Extent (Ha)	Extent (%)
Protected Areas	256.3	1%
Public Open Space – Untransformed	494.1	2%
Key Habitats	14017.5	68%
Riparian Corridors	2515.3	12%
Terrestrial Corridors	65.7	0%
Key Habitat and Riparian Corridors	1964.3	9%
Key Habitat and Public Open Space	558.2	3%
Key Habitat, Riparian Corridor and Public Open Space	124.5	1%
Protected Area and Riparian Corridor	18.3	0%
Protected Area and Public Open Space	517.8	2%
Protected Area, Riparian Corridor and Public Open Space	41.5	0%
Terrestrial Corridor and Public Open Space	2.6	0%
Riparian Corridor and Public Open Space	147.3	1%
Total	20723.5	
Transformed Public Open Space	1470.1	N/A

3.2. Landcover classes included in the ESP Mapping

The extent and relative proportion of different landcover classes is presented in Table 7, below.

Table 7. Extent of each landcover classes in the ESP Mapping.

Landcover class	Extent (Ha)	Extent (%)
Agriculture	2.0	0%
Alien plant stands	234.9	1%
Bushland	197.4	1%
Degraded bushland	276.1	1%
Degraded forest	470.6	2%

Landcover class	Extent (Ha)	Extent (%)
Degraded grassland	158.7	1%
Exposed rock	592.6	3%
Forest	901.2	4%
Grassland	9268.4	45%
Maintained areas	474.1	2%
Mines & Quarries	1.3	0%
Old fields (previously Bushland)	1.4	0%
Old fields (previously Grassland)	635.6	3%
Open water	257.7	1%
Settlement ponds	2.1	0%
Sewage system	0.1	0%
Shrubland	960.0	5%
Thicket	1963.9	9%
Transformed	1344.9	6%
Wetland	903.0	4%
Woodland	2077.6	10%
Transformed Public Open Space	1470.1	N/A

4. RECOMMENDATIONS / WAY FORWARD

This project has hopefully contributed towards the design of an open space system for Msunduzi that caters for the need for biodiversity conservation and maintenance of ecological goods and services for Msunduzi residents and downstream users. Much work is still required however for the adoption of and management of an open space network that caters for the needs of users and conservation priorities. Some of the key challenges and actions that need to be taken to ensure that the ESP becomes a useful tool for biodiversity protection are outlined below:

1. **Refinements to the ESP:** This desktop study has been undertaken to develop an ESP that caters for the important biodiversity elements occurring or predicted to occur within the Msunduzi Municipality. Much work still needs to be done however to include other aspects such as social and recreational aspects. Management implications associated with the implementation of an ESP also need to be considered and used to review and revise the ESP and / or implementation plan prior to formal adoption by the Municipality.

2. **Developing an implementation plan for the ESP:** Once the ESP has been refined, steps towards implementation need to be clearly defined and prioritized. Developing a formal implementation plan in conjunction with relevant stakeholders that addresses a number of the proposed actions defined below would be a potentially useful tool to drive this process.

3. **Support from political leadership:** This is perhaps the most important consideration for the effective implementation of an ESP for Msunduzi Municipality. A key opportunity in this regard, would be to better quantify the goods and service values of areas included in the ESP and to use this as a tool for promoting the need for sound management of open space assets. This has indeed been the approach adopted in the DMOSS which is now referred to as an Environmental Services Management Plan (EThekwini Municipality, 2003). Design and implementation of appropriate incentive schemes to encourage sound management should be another key consideration.

4. **Support and partnerships with local communities and initiatives:** This is a key element, particularly given the local context in which most of the proposed ESP is under private or communal tenure. All stakeholders using and managing open spaces will therefore need to collaborate to achieve open space management within the Municipality. Gaining buy-in and support for the initiative through appropriate consultation processes will be an essential first step in this regard. Prioritizing areas where community groups and NGOs can take responsibility for managing priority areas should also be considered and promoted.

5. **Effectiveness of the ESP:** It will be important to ensure that the desired biodiversity benefits are being retained within areas set aside in terms of the ESP. Possible means of verification include:

    - Auditing protected areas to establish the current protection status of each reserve including an audit (i) of their proclamation status and ownership; (ii) to identify which reserves require intervention, and (iii) identify the nature of the intervention / protection required for each reserve.

    - Monitoring use of corridors: This would be particularly beneficial for assessing the effectiveness of riparian corridors and terrestrial corridors designed specifically for promoting connectivity between specific species populations. Academic institutions such as the University of KwaZulu-Natal should be in a position to assist in undertaking further research on this matter.

6. **Status and tenure of land**: Maintaining and managing open spaces requires commitment by those responsible for managing open space assets to implement appropriate management actions. Securing commitment to sympathetic land management can be achieved through a number of possible interventions which should be investigated. These include:

- Implementing planning instruments (such as that intended through the EMF process) to limit development in priority areas;
- Aligning land use zoning schemes (SDF's, LUMS etc) with conservation objectives;
- Providing financial incentives or rates rebates for sound management of priority open space resources.
- Entering into co-operative management agreements between private land owners and government / conservation bodies;
- Purchase or acquisition by the Municipality or KZN Wildlife (e.g. those areas identified as the highest priority for biodiversity conservation) which could perhaps be offset through a process of selling areas of POS included in the ESP but of low social or biodiversity benefit;
- Providing disincentives (through financial instruments) for poor management or developments that impact on the ESP (e.g. alien plant encroachment in areas with rates rebates)

In order to inform appropriate interventions, a database should be compiled to identify priority cadastral land parcels for securing as part of the open space system. This could include consideration of conservation priority, acquisition costs and other factors and should be guided by a similar process to that adopted by eThekwini Municipality.

7. **Management responsibility & adequacy of resources:** For the ESPto deliver on its objectives of biodiversity conservation, it will be important to establish suitable institutional arrangements to guide the approach to open space management. As a starting point, a mandate for the oversight and management of open spaces would need to be designated to an appropriate municipal entity. This entity (potentially the Municipal Conservation & Environment Unit) would then need to be assigned the responsibility for the management and expansion of the network of open spaces, particularly those for which the municipality is directly or partially responsible. Appropriate skills will also be required to coordinate management and monitoring activities to ensure appropriate management and protection of the open space resource. Apart from skills, adequate budgets will also need to be allocated to achieve management objectives.

8. **Integration with other programmes in sustainable land management:** As with the DMOSS, this should be a key focus area to ensure that planning initiatives are appropriately aligned with the objectives of the planned ESP. This will need to include incorporating environmental concerns and guidelines into the Land Use Management System (LUMS) to

guide the development of urban land uses in a manner that supports the open space system and optimizes the delivery of environmental services to Municipal residents. Integration with other development planning initiatives such as spatial development frameworks will also need to be investigated.

9. **Community education and awareness:** The implementation of an ESP is new for Msunduzi and as such, appropriate communication will be necessary to inform and involve stakeholders in the refinement and implementation of the system. The Municipality will need to determine the most appropriate means of communication and information dissemination to support community education and awareness and may include not only electronic and printed media but the erection of appropriate signage at key open space resources.

10. **Broader conservation initiatives**: In human-dominated landscapes, processes and impacts arising from outside remnant habitats are likely to be as important, or more important, than processes within the habitat in determining conditions for fauna (Janzen 1986; Saunders *et al.* 1991 in Benet, 1998, 2003). Identifying and implementing other approaches to limit impacts on the ESP is another important consideration. For example, this may entail the inclusion of additional mitigation measures for development taking place adjacent to areas designated in terms of the ESP to ensure that impacts on the ESP areas are minimized.

11. **Planning and integration across Municipal boundaries:** Actions taken within the Municipality should be aligned as far as possible with initiatives in adjoining Municipalities. Given that eThekwini Municipality have successfully implemented a ESP, interaction with those responsible for the design and implementation of the system is particularly encouraged

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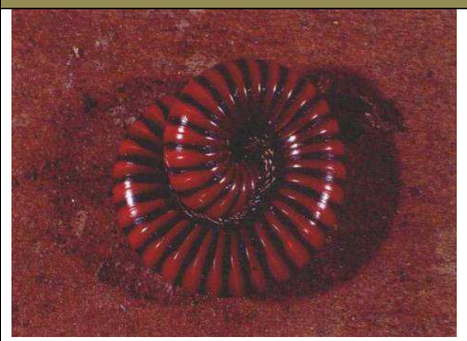
Annexure1. Details of animal species included in the conservation planning process identifying those species for which riparian and terrestrial habitats are regarded as important for species conservation.

Scientific name	English Name	Photo / Illustration	Description	Habitat preference / Priority areas for species conservation (Nesting sites etc)	Corridor design considerations	Riparian corridors	Terrestrial corridors
Afrixalus spinifrons intermedius	Natal leaf-folding frog	 Source: Mr V. Caruthers	A smallish frog (16 – 24 mm length) with a vertical pupil and tiny black "dots" (asperities) on the skin that are distributed rather evenly over the dorsal surface. Its colour is ivory to golden yellow above with a broad brown median band or wedge confined to the posterior part of the back. There is a light to dark unmarked brown band along each side of the body and the ventral surface is off-white	Inhabits marshes, dams, floodplains and river banks and also occurs in highland wetland areas. Inhabit the leaf axils of arums, reeds and sedges and are commonly located in arum lily flowers.	Maintenance of wetland and riparian areas and associated corridors should provide adequate connectivity for this species.	Y	N
Anthus brachyurus	Short-tailed Pipit	 Source :http://www.birdinfo.co.za/rarebirds/06_short-tailed_pipit.htm	The Short-tailed Pipit has a height of 12 cm and weighs around 16 gm. The head is coloured black, brown while the bill is coloured brown. The Anthus brachyurus has a white coloured throat, pink legs and a black, brown coloured back. The eyes are brown.	Their preferred habitat during the breeding season is short sparse grassland, while in the winter months are also recorded on short seasonally flooded grassland. Winter burning of grassland is important for the maintenance of short ankle-high grassland in which this species breeds. This species has been recorded at Darvil, Foxhill and Bisley Nature Reserve.	Given the mobility of birds, corridor design is not regarded as particularly important. This species can effectively “hop” from one area of suitable habitat to another. Primary management interventions should be aimed at ensuring maintenance of areas of preferred habitat identified in the systematic conservation plan.	N	N
Aonyx capensis	African clawless otter	 Source: http://itech.pjc.edu/sctag/extra/africanclawless2.jpg	The African clawless otter is the larger of the two species of otters occurring in southern Africa. It lacks the spotting of the neck, throat and chest which is found on the other species, the spotted-necked otter. As the name suggests the clawless otter has no claws on the digits and the digits are not webbed or used in propulsion when swimming (as is the case in the spotted necked otter).	Unpolluted streams and rivers with good supply of food (crabs) and dense riverine vegetation and other cover (holes, boulders). Dams provide less suitable habitat	Maintenance of wetland and riparian areas and associated corridors should provide adequate connectivity for this species.	Y	N

Scientific name	English Name	Photo / Illustration	Description	Habitat preference / Priority areas for species conservation (Nesting sites etc)	Corridor design considerations	Riparian corridors	Terrestrial corridors
Barbus gurneyi	Redtail barb	 Source: John Craigie, KZN Wildlife	Mouth terminal, with 2 pairs of barbells. Ripe males develop numerous conical tubercles on forehead, snout and lower jaws. Clear brown with dark scale borders, a thin band along body ends in a small distinct spot at base of caudal fin; fins pale yellow, turning orange-red in breeding males. Attains 100 mm standard length.	Altitudes of 300 – 1000 m, especially in clear, small streams of the sandstone belt. It favours pools that have sufficient vegetation cover.	Not specifically included in this study. Management of riparian corridors will however be important in limiting impacts to this species.	Y	N
Bradypodion melanocephalum	Black-headed dwarf chameleon	 Source: Dr. Adrian Armstrong	A small (max 11cm length) grey-brown chameleon. It has a row of horizontal small triangular flaps on the throat. The belly is slightly lighter than the flanks. Along the back is a row of enlarged tubercles (spikes). The back of the head is produced into a small casque (slightly pointed protrusion) and it has a “row” of enlarged flat scales along the side of the flanks. The gular grooves in the throat are white in colour.	Inhabits grasslands, wooded grasslands and forest edges in moist vegetation types. Typically forage in tall, thick grassland. Typically roost on thick-stemmed grasses but also roosts on woody trees and shrubs and occasionally on shrubs and trees just inside the forest margin (not typically in closed forest). Often located near moist areas (wetlands & river banks). Areas of low grassland / burnt or overgrazed grassland areas are not favoured by this species.	Although slow moving, corridors would be useful in promoting the maintenance of remaining populations of this species. Given the species ability to use a range of habitat types, even somewhat degraded areas (e.g. areas infested by alien plants) may act as suitable corridors for this species. Riparian corridors may also be effective in maintaining connectivity between remnant habitat patches.	Y	Y
Camaricoproctus planidens	No common name	 Source: Dr. Michelle Hamer	Up to 8cm long, stout, with light brown and black banding. Usually very sluggish, and spends most time curled up in the litter.	Leaf litter, often at base of trees, may also be in top 30cm of soil.	Although corridors are potentially useful linkages between areas of suitable habitat, the mobility of this species is extremely limited. As such, fine-scale changes in habitat characteristics are likely to form barriers to dispersal. Management of remaining areas of suitable habitat is therefore likely to be more important than creation of corridors for this species.	N	N

Scientific name	English Name	Photo / Illustration	Description	Habitat preference / Priority areas for species conservation (Nesting sites etc)	Corridor design considerations	Riparian corridors	Terrestrial corridors
Centrobolus lawrencei	Lawrence's red millipede	 Source: Dr. Michelle Hamer	Head black, legs yellowish brown, body with black and red bands. Species can only be confirmed by examination of male gonopods (modified legs on 7th segment of male)	Leaf litter, or on tree trunk or branches.	Although corridors are potentially useful linkages between areas of suitable habitat, the mobility of this species is extremely limited. As such, fine-scale changes in habitat characteristics are likely to form barriers to dispersal. Management of remaining areas of suitable habitat is therefore likely to be more important than creation of corridors for this species.	N	N
Circus ranivorus	African Marsh-Harrier	 Source: http://www.warwicktarboton.co.za/birdpgs/165AMHar.html	The African Marsh Harrier is found in southern, central and east Africa from South Africa to Sudan. The adult is 44-49cm long and is mostly brown with streaking on the forewings and underparts merging with deep rufous belly and thighs. The tail is brown with bold black barring which is visible in flight. The bill is black and the legs, feet and iris are yellow. The juvenile is dark chocolate brown with a whitish breast, buff shoulders and a brown iris. This species is not often heard calling except during courtship when the male gives a soft woot and the female a chip. In South Africa, breeding occurs throughout the year and nests are built of sticks, reed stems and grass and usually placed in a reed bed over water. These birds feed mainly on small rodents, birds and frogs.	Usually found in inland and coastal wetlands and moist areas adjacent to grasslands. In Pietermaritzburg known breeding sites are located at Darvil Sewage works and Foxhill.	Given the mobility of this species, corridor design is not regarded as particularly important. This species can effectively "hop" from one area of suitable habitat to another. Primary management interventions should be aimed at ensuring maintenance of areas of preferred habitat identified in the systematic conservation plan. Maintenance of corridors which include wetland and riparian areas will help promote conservation of suitable habitat for this species.	N	N
Crex crex	Corn crake	 Source: http://www.kolkatabirds.com/corncrake8sa.jpg	The adult Corn Crake is 22-25 cm long and has mainly brown, heavily spotted upper parts, a blue-grey head and neck, and reddish streaked flanks. It has a short bill and shows chestnut wings and long dangling legs in flight.	This species prefers grassland and savannah, with grasses up to 2 m tall, especially where grass is burnt in the dry season. Also uses rank grass near rivers, sewage works and ponds, the edges of old lands, longer grass on airfield fringes, and reed beds. This rarely seen non-breeding palaearctic migrant and has been recently recorded in Bisley Nature Reserve.	Given the mobility of this species, corridor design is not regarded as particularly important. This species can effectively "hop" from one area of suitable habitat to another. Primary management interventions should be aimed at ensuring maintenance of areas of preferred habitat identified in the systematic conservation plan.	N	N

Scientific name	English Name	Photo / Illustration	Description	Habitat preference / Priority areas for species conservation (Nesting sites etc)	Corridor design considerations	Riparian corridors	Terrestrial corridors
Crocidura maquassiensis	Makwassie musk shrew	 Source: Dr. Peter Taylor	Shrews are similar in appearance to rodents but possess a much longer snout, smaller ears and shorter legs. Unlike forest shrews (Myosorex spp) which have no obvious bristles on the tail, and have a coarse, dark-brown fur, musk shrews (Crocidura spp) and dwarf shrews (Suncus spp) have tails with conspicuous bristles and a smoother grey to brown coloured fur. Musk shrews are distinguished from dwarf shrews in their larger body size and in having a more brownish fur (dwarf shrews are grey coloured). The Makwassie musk shrew is the smallest musk shrew in the region, having a mass of 6g, and head and body length of about 60mm and a tail length of about 40mm. This is still larger than the least dwarf shrew (Suncus infinitesimus) which also occurs in the region but has a mass of 3g, head and body length of 50mm and a tail length of 25mm.	The species is likely to occur in undisturbed wetland areas and moist grasslands. Particularly in rank vegetation and / or rocky areas.	Corridors are potentially important for this species, although habitat characteristics of the corridor are likely to affect use by this small shrew. Given the species preference for wetland areas and moist grassland, maintenance of riparian corridors may provide a reasonable level of connectivity between areas of suitable habitat.	N	Y
Curvella caloglypta	Ribbed curvella	 Source: Dr. Dai Herbert	Shell small, relatively broad and somewhat globular, with a distinctively blunt apex; fragile and translucent, with strong but thin, arched axial riblets which cover almost the entire shell. Glossy, pale translucent milky white. Length up to 6.0 mm.	A poorly known and evidently very rare species recorded on very few occasions, particularly in recent years. Endemic to the KZN Midlands and recorded from the PMB botanical gardens in the early 1900's.	Although corridors are potentially useful linkages between areas of suitable habitat, the mobility of this species is extremely limited. As such, fine-scale changes in habitat characteristics are likely to form barriers to dispersal. Management of remaining areas of suitable habitat is therefore likely to be more important than creation of corridors for this species.	N	N
Dasophrys natalensis	Natal robberfly	No photo available. See Londt (1981) p. 670 Figs 107–112 (wing & male genitalia) for detailed drawings and more detailed description. A photo of another species of robber fly is provided below to provide some indication of general characteristics of this group.	This is the largest of all known Dasophrys species, found in forest patches in KwaZulu-Natal. It has dark red-brown antennae and thorax. Abdomen is black with gold pruinescence.	Occurs in Mistbelt forest margins, found in mid to late summer. The species is notoriously difficult to catch; living in the tree canopy or along margins of forest and appears to like sunny spots where it can bask amongst twigs and branches.	Given the mobility of this species, corridors between forest patches are likely to contribute to the conservation of this species.	N	Y

Scientific name	English Name	Photo / Illustration	Description	Habitat preference / Priority areas for species conservation (Nesting sites etc)	Corridor design considerations	Riparian corridors	Terrestrial corridors
		 Source: http://www.dpughphoto.com/images/robberfly%20eno%20cole%2081705%202.JPG					
Dasophrys umbripennis	Shaded-winged robberfly	No photo available. See Londt (1981) p. 690 Figs 179–184 (wing & male genitalia) for detailed drawings and more detailed description.	This robber fly has a black head and antennae. The thorax is also black with fine gold pruinescence. The abdomen is dark red-brown with orange-brown bristles.	The species occurs in forest margins and woodland and has been occasionally recorded in Pietermaritzburg gardens. It apparently flies from early winter through into midsummer.	Given the mobility of this species, fine-scale corridors between forest patches are likely to contribute to the conservation of this species.	N	Y
Doratogonus cristulatus	Cristulate black millipede	 Source: Dr. Michelle Hamer	Large (up to 12cm), black, shiny millipede with brown legs. Species can only be confirmed by examination of male gonopods (modified legs on 7th segment of male)	Eggs laid in thick vegetation, in soil or rotting logs or in cattle dung. Adults in leaf litter, under rocks or logs, or top 50cm of soil, in cool, wet weather often seen on soil / vegetation.	Although corridors are potentially useful linkages between areas of suitable habitat, the mobility of this species is extremely limited. As such, fine-scale changes in habitat characteristics are likely to form barriers to dispersal. Management of remaining areas of suitable habitat is therefore likely to be more important than creation of corridors for this species.	N	N
Gnomeskelus burius	Plough-share keeled millipede	 Source: Dr. Michelle Hamer	Gnomeskelus species: Keeled millipedes: all cream or white coloured, small (generally less than 2cm long), lacking eyes, with 20 segments, and small keels on each side of each segment. Species can only be distinguished on the male gonopods – modified legs on the 7th segment (these structures are quite obvious).	In rotting logs, under rocks or logs, in leaf litter.			

Scientific name	English Name	Photo / Illustration	Description	Habitat preference / Priority areas for species conservation (Nesting sites etc)	Corridor design considerations	Riparian corridors	Terrestrial corridors
Gnomeskelus circulipes	Circular-gonopod keeled millipede	No photo available	As for Gnomeskelus burius	In rotting logs, under rocks or logs, in leaf litter.			
Gnomeskelus jaculator	Javelin flat-backed millipede	No photo available	As for Gnomeskelus burius	In rotting logs, under rocks or logs, in leaf litter.			
Gnomeskelus larvatus	Ghost keeled millipede	No photo available	As for Gnomeskelus burius	In rotting logs, under rocks or logs, in leaf litter.			
Gnomeskelus retrusus	Obscure keeled millipede	No photo available	As for Gnomeskelus burius	In rotting logs, under rocks or logs, in leaf litter.			
Gnomeskelus tuberosus urbanus	Urban lumpy keeled millipede	No photo available	As for Gnomeskelus burius	In rotting logs, under rocks or logs, in leaf litter.			
Ischiolobos mesotopos	Midlands robberfly	No photo available. See Londt (2005b) p. 243 Fig. 6 (entire male), p. 248 Figs 63–64 (female genitalia) Figs 68–70 (male genitalia) Fig. 80 (distribution map) for detailed drawings and more detailed description.	The head is primarily black with black antennae. Thorax and abdomen also primarily black.	Known from Mistbelt grassland, and appears to favour tall grass areas. The species flies from November to February.	Given the mobility of this species, fine-scale corridors between grassland patches are likely to contribute to the conservation of this species.	N	Y
Labeobarbus natalensis	KwaZulu-Natal yellowfish	 Source: Mr. Douglas Macfarlane	Dorsal fin in front of pelvics, primary ray may be flexible (usually in upland fish) or spinous (lowland localities). Barbells well developed, as long as or greater than eye orbit diameter. Colour variable, depending on water clarity and body condition. Fry silvery with irregular dark markings, juvenile's loose dark marks but remain silvery. Adult's olive above, sides bronze, cream below. Attains 638 mm total length.	Found in a wide variety of habitats from pools and the rapids of clear streams to deep turbid waters of larger rivers and impoundments.	Not specifically included in this study. Management of riparian corridors will however be important in limiting impacts to this species.	Y	N
Lioptilus nigricapillus	Bush Blackcap	 Source http://www.hardaker.co.za/bushblackcap1.htm	The Bush Blackcap is distributed from the Eastern Cape through the KwaZulu-Natal interior, Zululand, Eastern Free State and Swaziland to the northern Transvaal. The adults are small in size, 16-18cm, and the sexes are alike in appearance. The top of the head and chin are jet black, the back is brown and the rest of the under parts are light grey. The legs and feet are light pink and the bright pink coral bill contrasts strikingly with the black cap. The juvenile is duller than the adult with light brown wash below, dull brown black cap and dusky pink bill. The call comprises a jumble of rapid, loud melodious notes. Breeding occurs from November to January and cup-shaped nests are placed between 1-6m above the ground in the branches of a leafy tree. Their diet consists predominantly of	Favours afro-montane and mistbelt forest patches and adjacent scrubby hillsides particularly Leucosidea and Buddleia thickets. Breeding sites within the Msunduzi LM have been recorded at Queen Elizabeth Park, Ferncliff and Doreen Clark (Just outside Municipality).	Given the mobility of this species, corridor design is not regarded as particularly important. This species can effectively "hop" from one area of suitable habitat to another. Primary management interventions should be aimed at ensuring maintenance of areas of preferred habitat identified in the systematic conservation plan.	N	N

Scientific name	English Name	Photo / Illustration	Description	Habitat preference / Priority areas for species conservation (Nesting sites etc)	Corridor design considerations	Riparian corridors	Terrestrial corridors
			fruit and insects.				
Microchaetus caementerii	Large Pietermaritzburg earthworm	 Source: Dr. Danuta Plisko	Large, near one meter long. Only identifiable from Microchaetus papillatus by carefully assessing the reproductive system, this is slightly different.	Thought to be extinct. Only known records are from Darvil, Scottsville golf course, St Peters church yard, Scottsville and the centre of town (Boschoff street & Liberty Life building). Suitable habitat was probably primary grassland.	Connectivity is likely to be important for the persistence of this species.	N	Y
Microchaetus papillatus	Green giant earthworm	 Source: Dr. Danuta Plisko	Large species, typically longer than one meter in length. Large, with greenish tint. build large hard casts	Indigenous, undisturbed grasslands, small patches between bushes or agriculture fields	Connectivity is likely to be important for the persistence of this species although corridors may include agricultural lands (rather than only pristine areas).	N	Y
Millenarius graminosus	Grassland millennium robberfly	No photo available. See Londt (2005a) p. 55 Figs 44–48 (male & female genitalia), Figs 52–55 (copulation, oviposition) for detailed drawings and more detailed description.	The head is dark red-brown to black with blackish antennae. Thorax and abdomen both dark red-brown to black with no shiny bare areas.	The species occurs in Mistbelt grassland habitats between December & April.	Given the mobility of this species, fine-scale corridors between grassland patches are likely to contribute to the conservation of this species.	Y	N
Miniopterus fraterculus	Lesser long-fingered bat	 Source:	See below for general description of bats of the genus Miniopterus. Miniopterus fraterculus is slightly smaller than M. natalensis with a forearm length (a standard measure of size in bats measured from wrist to elbow) of around 41-45 mm (42-50mm in M. natalensis) almost impossible to distinguish in the field.	The species utilizes two bat roosts in the Municipality, one at Town Bush cave and another at Doornhoek Tunnel (Old Mine). The species coexists with M. natalensis but in much smaller numbers. No important breeding roosts known within the Municipality	Although maintenance of corridors would provide an additional safeguard for the protection of this species, maintenance of roost sites and appropriate habitat for foraging is regarded as more important for the conservation of this species.	N	N

Scientific name	English Name	Photo / Illustration	Description	Habitat preference / Priority areas for species conservation (Nesting sites etc)	Corridor design considerations	Riparian corridors	Terrestrial corridors
		http://www.mammalogy.org/mil_images/images/ mid/396.jpg					
Miniopterus natalensis	Natal long-fingered bat	 Source: Dr. Peter Taylor	These bats belong to the “vesper” family of bats having a plain face and tail enclosed within the membrane. Long-fingered bats of the genus Miniopterus have an elongated third finger which gives the wing a “bent” look when folded. They are dark brown in colour with a distinctive raised forehead. They can congregate in dense clusters on the walls of caves, individuals packed closely together with thumb claws and hind claws attached to the substrate or each other (thus giving them the alternative name of “clinging bats”)	The species has been recorded at two cave sites in the municipality, Town Bush cave and Doornhoek Tunnel. The latter is an important breeding roost. Much of the foraging takes place within 1km of the cave.			
Myotis tricolor	Temminck's hairy bat	 Source: Dr. Peter Taylor	These bats also bats belong to the “vesper” family of bats having a plain face and tail enclosed within the membrane. They have a distinctive orange coloration which makes them quite easy to spot when they roost in clusters on the walls of caves. They also roost in dense masses as shown below left). They may roost together with long-fingered bats, or horseshoe bats where their orange colour contrasts clearly with the darker brown colour of the latter. The picture on upper left shows two Temminck’s hairy bats on either side of a Geoffrey’s horseshoe bat. Note: photograph provided by Joy Coleman; these bats were photographed roosting in Town Bush Cave	The species utilizes two bat roosts in the Municipality, one at Town Bush cave and another at Doornhoek Tunnel (Old Mine). The latter is an important breeding roost. This species appears to prefer rugged terrain and mountainous areas.			
Natalina quekettiana	Quekett’s cannibal snail	 Source: Dr. Dai Herbert	Shell with low spire and rounded whorls; umbilicus moderately wide and deep; upper surface dull and sculptured by close-set axial riblets, base smoother and glossy. Olive-brown above becoming olive-greenish below. Diameter rarely more than 30 mm. Animal dark brown to blackish.	Described from PMB and currently known only from Ferncliff Nature Reserve. Almost certainly occurs only in indigenous mist-belt forest. A real PMB special. This snail is carnivorous and probably occurs at relatively low population densities	Given the apparent specific habitat requirements (forest) and low mobility of this species, maintenance of remnant forest patches is regarded as more important than developing corridors between forest patches.	N	N

Scientific name	English Name	Photo / Illustration	Description	Habitat preference / Priority areas for species conservation (Nesting sites etc)	Corridor design considerations	Riparian corridors	Terrestrial corridors
Orthoporoides (new Spp)	No common name	 Source: Dr. Michelle Hamer	Males up to 7cm long, slender, shiny black, with red head; females larger, black with greyish-black, with black head and legs.	In top 30cm of soil or leaf litter, often around base of trees, may also be found climbing up tree trunks	Although corridors are potentially useful linkages between areas of suitable habitat, the mobility of this species is extremely limited. As such, fine-scale changes in habitat characteristics are likely to form barriers to dispersal. Management of remaining areas of suitable habitat is therefore likely to be more important than creation of corridors for this species.	N	N
Orycteropus afer	Aardvark	 Source: http://www.gruntandsmell.com/images/aardvark.jpg	This species is unmistakable. Pig-like in general appearance they have a body mass of around 50kg, long ears, an elongated snout and four digits on fore and hind feet sharply armed with long robust claws for digging through termite mounds to obtain their food. The long tail is white is colour.	Prefers open grasslands with presence of termite mounds	Maintenance of corridors between areas of suitable habitat (open grassland areas) is regarded as very important for this species. Corridors would however need to be of suitable habitat as this species is unlikely to move through heavily transformed areas (other than agricultural lands).	N	Y
Otomops martiensseni	Large-eared free-tailed bat	 Source: Dr. Peter Taylor	This bat belongs to the free-tailed family of bats, in which the tail protrudes beyond the hind margin of the tail membrane. They are large bats (mass around 30g, and forearm length of 63mm) with distinctive forward-projecting bonnet-like ears which attach to the long pig-like snout. The coloration is also highly distinctive with the tan-coloured dorsal fur contrasting with the white band around the shoulder and throat. In KZN they have only been found roosting in attics of houses (below left).	Species occurs primarily towards Durban, with two records from the KZN Wildlife QEP building. The species uses artificial roost (old buildings) in SA, preferring areas of rugged terrain.	Although maintenance of corridors would provide an additional safeguard for the protection of this species, maintenance of roost sites and appropriate habitat for foraging is regarded as more important for the conservation of this species.	N	N

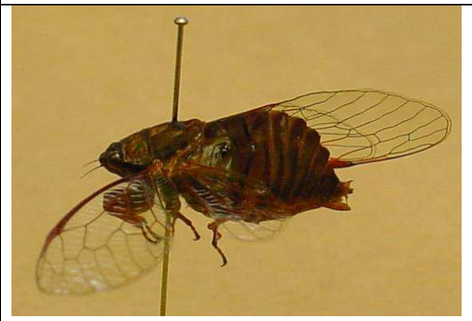
Scientific name	English Name	Photo / Illustration	Description	Habitat preference / Priority areas for species conservation (Nesting sites etc)	Corridor design considerations	Riparian corridors	Terrestrial corridors
Ourebia ourebi ourebi	Oribi	 Source: http://www.huntafrica.ca/animals/oribi.jpg	A distinctive antelope with straight erect horns, pure white belly and underside of tail.	This species prefers open grasslands in flat or undulating terrain. Areas of rank grass or patches of woody vegetation act as important refugia for resting and raising young.	Maintenance of terrestrial corridors is likely to contribute to the persistence of oribi populations. The main constraint to movement is however likely to be the presence of fences that limit movement. Translocation of species is a known viable option for maintaining diversity between isolated populations. Creation of terrestrial corridors has therefore not been prioritized for this species.	N	N
Patinatius bidentatus simulator	No common name	No photo available	Up to 4cm long, slender, yellowish coloured, with distinct black / brownish patterning along back	Leaf litter, often at base of trees, may also be in top 30cm of soil.	Although corridors are potentially useful linkages between areas of suitable habitat, the mobility of this species is extremely limited. As such, fine-scale changes in habitat characteristics are likely to form barriers to dispersal. Management of remaining areas of suitable habitat is therefore likely to be more important than creation of corridors for this species.	N	N
Philantomba monticola bicolor	Blue duiker	 Source: http://i.pbase.com/u36/dougj/large/17052209.152_5265P.jpg	The smallest of the duikers, having distinctively short horns which are present in both sexes. They have a distinctive smooth blue-grey colour, rounded posture and are only found in indigenous forest.	A forest specialist species, persisting in areas of low disturbance (habitat loss & dog predation).	Corridors may be potentially beneficial for this species. It should be noted however that management considerations (controlling snaring, dog poaching etc) are likely to be more important in maintaining habitat populations than linking suitable habitats with terrestrial corridors. Riparian corridors typically include woody vegetation and may also act as useful links between areas of suitable habitat.	Y	Y

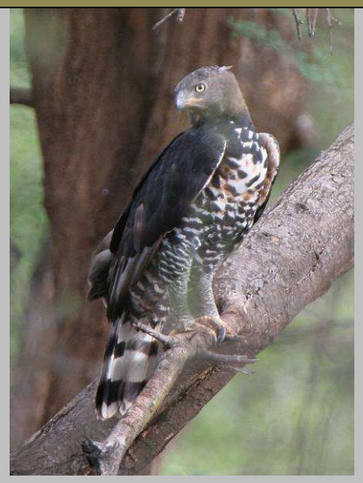
Scientific name	English Name	Photo / Illustration	Description	Habitat preference / Priority areas for species conservation (Nesting sites etc)	Corridor design considerations	Riparian corridors	Terrestrial corridors
Poecilogale albinucha	Striped weasel	 Source: Mr. David Rowe Rowe	This small carnivore can be distinguished on its distinctive skunk-like black and white markings. Unlike the African polecat (Ictonys striatus) which is long-haired, the striped weasel is short-haired.	Specialist of highland and mistbelt moist grassland. Known to occur at QE Park.	Maintenance of corridors may be potentially beneficial for this mobile species.	Y	Y
Polemaetus bellicosus	Martial eagle	 Source http://www.sa-venues.com/wildlife/birds_martial_eagle.htm	The Martial Eagle occurs throughout Africa south of the Sahara and in southern Africa is distributed across the region except Lesotho and the South Western Cape. The adult is 78-83cm long and has a dark brown head and breast. The underparts are spotted and in flight, the dark brown underwings are key features which distinguish it from the smaller Black-chested Snake Eagle. Other features include a relatively short tail, a short crest, yellow iris and pale greenish or bluish white feet. The juvenile has a brown head, grey flecked neck and brownish grey upper parts. The underparts are initially white and the tail is relatively short and finely barred. The species is not particularly vocal but in display gives a rapid kwi-kwi-kwi-kloee-kloee. Breeding occurs mainly between April and June with nests consisting of large platforms of sticks in a tall tree or pylon. Their diet varies regionally but comprises mainly small mammals, birds and reptiles.	This species is generally found in woodlands, open savannah or grasslands with clusters of large trees or pylons used for nest sites. There are no known breeding sites in Msunduzi LM. Although this is regarded as an important species, it has very large home ranges. Note: Despite this species using areas within the Municipality, it is not possible to identify particular areas that should be set aside specifically for the conservation of this species. This species was therefore not included in the conservation planning process.	Not specifically included in this study. It is worth noting however that the mobility of this species means that this eagle can fly between patches of suitable habitat with ease, making corridors less important for the persistence of this species.	N	N
Proandricus thornvillensis	Thornville earthworm	Not available	Large, extending to 40-45 cm. Grey to greenish dorsally	Indigenous grasslands, bushes on the river banks, in moist or wet sites; sometimes in well soaked soil; known only from Thornville area, along of the road to a local school (right side of the road P-mburg - Richmond) - presently only small areas of species persistence along bank of river.	Given the preference of this species for moist sites, maintenance of suitable riparian corridors is likely to be important for the persistence of this species.	Y	N

Scientific name	English Name	Photo / Illustration	Description	Habitat preference / Priority areas for species conservation (Nesting sites etc)	Corridor design considerations	Riparian corridors	Terrestrial corridors
Pronolagus crassicaudatus	Natal red hare	 Source: Dr. Peter Taylor	The Natal red hare has a uniformly reddish brown tail (above and below) which distinguishes it from the more common scrub hare which has a tail which is white underneath and black on top. The ears are relatively shorter in Natal red hares compared with scrub hares. Natal red hares are restricted to occurring on rocky slopes often below cliffs.	Specialist of rocky grass slopes in hilly terrain	Connectivity is likely to be important for the maintenance of isolated populations of this species. Habitat should however be of suitable habitat (grassland / rocky grassland) to facilitate movement between populations.	N	Y
Python sebae natalensis	Southern African Python	 Source: http://www.blueplanetbiomes.org /images/afr_rock_python.jpg	The largest snake in southern Africa, averaging 3-4m. Large specimens over 5m are rare nowadays. Thickset with a triangular head, distinct neck and a thick tail. Dark brown above with grey-brown blotches and dark speckling with widely spaced dark blotches on the sides. Blotches on the upper parts are typically irregularly connected with sinuous dark brown bands. There is a dark arrowhead marking on the crown of the head. The underside is white to dirty-white with dark blotches.	Fairly widespread, preferring rocky outcrops and moist, rocky, well wooded valleys in arid and moist savannah. They are water-dependant species, never found far from permanent water.	Maintenance of corridors between areas of suitable habitat is likely to contribute to the conservation of this species. At present however, no areas of suitable size have been identified for the persistence of this species in the Msunduzi Municipality. Management of existing open space and creation of riparian corridors is however likely to contribute to the conservation of this species.	Y	N
Rhinolophus clivosus zuluensis	Geoffroy's horseshoe bat	 Source: Dr. Peter Taylor	Horseshoe bats are immediately recognized by the complicated noseleaf structure on the face, which comprises a lower horseshoe-shaped crescent and upper flaps which rise to a pointed tip (in leaf-nosed bats this erect pointed flap is missing). Of the two horseshoe bats found in the region Rhinolophus clivosus is larger than R. simulator, being a medium-sized bat having a forearm length of 43 (45-60) mm and a mass of 17g.	Cave dependant species. The species utilizes two bat roosts in the Municipality, one at Town Bush cave and another at Doornhoek Tunnel (Old Mine). Occasionally recorded in winter months from storm drains in central Pietermaritzburg. Heavily reliant on tree cover for foraging.	Although maintenance of corridors would provide an additional safeguard for the protection of this species, maintenance of roost sites and appropriate habitat for foraging is regarded as more important for the conservation of this species.	N	N

Scientific name	English Name	Photo / Illustration	Description	Habitat preference / Priority areas for species conservation (Nesting sites etc)	Corridor design considerations	Riparian corridors	Terrestrial corridors
Rhinolophus simulator	Bushveld horseshoe bat	 Source: Dr. Peter Taylor	See above: R. simulator can be distinguished from R. clivosus on its size, being a smaller bat, having a mass of around 9g and a forearm length of around 44 (42-48)mm	Cave dependant species. The species utilizes a single bat roost in the Municipality, at Doornhoek Tunnel (Old Mine), although found occasionally at Town Bush Cave. Heavily reliant on tree cover for foraging.			
Rhopaleskelus pietermaritzburgensi	Pietermaritzburg keeled millipede	See Gnomeskelus	Similar to Gnomeskelus. Species can only be confirmed by examination of male gonopods (modified legs on 7th segment of male)	In rotting logs, under rocks or logs, in leaf litter.	Although corridors are potentially useful linkages between areas of suitable habitat, the mobility of this species is extremely limited. As such, fine-scale changes in habitat characteristics are likely to form barriers to dispersal. Management of remaining areas of suitable habitat is therefore likely to be more important than creation of corridors for this species.	N	N
Schoenicola brevirostris	Broad-tailed Warbler	 Photo by Alan Manson, Cedara, KwaZulu-Natal	The Broad-tailed Warbler occurs from Cameroon and Ethiopia in the north through to the moister eastern parts of Southern Africa. The adults are small in size, 15-16cm and alike in appearance. The upperparts are buffy or rusty brown and contrast with the long broad blackish tail that is barred buff underneath. The juvenile has a shorter, narrower tail with more rufous upperparts. The call is a slow deliberate, high-pitched tsee, tsee, tsee, tsee. Breeding takes place from November through March and the nest comprises a bulky cup of loosely woven coarse, dry grass. Their diet consists of insects.	Inhabits marshy grassland, tall rank grassland along drainage lines and moist grassy hillsides. Breeding sites in the Pietermaritzburg area have been recorded at Darvil, Foxhill and Thornville,	Given the mobility of this species, corridor design is not regarded as critically important. Maintenance of riparian corridors will however help promote movement between areas of suitable habitat for this species.	Y	N

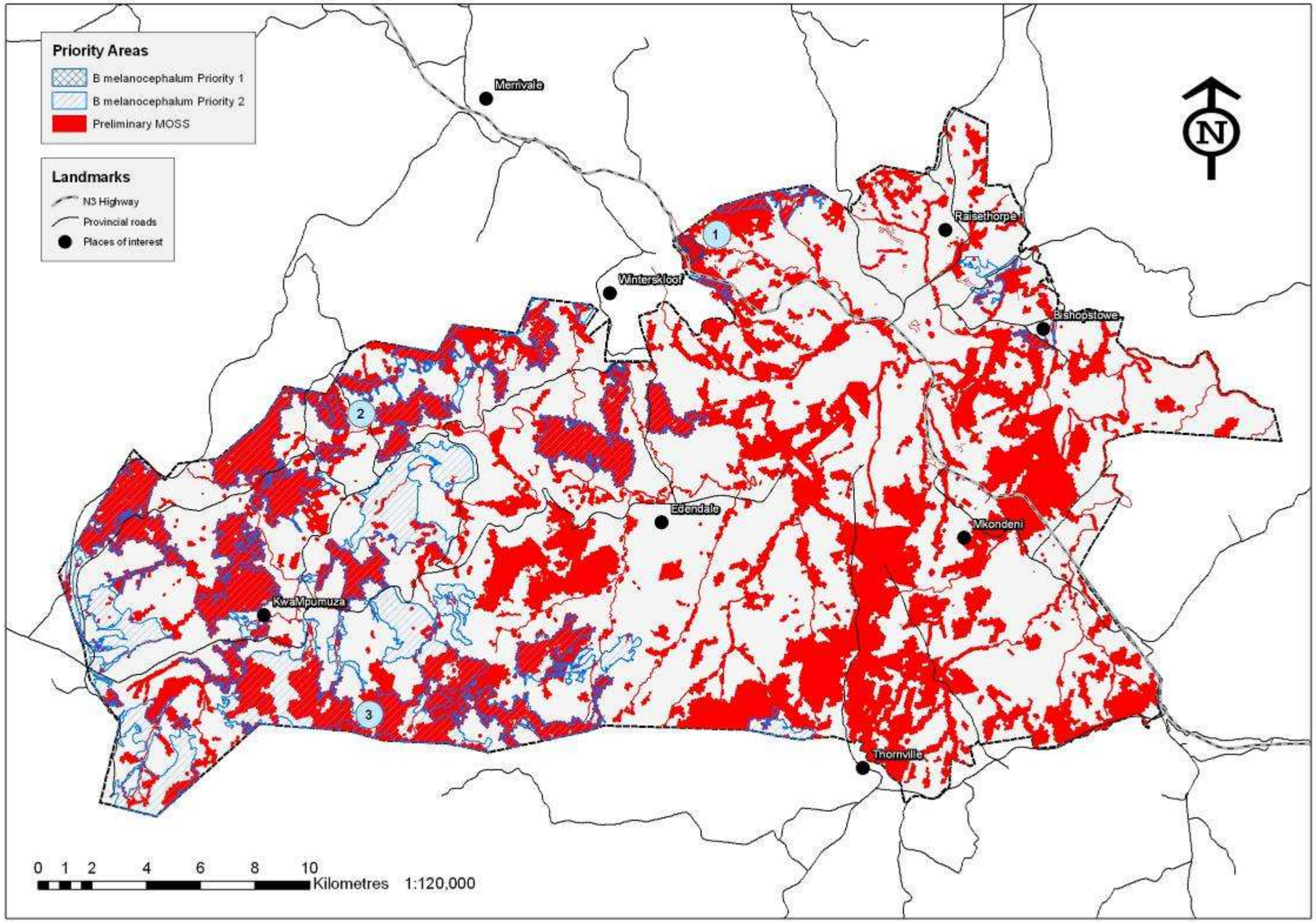
Scientific name	English Name	Photo / Illustration	Description	Habitat preference / Priority areas for species conservation (Nesting sites etc)	Corridor design considerations	Riparian corridors	Terrestrial corridors
Sheldonia burnupi	Burnup's tail-wagger	 Source: Dr. Dai Herbert	Shell small to moderate in size, rounded and very fragile. Shell translucent, pale yellowish with colour of underlying tissues showing through, the apical whorls whitish. Diameter up to 15.0 mm.	Rediscovered in 2004, this snail inhabits grassland in the mist belt of the KZN Midlands, to which it is endemic. Within the municipality the grassland of Wiley Park and beneath World's View seem to provide the most suitable habitat	Given the apparent specific habitat requirements (grassland) and low mobility of this species, maintenance of habitat in known localities is regarded as more important than developing corridors between areas of suitable habitat.	N	N
Sphaerotherium hanstromi	Hanstrom's pill millipede	 Source: Dr. Michelle Hamer	Colour may vary. Species can only be confirmed by examination of various characters – modified legs of male on last segment.	In rotting logs, under rocks or logs, in leaf litter.	Although corridors are potentially useful linkages between areas of suitable habitat, the mobility of this species is extremely limited. As such, fine-scale changes in habitat characteristics are likely to form barriers to dispersal. Management of remaining areas of suitable habitat is therefore likely to be more important than creation of corridors for this species.	N	N
Spinotarsus destructus	Destructive slender-spined millipede	 Source: Dr. Michelle Hamer	Long (up to 7cm), slender, dark brown coloured, with small pair of spines on last segment. Snake-like behaviour when threatened. Species can only be confirmed by examination of male gonopods (modified legs on 7th segment of male)	Under rocks and cattle dung			
Spinotarsus dingaanus	Dingaan's slender-spined millipede	No photo available	Long (up to 7cm), slender (less than 0.3cm wide), dark brown coloured, with small pair of spines on last segment. Snake-like behaviour when threatened. Species can only be confirmed by examination of male gonopods (modified legs on 7th segment of male)	In rotting logs, under rocks or logs, in leaf litter.			
Spinotarsus krausi	Kraus' slender-spined millipede	No photo available	Long (up to 7cm), slender (less than 0.3cm wide), with small pair of spines on last segment. Snake-like behaviour when threatened. Colour may be	In rotting logs, under rocks or logs, in leaf litter.			

Scientific name	English Name	Photo / Illustration	Description	Habitat preference / Priority areas for species conservation (Nesting sites etc)	Corridor design considerations	Riparian corridors	Terrestrial corridors
			different. Species can only be confirmed by examination of male gonopods (modified legs on 7th segment of male)				
Spinotarsus lawrencei	Lawrence's slender-spined millipede	No photo available	Long (up to 7cm), slender (less than 0.3cm), with small pair of spines on last segment. Snake-like behaviour when threatened. Colour may be different. Species can only be confirmed by examination of male gonopods (modified legs on 7th segment of male)	In rotting logs, under rocks or logs, in leaf litter.			
Spinotarsus maritzburgensis	Maritzburg slender-spined millipede	 Source: Dr. Michelle Hamer	Long (up to 7cm), slender (less than 0.3cm), dark brown coloured, with small pair of spines on last segment. Snake-like behaviour when threatened. Species can only be confirmed by examination of male gonopods (modified legs on 7th segment of male)	Under rocks, in leaf litter or top 30cm of soil.			
Stagira purpurea	Purple cicada	 Source: Dr. Adrian Armstrong	A small reddish-purple coloured cicada with green underneath the thorax. Forewing length = 19 mm.	Eastern Mistbelt forests. Prefers forest edge and other areas within the forest with good light penetration.	Given the mobility of this species, corridors between forest patches are likely to contribute to the conservation of this species.	N	Y

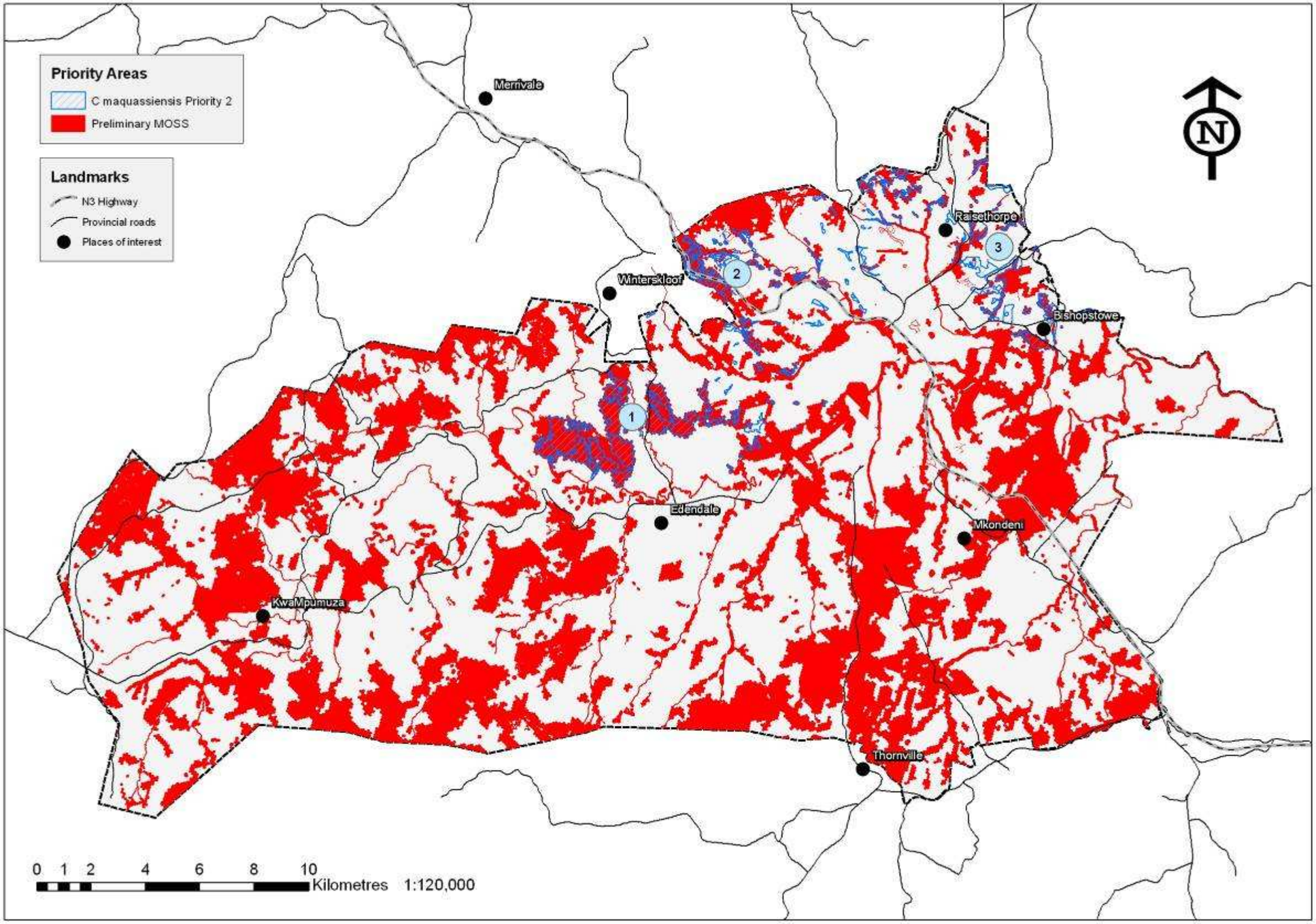
Scientific name	English Name	Photo / Illustration	Description	Habitat preference / Priority areas for species conservation (Nesting sites etc)	Corridor design considerations	Riparian corridors	Terrestrial corridors
Stephanoaetus coronatus	African Crowned Eagle	 Source http://www.hardaker.co.za/africancrownedeagle1.htm	The African Crowned Eagle is distributed across Tropical Africa but in South Africa is found discontinuously to the south and east largely because of fragmented habitat. The adult is 80-90cm in length with the female considerably larger than the male. The plumage is dark and blotched and the underparts are barred. In flight, the short broad wings are rufous in front and white behind with black barring. The iris is pale yellow, the bill is black and the gape and feet are yellow. The head and underparts of the juvenile are initially creamy white and the upperparts are light grey brown with a scalloped appearance. The tail is broadly barred and the neck is white, distinguishing it from the grey-fleck of the juvenile Martial Eagle. During aerial display, the female call is a melodious kewick-kewick-kewick and the male is a deeper kooi-kooi-kooi. In South Africa, breeding takes place mainly from August to October and large stick platform nests are built in the tallest canopy trees. Ninety-eight percent of their diet comprises small mammals including hyraxes, monkeys, antelope, hares, mongooses and genets.	Generally occurs in dense indigenous forest or woodlands, riparian forest or gum and pine plantations. Known nest sites in the Msunduzi LM have been located below Roberts Road and Queen Elizabeth Park and at Ferncliff and Winterskloof. Most know nest sites have been in large gum trees rather than in natural forest areas. Conservation of this species should focus on conservation of nest sites (currently not mapped) and instilling a conservation ethic that promotes the conservation of this and other raptor species. Note: Despite this species using areas within the Municipality, it is not possible to identify particular areas that should be set aside specifically for the conservation of this species. This species was therefore not included in the conservation planning process.	Not specifically included in this study. It is worth noting however that the mobility of this species means that this eagle can fly between patches of suitable habitat with ease, making corridors less important for the persistence of this species.	N	N
Tritogenia shawi	Shaw's earthworm	No photo available	In life moderate in size, compact, as “20-25 sausage roll, not pigmented	Only from indigenous, not disturbed grasslands and woody areas, sometimes been found in freshly made gardens but not persisting under extended agriculture practices.	Connectivity is likely to be important for the persistence of this species.	N	Y
Typhloxenus modestus	Modest millipede	 Source: Dr. Michelle Hamer	Minute (less than 1cm), white / cream coloured, resembles a caterpillar, with tufts of long bristles along sides of body.	In leaf litter, may also be found in trees on bark of trunk or branches	Although corridors are potentially useful linkages between areas of suitable habitat, the mobility of this species is extremely limited. As such, fine-scale changes in habitat characteristics are likely to form barriers to dispersal. Management of remaining areas of suitable habitat is therefore likely to be more important than creation of corridors for this species.	N	N

Scientific name	English Name	Photo / Illustration	Description	Habitat preference / Priority areas for species conservation (Nesting sites etc)	Corridor design considerations	Riparian corridors	Terrestrial corridors
Tyto capensis	African Grass-Owl, Grass Owl	 Source http://www.warwicktarboton.co.za/birdpgs/393GrOwl.html	The Grass Owl is found in Asia, Australia and Africa where it is distributed from Ethiopia to the eastern and moister parts of South Africa. The adults are 34-37cm long and resemble the Barn Owl. The upperparts are dark brown and the underparts are whitish with a buffy breast. In flight, the legs and yellowish pink feet protrude past a short tail. The white to pale brownish heart-shaped face contrasts with dark eyes. The juvenile is similar to the adult but buffier below. The call is a muted screech or a high pitched churring hiss. In South Africa, breeding occurs between February and April with nests comprised of a flimsy pad at the end of a tunnel of dense grass. Their diet includes rodents, predominantly vlei rats, birds and insects.	Usually occurs in long grass near water, vleis or marshes. May also be found in dense short grassland. In Pietermaritzburg breeding sites have been recorded at Thornville and Foxhill.	Given the mobility of this species, corridor design is not regarded as critically important, with birds able to fly between areas of suitable habitat. Maintenance of riparian corridors will however help promote movement between areas of suitable habitat for this species.	Y	N
Ulodesmus bispinosus	Two-spined soil millipede	See Ulodesmus major	Keeled millipedes: more robust than Gnomeskelus, also without eyes, yellowish / golden brown colour, with distinct keels along sides of segments. Species can only be confirmed by examination of male gonopods (modified legs on 7th segment of male)	In rotting logs, under rocks or logs, in leaf litter or in top 30cm soil.	Although corridors are potentially useful linkages between areas of suitable habitat, the mobility of this species is extremely limited. As such, fine-scale changes in habitat characteristics are likely to form barriers to dispersal. Management of remaining areas of suitable habitat is therefore likely to be more important than creation of corridors for this species.	N	N
Ulodesmus fossor	Digger soil millipede	See Ulodesmus major	As above.	In rotting logs, under rocks or logs, in leaf litter or in top 30cm soil.			
Ulodesmus major	Major soil millipede	 Source: Dr. Michelle Hamer	Large Ulodesmus, up to 4cm long and 0.5cm wide. Species can only be confirmed by examination of male gonopods (modified legs on 7th segment of male)	In rotting logs, under rocks or logs, in leaf litter or in top 30cm soil.			

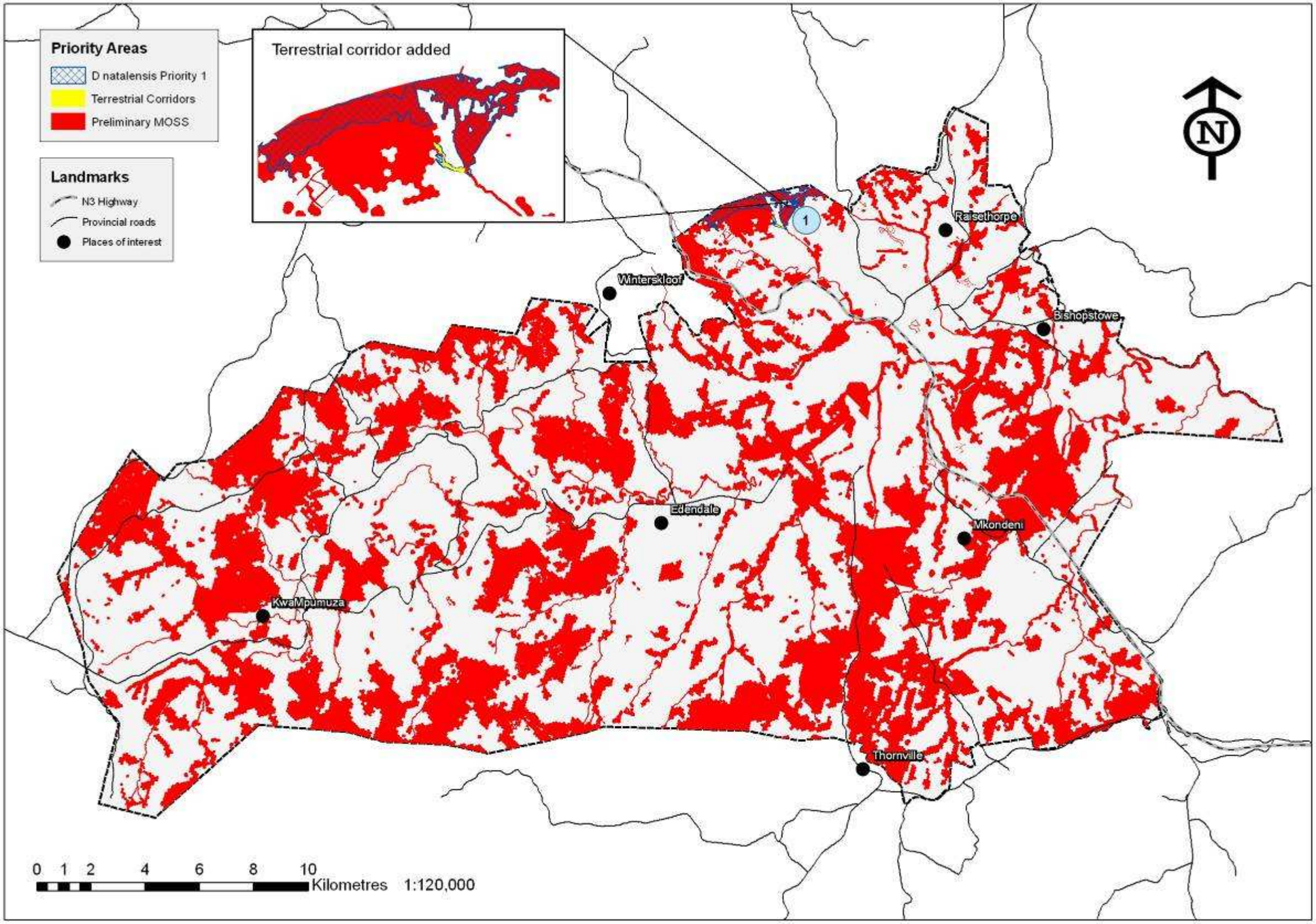
Annexure2. Species distribution maps used to assess the need for additional terrestrial corridors for priority species.



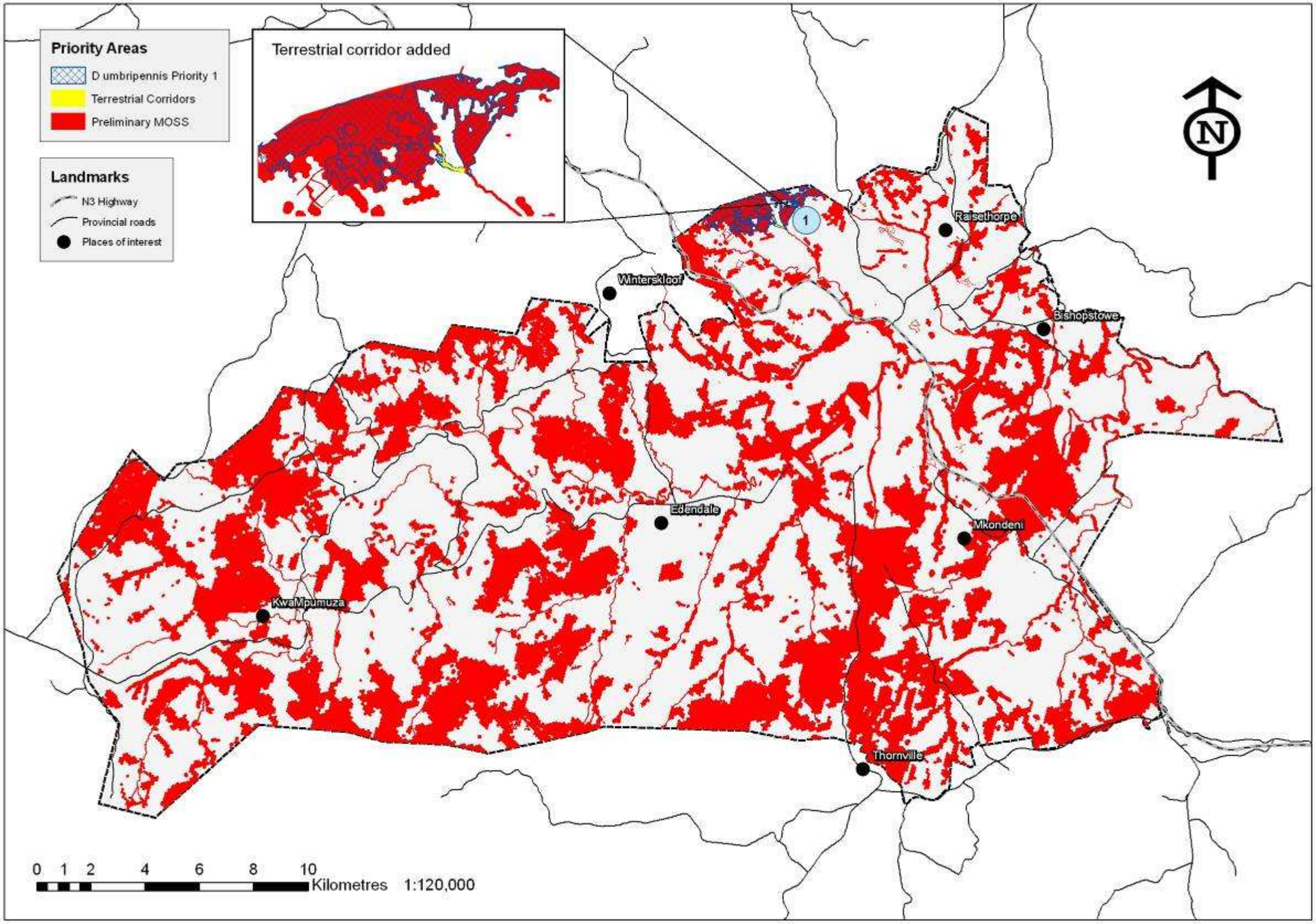
Map 1: Location of priority areas for the conservation of *Bradypodion melanocephalum* in relation to the preliminary ESP (excluding POS).



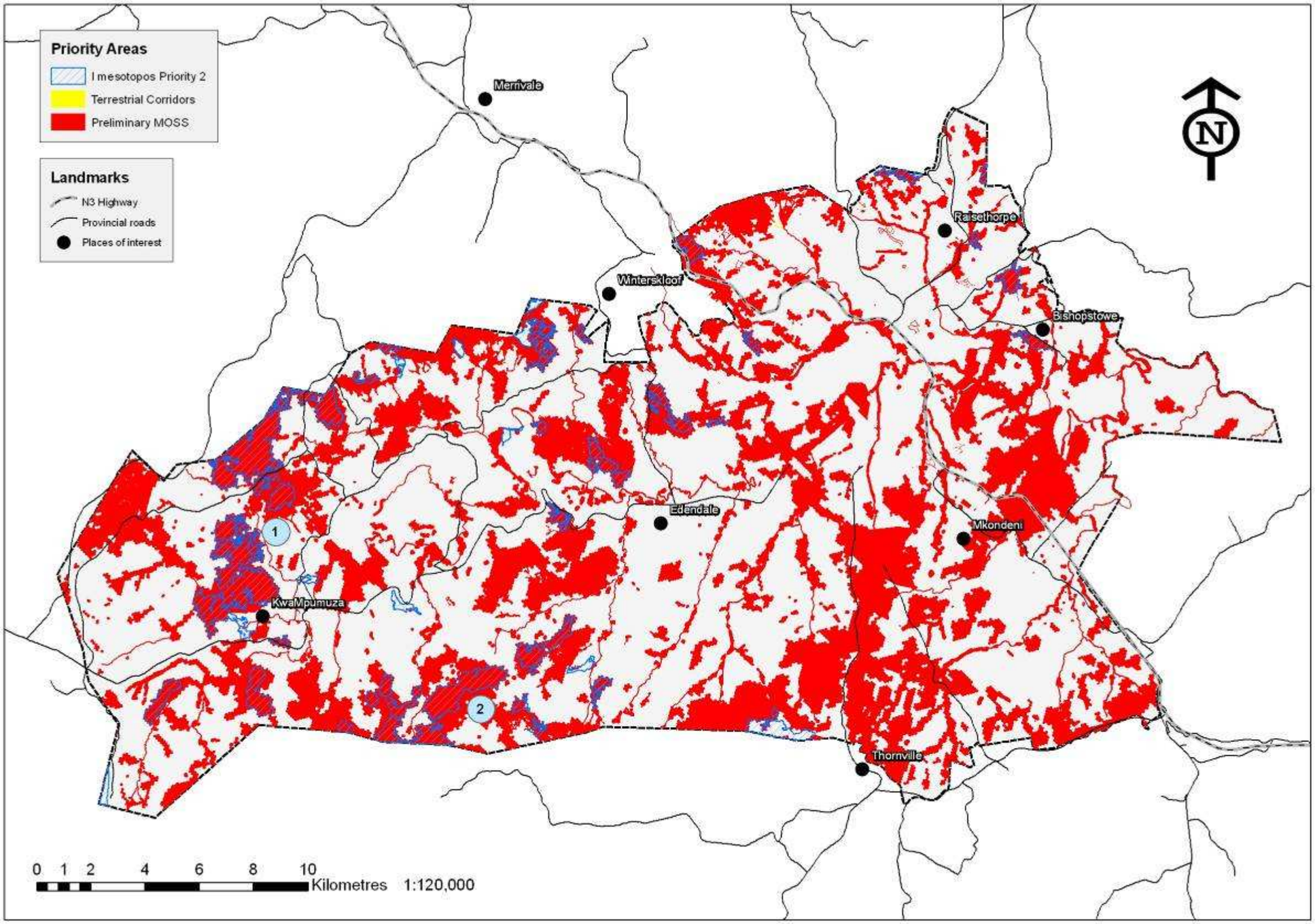
Map 2: Location of priority areas for the conservation of *Crocidura maquassiensis* in relation to the preliminary ESP (excluding POS).



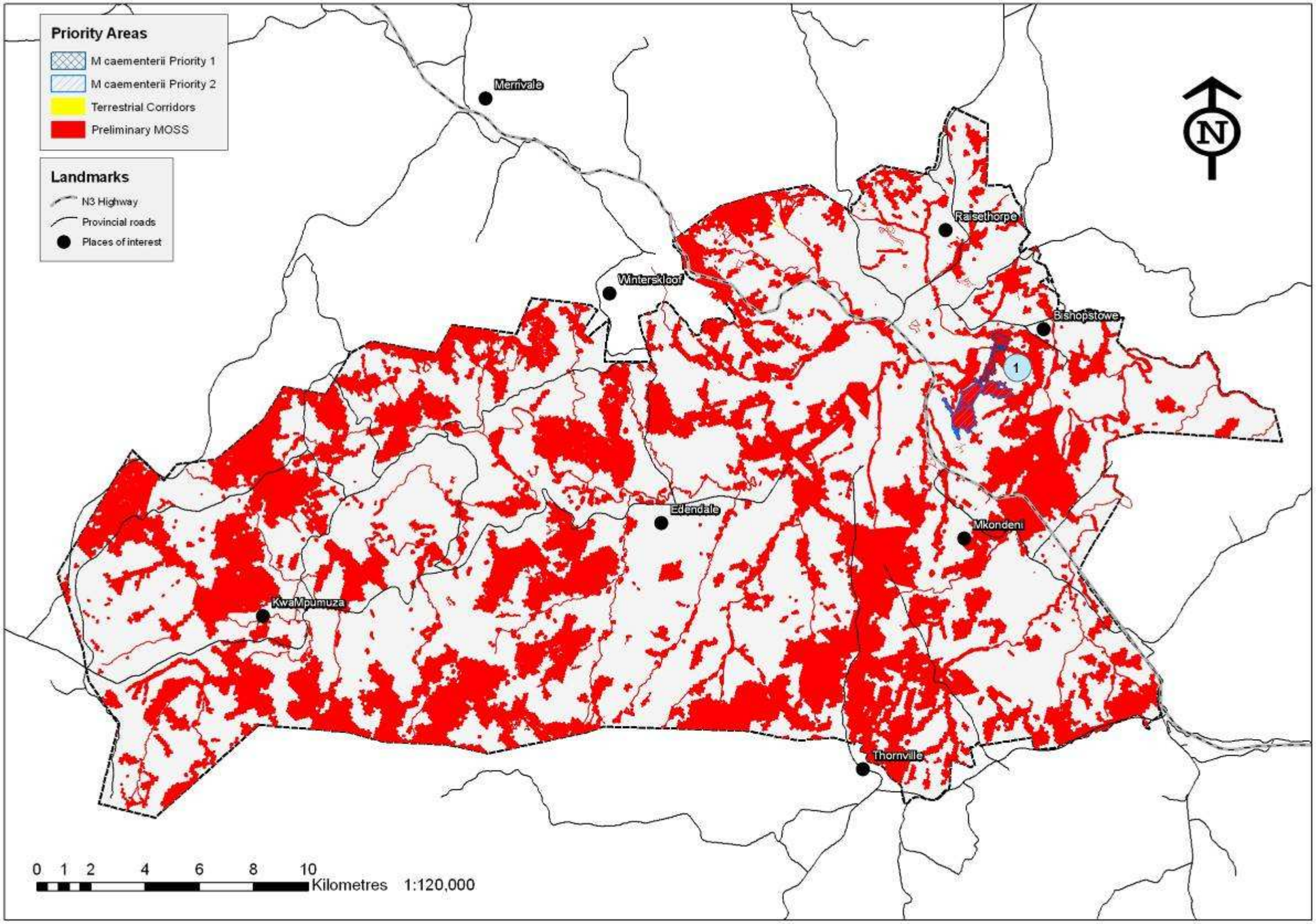
Map 3: Location of priority areas for the conservation of *Dasophrys natalensis* in relation to the preliminary ESP (excluding POS).



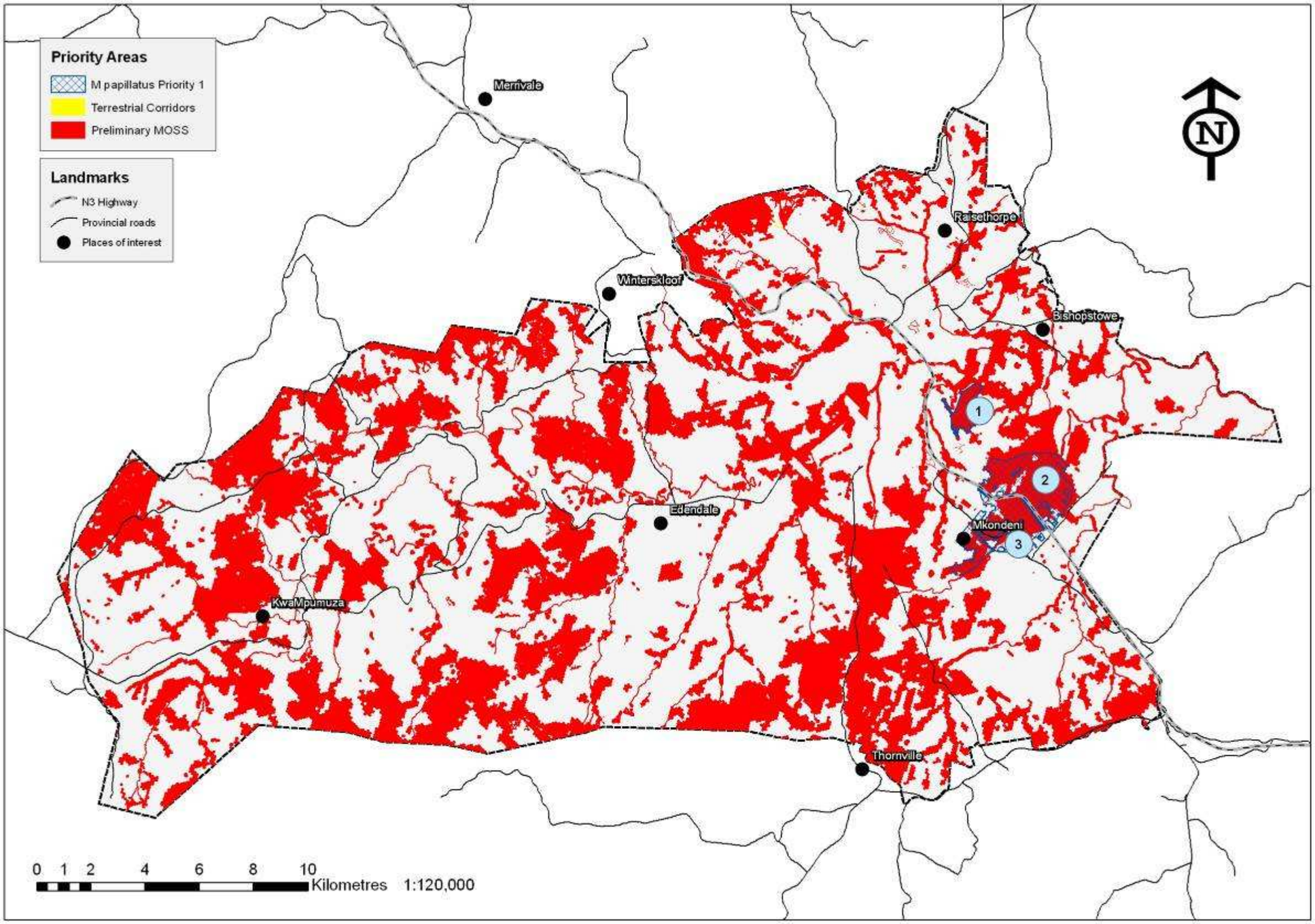
Map 4: Location of priority areas for the conservation of *Dasophrys umbripennis* in relation to the preliminary ESP (excluding POS).



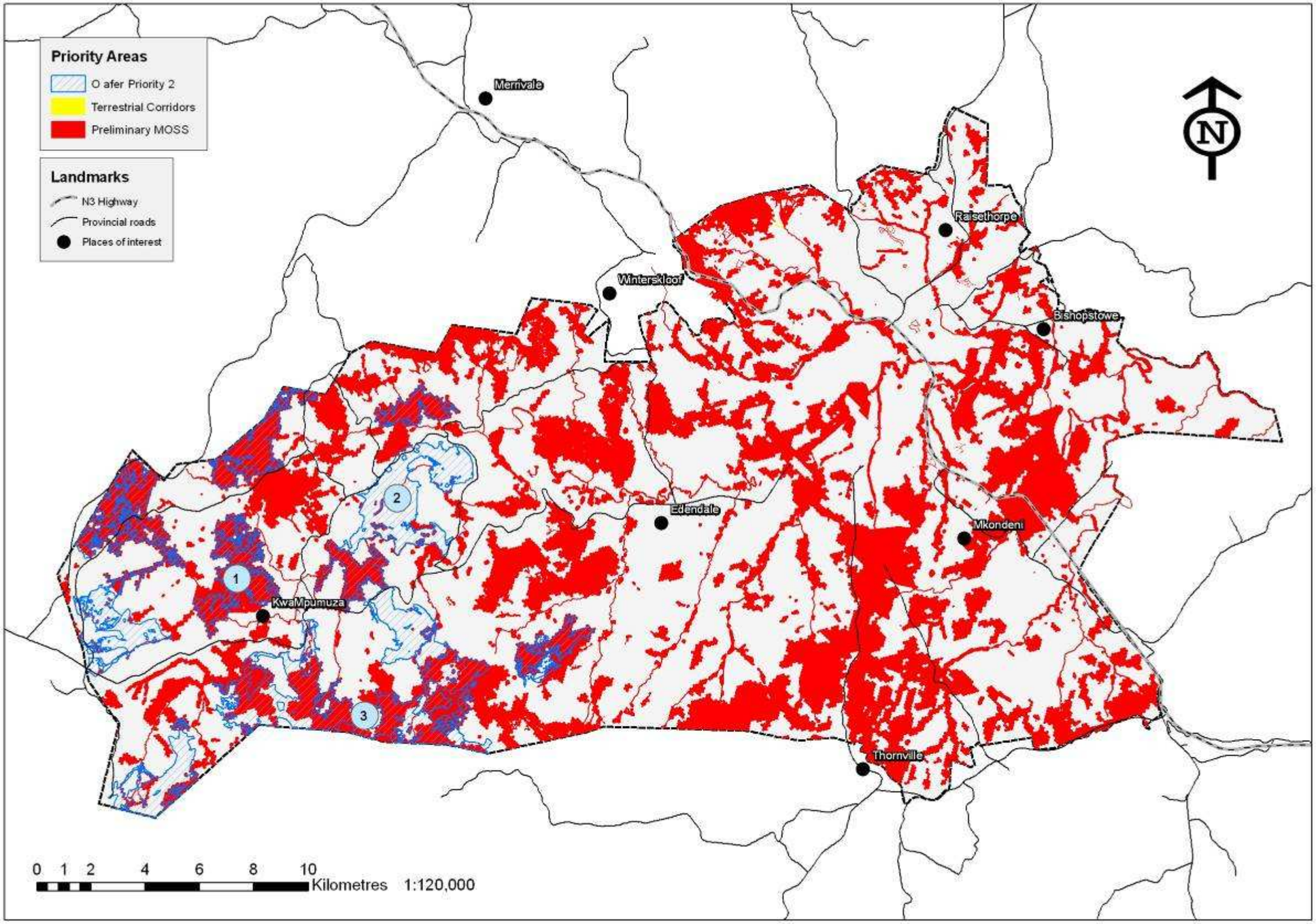
Map 5: Location of priority areas for the conservation of *Ischiolobos mesotopos* in relation to the preliminary ESP (excluding POS).



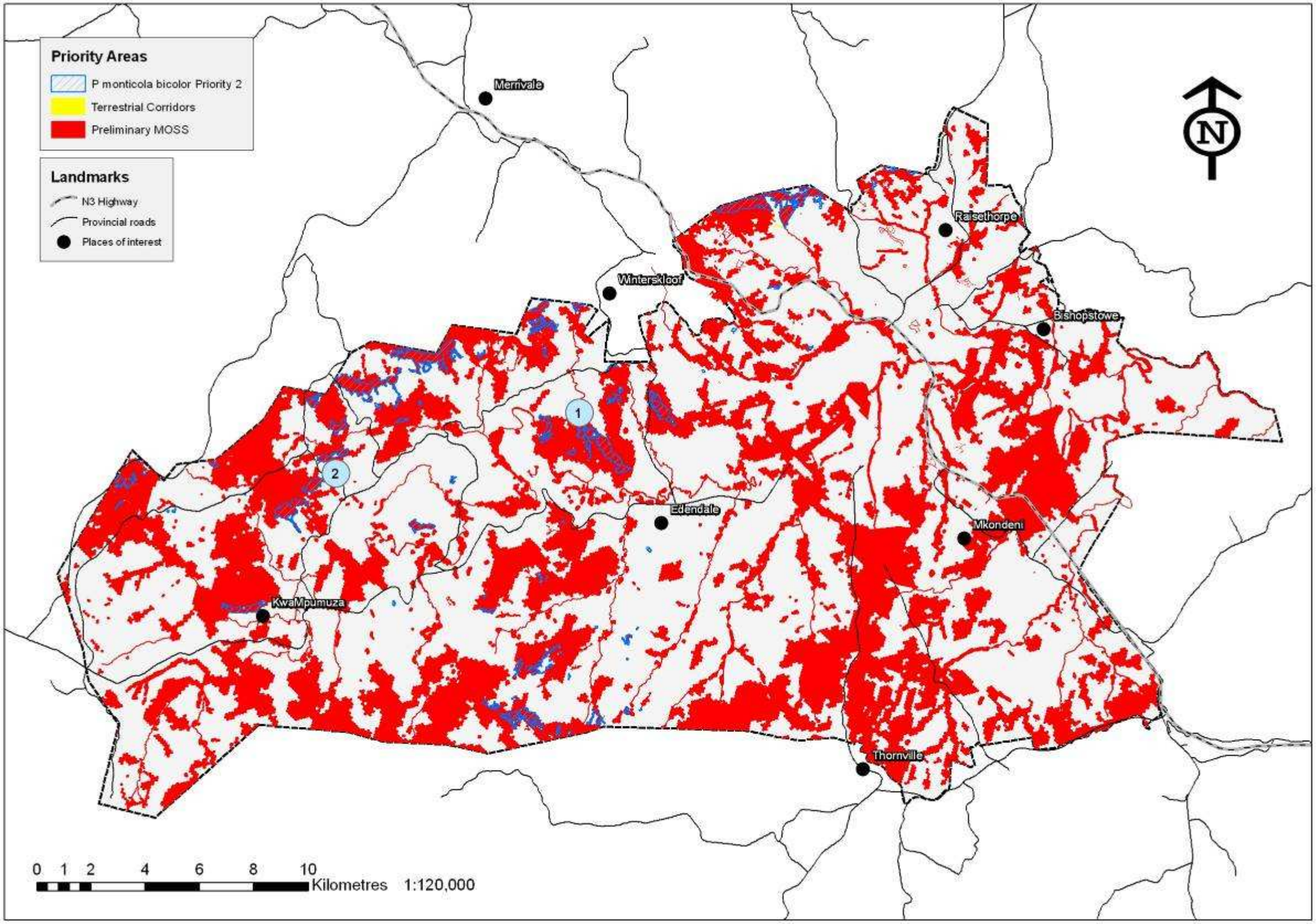
Map 6: Location of priority areas for the conservation of *Microchaetus caementerii* in relation to the preliminary ESP (excluding POS).



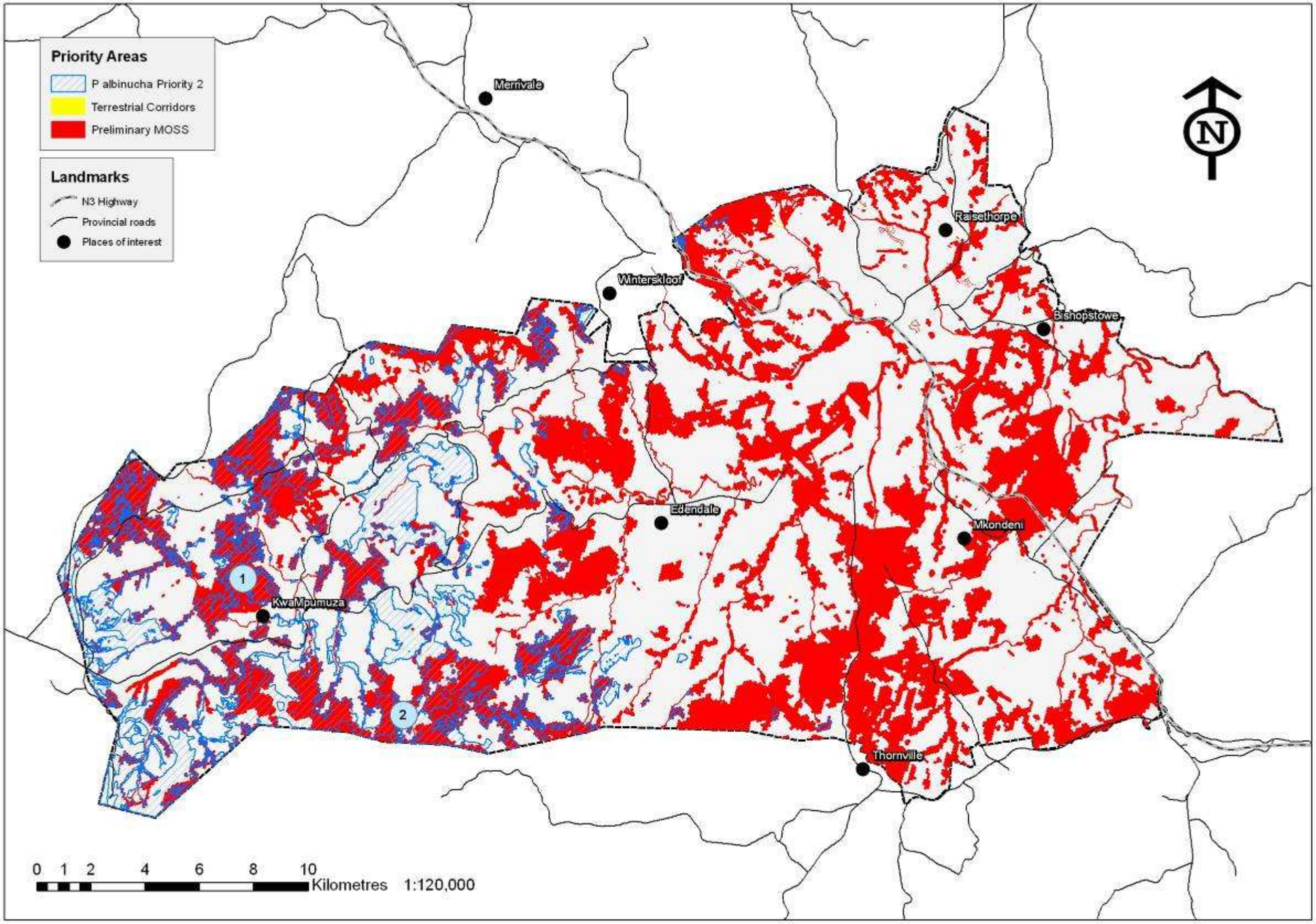
Map 7: Location of priority areas for the conservation of *Microchaetus papillatus* in relation to the preliminary ESP (excluding POS).



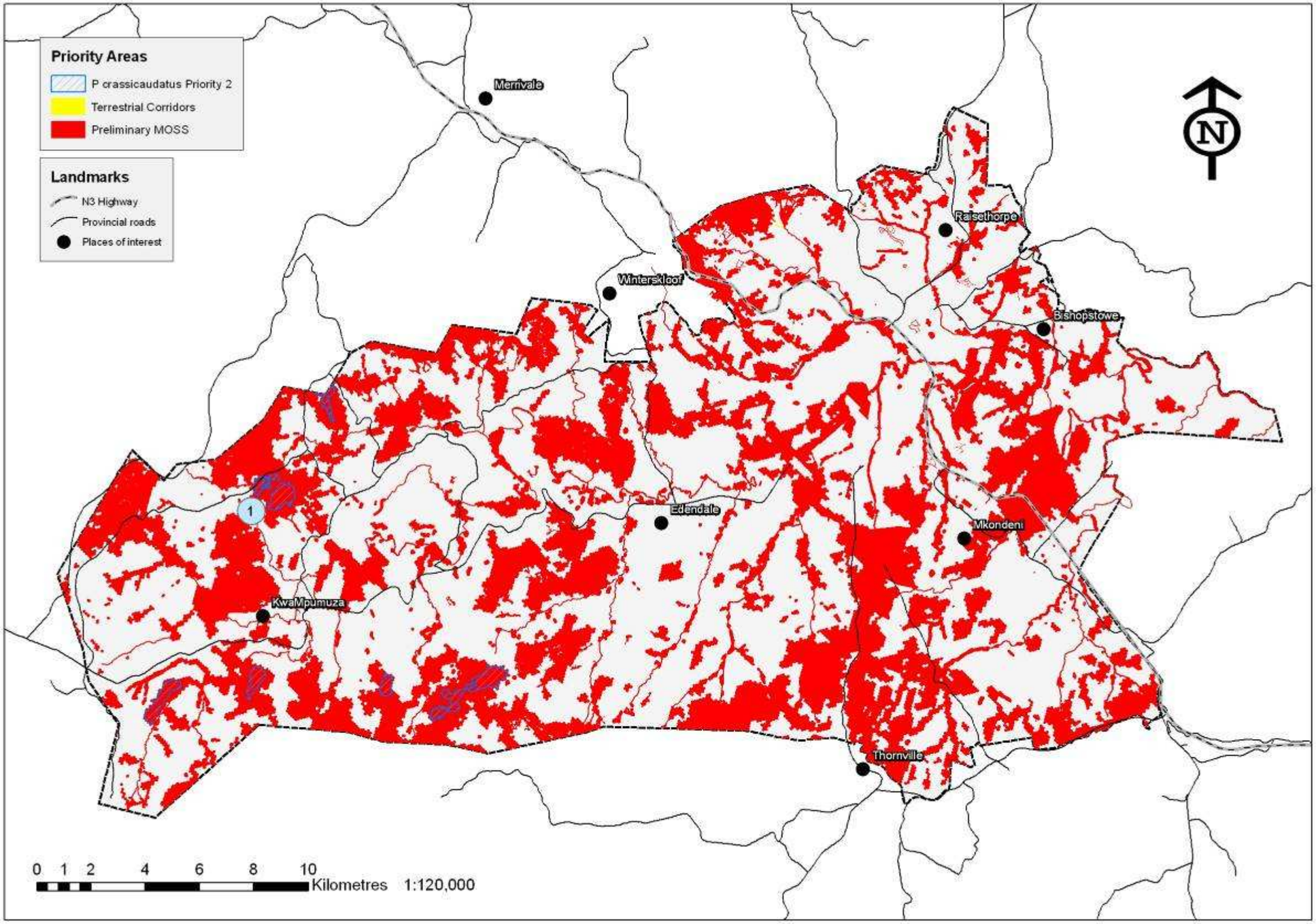
Map 8: Location of priority areas for the conservation of *Orycteropus afer* in relation to the preliminary ESP (excluding POS).



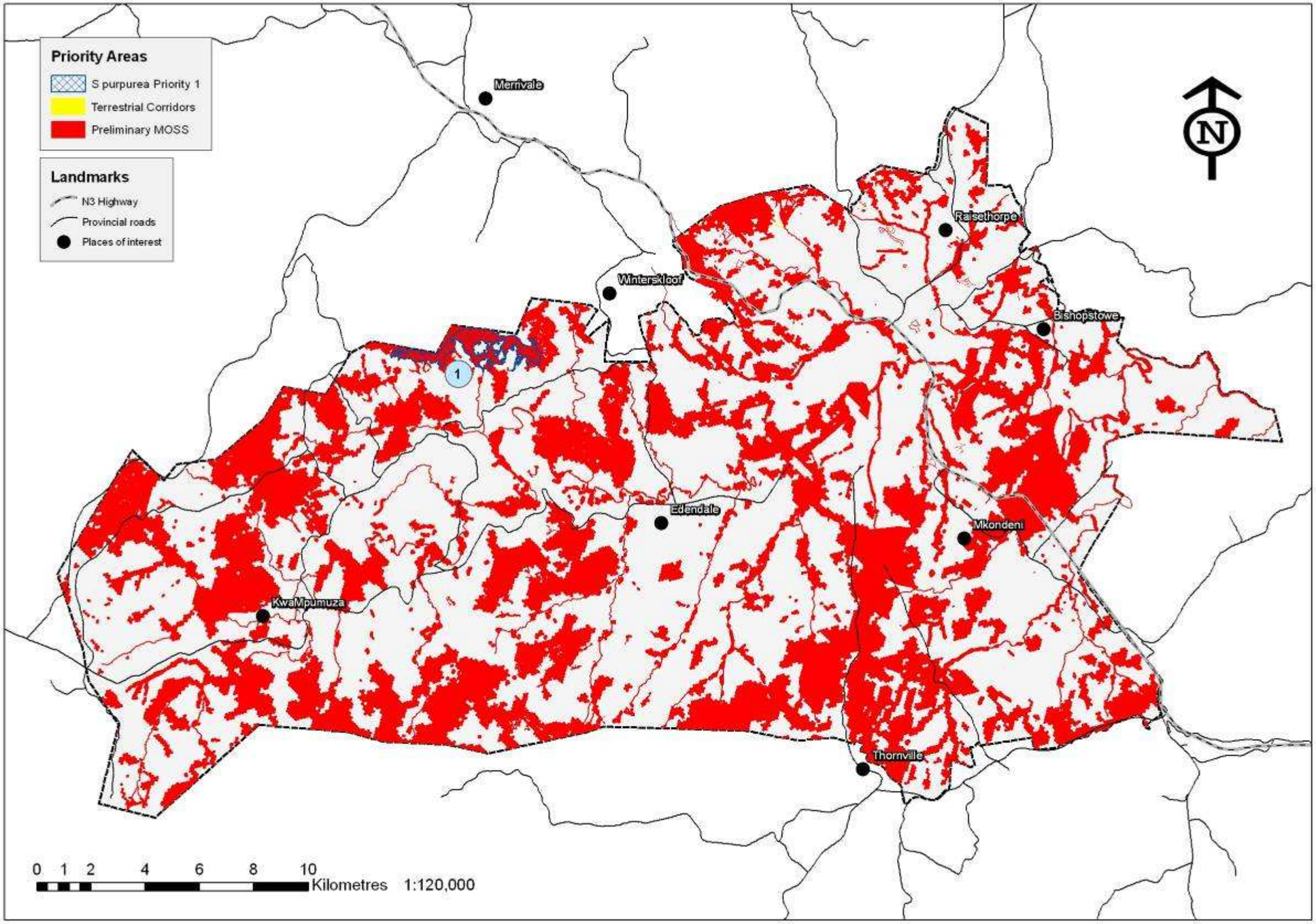
Map 9: Location of priority areas for the conservation of *Philantomba monticola bicolor* in relation to the preliminary ESP (excluding POS).



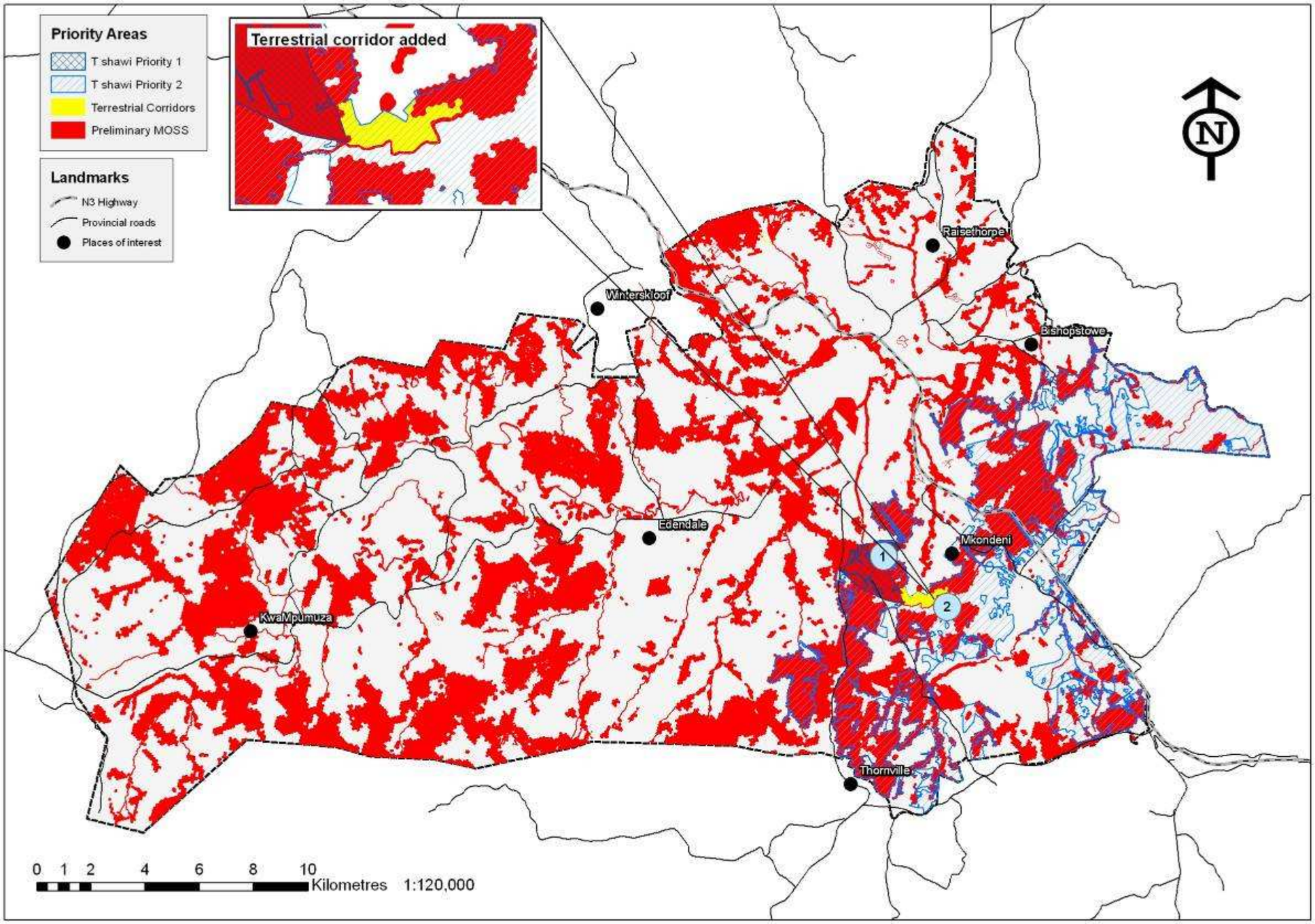
Map 10: Location of priority areas for the conservation of *Poecilogale albinucha* in relation to the preliminary ESP (excluding POS).



Map 11: Location of priority areas for the conservation of *Pronolagus crassicaudatus* in relation to the preliminary ESP (excluding POS).



Map 12: Location of priority areas for the conservation of *Stagira purpurea* in relation to the preliminary ESP (excluding POS).



Map 13: Location of priority areas for the conservation of *Tritogenia shawi* in relation to the preliminary ESP (excluding POS)

Appendix 2: Environmental Services Plan – Identification of Social Criteria

Msunduzi Municipality
Environmental Services Plan –
Identification of Social Criteria

Report Prepared for

Department of Environmental Affairs, Department of Agriculture, Environmental Affairs and Rural Development, and Msunduzi Municipality

Report No: 376998/DESP-SC

March 2010

SRK Consulting
Engineers and Scientists

Msunduzi Municipality

Environmental Services Plan –

Identification of Social Criteria

Report Prepared for

Department of Environmental Affairs, Department of Agriculture, Environmental Affairs and Rural Development, and Msunduzi Municipality

SRK Project Number: 376998

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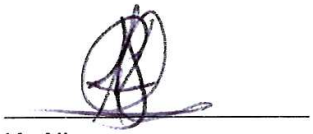

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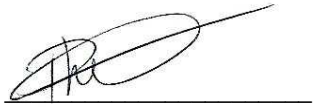

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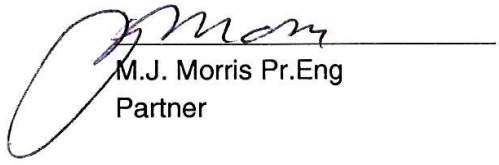

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Msunduzi Environmental Management Framework Environmental Services Plan (ESP) – Identification of Social Criteria

1 Introduction

The Msunduzi Municipality (Msunduzi), in partnership with the national Department of Environmental Affairs (DEA), previously the Department of Environmental Affairs and Tourism (DEAT) and the KwaZulu-Natal Department of Agriculture and Environmental Affairs and Rural Development (DAEA&RD) previously the Department of Agriculture and Environmental Affairs (DAEA), has recognised that to support sustainable social, economic and environmental development within the Municipality, the adoption and implementation of an appropriate policy to inform development planning and approval is required. To address these requirements, the preparation of an Environmental Management Framework (EMF) is being undertaken by SRK Consulting (SRK). The Msunduzi EMF includes a Status Quo Analysis, Strategic Environmental Assessment (SEA), an Environmental Services Plan (ESP) previously referred to as the Municipal Open Space System (MOSS), a Strategic Environmental Management Plan (SEMP) and GIS based Spatial Decision Support Tool (SDST) for Msunduzi. The Msunduzi EMF consists of 3 Phases as indicated in Figure 1.1. The ESP forms part of Phase three of the greater Msunduzi EMF project as illustrated in Figure 1.1.

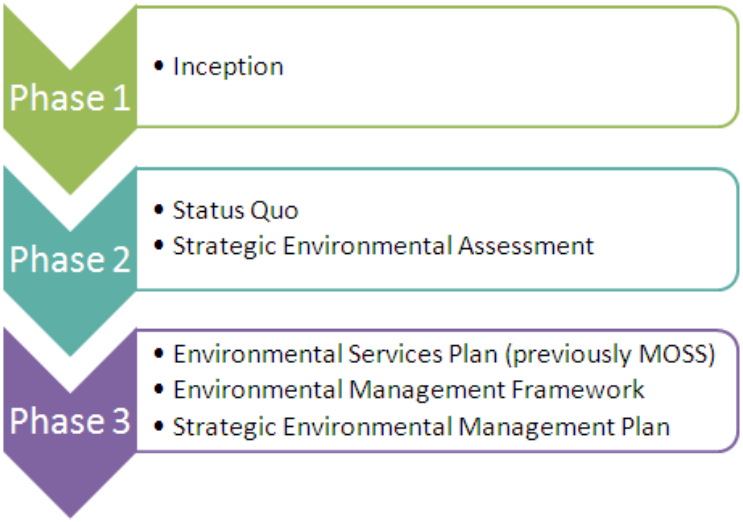

Figure 1.1: Phases of the Msunduzi EMF

This report constitutes the product of the ESP component of the Greater Msunduzi EMF project, specifically the Social Criteria as discussed further in 1.1 below. The MOSS component falls within Phase three of the greater Msunduzi EMF project. Phase one, the inception phase included consultation to finalise the approach to the remainder of the study. Phase two included the status quo where the current state of the environment was described and mapped and the SEA phase which consolidated the findings of the status quo phase and used these to develop a sustainability framework. Phase one and two of the project have been completed and phase three is underway. Phase three includes the preparation of the SEMP, EMF and ESP, this Report.

1.1 Understanding of the Terms of Reference

The process of identifying open space areas from a social and cultural perspective requires extensive public involvement. It was agreed that this level of public involvement fell outside of the scope of the ESP and that the public involvement required would be undertaken during the implementation of the ESP. Therefore in order to include social criteria in the identification of areas for inclusion in the ESP two strategies where identified. It was agreed that existing Msunduzi open space areas would be included in the ESP and that social criteria for prioritisation and identification of open space areas would be developed. Existing open spaces where included in the mapping produced as part of the INR Report, ESP - Areas required to maintain ecosystem goods and services. In order to identify social criteria SRK undertook the following tasks:

- Review the approach to developing Durban and other MOSS's;
- Review literature on social use values for open space & define criteria for inclusion of these area for uses such as education, scenic/aesthetic, recreational use, trails, buffers (i.e. between industrial and residential areas) etc;
- Define design criteria for identification of priority social use / values (incl. developed parks) areas as part of the implementation of the Msunduzi MOSS

This report therefore includes a literature review and a set of social criteria that may be used by the municipality to rate areas identified in terms of the INR Report and identify additional areas required to meet social open space.

1.2 Structure of the Report

Table 1.1 below provides an outline of this Report.

Table 1.1: Outline of this Report

Section	Title	Content
Executive Summary	Executive Summary	A short summary highlighting the key points of this report.
Section 1	Introduction	An introduction to this report, outlining the differences between a MOSS, ESP and Public Open Space. This section explains the role of a MOSS within the Msunduzi EMF.
Section 2	Methodology	Outlines the methodology used within this report.
Section 3	Literature Review	Review of other relevant MOSS's and studies to include: the eThekwini Environmental Services Management Plan 2001 and 2003; Gauteng Open Space Project: Phase 3 and the uMhlathuze Crime Prevention Study.
Section 4	Design criteria for identification of priority social use / values	Details social criteria that could be used within the Msunduzi Municipality to prioritise or include areas in the ESP
Section 5	Conclusions and Way forward	Outlines recommended actions for implementation of the ESP.

2 Methodology

This section outlines the methodology used to identify Social Criteria, and describes the collection of information and identification of the design criteria.

2.1 Collection and review of information

To inform the identification of social criteria other MOSS's and studies were reviewed. The three case studies reviewed include:

- eThekwini Environmental Services Management Plan 2001 and 2003 versions (EESP 2001 and EESP 2003 respectively),
- Gauteng Open Space Project Phase 3 (GOSP3) and
- uMhlathuze Municipality Crime prevention Plan focussing on use of Open Spaces.

Each of these studies aimed to identify open spaces within each of their respective municipalities; however slightly different methodologies were used in each. Section 3 of this report identifies key concepts from each in terms of relevance to the Msunduzi ESP.

2.2 Identification of design criteria for inclusion of priority areas for social use

From the studies reviewed, some key concepts were identified in terms of criteria that may be used in the determination of important social factors in open space planning. While ecology plays an important role in the identification of important open space areas, there are also social (aesthetic, cultural, recreational and historical) factors that need to be included in the design criteria for an open space plan.

Areas that hold a significant value for a community need to be conserved, particularly in urban areas where open space is limited. The identification of social criteria took into account the need to include areas that may not hold significant ecological value, but provide communities with space to socialise and 'escape' the urban lifestyle. The social criteria also considered other values such as areas of cultural or historical significance to specific communities.

The identification of these areas is inherently difficult. Any attempt to rank or quantify what is essentially a qualitative subject is difficult and needs to be undertaken in a sensitive manner. Each community has its own assumptions and values associated with open spaces, making the identification of the most important areas highly subjective. The design criteria identified in Section 0 of this report therefore aimed to reduce the subjective nature of the ranking of open space.

3 Literature Review

As described above a literature review was carried out to inform the identification of social criteria to refine the Msunduzi ESP during implementation. The three case studies reviewed were as follows:

- EESP 2001 and EESP 2003,
- GOSP3, and
- uMhlathuze Municipality Crime prevention Plan.

These are discussed further in the sections below.

3.1 EESP 2001 and EESP 2003

The EESP 2001 was based upon the Durban Metropolitan Open Space System (D'MOSS) of 1989 and the D'MOSS Framework Plan of 1999. The purpose of the EESP 2001 was to inform land use planning and allow for the sustainable use of the environmental services within the municipality.

While the EESP 2001 includes *"brown areas" such as: shopping malls, plazas and other paved concrete areas* in the definition of open spaces the EESP 2001 criteria for inclusion focus on identifying areas of ecological function. The EESP 2001 did however consider the human element but looked more at the impact of human actions on natural process. As a result a number of actions were identified that affect social use values of the open space areas, these include:

- The control of harvesting of the natural products supplied in an open space (medicine, firewood and other natural resources);
- Ensuring the scenic attractiveness of the open space;
- The control of disturbance to the fauna and flora in the open space through the actions of humans;
- Promote the development of compatible land use next to an open space; and
- Promote managed access to the open space.

The EESP 2003 is an update of the 2001 study and documents changes as a result of subsequent studies conducted by external consultants. The focus of the study remained the same, namely on the conservation of ecosystem goods and services but the criteria for the identification of open space were amended to include consideration of the use of open spaces. The criteria also considered aspects that would make the site undesirable for development such as slope and flooding. However the criteria for inclusion remained biophysical and no purely social criteria were considered other than consideration of existing open spaces.

3.2 GOSP3

The Gauteng Open Space Project Phase 3 (GOSP3) was initiated to refine the GOSP Phase 2 which identified, mapped and assessed the significance of open spaces in terms of their ecological, heritage and social values. The GOSP3 aimed to refine these values. The GOSP3 did not include a public involvement process and as such it was noted that the application of the social and cultural criteria may require refinement in light of the different values communities place on open spaces.

Open spaces to be set aside due to their cultural heritage value where identified through consolidation of existing datasets much like the Cultural Heritage Specialist Study undertaken in the Status Quo Phase of the Greater Msunduzi EMF project. Social criteria identified where as follows:

- Function – use of the area for its intended purpose such as recreation, education and providing a sense of place or visual relief;
- Frequency of use;
- Potential aesthetic value;
- Social Services – much like function;
- Economic Value – relating to ecosystem goods and services such as water, food and raw materials;
- Visual Absorption Capacity – the extent to which the open space mitigated aesthetic impacts of development;

These criteria were used to identify areas of social use value. The GOSP3 noted that while a site may have no ecological value it may have a high social use value. Alternatively however areas of ecological importance are not excluded from also providing social use values however the management of these area is important to ensure that use of the site for social needs does not compromise the ecological integrity of the site.

3.3 uMhlathuze Crime Prevention Study

As part of the city planning for uMhlathuze open spaces were set aside for social amenity and to preserve ecological function. It was however recognised that the extensive open space system was contributing to crime. As such SRK was appointed to undertake an audit of zoned open spaces and categorise the areas in relation to their crime potential in terms of their ecological, social and development value.

The potential for crime was determined through an on-site inspection of the open space. A questionnaire was completed in order to determine if the open space concerned was detrimental to the area. Some of the aspects on site that were investigated included, but were not limited to:

- Vegetation on site – height of the vegetation, visibility of the vegetation, potential for hiding places for criminals, types of vegetation, alien species and land use on site;
- Fencing of the site – the height of the fences, visible disturbances of the fences, condition of the fences and ownership of the fence;

- Equipment on site – what playground equipment is on site, the condition of any equipment and litter collection on site; and
- Visibility – how visible the site is from the outside and how the visibility in the site is.

Crime potential really relates the use of open spaces for uses other than those intended. Such use of the site compromises intended use and may be reason to transform open spaces. However the use of an area for crime is a management issue and appropriate management will be critical to ensure that a site is not inappropriately used.

4 Design criteria for identification of priority social use / values

The case studies above were used to inform the development of criteria, as detailed below, for the identification and prioritisation of open spaces within Msunduzi. These criteria should however be used together with extensive public consultation in order to refine the Draft ESP.

4.1 Function

This criterion gauges the extent to which a site is used or is intended for use as a public open space. Activities therefore that would be expected on the site would include:

- Recreation such as walking, picnicking, playing sport (formal and informal) or dog walking;
- Education such as information centres;
- Providing a sense of place and visual relief such as sites of urban greening or buffers between industrial or commercial areas and residential areas

The following ranking scale is recommended:

Table 4.1: Function Ranking Table

Areas used and maintained for intended public amenity	6
Areas used but not maintained for intended public amenity	3
Areas not intended or used for public amenity	1
Used for purposes other than that intended such as crime	0

4.2 Usage Frequency

Usage frequency refers to how frequently a public amenity area is used by a community. The ratings used are:

Table 4.2: Use Ranking Table

Areas used daily for the intended public amenity	6
Areas used weekly for the intended public amenity	5
Areas used monthly for the intended public amenity	4
Area used quarterly for the intended public amenity	3
Area is used annually for the intended public amenity	2
Area is not used for the intended public amenity	1

4.3 Social Services

Social Services offered by an area may include the following:

- Visual relief;
- Recreation;

- Education;
- Noise reduction; and
- Cultural importance

The ranking of the open space in terms of social services should be determined by the number of services it offers, as follows:

Table 4.3: Social Services Ranking Table

Provides 4 or 5 of the identified services	6
Provides 2 or 3 of the identified services	5
Provides 1 of the identified services	4
Provides none of the identified services	1

4.4 Visual Absorption Capacity (VAC)

VAC is the measure of the landscape's ability to accept / absorb changes to the landscape through development. The more a landscape can "hide" a developmental change, the higher the VAC.

For the purpose of ranking the VAC of an open space, the VAC for the area should be determined through investigations into slope, visual pattern (landscape texture) and vegetation height. The application of these aspects of VAC is described further below.

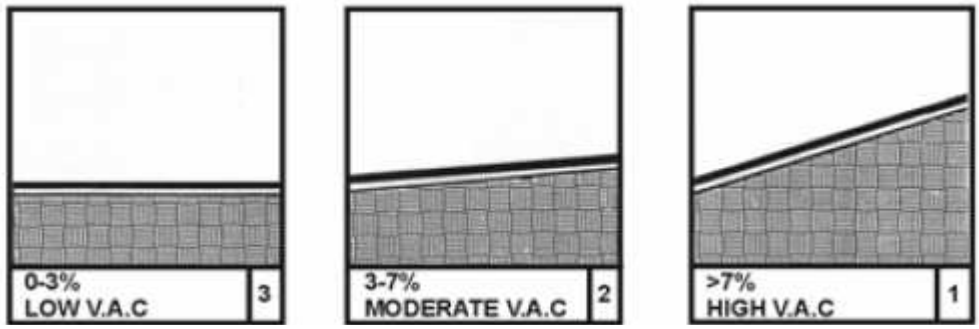

Figure 4.1: Slope VAC categories (sourced from GOSP3)

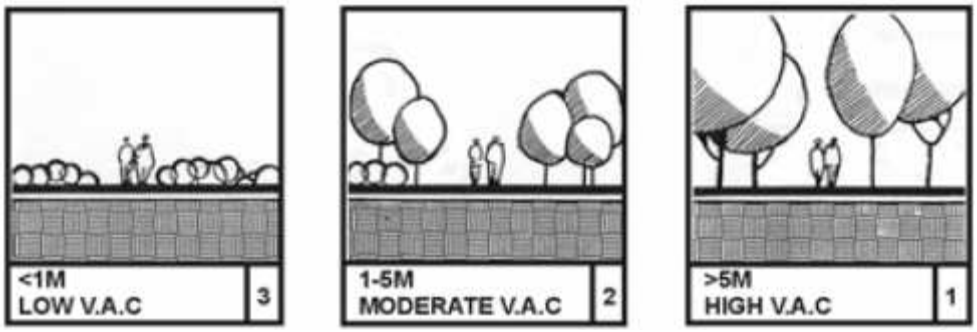

Figure 4.2: Vegetation Height VAC categories (sourced from GOSP3)

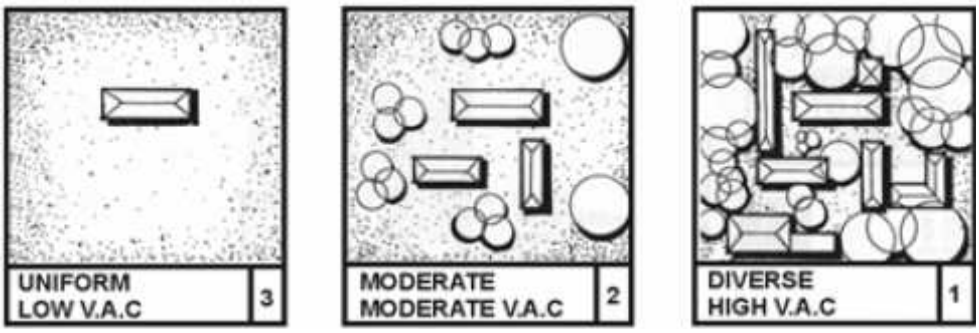

Figure 4.3: Visual Pattern of Landscape Character VAC categories (sourced from GOSP3)

For each aspect of VAC a ranking obtained, these rankings are then summed to provide a consolidated VAC ranking. Table 4.4 illustrates how the rankings should be summed to obtain a consolidated VAC ranking.

Table 4.4: VAC Ranking Table

Slope	0-3%	3-7%	>7
	3	2	1
Vegetation Height	<1m	1-5m	>5m
	3	2	1
Visual Pattern	Uniform	Moderate	Diverse
	3	2	1
Total	**9-7**	**6-4**	**3-1**
Ranking	**4**	**5**	**6**
Significance	**High**	**Medium**	**Low**

4.5 Economic Value

The economic value of an open space refers to the provision of the following items with economic value:

- Raw materials
- Water supply
- Food or opportunities for food production
- Medicinal plants
- Increased property values
- Income generating recreation i.e Duzi Canoes Marathon

As for social services the ranking of areas in terms of economic value should be based on the number of items it provides as follows:

Table 4.5: Economic Ranking Table

Provides 3 or more of the identified services	6
Provides 2 of the identified services	5
Provides 1 of the identified services	4
Provides none of the identified services	1

4.6 Heritage Criteria

As part of the Status Quo Phase of the greater Msunduzi EMF project zones and points of cultural heritage importance were identified from existing datasets and through consultation with cultural heritage specialists. The map of cultural heritage zones and points is included at Appendix 2. Inclusion of these points and zones into the ESP was discussed and it was decided not to include these areas for the following reasons:

- The majority of cultural heritage sites in Msunduzi are privately owned buildings and therefore do not constitute open space; and
- By definition the map is an Environmental Services Management Plan and the areas proposed as cultural heritage zones do not offer ecosystem goods and services.

Cultural heritage resources are however critically important in terms of the identification of areas of high social use value. As such it is suggested that the following ranking of cultural significance be used to identify areas of high social use value:

Table 4.6: Cultural Ranking Table

Open spaces within Cultural Heritage Zones	2
Opens spaces in which Cultural Heritage points exist	1.5
Opens spaces with no Cultural Heritage significance	1

As illustrated below the total value of a site is doubled if it falls within a cultural heritage zone and is increased by 50% if it has a cultural heritage point on the site. While the ranking numbers are low due to the calculation used Cultural Heritage has a significant impact on the overall significance rating.

4.7 Creation of a consolidated Social Significance Ranking

If sites are to be compared with one another in order to rank sites in terms of their social importance, it is critical that a consolidated ranking be determined. How the different components are summed determines the extent to which each of the component influence the consolidated total. It is therefore proposed that the sum of Function and Frequency be multiplied with the sum of Social Services VAC and Economic Services. This total should then be multiplied by the ranking for cultural significance as illustrated further in Table 4.7.

Table 4.7: Consolidated Ranking Matrix

Criteria	Significance			
	High	**Medium**	**Low**	**None**
Function	6 Areas used and maintained for intended public amenity	3 Areas used but not maintained for intended public amenity	1 Areas not intended or used for public amenity	0 Used for purposes other than that intended such as crime
Use	6-5 Areas used daily or weekly for the intended public amenity	4-3 Areas used monthly or quarterly for the intended public amenity	2 Area is used annually for the intended public amenity	1 Area is not used for the intended public amenity
Use Significance	**12-9**	**8-5**	**4-2**	**1**
Social Services	6 Provides 4 or 5 of the identified services	5 Provides 2 or 3 of the identified services	4 Provides 1 of the identified services	1 Provides none of the identified services
VAC	6 High	5 Medium	4 Low	NA
Economic Value	6 Provides 3 or more of the identified services	5 Provides 2 of the identified services	4 Provides 1 of the identified services	1 Provides none of the identified services
Service Significance	**18 - 13**	**12-8**	**7-3**	**2**
Cultural Significance	2 Open spaces within Cultural Heritage Zones	1.5 Opens spaces in which Cultural Heritage points exist	NA	1 Opens spaces with no Cultural Heritage significance
Consolidated	**432 - 234**	**233-60**	**59-6**	**<5**

5 Conclusions and Way Forward

This report aims to provide an introduction to the INR MOSS Report attached as Appendix 1, whilst providing an outline of open space system examples from three other municipalities. The review of the approach from other municipalities informed the approach for the Msunduzi ESP and the identification of criteria that should be used in the ranking of open space areas for social use.

The social criteria identified should be used during the implementation phase of the ESP to:

- Identify additional open spaces that have social value; and
- Rank areas of ecological value, identified in the INR Report, in terms of their social use value as part of the ecological services offered.

It is however critical that due to the subjective nature of the social aspects of these open spaces, extensive public participation be undertaken to ensure that as many criteria as possible are identified for use in the open space classifications.

6 References

Any references used should be inserted here. Use the reference style.

eThekwini Muncipality. **eThekwini Muncipality: Environmental Services Management Plan: 200**3. Environmental Management Branch Development and Planning Service Unit eThekwini Municipality (June 2003)

Roberts, D,. Boon, R., and Croucamp, P. **eThekwini Muncipality: Environmental Services Management Plan: 2001**. Environmental Management Branch Development and Planning Service Unit eThekwini Municipality (June 2001)

Strategic Environmental Focus (SEF). **Gauteng Open Space Project: Phase 3**. Gauteng Department of Agriculture, Conservation, Environment and Land Affairs

SRK Consulting. **Crime Prevention Through Environmental Design Phase 1: Open Space Identification and Auditing.** Prepared for: uMhlathuze Municipality Integrated Development and Planning Department. (November 2004)

Appendices

Appendix 1 Cultural Heritage Map

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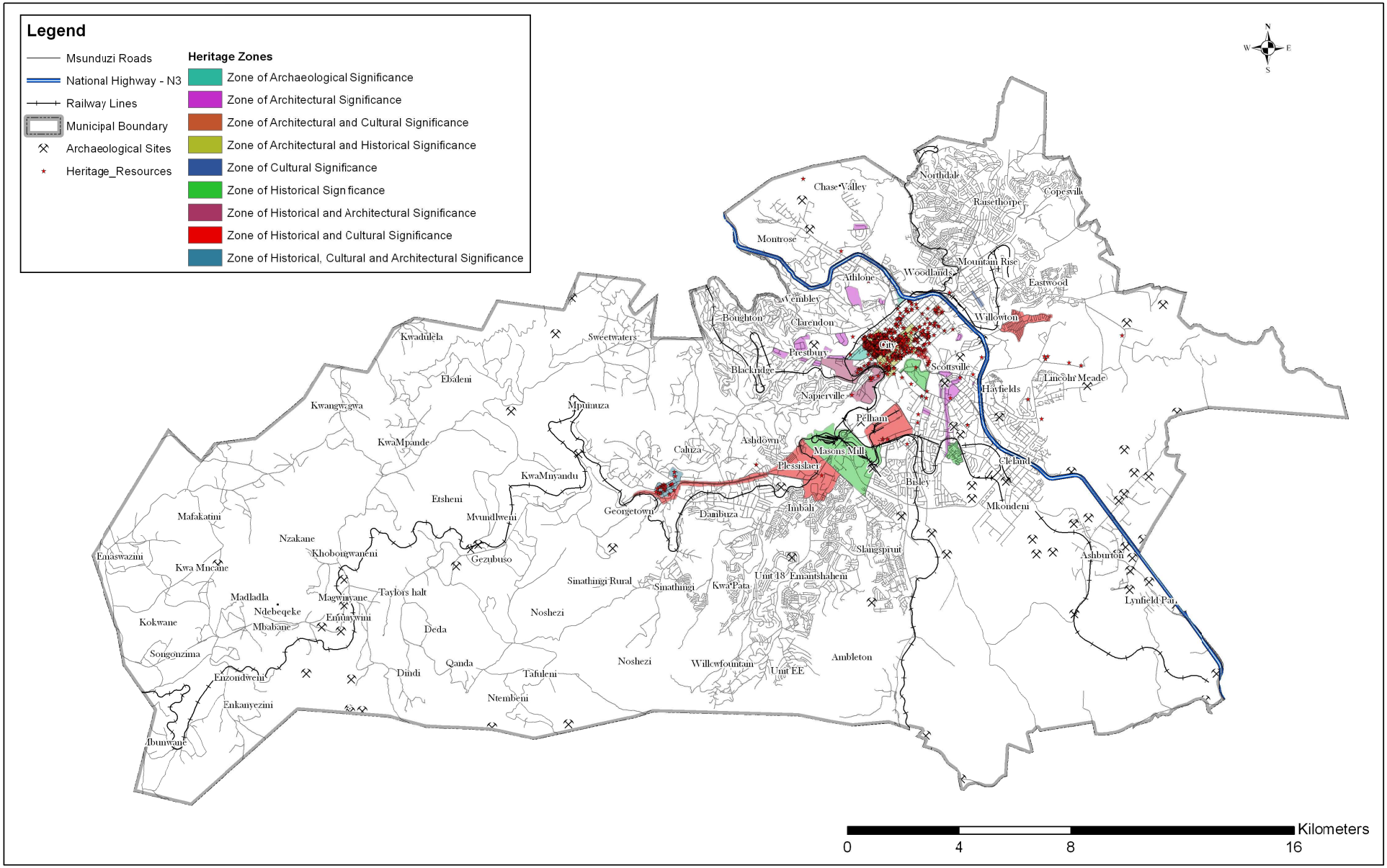

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