6.3.6 Section 6: Lusikisiki to Mthamvuna River

This section involves construction of a new road between Lusikisiki and Mthamvuna River (Figure 13), a distance of approximately 73.5 km, a new R61 interchange, intersections with all major district roads and major bridges over the Msikaba, Mthentu, Kwadlambu, Mnyameni, Kulumbe, Mpahlane and Mzamba River gorges (see FSR Chapter 4). There are a number of alternative alignments proposed along this section, namely the following:

1. in the vicinity of Ntafufu village and the Ntafufu River (2a alignments);
2. approach to the Msikaba bridge crossing site (5e and 5g alignments);
3. across the Mthentu River (9d_5 alignments);
4. across the Mnyameni River (10c, 10e and 10a alignments).
5. The Coastal Mzamba route between Lusikisiki and the Mthamvuna River

6.3.6.1 General assessment of the new road from Lusikisiki to Mthamvuna River

Description of effect

This assessment is concerned only with the proposed road, not with additional infrastructure such as bridges and toll plazas. The proposed construction of the road from Lusikisiki to Mthamvuna River will result in the loss of habitat, including habitats primarily associated with the Pondoland-Ugu Sandstone Coastal Sourveld vegetation type, along with the associated potential loss of biodiversity and potential loss of individuals of species of special concern as

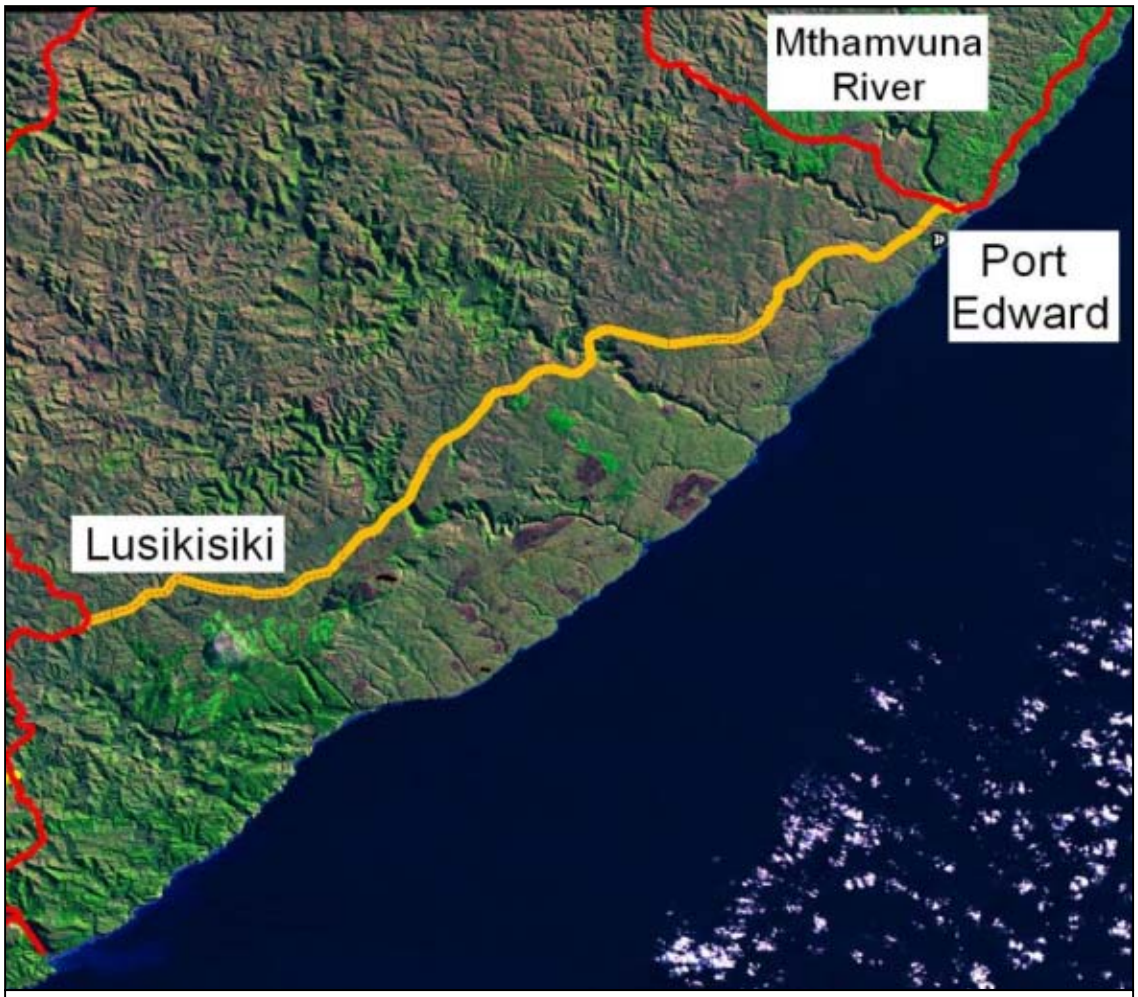

Figure 13: Proposed new road between Lusikisiki and Mthamvuna shown in yellow.

well as fragmentation of these habitats.

Assessment
The assessment of impacts both without and with mitigation measures is presented in Table 6.21 below. Pondoland-Ugu Sandstone Coastal Sourveld is considered to be Vulnerable and also forms one of the two primary habitats constituting the PCE. Impacts within this vegetation type therefore need to be carefully controlled. From Lusikisiki the proposed road follows the existing DR08024 to the village at Mateku (Msikaba Village). This is all within the Ngongoni Veld vegetation type. Any impacts along this stretch of road are an expansion of existing impacts, but most of this stretch of road is without natural vegetation alongside due to transformation by cultivation and townships. From Mateku the proposed road crosses various gorges via high-level bridges until it reaches the Mthamvuna River. This alignment crosses alternating natural and cultivated areas.

There is one impact identified as having potentially very high significance, namely "loss of habitat". The proposed alignment will directly impact upon grassland areas. This includes approximately 34 km of road (see FSR - Botanical screening report) through untransformed grassland (including grassland, rocky grassland, scrub and seasonal wetland plant communities) within Pondoland-Ugu Sandstone Coastal Sourveld. Assuming an 80 m wide directly affected zone (the width of the road servitude), this equates to approximately 272 ha of habitat that will be directly lost within Pondoland-Ugu Sandstone Coastal Sourveld due to construction of the road. The national assessment is that there are 92419 ha of this vegetation type remaining (Driver et al. 2004, Mucina & Rutherford 2006). Assuming that the national estimate of transformation is correct, the direct loss of habitat within Pondoland-Ugu Sandstone Coastal Sourveld due to construction of the road is 0.3% of the remaining total of this vegetation type.

There are five impacts identified as having potentially high significance, namely "fragmentation of habitat", "loss of species of special concern", "invasion by alien species", "strip/ribbon development" and "increased accessibility to remote habitats".

Given current patterns of transformation and degradation in the greenfields area, the proposed alignment may result in some fragmentation, but excludes core untransformed areas within the PCE in which it would be desirable to avoid fragmentation. Due to the position of the road alignment along the margin of the PCE, the areas with the highest possibility of impacts due to fragmentation are between the Mtentu and Mthamvuna Rivers, which is also the area with the greatest degree of transformation and degradation due to cultivation.

There are 35 plant species of conservation importance occurring in grasslands within the Pondoland area (see Appendix 1). This includes a number of PCE endemics, but constitutes all Red List species as well as other species for which there could be conservation concern. According to Provincial Ordinances there are also a number of protected species that may occur in grasslands as well as medicinal species that may not appear on either of these two lists. There is therefore a high probability of encountering species of special concern within the grasslands of this alignment.

Invasion by alien plants is potentially serious due to the high levels of invasion in similar disturbed habitats nearby and the fact that the invasion is almost certain to occur in the absence of any control measures. Alien plants are known to invade forests up to 150 m from the margin adjacent to disturbance and have been observed up to 100 m away in grasslands in the greenfields area. This indicates that approximately 680 ha of additional habitat (100 m on each side of the road for 34 km) may be altered adjacent to the road over and above that lost

directly to the construction of the road. This equates to approximately 3.3% of the remaining total area of Pondoland-Ugu Sandstone Coastal Sourveld.

The potential impact of strip development is very difficult to assess, but a precautionary approach has been taken here and it has been assumed that there would be no limitation to development along the coast due to the increased accessibility of these areas. It is acknowledged that SANRAL do not necessarily have any control over this potential impact and that it requires the political will from DEAT to limit this effect. However, on this basis, it is possible that large parts of the coastline may become developed for a distance of up to 2 km from the high tide mark. Although the likelihood of this is very low under current legislation and the confidence in this assessment is low, the risk of this happening needs to be taken into account. Conservatively, up to 2 000 ha of coastal land could become developed under this scenario, approximately 9.6% of the remaining total area of Pondoland-Ugu Sandstone Coastal Sourveld.

A road through this grassland area will definitely make previously inaccessible areas more accessible, especially for the removal of medicinal products and other species for which there may be horticultural interest. The current rates of harvesting of medicinal species in the area for muthi markets (mostly in Durban) has lead to the depletion of many species from anywhere near to existing settlements (Kepe 1997). An easy access road may accelerate this process.

There are three impacts that are assessed as medium, namely "loss of biodiversity", "increased runoff" and "reduction in the resilience/stability of ecosystems". These are all local scale, long-term impacts. The loss of biodiversity is directly linked to the loss of habitat, but may also occur due to increased harvesting of desirable species in more remote areas. Some habitats within the grasslands, e.g. rocky outcrops contain very high diversity. Impacts on these areas may lead to localised loss of biodiversity in the Pondoland-Ugu Sandstone Coastal Sourveld, but may not necessarily lead to loss of biodiversity in a regional context. Increased runoff will occur as a result of the new pavement area and is likely to lead to erosion problems in this high-rainfall area. The resilience/stability of these grasslands will be impaired by the direct loss of habitat, fragmentation, the introduction of alien species and the potential disruption of the flow of nutrients and materials through the landscape.

Table 6.21: Assessment of potential impacts associated with the proposed construction of a road between Lusikisiki and Mthamvuna River (SANRAL preferred route)

ISSUE / IMPACT	PHASE	EXTENT	DURATION	INTENSITY	PROBABILITY	SIGNIFICANCE	STATUS	CONFIDENCE
WITHOUT MITIGATION								
Loss of habitat	Construction	regional	permanent	high	definite	VERY HIGH	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of biodiversity	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fragmentation of habitat	Construction	regional	permanent	medium	definite	HIGH	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of species of special concern	Construction	local	permanent	high	definite	HIGH	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Increased runoff & drainage, soil erosion, silt loads & sedimentation	Construction	local	medium-term	medium	probable	LOW	negative	medium
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Invasion by alien weeds & invader plants	Construction	local	long-term	low	probable	LOW	negative	high
	Operation	local	long-term	high	probable	HIGH	negative	high
Pollution at construction camps	Construction	Site	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased risk of veld fires	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Vehicular pollution of soil, air or water	Construction	local	short-term	low	improbable	VERY LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium
Strip development	Construction	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Operation	regional	long-term	medium	probable	HIGH	negative	medium
Increased accessibility of remote habitats	Construction	local	short-term	medium	probable	LOW	negative	medium
	Operation	local	long-term	high	probable	HIGH	negative	medium
Reduction in resilience/stability of ecosystems	Construction	local	long-term	medium	probable	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Disruption of the flow of nutrients and materials	Construction	local	long-term	low	probable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
WITH MITIGATION								
Loss of habitat	Construction	regional	permanent	medium	definite	HIGH	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of biodiversity	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fragmentation of habitat	Construction	regional	permanent	medium	definite	HIGH	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of species of special concern	Construction	local	permanent	medium	definite	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased runoff & drainage, soil erosion, silt loads & sedimentation	Construction	local	medium-term	low	probable	VERY LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium
Invasion by alien weeds & invader plants	Construction	local	long-term	low	probable	LOW	negative	high
	Operation	local	long-term	low	probable	LOW	negative	high
Pollution at construction camps	Construction	Site	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased risk of veld fires	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Vehicular pollution of soil,	Construction	local	short-term	low	improbable	VERY LOW	negative	medium

air or water	Operation	local	long-term	low	probable	LOW	negative	medium
Strip development	Construction	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Operation	regional	long-term	medium	probable	HIGH	negative	medium
Increased accessibility of remote habitats	Construction	local	short-term	medium	probable	LOW	negative	medium
	Operation	local	long-term	high	probable	HIGH	negative	medium
Reduction in resilience/stability of ecosystems	Construction	local	long-term	medium	probable	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Disruption of the flow of nutrients and materials	Construction	local	long-term	low	probable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Mitigation objectives

Prevent or reduce loss of natural vegetation, prevent or reduce loss of biodiversity and species of special concern, reduce impact of additional runoff, and prevent the invasion and spread of alien weeds and invader plants. The secondary impacts of strip development and accessibility to remote habitats are beyond the control of SANRAL. The impact of vegetation fragmentation can only be addressed by considering different route alternatives, which has already been undertaken during previous phases of this project. Some local alternative alignments are assessed in other sections of the report.

Mitigation measures

Off-site mitigation, e.g. facilitation of the conservation of an area of grassland elsewhere for which the future conservation can be guaranteed.

- Minimise and restrict clearing to the area required for road construction purposes only and limit disturbance to adjacent undisturbed natural vegetation communities. Sensitive vegetation should be fenced off from the construction site to avoid impacts on these areas.
- Where destruction of vegetation is unavoidable, a botanical expert should identify any protected species at that site for which permits may be required for their destruction or removal.
- Revegetation of disturbed areas must be undertaken with site indigenous species. This can provide a buffer to protect indigenous vegetation from invasion by weeds.
- Structures such as bridges and culverts must be constructed in such a way as to minimise impacts on wetlands, streams and drainage areas.
- Protection of habitat through implementation of erosion and sediment control measures, including stormwater management and providing grassy channels at stormwater outlets.
- Ongoing monitoring and maintenance of revegetation works following commissioning of proposal.
- Appropriate locating of stockpiles, site offices and infrastructure, to limit damage to sensitive vegetation.
- Control alien plants in road reserve and in disturbed areas by implementing a weed control plan to avoid establishment and spread of weeds. The long-term measurable outcome will be the complete absence of alien plants.

Implementation of the recommended mitigation measures will reduce one impact from very high to high significance, two impacts from high or medium significance to low significance and one impact from high to medium significance. The construction of the new section of road will, however, still result in impacts of medium or high significance, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat", "loss of species of special concern", "strip

development", "increased accessibility of remote habitats" and "reduction in resilience/stability of ecosystems".

6.3.6.2 New road alternative at Msikaba bridge crossing (alternative 5e)

Description of effect

This assessment is concerned only with the proposed road along alternative 5e (see Figure 14), not additional infrastructure such as bridges and toll plazas. The assessment of this alternative is given relative to the SANRAL preferred route (see alternative 5g4 in Figure 14) and only for that section of the SANRAL preferred route that it replaces. The proposed construction of this section of road will result in the loss of habitat, including habitats primarily associated with the Pondoland-Ugu Sandstone Coastal Sourveld vegetation type, along with the associated potential loss of biodiversity and potential loss of individuals of species of special concern as well as fragmentation of these habitats. There are also six places where it may affect forested areas classified as Scarp Forest.

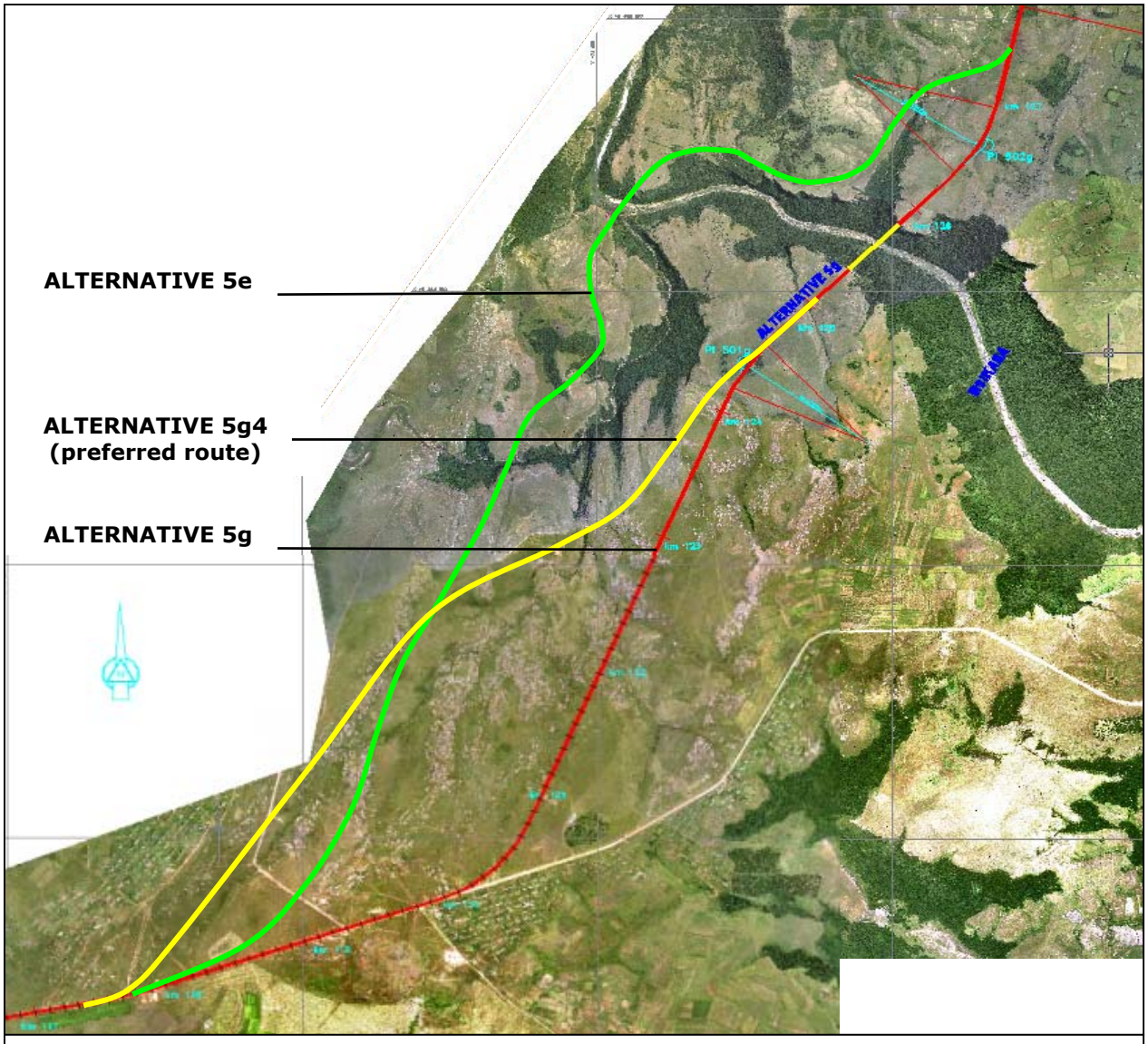

Figure 14: Alternative alignments at Msikaba River (Alternative 5g4 is the SANRAL preferred route).

Assessment
The assessment of impacts both without and with mitigation measures is presented in Table 6.22 below. Pondoland-Ugu Sandstone Coastal Sourveld is considered to be Vulnerable and also forms one of the two primary habitats constituting the PCE. The other is Scarp Forest, which is a protected vegetation type. Impacts within these vegetation types therefore need to be carefully controlled. From Mateku this alternative crosses a stretch of grassland with rocky areas before it crosses the Msikaba gorge fairly high up. There are six places where it crosses forested sections of gorge (either the main gorge or small tributaries). The SANRAL preferred alignment crosses a single gorge along this section.

There are seven impacts identified as having potentially high significance, namely "loss of habitat", "loss of biodiversity", "loss of species of special concern", "increased runoff", "invasion by alien species" , "increased accessibility to remote habitats" and "fragmentation of habitats."

The proposed alignment will directly impact upon approximately 10.7 km of habitat in untransformed grassland and forest within Pondoland-Ugu Sandstone Coastal Sourveld and Scarp Forest. Assuming an 80 m wide directly affected zone (the width of the road servitude), this equates to approximately 86 ha of habitat that will be directly lost due to construction of the road. The SANRAL preferred alignment for this same section is 9.3 km long which equates to approximately 74 ha of habitat.

This alignment will result in some fragmentation due to the fact that it passes through untransformed areas of vegetation, but it is located very close to the boundary between the Msikaba sandstone and Karoo sediments, which thus excludes core untransformed areas within which it would be desirable to avoid fragmentation. There will be some local scale fragmentation along the margins of forests. The proposed alignment (5e) crosses a number of gorges, whereas the SANRAL preferred alignment only crosses one.

There are a variety of habitats along this alignment, including grassland, rocky grassland, scrub, forest and wetland. Some of these contain naturally high levels of biodiversity which will be lost locally due to construction of this alignment.

There are 35 plant species of conservation importance occurring in grasslands within the Pondoland area (see Appendix 1). This includes a number of PCE endemics, but constitutes all Red List species as well as other species for which there could be conservation concern. According to Provincial Ordinances there are also a number of protected species that may occur in grasslands as well as medicinal species that may not appear on either of these two lists. There is therefore a high probability of encountering species of special concern within the grasslands of this alignment.

Increased runoff will occur as a result of the new pavement area and is likely to lead to erosion problems in this high-rainfall area. Portions of this alignment are at the base of some very steep slopes and it is likely that there will be severe runoff problems associated with placement of the road in this position.

Invasion by alien plants is potentially serious due to the high levels of invasion in similar disturbed habitats nearby and the fact that the invasion is almost certain to occur in the absence of any control measures. Alien plants are known to invade forests up to 150 m from the margin adjacent to disturbance and have been observed up to 100 m away in grasslands in the greenfields area. This indicates that approximately 214 ha of additional habitat (100 m on each side of the road for 10.7 km) may be altered adjacent to the road over and above that

lost directly to the construction of the road. This compares to 186 ha for the SANRAL preferred alignment to cover the same stretch of landscape.

A road through this grassland and forested area will definitely make previously inaccessible areas more accessible, especially for the removal of medicinal products and other species for which there may be horticultural interest. The current rates of harvesting of medicinal species in the area for muthi markets (mostly in Durban) has lead to the depletion of many species from areas surrounding existing settlements (Kepe 1997). An easy access road may accelerate this process.

There are three impacts that are assessed as medium, namely "strip development", "disruption of the flow of nutrients and materials" and "reduction in the resilience/stability of ecosystems". These are all local scale, long-term impacts. Increased development along this route is likely due to the existing township and the intended provision of intersections along this section of road. This applies to this alternative as well as the SANRAL preferred alignment. The disruption of natural landscape flow of nutrients and materials will occur due to this alignment bisecting a variety of landscape forms, whereas the SANRAL preferred alignment tends to cross relatively flat areas along this section of the landscape. The resilience/stability of these grasslands will be impaired by the direct loss of habitat, some fragmentation, the introduction of alien species and the potential disruption of the flow of nutrients and materials through the landscape.

Table 6.22: Assessment of potential impacts associated with the proposed construction of a road between Lusikisiki and Mthamvuna River (alternative 5e) and the SANRAL preferred alignment.*

ISSUE / IMPACT	PHASE	EXTENT	DURATION	INTENSITY	PROBABILITY	SIGNIFICANCE	STATUS	CONFIDENCE
WITHOUT MITIGATION								
Loss of habitat	Construction	local	permanent	high	definite	HIGH	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of biodiversity	Construction	local	long-term	high	probable	HIGH	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fragmentation of habitat	Construction	local	permanent	high/medium*	definite	HIGH/MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of species of special concern	Construction	local	permanent	high	definite	HIGH	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased runoff & drainage, soil erosion, silt loads & sedimentation	Construction	local	short-term	high	probable	LOW	negative	medium
	Operation	local	long-term	high	probable	HIGH	negative	medium
Invasion by alien weeds & invader plants	Construction	local	long-term	low	probable	LOW	negative	high
	Operation	local	long-term	high	probable	HIGH	negative	high
Pollution at construction camps	Construction	Site	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased risk of veld fires	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Vehicular	Construction	local	short-term	low	improbable	VERY LOW	negative	medium

pollution of soil, air or water	Operation	local	long-term	low	probable	LOW	negative	medium
Strip development	Construction	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Increased accessibility of remote habitats	Construction	local	short-term	medium	probable	LOW	negative	medium
	Operation	local	long-term	high	probable	HIGH	negative	medium
Reduction in resilience/stability of ecosystems	Construction	local	long-term	medium	probable	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Disruption of the flow of nutrients and materials	Construction	local	long-term	medium	probable	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
WITH MITIGATION								
Loss of habitat	Construction	local	permanent	high	definite	HIGH	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of biodiversity	Construction	local	long-term	high	probable	HIGH	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fragmentation of habitat	Construction	local	permanent	medium	definite	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of species of special concern	Construction	local	permanent	medium	definite	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased runoff & drainage, soil erosion, silt loads & sedimentation	Construction	local	short-term	high	probable	LOW	negative	medium
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Invasion by alien weeds & invader plants	Construction	local	long-term	low	probable	LOW	negative	high
	Operation	local	long-term	low	probable	LOW	negative	high
Pollution at construction camps	Construction	Site	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased risk of veld fires	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Vehicular pollution of soil, air or water	Construction	local	short-term	low	improbable	VERY LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium
Strip development	Construction	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Increased accessibility of remote habitats	Construction	local	short-term	medium	probable	LOW	negative	medium
	Operation	local	long-term	high	probable	HIGH	negative	medium
Reduction in resilience/stability of ecosystems	Construction	local	long-term	medium	probable	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Disruption of the flow of nutrients and materials	Construction	local	long-term	medium	probable	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a

*Where two assessments are given, the second applies to the SANRAL preferred alignment for that section of the proposed road. If not, the assessment applies to both alternatives.

Mitigation objectives
Prevent or reduce loss of natural vegetation, prevent or reduce loss of biodiversity and species of special concern, reduce impact of additional runoff, and prevent the invasion and spread of alien weeds and invader plants. The secondary impacts of strip development and accessibility to remote habitats are beyond the control of SANRAL.

Mitigation measures
- Minimise and restrict clearing to the area required for road construction purposes only and limit disturbance to adjacent undisturbed natural vegetation communities. Sensitive vegetation should be fenced off from the construction site to avoid impacts on these areas.
- Where destruction of vegetation is unavoidable, a botanical expert should identify any protected species at that site for which permits may be required for their destruction or removal.
- Revegetation of disturbed areas must be undertaken with site indigenous species. This can provide a buffer to protect indigenous vegetation from invasion by weeds.
- Structures such as bridges and culverts must be constructed in such a way as to minimise impacts on wetlands, streams and drainage areas.
- Protection of habitat through implementation of erosion and sediment control measures, including stormwater management and providing grassy channels at stormwater outlets.
- Ongoing monitoring and maintenance of revegetation works following commissioning of proposal.
- Appropriate locating of stockpiles, site offices and infrastructure, to limit damage to sensitive vegetation.
- Control alien plants in road reserve and in disturbed areas by implementing a weed control plan to avoid establishment and spread of weeds. The long-term measurable outcome will be the complete absence of alien plants.

Implementation of the recommended mitigation measures will reduce two impacts from high to medium significance and one impact from high to low significance. The construction of the new section of road will, however, still result in impacts of medium or high significance, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat", "loss of species of special concern", "increased runoff", "strip development", "increased accessibility of remote habitats", "reduction in resilience/stability of ecosystems" and "disruption of the flow of nutrients and materials".

6.3.6.3 New road alternative at Msikaba bridge crossing (alternative 5g)
Description of effect
This assessment is concerned only with the proposed road along alternative 5g (see Figure 14), not additional structures such as bridges or toll plazas. The assessment of this alternative is given relative to the SANRAL preferred route (see alternative 5g4 in Figure 14) and only for that section of the SANRAL preferred route that it replaces. The proposed construction of this section of road will result in the loss of habitat, including habitats primarily associated with the Pondoland-Ugu Sandstone Coastal Sourveld vegetation type, along with the associated potential loss of biodiversity and potential loss of individuals of species of special concern as well as fragmentation of these habitats.

Assessment
The assessment of impacts both without and with mitigation measures is presented in Table 6.23 below. Pondoland-Ugu Sandstone Coastal Sourveld is considered to be Vulnerable and also forms one of the two primary habitats constituting the PCE. Impacts within this vegetation

type therefore needs to be carefully controlled. From Mateku this alternative travels along the DR 08024 before crossing a stretch of grassland with rocky areas and then the Msikaba River.

There are four impacts identified as having potentially high significance, namely "loss of habitat", "increased runoff", "invasion by alien species" and "increased accessibility to remote habitats".

The proposed alignment will directly impact upon approximately 5.5 km of habitat in untransformed grassland and forest within Pondoland-Ugu Sandstone Coastal Sourveld. Assuming an 80 m wide directly affected zone (the width of the road servitude), this equates to approximately 44 ha of habitat that will be directly lost due to construction of the road. The SANRAL preferred alignment for this same section is 6.8 km long which equates to approximately 54 ha of habitat.

Increased runoff will occur as a result of the new pavement area and is likely to lead to erosion problems in this high-rainfall area. Portions of this alignment are along moderately steep slopes and it is likely that there will be runoff problems associated with placement of the road in this position.

Invasion by alien plants is potentially serious due to the high levels of invasion in similar disturbed habitats nearby and the fact that the invasion is almost certain to occur in the absence of any control measures. Alien plants are known to invade forests up to 150 m from the margin adjacent to disturbance and have been observed up to 100 m away in grasslands in the greenfields area. This indicates that approximately 110 ha of additional habitat (100 m on each side of the road for 5.5 km) may be altered adjacent to the road over and above that lost directly to the construction of the road. This compares to 136 ha for the SANRAL preferred alignment to cover the same stretch of landscape.

A road through this grassland and forested area will definitely make previously inaccessible areas more accessible, especially for the removal of medicinal products and other species for which there may be horticultural interest. The current rates of harvesting of medicinal species in the area for muthi markets (mostly in Durban) has lead to the depletion of many species from areas surrounding existing settlements (Kepe 1997). An easy access road may accelerate this process.

There are six impacts that are assessed as medium, namely "loss of biodiversity", "loss of species of special concern", "fragmentation of habitat", "strip development", "disruption of the flow of nutrients and materials" and "reduction in the resilience/stability of ecosystems". These are all local scale, long-term impacts. There are a variety of habitats along this alignment, including grassland, rocky grassland and wetland. Some of these contain naturally high levels of biodiversity which will be lost locally due to construction of this alignment. However, the amount of habitat containing high diversity is less than that for the SANRAL preferred alignment or alignment 5e.

There are 35 plant species of conservation importance occurring in grasslands within the Pondoland area (see Appendix 1). This includes a number of PCE endemics, but constitutes all Red List species as well as other species for which there could be conservation concern. According to Provincial Ordinances there are also a number of protected species that may occur in grasslands as well as medicinal species that may not appear on either of these two lists. There is therefore a high probability of encountering species of special concern within the grasslands of this alignment.

This alignment will result in some fragmentation due to the fact that it passes through untransformed areas of vegetation, but it is located very close to the boundary between the Msikaba sandstone and Karoo sediments, which thus excludes core untransformed areas within which it would be desirable to avoid fragmentation. Increased development along this route is likely due to the existing township and the intended provision of intersections along this section of road. This applies to this alternative as well as the SANRAL preferred alignment. The disruption of natural landscape flow of nutrients and materials will occur due to this alignment bisecting a variety of landscape forms, whereas the SANRAL preferred alignment tends to cross relatively flat areas along this section of the landscape. The resilience/stability of these grasslands will be impaired by the direct loss of habitat, some fragmentation, the introduction of alien species and the potential disruption of the flow of nutrients and materials through the landscape.

Table 6.23: Assessment of potential impacts associated with the proposed construction of a road between Lusikisiki and Mthamvuna River (alternative 5g) and the SANRAL preferred alignment.*

ISSUE / IMPACT	PHASE	EXTENT	DURATION	INTENSITY	PROBABILITY	SIGNIFICANCE	STATUS	CONFIDENCE
WITHOUT MITIGATION								
Loss of habitat	Construction	local	permanent	high	definite	HIGH	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of biodiversity	Construction	local	long-term	medium /high*	probable	MEDIUM /HIGH*	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fragmentation of habitat	Construction	local	permanent	medium	definite	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of species of special concern	Construction	local	permanent	medium /high*	definite	MEDIUM /HIGH*	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased runoff & drainage, soil erosion, silt loads & sedimentation	Construction	local	short-term	high	probable	LOW	negative	medium
	Operation	local	long-term	high	probable	HIGH	negative	medium
Invasion by alien weeds & invader plants	Construction	local	long-term	low	probable	LOW	negative	high
	Operation	local	long-term	high	probable	HIGH	negative	high
Pollution at construction camps	Construction	Site	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased risk of veld fires	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Vehicular pollution of soil, air or water	Construction	local	short-term	low	improbable	VERY LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium
Strip development	Construction	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Increased	Construction	local	short-term	medium	probable	LOW	negative	medium

accessibility of remote habitats	Operation	local	long-term	high	probable	HIGH	negative	medium
Reduction in resilience/stability of ecosystems	Construction	local	long-term	medium	probable	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Disruption of the flow of nutrients and materials	Construction	local	long-term	medium	probable	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
WITH MITIGATION								
Loss of habitat	Construction	local	permanent	high	definite	HIGH	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of biodiversity	Construction	local	long-term	medium /high	probable	MEDIUM /HIGH	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fragmentation of habitat	Construction	local	permanent	medium	definite	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of species of special concern	Construction	local	permanent	medium	definite	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased runoff & drainage, soil erosion, silt loads & sedimentation	Construction	local	short-term	high	probable	LOW	negative	medium
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Invasion by alien weeds & invader plants	Construction	local	long-term	low	probable	LOW	negative	high
	Operation	local	long-term	low	probable	LOW	negative	high
Pollution at construction camps	Construction	Site	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased risk of veld fires	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Vehicular pollution of soil, air or water	Construction	local	short-term	low	improbable	VERY LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium
Strip development	Construction	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Increased accessibility of remote habitats	Construction	local	short-term	medium	probable	LOW	negative	medium
	Operation	local	long-term	high	probable	HIGH	negative	medium
Reduction in resilience/stability of ecosystems	Construction	local	long-term	medium	probable	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Disruption of the flow of nutrients and materials	Construction	local	long-term	medium	probable	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a

*Where two assessments are given, the second applies to the SANRAL preferred alignment for that section of the proposed road. If not, the assessment applies to both alternatives.

Mitigation objectives

Prevent or reduce loss of natural vegetation, prevent or reduce loss of biodiversity and species of special concern, reduce impact of additional runoff, and prevent the invasion and spread of

alien weeds and invader plants. The secondary impacts of strip development and accessibility to remote habitats are beyond the control of SANRAL.

Mitigation measures

- Minimise and restrict clearing to the area required for road construction purposes only and limit disturbance to adjacent undisturbed natural vegetation communities. Sensitive vegetation should be fenced off from the construction site to avoid impacts on these areas.
- Where destruction of vegetation is unavoidable, a botanical expert should identify any protected species at that site for which permits may be required for their destruction or removal.
- Revegetation of disturbed areas must be undertaken with site indigenous species. This can provide a buffer to protect indigenous vegetation from invasion by weeds.
- Structures such as bridges and culverts must be constructed in such a way as to minimise impacts on wetlands, streams and drainage areas.
- Protection of habitat through implementation of erosion and sediment control measures, including stormwater management and providing grassy channels at stormwater outlets.
- Ongoing monitoring and maintenance of revegetation works following commissioning of proposal.
- Appropriate locating of stockpiles, site offices and infrastructure, to limit damage to sensitive vegetation.
- Control alien plants in road reserve and in disturbed areas by implementing a weed control plan to avoid establishment and spread of weeds. The long-term measurable outcome will be the complete absence of alien plants.

Implementation of the recommended mitigation measures will reduce one impact from high to medium significance and one impact from high to low significance. The construction of the new section of road will, however, still result in impacts of medium or high significance, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat", "loss of species of special concern", "increased runoff", "strip development", "increased accessibility of remote habitats", "reduction in resilience/stability of ecosystems" and "disruption of the flow of nutrients and materials".

6.3.6.4 New road alternative at Mthentu River (alternative 9d_5)

Description of effect

The assessment of this alternative is given relative to the SANRAL preferred route and only for that section of the SANRAL preferred route that it replaces. This section of road is an alternative crossing alignment for the Mtentu River gorge slightly south of the SANRAL preferred alignment (Figure 15). The proposed construction of this section of road will result in the loss of habitat, including habitats primarily associated with the Pondoland-Ugu Sandstone Coastal Sourveld vegetation type, along with the associated potential loss of biodiversity and potential loss of individuals of species of special concern as well as fragmentation of these habitats.

Assessment

The assessment of impacts both without and with mitigation measures is presented in Table 6.24 below. Pondoland-Ugu Sandstone Coastal Sourveld is considered to be Vulnerable and also forms one of the two primary habitats constituting the PCE. Impacts within this vegetation type therefore needs to be carefully controlled. From near the Mkambati/Holy Cross road this alternative crosses a stretch of grassland with some marshy areas before it crosses the Mtentu gorge further south than the SANRAL preferred alignment. The impact assessment below

applies to both the SANRAL preferred alignment and this alternative alignment (alternative 9d_5), i.e. there are no cases where the assessment of the impact differs.

There are five impacts identified as having potentially high significance, namely "loss of habitat", "loss of biodiversity", "loss of species of special concern", "increased runoff" and "invasion by alien species".

The proposed alternative alignment will directly impact upon approximately 4.1 km of untransformed habitat in grassland within Pondoland-Ugu Sandstone Coastal Sourveld (all west of the gorge). Assuming an 80 m wide directly affected zone (the width of the road servitude), this equates to approximately 33 ha of habitat that will be directly lost due to construction of the road. The SANRAL preferred alignment for this same section is 4.2 km long which equates to approximately 34 ha of habitat. The two alignments are therefore very similar.

There are a variety of habitats along this alignment, including grassland, a small piece of rocky grassland and marsh wetland. Some of these contain naturally high levels of biodiversity which will be lost locally due to construction of this alignment.

There are 35 plant species of conservation importance occurring in grasslands within the Pondoland area (see Appendix 1). This includes a number of PCE endemics, but constitutes all Red List species as well as other species for which there could be conservation concern. According to Provincial Ordinances there are also a number of protected species that may occur in grasslands as well as medicinal species that may not appear on either of these two lists. There is therefore a high probability of encountering species of special concern within the grasslands of this alignment.

Increased runoff will occur as a result of the new pavement area and is likely to lead to erosion problems in this high rainfall area. This is especially problematic for the areas of marsh wetland along this alignment.

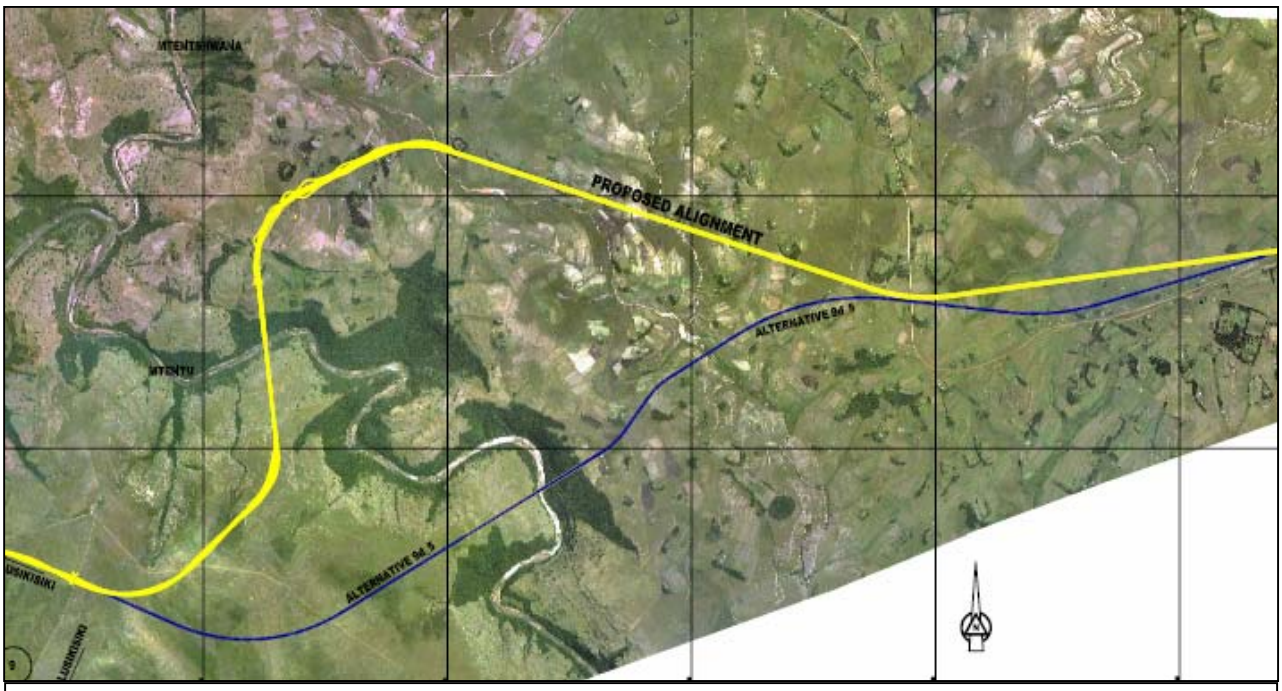

Figure 15: Alternative alignments at Mthentu River (Alternative 9e is the SANRAL preferred route).

Invasion by alien plants is potentially serious due to the high levels of invasion in similar disturbed habitats nearby and the fact that the invasion is almost certain to occur in the absence of any control measures. Alien plants are known to invade forests up to 150 m from the margin adjacent to disturbance and have been observed up to 100 m away in grasslands in the greenfields area. This indicates that approximately 82 ha of additional habitat (100 m on each side of the road for 4.1 km) may be altered adjacent to the road over and above that lost directly to the construction of the road. This compares to 84 ha for the SANRAL preferred alignment to cover the same stretch of landscape.

There are five impacts that are assessed as medium, namely "fragmentation of habitat", "strip development", "disruption of the flow of nutrients and materials", "increased accessibility to remote habitats" and "reduction in the resilience/stability of ecosystems". These are all local scale, long-term impacts. (1) This alignment will result in local fragmentation due to the fact that it passes through untransformed areas of vegetation, but it is located very close to the boundary between the Msikaba sandstone and Karoo sediments, which thus excludes core untransformed areas within which it would be desirable to avoid fragmentation at a more regional scale. (2) Increased development along this route is likely due to the existing settlements along the Mkambati/Holy Cross road and the intended provision of an intersection along this section of road. This applies to this alternative as well as the SANRAL preferred alignment. (3) The disruption of natural landscape flow of nutrients and materials will occur due to this alignment (and the SANRAL preferred alignment) bisecting a variety of landscape forms, including some marsh wetland areas. (4) The resilience/stability of these grasslands will be impaired by the direct loss of habitat, some fragmentation, the introduction of alien species and the potential disruption of the flow of nutrients and materials through the landscape. (5) A road through this grassland area will make previously inaccessible areas marginally more accessible, especially for the removal of medicinal products and other species for which there may be horticultural interest. There is, however, an existing track from the Mkambati/Holy Cross road which makes this area already accessible. The current rates of harvesting of medicinal species in the area for muthi markets (mostly in Durban) has lead to the depletion of many species from the surrounds of existing settlements (Kepe 1997). An easy access road may accelerate this process.

Table 6.24: Assessment of potential impacts associated with the proposed construction of a road between Lusikisiki and Mthamvuna River (alternative 9d_5) and the SANRAL preferred alignment. All impacts are identical for the alternative and the preferred alignment.

ISSUE / IMPACT	PHASE	EXTENT	DURATION	INTENSITY	PROBABILITY	SIGNIFICANCE	STATUS	CONFIDENCE
WITHOUT MITIGATION								
Loss of habitat	Construction	local	permanent	high	definite	HIGH	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of biodiversity	Construction	local	long-term	high	probable	HIGH	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fragmentation of habitat	Construction	local	permanent	medium	definite	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of species of special concern	Construction	local	permanent	high	definite	HIGH	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased runoff	Construction	local	short-term	high	probable	LOW	negative	medium

& drainage, soil erosion, silt loads & sedimentation	Operation	local	long-term	high	probable	HIGH	negative	medium
Invasion by alien weeds & invader plants	Construction	local	long-term	low	probable	LOW	negative	high
	Operation	local	long-term	high	probable	HIGH	negative	high
Pollution at construction camps	Construction	Site	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased risk of veld fires	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Vehicular pollution of soil, air or water	Construction	local	short-term	low	improbable	VERY LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium
Strip / ribbon development	Construction	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Increased accessibility of remote habitats	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Reduction in resilience/stability of ecosystems	Construction	local	long-term	medium	probable	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Disruption of the flow of nutrients and materials	Construction	local	long-term	medium	probable	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
WITH MITIGATION								
Loss of habitat	Construction	local	permanent	high	definite	HIGH	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of biodiversity	Construction	local	long-term	high	probable	HIGH	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fragmentation of habitat	Construction	local	permanent	medium	definite	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of species of special concern	Construction	local	permanent	medium	definite	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased runoff & drainage, soil erosion, silt loads & sedimentation	Construction	local	short-term	high	probable	LOW	negative	medium
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Invasion by alien weeds & invader plants	Construction	local	long-term	low	probable	LOW	negative	high
	Operation	local	long-term	low	probable	LOW	negative	high
Pollution at construction camps	Construction	Site	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased risk of veld fires	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Vehicular pollution of soil,	Construction	local	short-term	low	improbable	VERY LOW	negative	medium

air or water	Operation	local	long-term	low	probable	LOW	negative	medium
Strip development	Construction	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Increased accessibility of remote habitats	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Reduction in resilience/stability of ecosystems	Construction	local	long-term	medium	probable	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Disruption of the flow of nutrients and materials	Construction	local	long-term	low	probable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Mitigation objectives

Prevent or reduce loss of natural vegetation, prevent or reduce loss of biodiversity and species of special concern, reduce impact of additional runoff, and prevent the invasion and spread of alien weeds and invader plants. The secondary impacts of strip/ribbon development and accessibility to remote habitats are beyond the control of SANRAL.

Mitigation measures

- Minimise and restrict clearing to the area required for road construction purposes only and limit disturbance to adjacent undisturbed natural vegetation communities. Sensitive vegetation should be fenced off from the construction site to avoid impacts on these areas.
- Where destruction of vegetation is unavoidable, a botanical expert should identify any protected species at that site for which permits may be required for their destruction or removal.
- Revegetation of disturbed areas must be undertaken with site indigenous species. This can provide a buffer to protect indigenous vegetation from invasion by weeds.
- Structures such as bridges and culverts must be constructed in such a way as to minimise impacts on wetlands, streams and drainage areas.
- Protection of habitat through implementation of erosion and sediment control measures, including stormwater management and providing grassy channels at stormwater outlets.
- Ongoing monitoring and maintenance of revegetation works following commissioning of proposal.
- Appropriate locating of stockpiles, site offices and infrastructure, to limit damage to sensitive vegetation.
- Control alien plants in road reserve and in disturbed areas by implementing a weed control plan to avoid establishment and spread of weeds. The long-term measurable outcome will be the complete absence of alien plants.

Implementation of the recommended mitigation measures will reduce two impacts from high to medium significance, one impact from high to low significance and one impact from medium to low significance. The construction of the new section of road will, however, still result in impacts of medium or high significance, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat", "loss of species of special concern", "increased runoff", "strip development", "increased accessibility of remote habitats" and "reduction in resilience/stability of ecosystems".

6.3.6.5 New road alternative at Mnyameni River (alternative 10e)

Description of effect

The assessment of this alternative is given relative to the SANRAL preferred route and only for that section of the SANRAL preferred route that it replaces. This section of road is an alternative crossing alignment for the Mnyameni River gorge slightly south-east of the SANRAL preferred alignment (Figure 12). The proposed construction of this section of road will result in the loss of habitat, including habitats primarily associated with the Pondoland-Ugu Sandstone Coastal Sourveld vegetation type, along with the associated potential loss of biodiversity and potential loss of individuals of species of special concern as well as fragmentation of these habitats.

Assessment

The assessment of impacts both without and with mitigation measures is presented in Table 6.25 below. Pondoland-Ugu Sandstone Coastal Sourveld is considered to be Vulnerable and also forms one of the two primary habitats constituting the PCE. Impacts within this vegetation type therefore needs to be carefully controlled. Approximately 2.5 km south-west of the SANRAL preferred crossing of the Mnyameni River, this alignment runs parallel, crosses at an alternative position and then joins up to the SANRAL preferred alignment almost 2.5 km north-east of the crossing. This alternative crosses primarily grassland and rocky grassland. The impact assessment below applies to both the SANRAL preferred alignment and this alternative alignment (alternative 10e), with differences in the assessment of the impacts indicated, where necessary.

There are six impacts identified as having potentially high significance, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat", "loss of species of special concern", "increased runoff" and "invasion by alien species".

The proposed alignment will directly impact upon approximately 5.2 km of untransformed habitat in grassland within Pondoland-Ugu Sandstone Coastal Sourveld. Assuming an 80 m wide directly affected zone (the width of the road servitude), this equates to approximately 42 ha of habitat that will be directly lost due to construction of the road. The SANRAL preferred alignment for this same section is 5.4 km long which equates to approximately 43 ha of habitat. The two alignments are therefore very similar.

The main habitats along this alignment are grassland and rocky grassland. These contain naturally high levels of biodiversity which will be lost locally due to construction of this alignment. The SANRAL preferred alignment has a lower proportion of rocky grassland where high diversity resides and will therefore have a marginally lower impact on biodiversity.

This alignment will result in local fragmentation due to the fact that it passes through untransformed areas of vegetation. Local fragmentation will affect a large proportion of the rocky habitats through which this alignment passes.
Increased runoff will occur as a result of the new pavement area and is likely to lead to erosion problems in this high-rainfall area.

Invasion by alien plants is potentially serious due to the high levels of invasion in similar disturbed habitats nearby and the fact that the invasion is almost certain to occur in the absence of any control measures. Alien plants are known to invade forests up to 150 m from the margin adjacent to disturbance and have been observed up to 100 m away in grasslands in the greenfields area. This indicates that approximately 104 ha of additional habitat (100 m on each side of the road for 5.2 km) may be altered adjacent to the road over and above that lost

directly to the construction of the road. This compares to 106 ha for the SANRAL preferred alignment to cover the same stretch of landscape.

There are four impacts that are assessed as medium, namely "strip development", "disruption

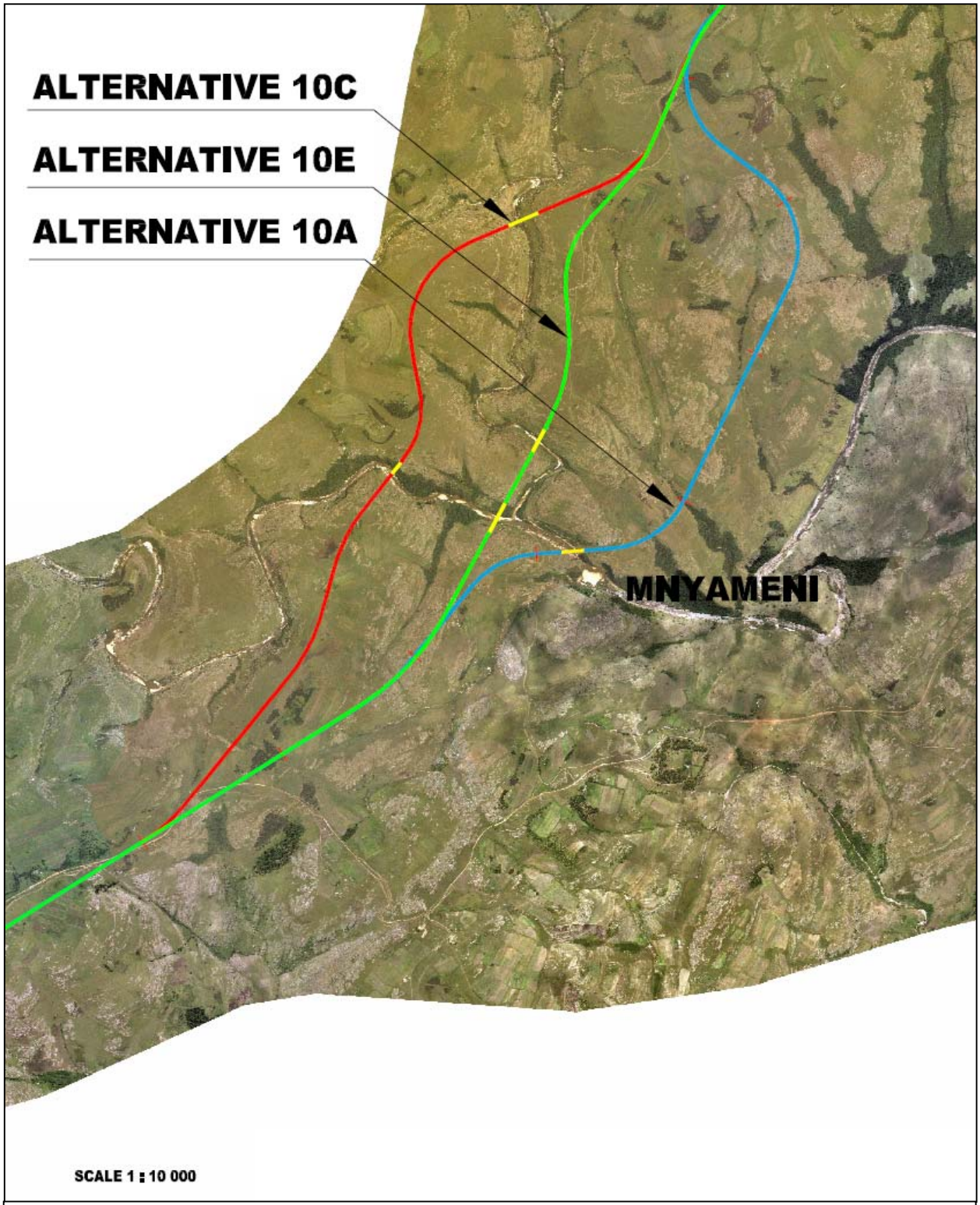

Figure 16: Alternative alignments at Mnyameni River (Alternative 10c is the SANRAL preferred route).

of the flow of nutrients and materials", "increased accessibility to remote habitats" and "reduction in the resilience/stability of ecosystems". These are all local scale, long-term impacts. (1) Increased development along this may occur due to the proximity of the intended intersection to the south-west of this section of road. This applies to this alternative as well as the SANRAL preferred alignment. (2) The disruption of natural landscape flow of nutrients and materials will occur due to this alignment (and the SANRAL preferred alignment) bisecting a variety of landscape forms. (3) The resilience/stability of these grasslands will be impaired by the direct loss of habitat, some fragmentation, the introduction of alien species and the potential disruption of the flow of nutrients and materials through the landscape. (4) A road through this grassland area will make previously inaccessible areas marginally more accessible, especially for the removal of medicinal products and other species for which there may be horticultural interest. The current rates of harvesting of medicinal species in the area for muthi markets (mostly in Durban) has lead to the depletion of many species from areas surrounding existing settlements (Kepe 1997). An easy access road may accelerate this process.

Table 6.25: Assessment of potential impacts associated with the proposed construction of a road between Lusikisiki and Mthamvuna River (alternative 10e), and the SANRAL preferred alignment.*

ISSUE / IMPACT	PHASE	EXTENT	DURATION	INTENSITY	PROBABILITY	SIGNIFICANCE	STATUS	CONFIDENCE
WITHOUT MITIGATION								
Loss of habitat	Construction	local	permanent	high /medium*	definite	HIGH /MEDIUM*	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of biodiversity	Construction	local	long-term	high /medium*	probable	HIGH /MEDIUM*	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fragmentation of habitat	Construction	local	permanent	high /medium*	definite	HIGH /MEDIUM*	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of species of special concern	Construction	local	permanent	high	definite	HIGH	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased runoff & drainage, soil erosion, silt loads & sedimentation	Construction	local	short-term	high	probable	LOW	negative	medium
	Operation	local	long-term	high	probable	HIGH	negative	medium
Invasion by alien weeds & invader plants	Construction	local	long-term	low	probable	LOW	negative	high
	Operation	local	long-term	high	probable	HIGH	negative	high
Pollution at construction camps	Construction	Site	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased risk of veld fires	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Vehicular pollution of soil, air or water	Construction	local	short-term	low	improbable	VERY LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium

Strip / ribbon development	Construction	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Operation	local	long-term	medium	improbable	MEDIUM	negative	medium
Increased accessibility of remote habitats	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Reduction in resilience/stability of ecosystems	Construction	local	long-term	medium	probable	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Disruption of the flow of nutrients and materials	Construction	local	long-term	medium	probable	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
WITH MITIGATION								
Loss of habitat	Construction	local	permanent	high /medium*	definite	HIGH /MEDIUM*	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of biodiversity	Construction	local	long-term	high /medium*	probable	HIGH /MEDIUM*	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fragmentation of habitat	Construction	local	permanent	high /medium*	definite	HIGH /MEDIUM*	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of species of special concern	Construction	local	permanent	medium	definite	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased runoff & drainage, soil erosion, silt loads & sedimentation	Construction	local	short-term	high	probable	LOW	negative	medium
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Invasion by alien weeds & invader plants	Construction	local	long-term	low	probable	LOW	negative	high
	Operation	local	long-term	low	probable	LOW	negative	high
Pollution at construction camps	Construction	Site	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased risk of veld fires	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Vehicular pollution of soil, air or water	Construction	local	short-term	low	improbable	VERY LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium
Strip development	Construction	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Increased accessibility of remote habitats	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Reduction in resilience/stability of ecosystems	Construction	local	long-term	medium	probable	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Disruption of the flow of nutrients and materials	Construction	local	long-term	low	probable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a

* Where two assessments are given, the second applies to the SANRAL preferred alignment for that section of the proposed road. If not, the assessment applies to both alternatives.

Mitigation objectives
Prevent or reduce loss of natural vegetation, prevent or reduce loss of biodiversity and species of special concern, reduce impact of additional runoff, and prevent the invasion and spread of alien weeds and invader plants. The secondary impacts of strip/ribbon development and accessibility to remote habitats are beyond the control of SANRAL.

Mitigation measures
- Minimise and restrict clearing to the area required for road construction purposes only and limit disturbance to adjacent undisturbed natural vegetation communities. Sensitive vegetation should be fenced off from the construction site to avoid impacts on these areas.
- Where destruction of vegetation is unavoidable, a botanical expert should identify any protected species at that site for which permits may be required for their destruction or removal.
- Revegetation of disturbed areas must be undertaken with site indigenous species. This can provide a buffer to protect indigenous vegetation from invasion by weeds.
- Structures such as bridges and culverts must be constructed in such a way as to minimise impacts on wetlands, streams and drainage areas.
- Protection of habitat through implementation of erosion and sediment control measures, including stormwater management and providing grassy channels at stormwater outlets.
- Ongoing monitoring and maintenance of revegetation works following commissioning of proposal.
- Appropriate locating of stockpiles, site offices and infrastructure, to limit damage to sensitive vegetation.
- Control alien plants in road reserve and in disturbed areas by implementing a weed control plan to avoid establishment and spread of weeds. The long-term measurable outcome will be the complete absence of alien plants.

Implementation of the recommended mitigation measures will reduce two impacts from high to medium significance, one impact from high to low significance and one impact from medium to low significance. The construction of the new section of road will, however, still result in impacts of medium or high significance, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat", "loss of species of special concern", "increased runoff", "strip development", "increased accessibility of remote habitats" and "reduction in resilience/stability of ecosystems".

6.3.6.6 New road alternative at Mnyameni River (alternative 10a)
Description of effect
The assessment of this alternative is given relative to the SANRAL preferred route and only for that section of the SANRAL preferred route that it replaces. This section of road is an alternative crossing alignment for the Mnyameni River gorge slightly south-east of the SANRAL preferred alignment (Figure 16). The proposed construction of this section of road will result in the loss of habitat, including habitats primarily associated with the Pondoland-Ugu Sandstone Coastal Sourveld vegetation type, along with the associated potential loss of biodiversity and potential loss of individuals of species of special concern as well as fragmentation of these habitats.

Assessment
The assessment of impacts both without and with mitigation measures is presented in Table 6.26 below. Pondoland-Ugu Sandstone Coastal Sourveld is considered to be Vulnerable and also forms one of the two primary habitats constituting the PCE. Impacts within this vegetation

type therefore needs to be carefully controlled. Approximately 2.5 km south-west of the SANRAL preferred crossing of the Mnyameni River, this alignment runs parallel, crosses at an alternative position and then joins up to the SANRAL preferred alignment almost 2.8 km north-east of the crossing. This alternative crosses primarily grassland and rocky grassland as well as the occasional forested gulley. The impact assessment below applies to both the SANRAL preferred alignment and this alternative alignment (alternative 10a), with differences in the assessment of the impacts indicated, where necessary.

There are six impacts identified as having potentially high significance, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat", "loss of species of special concern", "increased runoff" and "invasion by alien species".

The proposed alignment will directly impact upon approximately 7.0 km of untransformed habitat in grassland within Pondoland-Ugu Sandstone Coastal Sourveld. Assuming an 80 m wide directly affected zone (the width of the road servitude), this equates to approximately 56 ha of habitat that will be directly lost due to construction of the road. The SANRAL preferred alignment for this same section is 5.9 km long which equates to approximately 47 ha of habitat. The SANRAL preferred alignment therefore potentially affects marginally less habitat than alignment 10a.

The main habitats along this alignment are grassland and rocky grassland as well as some forested gulleys. These all contain naturally high levels of biodiversity which will be lost locally due to construction of this alignment. The SANRAL preferred alignment has a lower proportion of rocky grassland where high diversity resides and will therefore have a marginally lower impact on biodiversity.

This alignment will result in local fragmentation due to the fact that it passes through untransformed areas of vegetation. Local fragmentation will affect a large proportion of the rocky habitats through which this alignment passes.

There are 35 plant species of conservation importance occurring in grasslands within the Pondoland area (see Appendix 1). This includes a number of PCE endemics, but constitutes all Red List species as well as other species for which there could be conservation concern. According to Provincial Ordinances there are also a number of protected species that may occur in grasslands as well as medicinal species that may not appear on either of these two lists. There is therefore a high probability of encountering species of special concern within the grasslands of this alignment.

Increased runoff will occur as a result of the new pavement area and is likely to lead to erosion problems in this high-rainfall area.

Invasion by alien plants is potentially serious due to the high levels of invasion in similar disturbed habitats nearby and the fact that the invasion is almost certain to occur in the absence of any control measures. Alien plants are known to invade forests up to 150 m from the margin adjacent to disturbance and have been observed up to 100 m away in grasslands in the greenfields area. This indicates that approximately 140 ha of additional habitat (100 m on each side of the road for 5.2 km) may be altered adjacent to the road over and above that lost directly to the construction of the road. This compares to 118 ha for the SANRAL preferred alignment to cover the same stretch of landscape.

There are four impacts that are assessed as medium, namely "strip development", "disruption of the flow of nutrients and materials", "increased accessibility to remote habitats" and

"reduction in the resilience/stability of ecosystems". These are all local scale, long-term impacts. (1) Increased development along this may occur due to the proximity of the intended intersection to the south-west of this section of road. This applies to this alternative as well as the SANRAL preferred alignment. (2) The disruption of natural landscape flow of nutrients and materials will occur due to this alignment (and the SANRAL preferred alignment) bisecting a variety of landscape forms. (3) The resilience/stability of these grasslands will be impaired by the direct loss of habitat, some fragmentation, the introduction of alien species and the potential disruption of the flow of nutrients and materials through the landscape. (4) A road through this grassland area will make previously inaccessible areas marginally more accessible, especially for the removal of medicinal products and other species for which there may be horticultural interest. The current rates of harvesting of medicinal species in the area for muthi markets (mostly in Durban) has lead to the depletion of many species from areas near to existing settlements (Kepe 1997). An easy access road may accelerate this process.

Table 6.26: Assessment of potential impacts associated with the proposed construction of a road between Lusikisiki and Mthamvuna River (alternative 10a) and the SANRAL preferred alignment.*

ISSUE / IMPACT	PHASE	EXTENT	DURATION	INTENSITY	PROBABILITY	SIGNIFICANCE	STATUS	CONFIDENCE
WITHOUT MITIGATION								
Loss of habitat	Construction	local	permanent	high /medium*	definite	HIGH /MEDIUM*	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of biodiversity	Construction	local	long-term	high /medium*	probable	HIGH /MEDIUM*	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fragmentation of habitat	Construction	local	permanent	medium	definite	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of species of special concern	Construction	local	permanent	high	definite	HIGH	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased runoff & drainage, soil erosion, silt loads & sedimentation	Construction	local	short-term	high	probable	LOW	negative	medium
	Operation	local	long-term	high	probable	HIGH	negative	medium
Invasion by alien weeds & invader plants	Construction	local	long-term	low	probable	LOW	negative	high
	Operation	local	long-term	high	probable	HIGH	negative	high
Pollution at construction camps	Construction	Site	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased risk of veld fires	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Vehicular pollution of soil, air or water	Construction	local	short-term	low	improbable	VERY LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium
Strip / ribbon development	Construction	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium

Increased accessibility of remote habitats	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Reduction in resilience/stability of ecosystems	Construction	local	long-term	medium	probable	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Disruption of the flow of nutrients and materials	Construction	local	long-term	medium	probable	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
WITH MITIGATION								
Loss of habitat	Construction	local	permanent	high /medium*	definite	HIGH /MEDIUM*	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of biodiversity	Construction	local	long-term	high /medium*	probable	HIGH /MEDIUM*	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fragmentation of habitat	Construction	local	permanent	medium	definite	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of species of special concern	Construction	local	permanent	medium	definite	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased runoff & drainage, soil erosion, silt loads & sedimentation	Construction	local	short-term	high	probable	LOW	negative	medium
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Invasion by alien weeds & invader plants	Construction	local	long-term	low	probable	LOW	negative	high
	Operation	local	long-term	low	probable	LOW	negative	high
Pollution at construction camps	Construction	Site	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased risk of veld fires	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Vehicular pollution of soil, air or water	Construction	local	short-term	low	improbable	VERY LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium
Strip development	Construction	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Increased accessibility of remote habitats	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Reduction in resilience/stability of ecosystems	Construction	local	long-term	medium	probable	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Disruption of the flow of nutrients and materials	Construction	local	long-term	low	probable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a

* Where two assessments are given, the second applies to the SANRAL preferred alignment for that section of the proposed road. If not, the assessment applies to both alternatives.

Mitigation objectives
Prevent or reduce loss of natural vegetation, prevent or reduce loss of biodiversity and species of special concern, reduce impact of additional runoff, and prevent the invasion and spread of alien weeds and invader plants. The secondary impacts of strip/ribbon development and accessibility to remote habitats are beyond the control of SANRAL.

Mitigation measures
- Minimise and restrict clearing to the area required for road construction purposes only and limit disturbance to adjacent undisturbed natural vegetation communities. Sensitive vegetation should be fenced off from the construction site to avoid impacts on these areas.
- Where destruction of vegetation is unavoidable, a botanical expert should identify any protected species at that site for which permits may be required for their destruction or removal.
- Revegetation of disturbed areas must be undertaken with site indigenous species. This can provide a buffer to protect indigenous vegetation from invasion by weeds.
- Structures such as bridges and culverts must be constructed in such a way as to minimise impacts on wetlands, streams and drainage areas.
- Protection of habitat through implementation of erosion and sediment control measures, including stormwater management and providing grassy channels at stormwater outlets.
- Ongoing monitoring and maintenance of revegetation works following commissioning of proposal.
- Appropriate locating of stockpiles, site offices and infrastructure, to limit damage to sensitive vegetation.
- Control alien plants in road reserve and in disturbed areas by implementing a weed control plan to avoid establishment and spread of weeds. The long-term measurable outcome will be the complete absence of alien plants.

Implementation of the recommended mitigation measures will reduce two impacts from high to medium significance, one impact from high to low significance and one impact from medium to low significance. The construction of the new section of road will, however, still result in impacts of medium or high significance, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat", "loss of species of special concern", "increased runoff", "strip development", "increased accessibility of remote habitats" and "reduction in resilience/stability of ecosystems".

6.3.6.7 Coastal Mzamba new road alternative
Description of effect
The assessment of this alternative is given relative to the SANRAL preferred route and only for that section of the SANRAL preferred route that it replaces. This section of road is a more inland route of the section between the Mtentu and Mthamvuna Rivers following an alignment closer to the Mzamba River (Figure 17). The Coastal Mzamba route is 29.3 km long compared to 29.0 km for the SANRAL preferred alignment to cover the same section of route. For both options, large portions of the route are in a part of the PCE that has been heavily impacted by rural agriculture and only fragments of natural habitat still remain. The proposed construction of this section of road will, however, still result in the loss of habitat, including habitats primarily associated with the Pondoland-Ugu Sandstone Coastal Sourveld vegetation type, but also wetlands and stream crossings, along with the associated potential loss of biodiversity and potential loss of individuals of species of special concern as well as fragmentation of these remaining habitats.

Assessment
The assessment of impacts both without and with mitigation measures is presented in Table 6.27 below. From the northern side of the Mtentu River gorge this alignment travels approximately north-east until it almost reaches the Mzamba River. From here it curves around to head east to south-east until near the Mzamba River mouth, where it joins the SANRAL preferred alignment and crosses to the bridge at the Mthamvuna River. Approximately 9 km of the 29 km is in areas that have not been previously cultivated. This is compared to approximately 8.5 km of untransformed landscape for the SANRAL preferred alignment to cover the same section of route.

The main habitats crossed along this alignment are grasslands, wetlands and gorges with thicket, forest, scrub and gorge grassland. The grassland is in the Pondoland-Ugu Sandstone Coastal Sourveld vegetation type, which is considered to be Vulnerable and also forms one of the two primary habitats constituting the PCE. Impacts within this vegetation type therefore needs to be carefully controlled. Wetlands are vulnerable from a functional point of view and also need to be protected as much as possible.

There are two impacts assessed as having potentially very high significance, namely "fragmentation of habitat" and "disruption of the flow of nutrients and materials". This alignment will result in local fragmentation due to the fact that it passes through

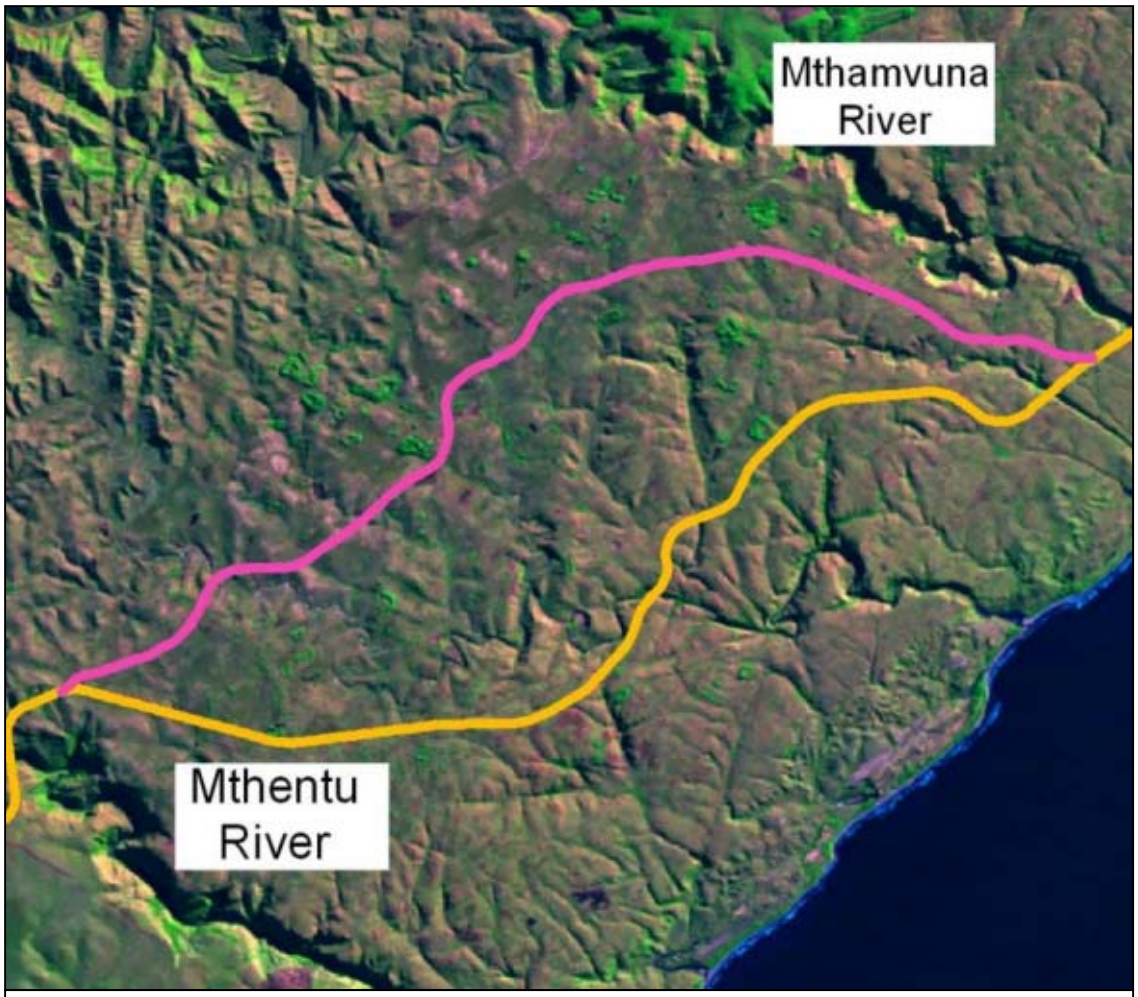

Figure 17: Proposed Coastal Mzamba alternative alignment between the Mthentu and Mthamvuna Rivers shown in pink.

untransformed areas of vegetation, especially a number of wetlands which are sensitive to being fragmented. Any fragmentation of the wetlands will lead to potentially disastrous impacts on various components of the functioning of these wetlands and could change the entire hydrology of the catchment. At a regional scale, fragmentation is less of an issue due to the already fragmented and transformed condition of much of the vegetation along this alignment and the fact that it is relatively close to the boundary of the PCE.

The disruption of natural landscape flow of nutrients and materials will occur due to this alignment (and the SANRAL preferred alignment) bisecting a variety of landscape forms, including a large number of marsh wetland and sandy stream areas. Road infrastructure in the wetlands will result in major changes to the flow of water, sediment and nutrients through the landscape and may result in pooling on the upstream side and erosion and fast flows on the downstream side.

There are three impacts identified as having potentially high significance, namely "increased runoff", "invasion by alien species" and "reduction in the resilience/stability of ecosystems".

Increased runoff will occur as a result of the new pavement area and is likely to lead to erosion problems in this high-rainfall area. This is especially problematic for the areas of marsh wetland and sandy bottom streams along this alignment. This is also partially true of the SANRAL preferred alignment, but the wetlands there tend to be narrower and more of the rocky bottom type.

Invasion by alien plants is potentially serious due to the high levels of invasion in similar disturbed habitats nearby and the fact that the invasion is almost certain to occur in the absence of any control measures. Alien plants are known to invade forests up to 150 m from the margin adjacent to disturbance and have been observed up to 100 m away in grasslands in the greenfields area. The wetlands and streams are especially vulnerable since aliens can spread easily downstream. There are also aliens present abundantly along this route, which makes the potential for spreading even greater.

The resilience/stability of the grasslands and wetlands will be impaired by the direct loss of habitat, some fragmentation, the introduction of alien species and the potential disruption of the flow of nutrients and materials through the landscape. This is especially problematic for the wetlands, which are especially vulnerable to disturbance and fragmentation by major infrastructure such as a road

There are five impacts that are assessed as medium, namely "loss of habitat", "loss of biodiversity", "loss of species of special concern", "strip development" and "increased accessibility to remote habitats". These are all local scale, long-term impacts.

The proposed Coastal Mzamba alignment will directly impact upon approximately 9.0 km of untransformed habitat in grassland and wetlands within Pondoland-Ugu Sandstone Coastal Sourveld. Assuming an 80 m wide directly affected zone (the width of the road servitude), this equates to approximately 72 ha of habitat that will be directly lost due to construction of the road. The SANRAL preferred alignment for this same section has 8.5 km of untransformed habitat which equates to approximately 68 ha. The two alignments are therefore very similar.

There are a variety of habitats along this alignment, including some grassland and rocky grassland (especially near the Mzamba River), but mostly wetland-related habitat. Some of these contain naturally high levels of biodiversity or species that are restricted to these habitats which will be lost locally due to construction of this alignment.

There are 35 plant species of conservation importance occurring in grasslands within the Pondoland area (see Appendix 1). This includes a number of PCE endemics, but constitutes all Red List species as well as other species for which there could be conservation concern. According to Provincial Ordinances there are also a number of protected species that may occur in grasslands as well as medicinal species that may not appear on either of these two lists. Due to the limited area of grassland remaining, there is a medium probability of encountering species of special concern within the grasslands of this alignment. Many of the threatened species in the study area are restricted to wetland habitats, which are common along this alignment.

Increased development along parts of this route is likely due to the existing settlements along the Amadiba road and near the Mzamba River and the intended provision of an intersection along this section of road. This applies to this alternative as well as the SANRAL preferred alignment.

A road through this grassland area will make previously inaccessible areas marginally more accessible, especially for the removal of medicinal products and other species for which there may be horticultural interest. There is, however, an existing road which makes this area already accessible. The current rates of harvesting of medicinal species in the area for muthi markets (mostly in Durban) has lead to the depletion of many species from areas surrounding existing settlements (Kepe 1997). An easy access road may accelerate this process.

Table 6.27: Assessment of potential impacts associated with the proposed construction of a road between Lusikisiki and Mthamvuna River (Coastal Mzamba alignment) and the SANRAL preferred alignment.*

ISSUE / IMPACT	PHASE	EXTENT	DURATION	INTENSITY	PROBABILITY	SIGNIFICANCE	STATUS	CONFIDENCE
WITHOUT MITIGATION								
Loss of habitat	Construction	regional /local*	permanent	high /medium*	definite	VERY HIGH /MEDIUM*	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of biodiversity	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fragmentation of habitat	Construction	regional /local*	permanent	high /medium*	definite	VERY HIGH /MEDIUM*	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of species of special concern	Construction	local	permanent	medium	definite	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased runoff & drainage, soil erosion, silt loads & sedimentation	Construction	local	short-term	high /medium*	probable	LOW /VERY LOW*	negative	medium
	Operation	local	long-term	high /medium*	probable	HIGH /MEDIUM*	negative	medium
Invasion by alien	Construction	local	long-term	low	probable	LOW	negative	high

weeds & invader plants	Operation	local	long-term	high	probable	HIGH	negative	high
Pollution at construction camps	Construction	Site	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased risk of veld fires	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Vehicular pollution of soil, air or water	Construction	local	short-term	low	improbable	VERY LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium
Strip / ribbon development	Construction	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Increased accessibility of remote habitats	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Reduction in resilience/stability of ecosystems	Construction	local	long-term	high /medium*	probable	HIGH /MEDIUM*	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Disruption of the flow of nutrients and materials	Construction	regional	long-term	high /medium*	probable	VERY HIGH /HIGH*	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
WITH MITIGATION								
Loss of habitat	Construction	regional /local*	permanent	medium /low*	definite	HIGH /LOW*	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of biodiversity	Construction	local	long-term	low	probable	LOW	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fragmentation of habitat	Construction	regional	permanent	medium	definite	HIGH	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of species of special concern	Construction	local	permanent	low	definite	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased runoff & drainage, soil erosion, silt loads & sedimentation	Construction	local	short-term	high /medium*	probable	LOW /VERY LOW*	negative	medium
	Operation	local	long-term	medium /low*	probable	MEDIUM /LOW*	negative	medium
Invasion by alien weeds & invader plants	Construction	local	long-term	low	probable	LOW	negative	high
	Operation	local	long-term	low	probable	LOW	negative	high
Pollution at construction camps	Construction	Site	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased risk of veld fires	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Vehicular pollution of soil, air or water	Construction	local	short-term	low	improbable	VERY LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium
Strip development	Construction	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium

Increased accessibility of remote habitats	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Reduction in resilience/stability of ecosystems	Construction	local	long-term	medium /low*	probable	MEDIUM /LOW*	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Disruption of the flow of nutrients and materials	Construction	regional	long-term	medium /low*	probable	MEDIUM /LOW*	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a

*Where two assessments are given, the second applies to the SANRAL preferred alignment for that section of the proposed road. If not, the assessment applies to both alternatives.

Mitigation objectives

The most important impact to avoid is the fragmentation of habitat, especially the large number of wetlands present along this route. Further mitigation objectives include: prevent or reduce loss of natural vegetation, prevent or reduce loss of biodiversity and species of special concern, reduce impact of additional runoff, and prevent the invasion and spread of alien weeds and invader plants. The secondary impacts of strip/ribbon development and accessibility to remote habitats are beyond the control of SANRAL.

Mitigation measures

- Structures such as bridges and culverts must be constructed in such a way as to minimise impacts on wetlands, streams and drainage areas. For this alignment, it may require viaduct-like structures to cross the wide wetland areas. Filling of wetlands for road construction purposes would result in potentially very high impacts that would result in the complete alteration of the functioning of these wetlands.
- Protection of habitat through implementation of erosion and sediment control measures, including stormwater management and providing grassy channels at stormwater outlets.
- Revegetation of disturbed areas must be undertaken with site indigenous species. This can provide a buffer to protect indigenous vegetation from invasion by weeds.
- Control alien plants in road reserve and in disturbed areas by implementing a weed control plan to avoid establishment and spread of weeds. The long-term measurable outcome will be the complete absence of alien plants.
- Minimise and restrict clearing to the area required for road construction purposes only and limit disturbance to adjacent undisturbed natural vegetation communities. Sensitive vegetation should be fenced off from the construction site to avoid impacts on these areas.
- Where destruction of vegetation is unavoidable, a botanical expert should identify any protected species at that site for which permits may be required for their destruction or removal.
- Ongoing monitoring and maintenance of revegetation works following commissioning of proposal.
- Appropriate locating of stockpiles, site offices and infrastructure, to limit damage to sensitive vegetation.

Implementation of the recommended mitigation measures will reduce two impacts from medium to low significance, one impact from high to low significance and one impact from high to medium significance. There are also three impacts classified as having very high significance, two of which can be reduced to high and the other to medium significance with the application of mitigation measures. The construction of the new section of road will, however, still result in impacts of medium or high significance, namely "loss of habitat", "fragmentation

of habitat", "loss of species of special concern", "increased runoff", "strip development", "increased accessibility of remote habitats" and "disruption of the flow of nutrients and materials".

6.3.6.8 New bridge over the Msikaba River

Description of effect

The new high-level bridge over the Msikaba River may affect vegetation along lip of the gorge and the steep slopes down from there. This construction may result in some direct loss of habitat or impacts on ecological processes associated with the gorge habitat. A previous study (CES 2004) provides a detailed study of the impacts of the bridge at this site and must also be referred to.

Assessment

The assessment of impacts both without and with mitigation measures is presented in Table 6.28 below. The proposed bridge crosses at a narrowing of the gorge with vertical faces dropping to forested areas on the banks of the river below.

There are four impacts identified as having potentially high significance, namely "loss of species of special concern", "increased runoff", "invasion by alien species" and "increased accessibility of remote habitats".

There are 35 plant species of conservation importance occurring in grasslands and 38 in forests within the Pondoland area (see Appendix 1). This includes a number of PCE endemics, but constitutes all Red List species as well as other species for which there could be conservation concern. According to Provincial Ordinances there are also a number of protected species that may occur in grasslands and forests as well as medicinal species that may not appear on either of these two lists. Due to the fact that the site of the bridge contains a variety of grassland and forest habitats, there is a high probability of encountering species of special concern at this site. A previous study of this bridge site (CES 2004) encountered at least 15 protected plant species.

Increased runoff will occur as a result of the new pavement and bridge area and is likely to lead to erosion problems in this high-rainfall area.

Invasion by alien plants is potentially serious due to the high levels of invasion in similar disturbed habitats nearby and the fact that the invasion is almost certain to occur in the absence of any control measures. Alien plants are known to invade forests up to 150 m from the margin adjacent to disturbance and have been observed up to 100 m away in grasslands in the greenfields area. The forests are especially vulnerable since aliens can spread easily downslope from the sides of the bridge.

A road through this area will make previously inaccessible areas marginally more accessible, especially for the removal of medicinal products and other species for which there may be horticultural interest. There is, however, an existing road nearby which makes this area already accessible to some degree. The current rates of harvesting of medicinal species in the area for muthi markets (mostly in Durban) have depleted many species from areas near to existing settlements (Kepe 1997). An easy access road may accelerate this process. The gorges are home to a number of species that may be of horticultural interest, e.g. cycads, and this road and bridge will provide easier access to these.

There are four impacts that are assessed as medium, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat" and "reduction in resilience/stability of ecosystems". These are all local scale, long-term impacts.

The main habitats at the site of this bridge are grassland, rocky grassland and forest in the gorge. These contain naturally high levels of biodiversity or a species composition which is unique to that habitat. These will be lost locally due to construction of this bridge.

Construction of the bridge will potentially result in local fragmentation due to the fact that it passes through untransformed areas of vegetation. The construction of the bridge is not, however, expected to impact on the forest in the gorge to any major degree unless secondary impacts result in localised loss of forest. If this were to be severe it could result in a break in the forest that may result in fragmentation of this habitat.

The resilience/stability of the grasslands and forests could potentially be impaired by the direct loss of habitat, some fragmentation, the introduction of alien species and the potential disruption of the flow of nutrients and materials through the landscape.

Table 6.28: Assessment of potential impacts associated with the proposed construction of a new high-level bridge over the Msikaba River

ISSUE / IMPACT	PHASE	EXTENT	DURATION	INTENSITY	PROBABILITY	SIGNIFICANCE	STATUS	CONFIDENCE
WITHOUT MITIGATION								
Loss of habitat	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of biodiversity	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fragmentation of habitat	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of species of special concern	Construction	local	permanent	high	definite	HIGH	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased runoff & drainage, soil erosion, silt loads & sedimentation	Construction	local	short-term	medium	probable	VERY LOW	negative	medium
	Operation	local	long-term	high	probable	HIGH	negative	medium
Invasion by alien weeds & invader plants	Construction	local	long-term	low	probable	LOW	negative	high
	Operation	local	long-term	high	probable	HIGH	negative	high
Increased accessibility of remote habitats	Construction	local	short-term	high	probable	LOW	negative	medium
	Operation	local	long-term	high	probable	HIGH	negative	medium
Reduction in resilience/stability of ecosystems	Construction	local	long-term	medium	improbable	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Disruption of the flow of nutrients and materials	Construction	local	long-term	low	probable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
WITH MITIGATION								

Loss of habitat	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of biodiversity	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fragmentation of habitat	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of species of special concern	Construction	local	permanent	medium	definite	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased runoff & drainage, soil erosion, silt loads & sedimentation	Construction	local	short-term	medium	probable	VERY LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium
Invasion by alien weeds & invader plants	Construction	local	long-term	low	probable	LOW	negative	high
	Operation	local	long-term	low	probable	LOW	negative	high
Increased accessibility of remote habitats	Construction	local	short-term	high	probable	LOW	negative	medium
	Operation	local	long-term	high	probable	HIGH	negative	medium
Reduction in resilience/stability of ecosystems	Construction	local	long-term	low	improbable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Disruption of the flow of nutrients and materials	Construction	local	long-term	low	probable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Mitigation objectives

Prevent or reduce loss of sensitive natural vegetation, biodiversity and species of special concern, prevent the invasion and spread of alien weeds and invader plants, reduce impact of additional runoff and prevent fragmentation of habitat. The secondary impact of accessibility to remote habitats is possibly beyond the control of SANRAL.

Mitigation measures

- Minimise and restrict clearing to the area required for road construction purposes only and limit disturbance to adjacent undisturbed natural vegetation communities. Sensitive areas must be defined and all efforts made to avoid construction activities within these areas.
- Where destruction of vegetation is unavoidable, a botanical expert should identify any protected species at that site for which permits may be required for destruction or removal. In addition, plant search-and-rescue operations should be undertaken prior to clearing of natural vegetation classified as sensitive or species-rich.
- Revegetation of disturbed areas must be undertaken with site indigenous species and should be scheduled to take place as soon after construction as possible to avoid invasion by alien plants. This can provide a buffer to protect indigenous vegetation from invasion by weeds. Indigenous species may be those previously reduced during clearing of vegetation prior to construction.
- Protection of habitat through implementation of erosion and sediment control measures, including stormwater management.
- Control alien plants in the road reserve, in areas around the bridge and in any other disturbed areas by implementing a weed control plan to avoid establishment and spread of weeds. The long-term measurable outcome will be the complete absence of alien plants.

- Slopes must be stable or stabilised to prevent collapsing.
- Bridges must be designed and constructed in such a way as to minimise impacts on riparian areas. The high-level construction proposed for this bridge will satisfy this requirement, but construction impacts must also be minimised.
- Ensure design of bridge does not accommodate direct pedestrian access to the gorge.
- Approach roads must be designed and constructed to drain towards naturally wet areas to avoid impeded flow of water over the landscape.
- Ongoing monitoring and maintenance of revegetation works following commissioning of proposal.

Implementation of the recommended mitigation measures will reduce two impacts from high to low significance, one impact from medium to low significance and one impact from high to medium significance. The construction of the bridge will, however, still result in impacts of medium or high significance, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat", "loss of species of special concern" and "increased accessibility of remote habitats".

6.3.6.9 New bridge over the Mthentu River

Description of effect

The new high-level bridge over the Mthentu River may affect vegetation along lip of the gorge and the steep slopes down from there. This construction may result in some direct loss of habitat or impacts on ecological processes associated with the gorge habitat. A previous study (CES 2004b) provides a detailed study of the impacts of the bridge at this site and must also be referred to.

Assessment

The assessment of impacts both without and with mitigation measures is presented in Table 6.29 below. The proposed bridge crosses at a relatively wide part of the gorge, but at a point where there is an initial drop followed by a second steeper drop with vertical faces dropping to forested areas on the banks of the river below.

There are seven impacts identified as having potentially high significance, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat", "loss of species of special concern", "increased runoff", "invasion by alien species" and "increased accessibility of remote habitats".

The main habitats at the site of this bridge are grassland, rocky grassland and forest in the gorge. These contain naturally high levels of biodiversity or a species composition which is unique to that habitat. These will be lost locally due to construction of this bridge and the supporting pylons.

Construction of the bridge will potentially result in local fragmentation due to the fact that it passes through untransformed areas of vegetation. The construction of the bridge is not, however, expected to impact on the forest in the gorge to any major degree unless secondary impacts result in localised loss of forest. If this were to be severe it could result in a break in the forest that may result in fragmentation of this habitat.

There are 35 plant species of conservation importance occurring in grasslands and 38 in forests within the Pondoland area (see Appendix 1). This includes a number of PCE endemics, but constitutes all Red List species as well as other species for which there could be conservation concern. According to Provincial Ordinances there are also a number of protected species that may occur in grasslands and forests as well as medicinal species that may not appear on either of these two lists. Due to the fact that the site of the bridge contains a variety of grassland and forest habitats, there is a high probability of encountering species of special concern at this

site. A previous study of this bridge site (CES 2004) encountered at least 29 species of special concern in a single survey.

Increased runoff will occur as a result of the new pavement and bridge area and is likely to lead to erosion problems in this high-rainfall area. This is most likely to affect the steep slopes with grassland before the main gorge.

Invasion by alien plants is potentially serious due to the high levels of invasion in similar disturbed habitats nearby and the fact that the invasion is almost certain to occur in the absence of any control measures. Alien plants are known to invade forests up to 150 m from the margin adjacent to disturbance and have been observed up to 100 m away in grasslands in the greenfields area. The forests are especially vulnerable since aliens can spread easily downslope from the sides of the bridge.

A road through this area will make previously inaccessible areas marginally more accessible, especially for the removal of medicinal products and other species for which there may be horticultural interest. There is, however, an existing road nearby which makes this area already accessible to some degree. The current rates of harvesting of medicinal species in the area for muthi markets (mostly in Durban) has lead to the depletion of many species from areas near to existing settlements (Kepe 1997). An easy access road may accelerate this process. The gorges are home to a number of species that may be of horticultural interest, e.g. cycads, and this road and bridge will provide easier access to these.

There is one impact that is assessed as medium, namely and "reduction in resilience/stability of ecosystems". The resilience/stability of the grasslands and forests could potentially be impaired by direct loss of habitat, some fragmentation, introduction of alien species and the potential increase in runoff through the landscape.

Table 6.29: Assessment of potential impacts associated with the proposed construction of a new high-level bridge over the Mthentu River

ISSUE / IMPACT	PHASE	EXTENT	DURATION	INTENSITY	PROBABILITY	SIGNIFICANCE	STATUS	CONFIDENCE
WITHOUT MITIGATION								
Loss of habitat	Construction	local	long-term	high	probable	HIGH	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of biodiversity	Construction	local	long-term	high	probable	HIGH	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fragmentation of habitat	Construction	local	long-term	high	probable	HIGH	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of species of special concern	Construction	local	permanent	high	definite	HIGH	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased runoff & drainage, soil erosion, silt loads & sedimentation	Construction	local	short-term	medium	probable	VERY LOW	negative	medium
	Operation	local	long-term	high	probable	HIGH	negative	medium
Invasion by alien weeds & invader plants	Construction	local	long-term	low	probable	LOW	negative	high
	Operation	local	long-term	high	probable	HIGH	negative	high

Increased risk of veld fires	Construction	local	short-term	medium	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased accessibility of remote habitats	Construction	local	short-term	high	probable	LOW	negative	medium
	Operation	local	long-term	high	probable	HIGH	negative	medium
Reduction in resilience/stability of ecosystems	Construction	local	long-term	medium	improbable	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Disruption of the flow of nutrients and materials	Construction	local	long-term	low	probable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
WITH MITIGATION								
Loss of habitat	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of biodiversity	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fragmentation of habitat	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of species of special concern	Construction	local	permanent	medium	definite	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased runoff & drainage, soil erosion, silt loads & sedimentation	Construction	local	short-term	medium	probable	VERY LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium
Invasion by alien weeds & invader plants	Construction	local	long-term	low	probable	LOW	negative	high
	Operation	local	long-term	low	probable	LOW	negative	high
Increased risk of veld fires	Construction	local	short-term	medium	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased accessibility of remote habitats	Construction	local	short-term	high	probable	LOW	negative	medium
	Operation	local	long-term	high	probable	HIGH	negative	medium
Reduction in resilience/stability of ecosystems	Construction	local	long-term	low	improbable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Disruption of the flow of nutrients and materials	Construction	local	long-term	low	probable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Mitigation objectives

Prevent or reduce loss of sensitive natural vegetation, biodiversity and species of special concern, prevent the invasion and spread of alien weeds and invader plants, reduce impact of additional runoff and prevent fragmentation of habitat. The secondary impact of accessibility to remote habitats is possibly beyond the control of SANRAL.

Mitigation measures

- Minimise and restrict clearing to the area required for road construction purposes only and limit disturbance to adjacent undisturbed natural vegetation communities. Sensitive

areas must be defined and all efforts made to avoid construction activities within these areas.
- Where destruction of vegetation is unavoidable, a botanical expert should identify any protected species at that site for which permits may be required for destruction or removal. In addition, plant search-and-rescue operations should be undertaken prior to clearing of natural vegetation classified as sensitive or species-rich.
- Revegetation of disturbed areas must be undertaken with site indigenous species and should be scheduled to take place as soon after construction as possible to avoid invasion by alien plants. This can provide a buffer to protect indigenous vegetation from invasion by weeds. Indigenous species may be those previously reduced during clearing of vegetation prior to construction.
- Protection of habitat through implementation of erosion and sediment control measures, including stormwater management.
- Control alien plants in the road reserve, in areas around the bridge and in any other disturbed areas by implementing a weed control plan to avoid establishment and spread of weeds. The long-term measurable outcome will be the complete absence of alien plants.
- Slopes must be stable or stabilised to prevent collapsing.
- Bridges must be designed and constructed in such a way as to minimise impacts on riparian areas. The high-level construction proposed for this bridge will satisfy this requirement, but construction impacts must also be minimised.
- Ensure design of bridge does not accommodate direct pedestrian access to the gorge.
- Approach roads must be designed and constructed to drain towards naturally wet areas to avoid impeded flow of water over the landscape.
- Ongoing monitoring and maintenance of revegetation works following commissioning of proposal.

Implementation of the recommended mitigation measures will reduce four impacts from high to medium significance, one impact from medium to low significance and two impacts from high to low significance. The construction of the bridge will, however, still result in impacts of medium or high significance, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat", "loss of species of special concern" and "increased accessibility of remote habitats".

6.3.6.10 New bridge over the Kwadlambu River

Description of effect

The new bridge over the Kwadlambu River will affect marsh wetland and riparian vegetation. This construction may result in some direct loss of habitat or impacts on ecological processes associated with the wetland habitat.

Assessment

The assessment of impacts both without and with mitigation measures is presented in Table 6.30 below. The proposed bridge crosses a shallow drainage area with a stream channel in the middle. The vegetation on each side is almost entirely transformed by cultivation and alien trees. The marsh wetland in the drainage channel has also been cultivated in places, but the drainage system is geomorphologically intact. The construction of a bridge at this site is likely to lead to increased canalisation and concentration of water flow that may lead to general damage to the wetland system and possibly to further long-term degradation of downstream areas and could thus result in further loss of habitat.

There are seven impacts identified as having potentially high significance, namely "loss of habitat", "fragmentation of habitat", "loss of species of special concern", "increased runoff",

"invasion by alien species", "reduction in resilience/stability of ecosystems" and "disruption of the flow of nutrients and materials".

The main habitats at this site are marsh wetland along with the stream channel and associated habitat. The marsh wetland is a habitat type with a relatively small area within the PCE and many of the species found in this habitat are restricted entirely to it. The habitat contains moderately high levels of biodiversity which will be lost locally due to construction of this bridge.

Construction of the bridge will potentially result in local fragmentation due to the fact that it passes perpendicularly across the habitat. If this results in the local loss of habitat it could also fragment the habitat in such a way as to locally separate upstream and downstream areas entirely from one another. This may be aggravated by downstream erosion due to constriction of water flow at the bridge site.

There are 14 plant species of conservation importance occurring in wetlands and marshy areas within the Pondoland area (see Appendix 1). This includes a number of PCE endemics, but constitutes all Red List species as well as other species for which there is conservation concern. According to Provincial Ordinances there are also a number of protected species that may occur in wetlands as well as medicinal species. Due to the fact that the site of the bridge contains wetland habitats, there is a high probability of encountering species of special concern at this site.

Increased runoff will occur as a result of the new pavement and bridge area and is likely to lead to erosion problems in this high-rainfall area. This is likely to aggravate any water-flow problems under the bridge.

Invasion by alien plants is potentially serious due to the high levels of invasion in similar disturbed habitats nearby and the fact that the invasion is almost certain to occur in the absence of any control measures. Alien plants are known to invade forests up to 150 m from the margin adjacent to disturbance and have been observed up to 100 m away in grasslands in the greenfields area. The wetlands are especially vulnerable since aliens can spread easily downstream from existing invasions. There are already serious invasions in wetlands in this area.

The resilience/stability of the wetlands could potentially be impaired by the direct loss of habitat, some fragmentation, the introduction of alien species and the potential disruption of the flow of nutrients and materials through the landscape.

The disruption of natural landscape flow of nutrients and materials will occur due to the construction of this bridge bisecting the wetlands. Road infrastructure in the wetlands will result in potentially major changes to the flow of water, sediment and nutrients through the landscape and may result in pooling on the upstream side and erosion and fast flows on the downstream side, depending on the design of the bridge.

Table 6.30: Assessment of potential impacts associated with the proposed construction of a new high-level bridge over the Kwadlambu River

ISSUE / IMPACT	PHASE	EXTENT	DURATION	INTENSITY	PROBABILITY	SIGNIFICANCE	STATUS	CONFIDENCE
WITHOUT MITIGATION								
Loss of habitat	Construction	local	long-term	high	definite	HIGH	negative	high
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Loss of biodiversity	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fragmentation of habitat	Construction	local	long-term	high	probable	HIGH	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of species of special concern	Construction	local	permanent	high	definite	HIGH	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased runoff & drainage, soil erosion, silt loads & sedimentation	Construction	local	short-term	medium	probable	VERY LOW	negative	medium
	Operation	local	long-term	high	probable	HIGH	negative	medium
Invasion by alien weeds & invader plants	Construction	local	long-term	low	probable	LOW	negative	high
	Operation	local	long-term	high	probable	HIGH	negative	high
Pollution at construction camps	Construction	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased risk of veld fires	Construction	local	short-term	medium	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Reduction in resilience/stability of ecosystems	Construction	local	long-term	high	probable	HIGH	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Disruption of the flow of nutrients and materials	Construction	regional	long-term	medium	probable	HIGH	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
WITH MITIGATION								
Loss of habitat	Construction	local	long-term	medium	definite	MEDIUM	negative	high
	Operation	local	long-term	low	probable	LOW	negative	medium
Loss of biodiversity	Construction	local	long-term	low	probable	LOW	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fragmentation of habitat	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of species of special concern	Construction	local	permanent	medium	definite	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased runoff & drainage, soil erosion, silt loads & sedimentation	Construction	local	short-term	medium	probable	VERY LOW	negative	medium
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Invasion by alien	Construction	local	long-term	low	probable	LOW	negative	high

weeds & invader plants	Operation	local	long-term	low	probable	LOW	negative	high
Pollution at construction camps	Construction	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased risk of veld fires	Construction	local	short-term	medium	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Reduction in resilience/stability of ecosystems	Construction	local	long-term	medium	probable	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Disruption of the flow of nutrients and materials	Construction	regional	long-term	low	probable	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Mitigation objectives

Prevent or reduce loss of sensitive natural vegetation, biodiversity and species of special concern, prevent the invasion and spread of alien weeds and invader plants, reduce impact of additional runoff and the disruption of the flow of nutrients and material and prevent fragmentation of habitat.

Mitigation measures

- Minimise and restrict clearing to the area required for road construction purposes only and limit disturbance to adjacent undisturbed natural vegetation communities. Sensitive areas must be defined and all efforts made to avoid construction activities within these areas.
- Where destruction of vegetation is unavoidable, a botanical expert should identify any protected species at that site for which permits may be required for destruction or removal. In addition, plant search-and-rescue operations should be undertaken prior to clearing of natural vegetation classified as sensitive or species-rich.
- Revegetation of disturbed areas must be undertaken with site indigenous species and should be scheduled to take place as soon after construction as possible to avoid invasion by alien plants. This can provide a buffer to protect indigenous vegetation from invasion by weeds. Indigenous species may be those previously reduced during clearing of vegetation prior to construction.
- Protection of habitat through implementation of erosion and sediment control measures, including stormwater management.
- Control alien plants in the road reserve, in areas around the bridge and in any other disturbed areas by implementing a weed control plan to avoid establishment and spread of weeds. The long-term measurable outcome will be the complete absence of alien plants.
- Slopes must be stable or stabilised to prevent collapsing.
- Bridges must be designed and constructed in such a way as to minimise impacts on wetland areas. This would require a single span from one side of the wetland to the other and minimisation of construction impacts on the wetland area.
- Approach roads must be designed and constructed to drain towards naturally wet areas to avoid impeded flow of water over the landscape.
- Ongoing monitoring and maintenance of revegetation works following commissioning of proposal.

Implementation of the recommended mitigation measures will reduce six impacts from high to medium significance, one impact from medium to low significance and one impact from high to low significance. The construction of the bridge will, however, still result in impacts of medium significance, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat", "loss of species of special concern", "increased runoff", "Reduction in resilience/stability of ecosystems" and "Disruption of the flow of nutrients and materials".

6.3.6.11 New bridge over the Mnyameni River

Description of effect

The new bridge over the Mnyameni River may affect vegetation along the lip of the gorge and the steep slopes down from there, including some rocky grassland and some forest in the gorge below. This construction may result in some direct loss of habitat or impacts on ecological processes associated with the gorge habitat.

Assessment

The assessment of impacts both without and with mitigation measures is presented in Table 6.31 below. The proposed bridge crosses at a relatively narrow section of the gorge with steep slopes dropping to a narrow strip of forested area on the banks of the river below.

There are two impacts identified as having potentially high significance, namely "increased runoff" and "invasion by alien species".

Increased runoff will occur as a result of the new pavement and bridge area and is likely to lead to erosion problems in this high-rainfall area. Much of the edge of the gorge is a rocky substrate, which should be stable, but further upslope is some grassland on soils that are more vulnerable to erosion. The erosion itself may cause less of an impact than siltation into the stream below, which would affect aquatic habitats from this point downstream.

Invasion by alien plants is potentially serious due to the high levels of invasion in similar disturbed habitats nearby and the fact that the invasion is almost certain to occur in the absence of any control measures. Alien plants are known to invade forests up to 150 m from the margin adjacent to disturbance and have been observed up to 100 m away in grasslands in the greenfields area. The forests and wetlands are especially vulnerable since aliens can spread easily downslope from the sides of the bridge and then downstream from the site of the bridge.

There are five impacts that are assessed as medium, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat", "loss of species of special concern" and "reduction in resilience/stability of ecosystems". These are all local scale, long-term impacts.

The main habitats at the site of this bridge are grassland, rocky grassland and forest in the gorge. These contain naturally high levels of biodiversity or a species composition which is unique to that habitat. It is likely that grassland and rocky grassland habitat will be lost locally due to construction of this bridge.

There are 35 plant species of conservation importance occurring in grasslands and 38 in forests within the Pondoland area (see Appendix 1). This includes a number of PCE endemics, but constitutes all Red List species as well as other species for which there could be conservation concern. According to Provincial Ordinances there are also a number of protected species that may occur in grasslands and forests as well as medicinal species that may not appear on either of these two lists. Due to the fact that the site of the bridge contains grassland and forest habitats, there is a high probability of encountering species of special concern at this site.

Construction of the bridge will potentially result in local fragmentation due to the fact that it passes through untransformed areas of vegetation. The construction of the bridge is not, however, expected to impact on the forest in the gorge to any major degree unless secondary impacts result in localised loss of forest.

The resilience/stability of the grasslands and forests could potentially be impaired by the direct loss of habitat, some fragmentation, the introduction of alien species and the potential disruption of the flow of nutrients and materials through the landscape.

Table 6.31: Assessment of potential impacts associated with the proposed construction of a new high-level bridge over the Mnyameni River

ISSUE / IMPACT	PHASE	EXTENT	DURATION	INTENSITY	PROBABILITY	SIGNIFICANCE	STATUS	CONFIDENCE
WITHOUT MITIGATION								
Loss of habitat	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of biodiversity	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fragmentation of habitat	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of species of special concern	Construction	local	permanent	medium	definite	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased runoff & drainage, soil erosion, silt loads & sedimentation	Construction	local	short-term	medium	probable	VERY LOW	negative	medium
	Operation	local	long-term	high	probable	HIGH	negative	medium
Invasion by alien weeds & invader plants	Construction	local	long-term	low	probable	LOW	negative	high
	Operation	local	long-term	high	probable	HIGH	negative	high
Pollution at construction camps	Construction	local	short-term	medium	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased risk of veld fires	Construction	local	short-term	medium	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased accessibility of remote habitats	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium
Reduction in resilience/stability of ecosystems	Construction	local	long-term	medium	improbable	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Disruption of the flow of nutrients and materials	Construction	local	long-term	low	probable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
WITH MITIGATION								
Loss of habitat	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Loss of biodiversity	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fragmentation of habitat	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of species of special concern	Construction	local	permanent	low	definite	LOW	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased runoff & drainage, soil erosion, silt loads & sedimentation	Construction	local	short-term	medium	probable	VERY LOW	negative	medium
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Invasion by alien weeds & invader plants	Construction	local	long-term	low	probable	LOW	negative	high
	Operation	local	long-term	low	probable	LOW	negative	high
Pollution at construction camps	Construction	local	short-term	medium	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased risk of veld fires	Construction	local	short-term	medium	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased accessibility of remote habitats	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium
Reduction in resilience/stability of ecosystems	Construction	local	long-term	low	improbable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Disruption of the flow of nutrients and materials	Construction	local	long-term	low	probable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Mitigation objectives

Prevent or reduce loss of sensitive natural vegetation, biodiversity and species of special concern, prevent the invasion and spread of alien weeds and invader plants, reduce impact of additional runoff and prevent fragmentation of habitat.

Mitigation measures

- Minimise and restrict clearing to the area required for road construction purposes only and limit disturbance to adjacent undisturbed natural vegetation communities. Sensitive areas must be defined and all efforts made to avoid construction activities within these areas.
- Where destruction of vegetation is unavoidable, a botanical expert should identify any protected species at that site for which permits may be required for destruction or removal. In addition, plant search-and-rescue operations should be undertaken prior to clearing of natural vegetation classified as sensitive or species-rich.
- Revegetation of disturbed areas must be undertaken with site indigenous species and should be scheduled to take place as soon after construction as possible to avoid invasion by alien plants. This can provide a buffer to protect indigenous vegetation from invasion by weeds. Indigenous species may be those previously reduced during clearing of vegetation prior to construction.
- Protection of habitat through implementation of erosion and sediment control measures, including stormwater management.

- Control alien plants in the road reserve, in areas around the bridge and in any other disturbed areas by implementing a weed control plan to avoid establishment and spread of weeds. The long-term measurable outcome will be the complete absence of alien plants.
- Slopes must be stable or stabilised to prevent collapsing.
- Bridges must be designed and constructed in such a way as to minimise impacts on riparian areas. The high-level construction proposed for this bridge will satisfy this requirement, but construction impacts must also be minimised.
- Approach roads must be designed and constructed to drain towards naturally wet areas to avoid impeded flow of water over the landscape.
- Ongoing monitoring and maintenance of revegetation works following commissioning of proposal.

Implementation of the recommended mitigation measures will reduce two impacts from medium to low significance, one impact from high to low significance and one impact from high to medium significance. The construction of the bridge will, however, still result in impacts of medium significance, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat", and "increased runoff".

6.3.6.12 New bridge over the Kulumbe River

Description of effect

The new high-level bridge over the Kulumbe River may affect vegetation along the lip of the gorge and the steep slopes down from there, including some rocky grassland. This construction may result in some direct loss of habitat or impacts on ecological processes associated with the gorge habitat.

Assessment

The assessment of impacts both without and with mitigation measures is presented in Table 6.32 below. The proposed bridge crosses at a relatively narrow section of the gorge with steep slopes dropping to the banks of the river below.

There are two impacts identified as having potentially high significance, namely "increased runoff" and "invasion by alien species".

Increased runoff will occur as a result of the new pavement and bridge area and is likely to lead to erosion problems in this high-rainfall area. Much of the edge of the gorge is a rocky substrate, which should be stable, but further upslope is some grassland on soils that are more vulnerable to erosion. The erosion itself may cause less of an impact than siltation into the stream below, which would affect aquatic habitats from this point downstream.

Invasion by alien plants is potentially serious due to the high levels of invasion in similar disturbed habitats nearby and the fact that the invasion is almost certain to occur in the absence of any control measures. Alien plants are known to invade forests up to 150 m from the margin adjacent to disturbance and have been observed up to 100 m away in grasslands in the greenfields area. The wetlands are especially vulnerable since aliens can spread easily downslope from the sides of the bridge and then downstream from the site of the bridge.

There are five impacts that are assessed as medium, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat", "loss of species of special concern" and "reduction in resilience/stability of ecosystems". These are all local scale, long-term impacts.

The main habitats at the site of this bridge are grassland and rocky grassland on the edge of the gorge. These contain naturally high levels of biodiversity or a species composition which is unique to that habitat. It is likely that grassland and rocky grassland habitat will be lost locally due to construction of this bridge.

There are 35 plant species of conservation importance occurring in grasslands within the Pondoland area (see Appendix 1). This includes a number of PCE endemics, but constitutes all Red List species as well as other species for which there could be conservation concern. According to Provincial Ordinances there are also a number of protected species that may occur in grasslands as well as medicinal species that may not appear on either of these two lists. Due to the fact that the site of the bridge contains grassland habitats, there is a high probability of encountering species of special concern at this site.

Construction of the bridge will potentially result in local fragmentation due to the fact that it passes through untransformed areas of vegetation.

The resilience/stability of the grasslands could potentially be impaired by the direct loss of habitat, some fragmentation, the introduction of alien species and the potential disruption of the flow of nutrients and materials through the landscape.

Table 6.32: Assessment of potential impacts associated with the proposed construction of a new high-level bridge over the Kulumbe River

ISSUE / IMPACT	PHASE	EXTENT	DURATION	INTENSITY	PROBABILITY	SIGNIFICANCE	STATUS	CONFIDENCE
WITHOUT MITIGATION								
Loss of habitat	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of biodiversity	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fragmentation of habitat	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of species of special concern	Construction	local	permanent	medium	definite	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased runoff & drainage, soil erosion, silt loads & sedimentation	Construction	local	short-term	medium	probable	VERY LOW	negative	medium
	Operation	local	long-term	high	probable	HIGH	negative	medium
Invasion by alien weeds & invader plants	Construction	local	long-term	low	probable	LOW	negative	high
	Operation	local	long-term	high	probable	HIGH	negative	high
Pollution at construction camps	Construction	local	short-term	medium	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased risk of veld fires	Construction	local	short-term	medium	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Increased accessibility of remote habitats	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium
Reduction in resilience/stability of ecosystems	Construction	local	long-term	medium	improbable	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Disruption of the flow of nutrients and materials	Construction	local	long-term	low	probable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
WITH MITIGATION								
Loss of habitat	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of biodiversity	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fragmentation of habitat	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of species of special concern	Construction	local	permanent	low	definite	LOW	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased runoff & drainage, soil erosion, silt loads & sedimentation	Construction	local	short-term	medium	probable	VERY LOW	negative	medium
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Invasion by alien weeds & invader plants	Construction	local	long-term	low	probable	LOW	negative	high
	Operation	local	long-term	low	probable	LOW	negative	high
Pollution at construction camps	Construction	local	short-term	medium	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased risk of veld fires	Construction	local	short-term	medium	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased accessibility of remote habitats	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium
Reduction in resilience/stability of ecosystems	Construction	local	long-term	low	improbable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Disruption of the flow of nutrients and materials	Construction	local	long-term	low	probable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Mitigation objectives

Prevent or reduce loss of sensitive natural vegetation, biodiversity and species of special concern, prevent the invasion and spread of alien weeds and invader plants, reduce impact of additional runoff and prevent fragmentation of habitat.

Mitigation measures

- Minimise and restrict clearing to the area required for road construction purposes only and limit disturbance to adjacent undisturbed natural vegetation communities. Sensitive areas must be defined and all efforts made to avoid construction activities within these areas.

- Where destruction of vegetation is unavoidable, a botanical expert should identify any protected species at that site for which permits may be required for destruction or removal. In addition, plant search-and-rescue operations should be undertaken prior to clearing of natural vegetation classified as sensitive or species-rich.
- Revegetation of disturbed areas must be undertaken with site indigenous species and should be scheduled to take place as soon after construction as possible to avoid invasion by alien plants. This can provide a buffer to protect indigenous vegetation from invasion by weeds. Indigenous species may be those previously reduced during clearing of vegetation prior to construction.
- Protection of habitat through implementation of erosion and sediment control measures, including stormwater management.
- Control alien plants in the road reserve, in areas around the bridge and in any other disturbed areas by implementing a weed control plan to avoid establishment and spread of weeds. The long-term measurable outcome will be the complete absence of alien plants.
- Slopes must be stable or stabilised to prevent collapsing.
- Bridges must be designed and constructed in such a way as to minimise impacts on riparian areas. The high-level construction proposed for this bridge will satisfy this requirement, but construction impacts must also be minimised.
- Approach roads must be designed and constructed to drain towards naturally wet areas to avoid impeded flow of water over the landscape.
- Ongoing monitoring and maintenance of revegetation works following commissioning of proposal.

Implementation of the recommended mitigation measures will reduce two impacts from medium to low significance, one impact from high to low significance and one impact from high to medium significance. The construction of the bridge will, however, still result in impacts of medium significance, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat", and "increased runoff".

6.3.6.13 New bridge over the Mpahlane River

Description of effect

The new high-level bridge over the Mpahlane River may affect vegetation along the lip of the gorge and the steep slopes down from there, including some rocky grassland and some forest in the gorge below. This construction may result in some direct loss of habitat or impacts on ecological processes associated with the gorge habitat.

Assessment

The assessment of impacts both without and with mitigation measures is presented in Table 6.33 below. The proposed bridge crosses at a relatively narrow section of the gorge with steep slopes dropping to a narrow strip of forested area on the banks of the river below. The margins of the gorge contain rocky grassland, but beyond this the open grassland has been impacted upon by cultivation and is mostly transformed.

There are two impacts identified as having potentially high significance, namely "increased runoff" and "invasion by alien species".

Increased runoff will occur as a result of the new pavement and bridge area and is likely to lead to erosion problems in this high-rainfall area. Much of the edge of the gorge is a rocky substrate, which should be stable, but further upslope is some grassland on soils that are more vulnerable to erosion. The erosion itself may cause less of an impact than siltation into the stream below, which would affect aquatic habitats from this point downstream.

Invasion by alien plants is potentially serious due to the high levels of invasion in similar disturbed habitats nearby and the fact that the invasion is almost certain to occur in the absence of any control measures. Alien plants are known to invade forests up to 150 m from the margin adjacent to disturbance and have been observed up to 100 m away in grasslands in the greenfields area. The forests and wetlands are especially vulnerable since aliens can spread easily downslope from the sides of the bridge and then downstream from the site of the bridge.

There are five impacts that are assessed as medium, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat", "loss of species of special concern" and "reduction in resilience/stability of ecosystems". These are all local scale, long-term impacts.

The main habitats at the site of this bridge are rocky grassland and forest in the gorge. These contain naturally high levels of biodiversity or a species composition which is unique to that habitat. It is likely that rocky grassland habitat will be lost locally due to construction of this bridge.

There are 35 plant species of conservation importance occurring in grasslands and 38 in forests within the Pondoland area (see Appendix 1). This includes a number of PCE endemics, but constitutes all Red List species as well as other species for which there could be conservation concern. According to Provincial Ordinances there are also a number of protected species that may occur in grasslands and forests as well as medicinal species that may not appear on either of these two lists. Due to the fact that the site of the bridge contains grassland and forest habitats, there is a high probability of encountering species of special concern at this site.

Construction of the bridge will potentially result in local fragmentation due to the fact that it passes through untransformed areas of vegetation close to the gorge. The construction of the bridge is not, however, expected to impact on the forest in the gorge to any major degree unless secondary impacts result in localised loss of forest.

The resilience/stability of the rocky grasslands and forests could potentially be impaired by the direct loss of habitat, some fragmentation, the introduction of alien species and the potential disruption of the flow of nutrients and materials through the landscape.

Table 6.33: Assessment of potential impacts associated with the proposed construction of a new high-level bridge over the Mpahlane River

ISSUE / IMPACT	PHASE	EXTENT	DURATION	INTENSITY	PROBABILITY	SIGNIFICANCE	STATUS	CONFIDENCE
WITHOUT MITIGATION								
Loss of habitat	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of biodiversity	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fragmentation of habitat	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of species of special concern	Construction	local	permanent	medium	definite	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Increased runoff & drainage, soil erosion, silt loads & sedimentation	Construction	local	short-term	medium	probable	VERY LOW	negative	medium
	Operation	local	long-term	high	probable	HIGH	negative	medium
Invasion by alien weeds & invader plants	Construction	local	long-term	low	probable	LOW	negative	high
	Operation	local	long-term	high	probable	HIGH	negative	high
Pollution at construction camps	Construction	local	short-term	medium	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased risk of veld fires	Construction	local	short-term	medium	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased accessibility of remote habitats	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium
Reduction in resilience/stability of ecosystems	Construction	local	long-term	medium	improbable	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Disruption of the flow of nutrients and materials	Construction	local	long-term	low	probable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
WITH MITIGATION								
Loss of habitat	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of biodiversity	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fragmentation of habitat	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of species of special concern	Construction	local	permanent	low	definite	LOW	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased runoff & drainage, soil erosion, silt loads & sedimentation	Construction	local	short-term	medium	probable	VERY LOW	negative	medium
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Invasion by alien weeds & invader plants	Construction	local	long-term	low	probable	LOW	negative	high
	Operation	local	long-term	low	probable	LOW	negative	high
Pollution at construction camps	Construction	local	short-term	medium	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased risk of veld fires	Construction	local	short-term	medium	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased accessibility of remote habitats	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium
Reduction in resilience/stability of ecosystems	Construction	local	long-term	low	improbable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Disruption of the	Construction	local	long-term	low	probable	LOW	negative	medium

flow of nutrients and materials	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Mitigation objectives
Prevent or reduce loss of sensitive natural vegetation, biodiversity and species of special concern, prevent the invasion and spread of alien weeds and invader plants, reduce impact of additional runoff and prevent fragmentation of habitat.

Mitigation measures

- Minimise and restrict clearing to the area required for road construction purposes only and limit disturbance to adjacent undisturbed natural vegetation communities. Sensitive areas must be defined and all efforts made to avoid construction activities within these areas.
- Where destruction of vegetation is unavoidable, a botanical expert should identify any protected species at that site for which permits may be required for destruction or removal. In addition, plant search-and-rescue operations should be undertaken prior to clearing of natural vegetation classified as sensitive or species-rich.
- Revegetation of disturbed areas must be undertaken with site indigenous species and should be scheduled to take place as soon after construction as possible to avoid invasion by alien plants. This can provide a buffer to protect indigenous vegetation from invasion by weeds. Indigenous species may be those previously reduced during clearing of vegetation prior to construction.
- Protection of habitat through implementation of erosion and sediment control measures, including stormwater management.
- Control alien plants in the road reserve, in areas around the bridge and in any other disturbed areas by implementing a weed control plan to avoid establishment and spread of weeds. The long-term measurable outcome will be the complete absence of alien plants.
- Slopes must be stable or stabilised to prevent collapsing.
- Bridges must be designed and constructed in such a way as to minimise impacts on riparian areas. The high-level construction proposed for this bridge will satisfy this requirement, but construction impacts must also be minimised.
- Approach roads must be designed and constructed to drain towards naturally wet areas to avoid impeded flow of water over the landscape.
- Ongoing monitoring and maintenance of revegetation works following commissioning of proposal.

Implementation of the recommended mitigation measures will reduce two impacts from medium to low significance, one impact from high to low significance and one impact from high to medium significance. The construction of the bridge will, however, still result in impacts of medium significance, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat", and "increased runoff".

6.3.6.14 New bridge over the Mzamba River
Description of effect
The new high-level bridge over the Mzamba River may affect vegetation along the lip of the gorge and the steep slopes down from there, including some rocky grassland and some forest in the gorge below. This construction may result in some direct loss of habitat or impacts on ecological processes associated with the gorge habitat.

Assessment

The assessment of impacts both without and with mitigation measures is presented in Table 6.34 below. The proposed bridge crosses at a relatively narrow section of the gorge (400 m) with a steep scree slope on the southern side and an almost vertical slope on the northern side dropping to a patchy strip of forested area on the banks of the river below. The margins of the gorge contain rocky grassland, but beyond this the open grassland has been impacted upon by cultivation and is mostly transformed.

There are two impacts identified as having potentially high significance, namely "increased runoff" and "invasion by alien species".

Increased runoff will occur as a result of the new pavement and bridge area and is likely to lead to erosion problems in this high-rainfall area. The edge of the gorge is a rocky substrate, which should be stable, but further upslope is some grassland on soils that are more vulnerable to erosion, and the southern scree slope is potentially a lot less stable. The erosion itself may cause less of an impact than siltation into the stream below, which would affect aquatic habitats from this point downstream.

Invasion by alien plants is potentially serious due to the high levels of invasion in similar disturbed habitats nearby and the fact that the invasion is almost certain to occur in the absence of any control measures. Alien plants are known to invade forests up to 150 m from the margin adjacent to disturbance and have been observed up to 100 m away in grasslands in the greenfields area. The forests and wetlands are especially vulnerable since aliens can spread easily downslope from the sides of the bridge and then downstream from the site of the bridge.

There are five impacts that are assessed as medium, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat", "loss of species of special concern" and "reduction in resilience/stability of ecosystems". These are all local scale, long-term impacts.

The main habitats at the site of this bridge are rocky grassland and forest in the gorge. These contain naturally high levels of biodiversity or a species composition which is unique to that habitat. It is likely that rocky grassland habitat will be lost locally due to construction of this bridge.

There are 35 plant species of conservation importance occurring in grasslands and 38 in forests within the Pondoland area (see Appendix 1). This includes a number of PCE endemics, but constitutes all Red List species as well as other species for which there could be conservation concern. According to Provincial Ordinances there are also a number of protected species that may occur in grasslands and forests as well as medicinal species that may not appear on either of these two lists. Due to the fact that the site of the bridge contains grassland and forest habitats, there is a high probability of encountering species of special concern at this site.

Construction of the bridge will potentially result in local fragmentation due to the fact that it passes through untransformed areas of vegetation close to the gorge. The construction of the bridge is not, however, expected to impact on the forest in the gorge to any major degree unless secondary impacts result in localised loss of forest.

The resilience/stability of the rocky grasslands and forests could potentially be impaired by the direct loss of habitat, some fragmentation, the introduction of alien species and the potential disruption of the flow of nutrients and materials through the landscape.

Table 6.34: Assessment of potential impacts associated with the proposed construction of a new high-level bridge over the Mzamba River

ISSUE / IMPACT	PHASE	EXTENT	DURATION	INTENSITY	PROBABILITY	SIGNIFICANCE	STATUS	CONFIDENCE
WITHOUT MITIGATION								
Loss of habitat	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of biodiversity	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fragmentation of habitat	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of species of special concern	Construction	local	permanent	medium	definite	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased runoff & drainage, soil erosion, silt loads & sedimentation	Construction	local	short-term	medium	probable	VERY LOW	negative	medium
	Operation	local	long-term	high	probable	HIGH	negative	medium
Invasion by alien weeds & invader plants	Construction	local	long-term	low	probable	LOW	negative	high
	Operation	local	long-term	high	probable	HIGH	negative	high
Pollution at construction camps	Construction	local	short-term	medium	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased risk of veld fires	Construction	local	short-term	medium	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased accessibility of remote habitats	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium
Reduction in resilience/stability of ecosystems	Construction	local	long-term	medium	improbable	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Disruption of the flow of nutrients and materials	Construction	local	long-term	low	probable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
WITH MITIGATION								
Loss of habitat	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of biodiversity	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fragmentation of habitat	Construction	local	long-term	medium	probable	MEDIUM	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of species of special concern	Construction	local	permanent	low	definite	LOW	negative	high
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased runoff & drainage, soil	Construction	local	short-term	medium	probable	VERY LOW	negative	medium

erosion, silt loads & sedimentation	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Invasion by alien weeds & invader plants	Construction	local	long-term	low	probable	LOW	negative	high
	Operation	local	long-term	low	probable	LOW	negative	high
Pollution at construction camps	Construction	local	short-term	medium	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased risk of veld fires	Construction	local	short-term	medium	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased accessibility of remote habitats	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium
Reduction in resilience/stability of ecosystems	Construction	local	long-term	low	improbable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Disruption of the flow of nutrients and materials	Construction	local	long-term	low	probable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Mitigation objectives

Prevent or reduce loss of sensitive natural vegetation, biodiversity and species of special concern, prevent the invasion and spread of alien weeds and invader plants, reduce impact of additional runoff and prevent fragmentation of habitat.

Mitigation measures

- Minimise and restrict clearing to the area required for road construction purposes only and limit disturbance to adjacent undisturbed natural vegetation communities. Sensitive areas must be defined and all efforts made to avoid construction activities within these areas.
- Where destruction of vegetation is unavoidable, a botanical expert should identify any protected species at that site for which permits may be required for destruction or removal. In addition, plant search-and-rescue operations should be undertaken prior to clearing of natural vegetation classified as sensitive or species-rich.
- Revegetation of disturbed areas must be undertaken with site indigenous species and should be scheduled to take place as soon after construction as possible to avoid invasion by alien plants. This can provide a buffer to protect indigenous vegetation from invasion by weeds. Indigenous species may be those previously reduced during clearing of vegetation prior to construction.
- Protection of habitat through implementation of erosion and sediment control measures, including stormwater management.
- Control alien plants in the road reserve, in areas around the bridge and in any other disturbed areas by implementing a weed control plan to avoid establishment and spread of weeds. The long-term measurable outcome will be the complete absence of alien plants.
- Slopes must be stable or stabilised to prevent collapsing.
- Bridges must be designed and constructed in such a way as to minimise impacts on riparian areas. The high-level construction proposed for this bridge will satisfy this requirement, but construction impacts must also be minimised.

- Approach roads must be designed and constructed to drain towards naturally wet areas to avoid impeded flow of water over the landscape.
- Ongoing monitoring and maintenance of revegetation works following commissioning of proposal.

Implementation of the recommended mitigation measures will reduce two impacts from medium to low significance, one impact from high to low significance and one impact from high to medium significance. The construction of the bridge will, however, still result in impacts of medium significance, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat", and "increased runoff".

6.3.6.15 New R61 interchange

Description of effect

The anticipated widening of the road reserve associated with the proposed new R61 interchange may result in some habitat loss in the adjacent vegetation, including habitats associated with the Pondoland-Ugu Sandstone Coastal Sourveld vegetation type. However, the natural vegetation is almost completely transformed at this site. There is likely to be increased runoff from the additional paved areas that may lead to downslope impacts, including erosion and siltation. The disturbance to the adjacent vegetation will probably lead to an increased incidence of invasion by alien plants, which may become worse over the medium- to long-term. There may be pollution at construction camps and increased risk of veld fires emanating from these construction sites, but this will be limited to the construction phase.

Assessment

The assessment of impacts both without and with mitigation measures is presented in Table 6.35 below. Near to the site of the proposed R61 interchange is the existing R61 road and adjacent to the road is various levels of existing disturbance, including cultivation, settlements and the Wild Coast Sun complex. This reduces the potential for many impacts on the botanical receiving environment. However, the site is adjacent to a drainage line running towards the south from the site. Downstream from this drainage line are two dams within the golf course area of the Wild Coast Sun complex. There is the potential for runoff impacts into this drainage system as well as spread of alien plants.

Five impacts that could occur have been assessed as having medium significance, namely "increased runoff", "invasion by alien weeds", "strip development", "reduction in resilience/stability of ecosystems" and "disruption of the flow of nutrients and materials". These are local scale, long-term impacts. Increased runoff will occur as a result of the increased pavement area and invasion by alien weeds is likely to increase with time and is thus more of an operational phase impact. Strip development may occur due to the existence of surrounding settlements, an existing road (R61 road) and the proposed intersection.

Table 6.35: Assessment of potential impacts associated with the proposed R61 interchange

ISSUE / IMPACT	PHASE	EXTENT	DURATION	INTENSITY	PROBABILITY	SIGNIFICANCE	STATUS	CONFIDENCE
WITHOUT MITIGATION								
Loss of habitat	Construction	local	permanent	negligible	improbable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Increased runoff & drainage, soil erosion, silt loads & sedimentation	Construction	local	short-term	medium	probable	LOW	negative	medium
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Invasion by alien weeds & invader plants	Construction	local	long-term	low	probable	LOW	negative	medium
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Pollution at construction camps	Construction	Site	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased risk of veld fires	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Strip development	Construction	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Reduction in resilience/stability of ecosystems	Construction	local	short-term	medium	probable	LOW	negative	medium
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Disruption of the flow of nutrients and materials	Construction	local	short-term	medium	probable	LOW	negative	medium
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
WITH MITIGATION								
Loss of habitat	Construction	site	permanent	negligible	improbable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased runoff & drainage, soil erosion, silt loads & sedimentation	Construction	local	long-term	low	probable	LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium
Invasion by alien weeds & invader plants	Construction	local	long-term	low	probable	LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium
Pollution at construction camps	Construction	Site	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased risk of veld fires	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Strip development	Construction	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Reduction in resilience/stability of ecosystems	Construction	local	short-term	medium	probable	LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium
Disruption of the flow of nutrients and materials	Construction	local	short-term	medium	probable	LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium

Mitigation objectives

Reduce impact of additional runoff and prevent the invasion and spread of alien weeds and invader plants. This will prevent the disruption of the flow of nutrients/materials as well as the potential for reduction in the stability/resilience of ecosystems.

Mitigation measures

- Revegetation of disturbed areas must be undertaken with site indigenous species and should be scheduled to take place as soon after construction as possible to avoid invasion by alien plants.
- Implementation of erosion and sediment control measures, including stormwater management and providing grassy channels at stormwater outlets.
- Ongoing monitoring and maintenance of revegetation works following commissioning of proposal.
- Appropriate locating of stockpiles, site offices and infrastructure, to limit damage to untransformed vegetation.
- Implement a weed control plan to avoid establishment and spread of weeds with the long-term measurable outcome the complete absence of alien plants.

Implementation of the recommended mitigation measures will reduce four of the impacts from medium to low significance. The construction of the interchange will then be unlikely to result in any impacts of medium or high significance, except for potential ribbon development associated with the presence of the new road.

6.3.6.16 New intersections with district roads

Description of effect

The proposed construction of new intersections with district roads will occur at a variety of sites, including the following: DR 08141, Mkamela access road, Holy Cross/Mkambati road, DR 08122 (several times) and the "Amadiba" access road. In most cases, these sites are transformed by cultivation and villages. The exception is that most of these sites are within a short distance of wetland areas which have been maintained in a largely naturally functioning state. For example:

- There are wetland areas within 140 m to the west and south of the Mkamela road at the point where the SANRAL preferred alignment crosses.
- There are wetland areas within 90 m to the north-east of the Holy Cross/Mkambati road at the point where the SANRAL preferred alignment crosses.
- There are wetland areas within 300 m to the west and east of the Amadiba road at the point where the SANRAL preferred alignment crosses.

Except for potential runoff impacts on these drainage lines and potential invasion by alien plants, the construction of the intersections is unlikely to result in any negative impacts on the botanical receiving environment.

Assessment

The assessment of impacts both without and with mitigation measures is presented in Table 6.36 below. The sites of the proposed intersections are within areas containing existing disturbance, including cultivation and settlements. This reduces the potential for many impacts on the botanical receiving environment. However, the sites are often adjacent to a drainage line or wetland area. There is the potential for runoff impacts into these drainage systems as well as spread of alien plants.

Five impacts that could occur have been assessed as having medium significance, namely "increased runoff", "invasion by alien weeds", "strip development", "reduction in resilience/stability of ecosystems" and "disruption of the flow of nutrients and materials". These are local scale, long-term impacts. Increased runoff will occur as a result of the increased pavement area and invasion by alien weeds is likely to increase with time and is thus more of an operational phase impact. Strip development may occur due to the existence of surrounding settlements, an existing road and the proposed intersection (which provides good access).

Table 6.36: Assessment of potential impacts associated with the proposed construction and upgrading of intersections

ISSUE / IMPACT	PHASE	EXTENT	DURATION	INTENSITY	PROBABILITY	SIGNIFICANCE	STATUS	CONFIDENCE
WITHOUT MITIGATION								
Loss of habitat	Construction	local	permanent	negligible	improbable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased runoff & drainage, soil erosion, silt loads & sedimentation	Construction	local	short-term	medium	probable	LOW	negative	medium
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Invasion by alien weeds & invader plants	Construction	local	long-term	low	probable	LOW	negative	medium
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Pollution at construction camps	Construction	Site	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased risk of veld fires	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Strip development	Construction	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Reduction in resilience/stability of ecosystems	Construction	local	short-term	medium	probable	LOW	negative	medium
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Disruption of the flow of nutrients and materials	Construction	local	short-term	medium	probable	LOW	negative	medium
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
WITH MITIGATION								
Loss of habitat	Construction	site	permanent	negligible	improbable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased runoff & drainage, soil erosion, silt loads & sedimentation	Construction	local	long-term	low	probable	LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium
Invasion by alien weeds & invader plants	Construction	local	long-term	low	probable	LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium
Pollution at construction camps	Construction	Site	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased risk of veld fires	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Strip development	Construction	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium

Reduction in resilience/stability of ecosystems	Construction	local	short-term	medium	probable	LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium
Disruption of the flow of nutrients and materials	Construction	local	short-term	medium	probable	LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium

Reduce impact of additional runoff and prevent the invasion and spread of alien weeds and invader plants. This will prevent the disruption of the flow of nutrients/materials as well as the potential for reduction in the stability/resilience of ecosystems.

Mitigation measures

- Revegetation of disturbed areas must be undertaken with site indigenous species and should be scheduled to take place as soon after construction as possible to avoid invasion by alien plants.
- Implementation of erosion and sediment control measures, including stormwater management and providing grassy channels at stormwater outlets.
- Ongoing monitoring and maintenance of revegetation works following commissioning of proposal.
- Appropriate locating of stockpiles, site offices and infrastructure, to limit damage to untransformed vegetation.
- Implement a weed control plan to avoid establishment and spread of weeds with the long-term measurable outcome the complete absence of alien plants.

Implementation of the recommended mitigation measures will reduce four of the impacts from medium to low significance. The construction of the intersections will then be unlikely to result in any impacts of medium or high significance, except for potential ribbon development associated with the presence of the new road.

6.3.6.17 Mthenthu mainline toll plaza

Description of effect

The anticipated widening of the road reserve associated with the proposed Mthenthu mainline toll plaza may result in some habitat loss in the adjacent vegetation, including habitats associated with the Pondoland-Ugu Sandstone Coastal Sourveld vegetation type. However, the natural vegetation is almost completely transformed at this site. There is likely to be increased runoff from the additional paved areas that may lead to downslope impacts, including erosion and siltation. The disturbance to the adjacent vegetation will probably lead to an increased incidence of invasion by alien plants, which may become worse over the medium- to long-term. There may be pollution at construction camps and increased risk of veld fires emanating from these construction sites, but this will be limited to the construction phase.

Assessment

The assessment of impacts both without and with mitigation measures is presented in Table 6.37 below. Near to the site of the proposed Mthenthu mainline toll plaza is an existing road (Mkambati / Holy Cross road) and adjacent to the road are various levels of existing disturbance, including cultivation, settlements and stands of alien trees. This reduces the potential for many impacts on the botanical receiving environment. However, the site is on a watershed with drainage lines running towards the north and south from the site, including the upper reaches of the Mkambati River. There is the potential for runoff impacts into these systems as well as spread of alien plants.

Five impacts that could occur have been assessed as having medium significance, namely "increased runoff", "invasion by alien weeds", "strip development", "reduction in resilience/stability of ecosystems" and "disruption of the flow of nutrients and materials". These are local scale, long-term impacts. Increased runoff will occur as a result of the increased pavement area and invasion by alien weeds is likely to increase with time and is thus more of an operational phase impact. Strip development may occur due to the existence of surrounding settlements, an existing road (Mkambati / Holy Cross road), the proposed intersection and the proposed presence of the toll plaza infrastructure.

Table 6.37: Assessment of potential impacts associated with the proposed Mthenthu mainline toll plaza

ISSUE / IMPACT	PHASE	EXTENT	DURATION	INTENSITY	PROBABILITY	SIGNIFICANCE	STATUS	CONFIDENCE
WITHOUT MITIGATION								
Loss of habitat	Construction	local	permanent	negligible	improbable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased runoff & drainage, soil erosion, silt loads & sedimentation	Construction	local	short-term	medium	probable	LOW	negative	medium
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Invasion by alien weeds & invader plants	Construction	local	long-term	low	probable	LOW	negative	medium
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Pollution at construction camps	Construction	Site	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased risk of veld fires	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Strip development	Construction	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Reduction in resilience/stability of ecosystems	Construction	local	short-term	medium	probable	LOW	negative	medium
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Disruption of the flow of nutrients and materials	Construction	local	short-term	medium	probable	LOW	negative	medium
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
WITH MITIGATION								
Loss of habitat	Construction	site	permanent	negligible	improbable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased runoff & drainage, soil erosion, silt loads & sedimentation	Construction	local	long-term	low	probable	LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium
Invasion by alien weeds & invader plants	Construction	local	long-term	low	probable	LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium

Pollution at construction camps	Construction	Site	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased risk of veld fires	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Strip development	Construction	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Reduction in resilience/stability of ecosystems	Construction	local	short-term	medium	probable	LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium
Disruption of the flow of nutrients and materials	Construction	local	short-term	medium	probable	LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium

Mitigation objectives
Reduce impact of additional runoff and prevent the invasion and spread of alien weeds and invader plants. This will prevent the disruption of the flow of nutrients/materials as well as the potential for reduction in the stability/resilience of ecosystems.

Mitigation measures

- Revegetation of disturbed areas must be undertaken with site indigenous species and should be scheduled to take place as soon after construction as possible to avoid invasion by alien plants.
- Implementation of erosion and sediment control measures, including stormwater management and providing grassy channels at stormwater outlets.
- Ongoing monitoring and maintenance of revegetation works following commissioning of proposal.
- Appropriate locating of stockpiles, site offices and infrastructure, to limit damage to untransformed vegetation.
- Implement a weed control plan to avoid establishment and spread of weeds with the long-term measurable outcome the complete absence of alien plants.

Implementation of the recommended mitigation measures will reduce four of the impacts from medium to low significance. The construction of the toll plaza will then be unlikely to result in any impacts of medium or high significance, except for potential ribbon development associated with the presence of the new road.

6.3.7 Section 7: Mthamvuna River to Isipingo Interchange

This is an existing route and only minor construction will take place to upgrade the road, where necessary (see FSR Chapter 4). This includes widening in places, construction of the Port Edward, Southbroom and Adams Road Interchanges, construction of the Park Rynie and Isipingo mainline toll plazas, construction of ramp plazas at Pennington, Park Rynie, Scottburgh, Umkomaas, Adams Road, Moss Kolnick Drive and Joyner Road and widening of the bridge at Amanzimtoti River. Construction of the ramp plazas will take place within the existing road reserve on existing roads and no additional impacts are anticipated. Potential impacts for construction of remaining infrastructure are assessed below.

6.3.7.1 Park Rynie mainline toll plaza

Description of effect

The anticipated widening of the road reserve associated with the proposed Park Rynie mainline toll plaza is not going to result in any natural habitat loss since the adjacent areas consist of a combination of sugarcane and plantations of alien trees. There may be some increased runoff from the additional paved areas that may lead to downslope impacts, including erosion and siltation, but this will not impact on any natural systems, because there are none nearby. Due to the fact that adjacent areas are intensively managed, it is unlikely that the construction will lead to increased incidence of invasion by alien plants. There may be pollution at construction camps and increased risk of veld fires emanating from these construction sites, but this will not impact on any natural vegetation.

Assessment

No assessment is necessary since there is no indigenous vegetation or flora in the near vicinity which could be impacted upon. The construction of the toll plaza will not result in any impacts on the botanical receiving environment.

6.3.7.2 Isipingo mainline toll plaza

Description of effect

The anticipated widening of the road reserve associated with the proposed Isipingo mainline toll plaza is not going to result in any natural habitat loss since the adjacent areas consist of an urbanised landscape consisting of a combination of industry and urban areas with the occasional lawn adjacent to the highway. There may be some increased runoff from the additional paved areas that may lead to downslope impacts, including erosion and siltation, but this will not impact on any natural vegetation, because there is none nearby. Due to the fact that adjacent areas are intensively managed, it is unlikely that the construction will lead to increased incidence of invasion by alien plants.

Assessment

No assessment is necessary since there is no indigenous vegetation or flora in the near vicinity which could be impacted upon. The construction of the toll plaza will not result in any impacts on the botanical receiving environment.

6.3.7.3 Construction of Port Edward, Southbroom and Adams Road Interchanges

Description of effect

The anticipated widening of the road reserve associated with the proposed Port Edward, Southbroom and Adams Road Interchanges is not going to result in any natural habitat loss since the adjacent areas consist of combination of sugarcane, plantations of alien trees and urbanised areas associated with south-coast resorts. There may be some increased runoff from the additional paved areas that may lead to downslope impacts, including erosion and siltation, but this will not impact on any natural vegetation, because there is none nearby at any of these three sites. Due to the fact that adjacent areas are intensively managed, it is unlikely that the construction will lead to increased incidence of invasion by alien plants.

Assessment

No assessment is necessary since there is no indigenous vegetation or flora in the near vicinity of any of the three sites which could be impacted upon. The construction of the interchanges will not result in any impacts on the botanical receiving environment.

6.3.7.4 Widening of roads

Description of effect

The proposed widening of the road in some places between Mthamvuna River and the Isipingo Interchange to accommodate passing lanes may result in the loss of some habitat adjacent to the existing road, including habitats associated with the KwaZulu-Natal Coastal Belt vegetation type. Such remaining habitat is, however, scattered and consists of small remaining patches. Road widening may result in some direct loss of habitat with associated loss of species, but it must be emphasised that these remaining patches of vegetation are very scattered and small.

Assessment

The assessment of impacts both without and with mitigation measures is presented in Table 6.38 below. The small areas of coastal thicket associated with KwaZulu-Natal Coastal Belt that could be lost may be significant due to the very rates of conversion of this vegetation type. The KwaZulu-Natal Coastal Belt vegetation type is considered to be Endangered nationally and loss of any areas of this vegetation may have significant conservation impacts on the vegetation type as well as species of special concern. It must be emphasised that these patches are unlikely to be affected by widening of the road, but if they are affected then the impact may be significant due to the high conservation status of the vegetation type. There are also various streams, rivers and wetlands along this route section and impacts within these systems need to be avoided to reduce the possibility of impacts on ecological processes with a wider influence. Along most of the section of road between Mthamvuna River and the Isipingo Interchange is an existing road and adjacent to the road are high levels of existing disturbance, including cultivation, plantations and settlements. This area of landscape is in generally transformed condition mostly due to sugarcane cultivation. The proposed widening of the road occurs where there is an existing road and most potential impacts are an increase or expansion of existing impacts.

Five impacts that will probably occur have been assessed as having medium significance, namely "loss of habitat", "loss of biodiversity", "loss of species of special concern", "increased runoff" and "invasion by alien weeds". These are local scale, long-term impacts. Increased runoff will occur as a result of the increased pavement area. Invasion by alien weeds is likely to increase with time and is thus more of an operational phase impact. Loss of habitat may affect remaining areas of coastal thicket as well as rivers, streams or wetlands and loss of biodiversity would be associated with this habitat loss.

Table 6.38: Assessment of potential impacts associated with the proposed widening of roads between Mthamvuna River and Isipingo Interchange

ISSUE / IMPACT	PHASE	EXTENT	DURATION	INTENSITY	PROBABILITY	SIGNIFICANCE	STATUS	CONFIDENCE
WITHOUT MITIGATION								
Loss of habitat	Construction	local	permanent	medium	probable	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of biodiversity	Construction	local	long-term	medium	probable	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fragmentation of habitat	Construction	local	permanent	low	improbable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of species of special concern	Construction	local	permanent	medium	probable	MEDIUM	negative	low
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Increased runoff & drainage, soil erosion, silt loads & sedimentation	Construction	local	medium-term	medium	probable	LOW	negative	medium
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Invasion by alien weeds & invader plants	Construction	local	long-term	low	probable	LOW	negative	high
	Operation	local	long-term	medium	probable	MEDIUM	negative	high
Pollution at construction camps	Construction	Site	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased risk of veld fires	Construction	local	short-term	low	improbable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Reduction in resilience/stability of ecosystems	Construction	local	long-term	low	improbable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Disruption of the flow of nutrients and materials	Construction	local	long-term	low	probable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
WITH MITIGATION								
Loss of habitat	Construction	local	permanent	low	probable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of biodiversity	Construction	local	long-term	low	probable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fragmentation of habitat	Construction	local	permanent	low	improbable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of species of special concern	Construction	local	permanent	low	probable	LOW	negative	low
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased runoff & drainage, soil erosion, silt loads & sedimentation	Construction	local	medium-term	low	probable	VERY LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium
Invasion by alien weeds & invader plants	Construction	local	long-term	low	probable	LOW	negative	high
	Operation	local	long-term	low	probable	LOW	negative	high
Pollution at construction camps	Construction	Site	short-term	low	probable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased risk of veld fires	Construction	local	short-term	low	improbable	VERY LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Reduction in resilience/stability of ecosystems	Construction	local	long-term	low	improbable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Disruption of the flow of nutrients and materials	Construction	local	long-term	low	probable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Mitigation objectives
Prevent or reduce loss of natural thicket vegetation and diversity as well as species of special concern, reduce impact of additional runoff and prevent the invasion and spread of alien weeds and invader plants.

Mitigation measures
- Minimise and restrict clearing to the area required for road construction purposes only and limit disturbance to adjacent undisturbed natural vegetation communities.
- Where indigenous thicket vegetation is encountered, consider all alternatives for reducing further loss of this vegetation.
- Where indigenous thicket vegetation is encountered, these patches should be investigated by a botanist to evaluate the potential for loss of species of special concern, including species that are likely to be protected under Provincial Ordinances or according to the National Forests Act and for which permits may be required for removal.
- Revegetation of disturbed areas must be undertaken with site indigenous species. This can provide a buffer to protect indigenous vegetation from invasion by weeds.
- Structures such as bridges and culverts must be constructed in such a way as to minimise impacts on wetlands, streams and riparian areas.
- Protection of habitat through implementation of erosion and sediment control measures, including stormwater management and providing grassy channels at stormwater outlets.
- Ongoing monitoring and maintenance of revegetation works following commissioning of proposal.
- Appropriate locating of stockpiles, site offices and infrastructure, to limit damage to sensitive vegetation.
- Control alien plants in road reserve and in disturbed areas by implementing a weed control plan to avoid establishment and spread of weeds. The long-term measurable outcome will be the complete absence of alien plants.

Implementation of the recommended mitigation measures will reduce five impacts from medium to low significance. The widening of roads will then be unlikely to result in any impacts of medium or high significance.

6.3.7.5 Widening of bridge at the Amanzimtoti River
Description of effect
The widening of the bridge at the Amanzimtoti River may affect riparian and floodplain vegetation alongside the existing bridge. This construction may result in some direct loss of habitat or impacts on ecological processes associated with the riparian and floodplain habitat.

Assessment
The assessment of impacts both without and with mitigation measures is presented in Table 6.39 below. The proposed widening of the bridge is at a site where it is already moderately disturbed by the existing bridges. The proposed widening of the bridge therefore occur where there is an existing road and most potential impacts are an increase or expansion of existing impacts. There is, however, some untransformed floodplain vegetation on both sides of the river. Five impacts that will probably occur have been assessed as having medium significance, namely "loss of habitat", "fragmentation of habitat", "increased runoff", "invasion by alien weeds" and "disruption of the flow of nutrients and materials". These are local scale, long-term impacts. Loss of habitat may affect localised areas of the rivers. Fragmentation of habitat may occur if the bridge causes a transverse break in the vegetation that did not previously occur. If this is sufficiently wide then it may result in a permanent break in the riparian habitat resulting in fragmentation of this habitat. Increased runoff and the consequent potential increase in erosion will occur due to the increased road surface. Where there is disturbance, invasion by

alien weeds is likely to increase with time and is thus an operational phase impact. Any structures built within the floodplain of the river may result in the disruption of the flow of water, nutrients and material down the river that could affect the ecological functioning of the river or affect downstream riparian habitats.

Table 6.39: Assessment of potential impacts associated with the proposed widening of the bridge at the Amanzimtoti River

ISSUE / IMPACT	PHASE	EXTENT	DURATION	INTENSITY	PROBABILITY	SIGNIFICANCE	STATUS	CONFIDENCE
WITHOUT MITIGATION								
Loss of habitat	Construction	local	long-term	medium	probable	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of biodiversity	Construction	local	long-term	low	probable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fragmentation of habitat	Construction	local	long-term	medium	probable	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of species of special concern	Construction	local	permanent	low	improbable	LOW	negative	low
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased runoff & drainage, soil erosion, silt loads & sedimentation	Construction	local	short-term	medium	probable	VERY LOW	negative	medium
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Invasion by alien weeds & invader plants	Construction	local	long-term	low	probable	LOW	negative	high
	Operation	local	long-term	medium	probable	MEDIUM	negative	high
Reduction in resilience/stability of ecosystems	Construction	local	long-term	low	improbable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Disruption of the flow of nutrients and materials	Construction	local	long-term	medium	probable	MEDIUM	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
WITH MITIGATION								
Loss of habitat	Construction	local	long-term	low	probable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of biodiversity	Construction	local	long-term	low	probable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Fragmentation of habitat	Construction	local	long-term	low	probable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Loss of species of special concern	Construction	local	permanent	low	improbable	LOW	negative	low
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Increased runoff & drainage, soil erosion, silt loads & sedimentation	Construction	local	short-term	medium	probable	VERY LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium
Invasion by alien weeds & invader plants	Construction	local	long-term	low	probable	LOW	negative	high
	Operation	local	long-term	low	probable	LOW	negative	high

Reduction in resilience/stability of ecosystems	Construction	local	long-term	low	improbable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Disruption of the flow of nutrients and materials	Construction	local	long-term	low	probable	LOW	negative	medium
	Operation	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Mitigation objectives
Prevent or reduce loss of floodplain vegetation, prevent fragmentation of floodplain and riparian habitat, reduce the impact of increased runoff, prevent the invasion and spread of alien weeds and invader plants and prevent the long-term disruption of the flow of water, material and nutrients downstream.

Mitigation measures
- Minimise and restrict clearing to the area required for road construction purposes only and limit disturbance to adjacent undisturbed natural riparian or floodplain vegetation communities.
- Revegetation of disturbed areas must be undertaken with site indigenous species. This can provide a buffer to protect indigenous vegetation from invasion by weeds.
- Bridges must be designed and constructed in such a way as to minimise impacts on riparian and floodplain areas.
- Protection of habitat through implementation of erosion and sediment control measures, including stormwater management.
- Ongoing monitoring and maintenance of revegetation works following commissioning of proposal.
- Control alien plants in riparian areas around the bridge and in disturbed areas by implementing a weed control plan to avoid establishment and spread of weeds. The long-term measurable outcome will be the complete absence of alien plants.

Implementation of the recommended mitigation measures will reduce five impacts from medium to low significance. The bridge widening will then be unlikely to result in any impacts of medium or high significance.

6.4 Impacts beyond the route corridor

6.4.1 Impacts associated with easier access to sensitive habitats
Description of effect
The proposed new roads between Ndwalane and Ntafufu and between Lusikisiki and Mthamvuna River would introduce a number of indirect impacts on vegetation and flora as a result of easier access to previously remote habitats. This may lead to higher rates of harvesting of plant species such as medicinal plants, forest products, rare species, or horticultural plants. For example, this factor has been largely responsible for the increased degradation of Amazon jungle following road construction into remote areas. An example of a group of species particularly under threat includes the cycads, which are harvested in the wild for sale as items of collection. There are also a number of woody forest species from which medicinal products are obtained, e.g. bark. Over-harvesting of these products often leads to high mortality rates amongst such species and potential local extinction. The potential impact is likely to be on target species rather than on whole ecosystems, but whole ecosystems may suffer as a consequence.

Assessment
The assessment of impacts both without and with mitigation measures is presented in Table 6.40 below. The main potential impact is "loss of species of special concern". Increased disturbance of these habitats may also cause the impact, "increased invasion by alien species" and severe resource harvesting may eventually result in "loss of habitat". Impacts are assessed relative to the current situation in these remote areas, i.e. the "no go" option. Two impacts are assessed as having medium significance during the operational phase. It was taken into account that there is already a high degree of harvesting of natural products in the greenfields area and that the new road would provide easier access, not necessarily new access.

Table 6.40: Assessment of potential impacts associated with increased accessibility of remote habitats

ISSUE / IMPACT	PHASE	EXTENT	DURATION	INTENSITY	PROBABILITY	SIGNIFICANCE	STATUS	CONFIDENCE
WITHOUT MITIGATION								
Loss of biodiversity	Construction	local	short-term	low	probable	VERY LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium
Loss of species of special concern	Construction	local	short-term	medium	probable	LOW	negative	medium
	Operation	local	long-term	medium	probable	MEDIUM	negative	medium
Invasion by alien weeds & invader plants	Construction	local	short-term	low	probable	VERY LOW	negative	high
	Operation	local	long-term	medium	probable	MEDIUM	negative	high
Loss of habitat	Construction	local	short-term	low	improbable	VERY LOW	negative	medium
	Operation	local	long-term	low	probable	LOW	negative	medium

Mitigation objectives
No direct mitigation measures are possible to prevent or reduce this impact since the affected areas are beyond the control of SANRAL or the contractor that will eventually manage this section of road. Improved economic opportunities in the area may reduce or increase the pressure to harvest natural resources directly, but this is unlikely to materialise in the short term. Effective protection and policing of populations of rare species may provide some protection, but this requires institutional capacity and commitment at a national level from various potential role players.

Mitigation measures
- None proposed.

6.4.2 Impacts associated with a reduction in the extent of components of the Pondoland Centre of Endemism
Description of effect
The proposed new roads between Ndwalane and Ntafufu and between Lusikisiki and Mthamvuna River would introduce a number of direct and indirect impacts on vegetation and flora that could lead to a reduction in the area of extent of parts of the PCE or lead to loss of species that are characteristic of the PCE.

The mapping of landcover indicates that there are significant areas transformed in the PCE by various factors and that the PCE is not in pristine condition. Assessment of direct impacts indicates that a further approximately 952 ha of Pondoland-Ugu Sandstone Coastal Sourveld may be lost due to construction of the road. Indirect impacts leading to habitat loss are difficult to predict, but are calculated to be in the region of approximately 11 800 ha (see section 6.4.5 below for calculation). A loss of 952 ha of this grassland type will result in there being approximately 69% still remaining (as compared to the currently remaining area of approximately 70%), which would lead to the vegetation remaining in the Vulnerable conservation category. A loss of 11 800 ha of this grassland type will result in there being approximately 61% still remaining, which would lead to the vegetation potentially being reclassified as Endangered, especially considering the low rates of conservation of this vegetation type. Very little Scarp Forest is likely to be lost as a result of construction of the road due to the high-level design of the bridges over the gorges. Some Transkei Coastal Belt forest will be lost between Ndwalane and Ntafufu, but this is insufficient by far to lead to a change in the conservation category of this vegetation type.

No species of special concern are likely to be impacted upon directly by construction of the proposed road to such an extent that they are re-categorised into a higher conservation category. Indirect impacts from harvesting of target species or loss of habitat due to secondary impacts from the presence of the road are potentially more serious and may result in loss of individuals or populations. There is a risk of some species being negatively impacted upon, but the magnitude of this impact is unlikely to lead to significant changes in the conservation status of any threatened plant species (see assessment in section 6.7.1 below).

It must therefore be concluded that there will be direct impacts that may render components of the PCE more vulnerable from a conservation point of view, but these are not so severe as to immediately jeopardise the existence of the PCE or its components.

6.4.3 Impacts associated with a reduction in the opportunity to undertake effective conservation, biodiversity conservation planning or establish conservation areas in the region

A proposed Pondoland Park has been proposed, the boundaries of which include a significant proportion of the remaining areas of the PCE. Approximately 22 km of the proposed road alignment is within 2 km of the inside of the proposed Pondoland Park boundary (Figure 18). An additional 27 km is well within this planning boundary, but this tends to be in the northern half of the proposed conservation area where the most severe degradation and transformation exist. The Coastal Mzamaba alignment would reduce this included 27 km to 15 km. The appearance is therefore that the proposed road fragments the area being considered as forming the proposed Pondoland Park. However, the proposed road, following the SANRAL preferred alignment, potentially only reduces the core area of the proposed park to 88% of its planned area, if the fragments are excluded from the park. If the inland fragment is included in the proposed park, then very little habitat is potentially lost from within the proposed park. Construction of the Coastal Mzamba alignment would result in this included proportion becoming almost 97% of the desired area. The proposed road does not, therefore, have a major impact on the potential to undertake conservation planning in the PCE area, especially if the Coastal Mzamba alignment is selected.

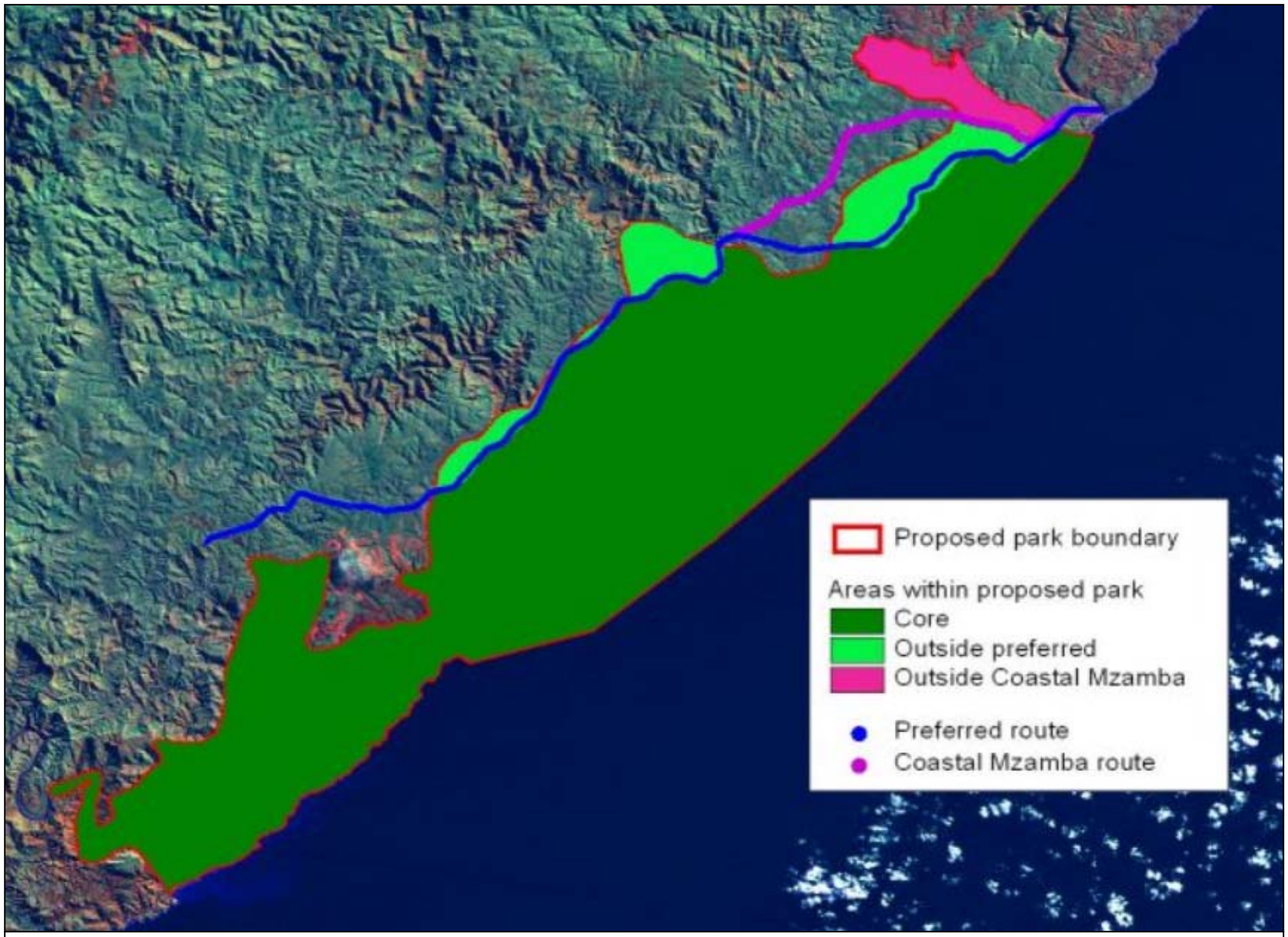

Figure 18: Relationship between the proposed greenfields alignment (preferred and Coastal Mzamba routes) and the proposed Pondoland Park boundary.

6.4.4 Impacts associated with fragmentation of habitat and barriers to movement due to the road cutting through areas of untransformed natural habitat

Linear infrastructures are characterised by a series of common problems in terms of ecological impact, due to the complex interactions with the landscape they cross. A linear infrastructure represents a new artificial element that interferes with the natural structure of the landscape: it creates barriers, breaks natural corridors, and alters the conditions within both the intersected and the surrounding ecosystems. Infrastructures cutting through the landscape can cause not only a loss of natural areas, but also a reduction in the quality of the remaining ones, due to fragmentation.

Ecosystem fragmentation refers to the break-up of habitat expanses into smaller and more isolated units. It determines a wide range of threats to biodiversity, such as invasion of exotic species, reduction of organism movement, reduction of genetic diversity and population viability and alteration of ecological flowpaths. Roads, as linear infrastructures in general, are acknowledged to be a major cause of fragmentation.

For the current project, the potential impact of the proposed road associated with fragmentation within the PCE was considered to be the greatest concern. In order to evaluate the potential fragmentation impact of the road through the greenfields area at a landscape level, fragmentation was assessed within the PCE by measuring the changes in some indicators of fragmentation within a GIS environment:

- ecosystem core area (amount of untransformed area greater than 500 m from a patch boundary and area occupied by the largest patch),
- ecosystem connectivity (number of patches), and
- ecosystem disturbance (amount of edge: ratio of perimeter to area).

These indicators were applied to the current state ("No go option"), the SANRAL preferred alignment and the Coastal Mzamba alignment as a comparison. A summary of the results is given in Table 6.41.

Table 6.41: Indicators of fragmentation within the PCE due to the proposed road.

Indicator	Current status	SANRAL preferred alignment	Coastal Mzamba alignment
No of patches	1008	1028	1033
% PCE area occupied by largest patch	35.6%	33.4%	33.3%
% PCE area > 500 m from edge	50.7%	48.4%	48.6%
perimeter to area ratio (m/km^2)	1690	1781	1782
Fragmentation index (%)*	42.30%	44.53%	44.54%

*With no transformation or fragmentation, i.e. in an entirely natural state, the PCE would have a fragmentation index of 5.60%

The data indicates that neither alignment causes a great increase in the overall number of patches or perimeter to area ratio relative to the current situation. This is due to the fact that there is already a relatively high proportion of disturbance in the PCE grasslands (the reason why the grasslands are classified as a Vulnerable vegetation type). This factor also results in

the fact that neither alignment causes a large decrease in the proportion of the PCE that is not directly influenced by a disturbance zone.

The proportion of the PCE occupied by the largest patch of untransformed vegetation is marginally reduced by both alternative alignments. This large patch includes the Mkambati and Tracor area and the proposed alignments are positioned towards the edge of this area.

6.4.5 Impacts associated with the potential for ribbon development along new roads and in areas that become accessible from new roads

Ribbon development

It is likely that the accessibility provided by the new road and the various intersections that will be provided could lead to local settlement of people along the road. It is known that low-income ribbon development occurs where a new road traverses communal areas, as is evident in the study area in Pondoland. The remote areas of the greenfields section have dispersed settlement patterns now, but "the re-alignment of the N2 Toll Road towards the coastal belt is expected to result in a trend towards new settlements clustering close to the new route in Pondoland" (Naidoo & Wanklin 2007). Such ribbon or nodal development may, in the greenfields section, result in accelerated loss of habitat adjacent to these routes and increased spreading of settlements into adjacent countryside. The likelihood is that, if such ribbon /nodal development were to take place, that it would occur adjacent to existing settlements as well as near to where intersections will be positioned on the new road, especially if these intersections are major routes to other destinations, e.g. Mbotyi. Of greatest concern is the fact that ribbon and nodal development will probably be relatively uncontrolled.

The proposed intersections are given in the FSR and the impacts of these are assessed in section 6.3.6.17 "New intersections with district roads". The intersections include the following: DR 08141, Mkamela access road, Holy Cross/Mkambati road, DR 08122 (several times) and the "Amadiba" access road. There are six such sites within the PCE where there is a high likelihood of expansion of settlements, on the basis of the above argument. Assuming that these expand on average by approximately 100-200 ha, this will result in approximately 600-1200 ha of direct habitat loss. There is also a likelihood of development in previously unsettled areas, but it is difficult to predict where this may occur.

Increased coastal development

Due to the high attraction of coastal property and the relatively unspoilt nature of this coastline it is likely that nodal development may also occur along the coastline due to improved access resulting in a situation similar to the KZN south coast. According to the specialist planning/development study (Naidoo & Wanklin 2007), "The new N2 Toll Road is seen as an important means of providing high standard access to coastal resorts on the Wild Coast. This increased connectivity would raise the competitive profile of the resorts leading to opportunities for tourism and leisure based residential development". This is most likely to occur where there are existing roads leading from the new road to the coast. Msikaba and Mbotyi have been identified as tourism nodes along the coast. Likely locations for increased development pressure include the following, most of which already have access roads or tracks or they could be developed relatively easily:

- Mzamba River mouth - High likelihood
- Mpahlana and Mpahlanyana River mouths
- Mnyameni River mouth
- Kwanyana lagoon/estuary
- Northern Mtentu River mouth
- Southern Msikaba Mouth (South Sand Bluff lighthouse) - High likelihood

- Kilroe Beach
- Port Grosvenor
- Mkweni River mouth
- Luphuthana River mouth
- Waterfall Bluff
- Mfihlela Falls
- Mgcagcama
- Mbotyi - High likelihood
- Manteku (mouth of the Mzintlava River)
- Mtambalala Forest Station

There are likely to be limited controls on coastal development: according to the specialist planning/development study (Naidoo & Wanklin 2007), the Integrated Development Plans and supporting Spatial Development Framework Plans for the Eastern Cape Municipalities "have very broad, high level policies, strategies and plans" that "are not considered to be of a sufficient detail to enable effective management and control of development likely to result from the impact of the Toll Road (particularly in the greenfields section)". Assuming approximately 50 ha per site in the medium term, it is possible that up to 800 ha could become developed as resorts along the coast. This would make this the third highest potential impact on the PCE in the medium term after direct habitat loss from the road itself and potential habitat degradation due to alien invasions. A worst-case scenario is that the entire Wild Coast becomes developed in the same way as the KwaZulu-Natal South Coast, where there is almost uninterrupted development down the entire coast for approximately 1000 m (up to 2 km at larger nodes), it is possible that up to 11 000 ha may be lost to coastal development along the Pondoland coastline within the PCE.

The combined potential loss of habitat due to ribbon development and coastal resort development may be approximately 2 000 ha and may even be up to 11 800 ha. This, in combination with other direct impacts may be sufficient to reclassify Pondoland-Ugu Sandstone Coastal Sourveld from Vulnerable to an Endangered vegetation type. The overall impact of strip / ribbon development by the road may be highly significant and of high magnitude.

6.4.6 Impacts associated with the reduction in resilience/stability of plant communities and ecosystems due to impacts generated by the new road

It is possible that the proposed road may lead to conditions in the greenfields area that promote reduction in resilience/stability of plant communities and ecosystems due to, for example, habitat fragmentation, reduction in area of remaining patches, importation of foreign pathogens and species, loss of biodiversity, disruption of biological interactions leading to a loss or change of ecosystem function (such as nutrient cycling, hydrological cycling, pollination, and carbon sequestration) or blocking of linear processes. Considered on a regional level, a number of these factors have already been assessed (e.g. section 6.3.5 above). These assessments indicate that there will not be a significant fragmentation impact from the road, the reduction in remaining patches of vegetation will not be great and the total loss of habitat will be relatively small compared to the overall extent of vegetation. There may be some localised restrictions on linear processes, but these can also be controlled to some degree due to the fact that they tend to be associated with wetlands systems across which suitable bridges can be built. At a local scale, the potential for invasion by alien plants is likely to be very high unless controlled. This could lead to a more regional impact, if not controlled, but this is the primary risk factor which could lead to the reduction in resilience/stability of plant communities and ecosystems. If this factor can be controlled then the overall impact on ecosystem resilience by the road will probably not be significant.

6.4.7 Impacts associated with the disruption of the linear flow of nutrients and materials by road infrastructure leading to the interruption of biogeochemical cycles

The most well-known and important biogeochemical cycles include the carbon cycle, the nitrogen cycle, the oxygen cycle, the phosphorus cycle, and the water cycle. Biogeochemical cycles always involve equilibrium states: a balance in the cycling of the element between compartments. However, overall balance may involve compartments distributed on a global scale. There is a chance that there will be impacts from the construction of the new road that will lead to the disruption of the linear flow of nutrients and materials leading to the interruption of biogeochemical cycles (through factors such as alteration of flows of surface and groundwater, removal of biomass, relocation of topsoil, and increase in sources of nutrients). The most problematic situation would arise if soil and nutrients are flushed out of the landscape and washed down river systems due to higher velocity surface water flow. This would result in a net loss of water and nutrients from the landscape that could lead to lowered productivity levels in the vegetation, thus reducing vegetation cover, carrying capacity, and other ecological services, potentially leading to a change in species composition and aridification of the soil. Alternatively, the road may impede flow resulting in localised sinks. A potential solution to this possible impact is to make the road permeable to overland flow without concentrating flows too much into point sources. This would involve the incorporation of sufficient culverts, bridges and other structures to accommodate overland flow, especially in drainage areas, and to ensure that these are designed in such a way as to minimise concentration of flow and the associated increase in velocity of flow at these points. If this can be achieved then the overall impact on the linear flow of nutrients and materials by the road will probably not be significant.

6.5 Summary of potential mitigation measures

To protect biodiversity, a three-step approach may be taken: avoid, minimise or, where impacts cannot be avoided, replace the lost value in some way (offset).
There are a number of ways of avoiding or minimizing impacts, for example:

- Selecting an alternative alignment.
- Extended bridge structures to avoid sensitive vegetation sucn as along drainage lines and streams. This can be taken further by reducing the number of piers. The high-level bridge constructions proposed by SANRAL in the greenfields section meet these requirements adequately.
- Identify "no go" zones to limit access during construction (this requires careful supervision and the continuous presence of an independent environmental control officer).
- Plant translocation (useful where impacts are unavoidable and the species are able to be translocated, but usually only useful for herbaceous or small woody species).
- Revegetation with site indigenous species. This can provide a buffer to protect indigenous vegetation from invasion by weeds and can provide linkages between vegetation patches. This is not always successful at preventing weed invasion and may also require further maintenance.

A number of specific measures are proposed to mitigate the impact of the proposal on vegetation within the study area:

- There must be post-construction commitment to monitoring and management of biodiversity. Ongoing monitoring and maintenance of revegetation works following commissioning of the proposal will ensure a more effective outcome.
- Relevant biodiversity management requirements must be incorporated into contract specifications. Contract specification clauses should be reviewed (and preferably prepared) by someone with the appropriate biological skills and knowledge.

- Landscaping and revegetation plays an important role in minimising biodiversity impacts. Where practical, roadside landscaping and revegetation should attempt to use species locally native to the site and not use any environmental weeds.
- Preparation and implementation of a flora and vegetation Management Plan, including a revegetation plan, using native species endemic to the locality.
- Preparation of a Weed Management Plan as part of the flora and vegetation Management Plan to be implemented along the route during the landscaping and maintenance works.
- Retention of native species where possible along the alignment.
- On-site seed collection and transplanting of native plant species should be implemented and included in revegetation works. These works should be started early to establish a source of plants for regeneration.
- Cleared native vegetation should be chopped and mulched for use in revegetation works.
- Any revegetation works should be undertaken by qualified and experienced people.
- Identification and temporary fencing of areas of vegetation to be retained during construction activities.
- Clearing should be minimised and restricted to the area required for road construction purposes only and disturbance to adjacent vegetation communities and/or remnant trees within the corridor should be strictly controlled. This planning can take place during the design phase of the project.
- It is important to ensure that contractors are made aware of the environmental issues and associated risks prior to commencement of construction work. Biodiversity aspects that need to be included in the induction process include:
    - Extent of no-go zones
    - Areas of significant vegetation and habitat
    - Potential of discovery of additional populations of sensitive species and what to do in this event.
- Potential biodiversity risks that need to be addressed in the EMP include:
    - Appropriate locating of stockpiles, site offices and infrastructure, to limit damage to sensitive vegetation.
    - Weed control to avoid spread of weeds due to failure to appropriately identify and control weeds
    - Site protection measures for existing flora and vegetation.
- All necessary permits must be obtained prior to construction, e.g. for removal of flora or protected species.
- Protection of habitat through implementation of erosion and sediment control measures. For example, drainage of road runoff through grassy channels, as an erosion and sediment control measure, greatly reduces toxic solid- and heavy-metal concentrations. Dense vegetation also increases soil infiltration and storage and reduces the erosion effects of runoff water.
- Lobbying for the implementation of an effective conservation plan for the Pondoland area will provide impetus for the development of conservation areas that will protect key components of the PCE. This will reduce the significance of potential secondary impacts on these areas due to the proposed road.

6.6 Proposed monitoring measures

There are various methods for monitoring the potential success of mitigation measures relative to unaffected areas. These address the success of the following impact control activities, which have been identified as the main potential threats to biodiversity in the PCE (and more widely, in some cases):

1. alien control
2. erosion control

3. rehabilitation of disturbed areas
    a. species composition
    b. landscape functionality and stability
4. impacts on downstream habitats (erosion, composition, water quality)
5. impacts on untransformed sensitive habitats
6. populations of species of special concern
7. biodiversity

It is proposed that ongoing monitoring takes place following construction of the road in order to assess the success of mitigation measures proposed. This may be done at different levels of detail, as follows:

1. Visual assessment using fixed point photography over time
   The objective would be to take photographs at fixed sites at given intervals of time in order to provide a visual comparison through time. This could be used to monitor the development of vegetation in rehabilitated areas (such as cover and structure), erosion at vulnerable points (e.g. on steep slopes and below culverts and bridges), and the presence of alien plants on the roadside as well as any obvious impacts in demarcated sensitive areas. At the same time, the presence of erosion features in impacted zones and rehabilitated areas can be visually assessed by noting the nature and severity or erosion features.

2. Sampling of simple functional attributes of the landscape surface at fixed sites over time
   A methodology is available that is quick and easy to apply that can measure various functional attributes of a site that can be used to determine whether the landscape at the site is becoming more ecologically functional. This would be useful for monitoring rehabilitated areas to determine whether ecological functionality is returning to the landscape. The measured attributes provide information on the following and can be plotted in graph form over time:
    i. erosion and vulnerability to erosion;
    ii. infiltration and permeability;
    iii. deposition and retention of material;
    iv. nutrient cycling;
    v. decomposition (ecological process);
    vi. surface stability and resistance to disturbance.

3. Monitoring of alien plants
   A roadside alien plant monitoring programme would be critical for controlling alien plant invasions. The best approach would be to undertake drive-through surveys for alien plants, stopping to record species as they are encountered. This would provide the following information:
    i. identification of alien species;
    ii. date of observation;
    iii. distribution (GPS reading per observation);
    iv. density and approximate age/size of alien plants;
    v. evidence of spreading into surrounding landscape;
    vi. information for maintaining a register of control measures and the impact of control measures.

   This information would be essential for record keeping within the context of an alien control EMS.

4. Floristic monitoring sites
   A number of permanent monitoring sites may be established which can be used to do detailed biodiversity monitoring, especially in the greenfields section. The sampling design would include benchmark sites some distance from the road to be used for

comparison (control sites). The best approach is to establish these sample sites before construction and then undertake sampling at random time intervals into the future (classic BACI[1] sampling). Within each site, data would be collected that would provide information on species richness and composition as well as vegetation structure over time. The data would provide statistically meaningful information on the impact of the project on biodiversity relative to areas not directly influenced by the project. It could also provide very useful data on the floristic development of rehabilitated areas relative to natural habitat (an approach that has been applied very successfully in the mining industry to demonstrate the floristic trajectory of rehabilited areas). In addition, it can be used to detect the presence of alien plants and the conditions under which they are becoming established.

5. Monitoring populations of species of special concern
   If necessary, particular populations of species of special concern can be monitored over time. This would involve the undertaking of detailed studies on the population structure (numbers, ages, recruitment and mortality) within a population at a particular site and any obvious threats to the population. It is often useful and cost-effective to sponsor a post-graduate student to undertake this type of study. The monitoring of such populations should be done with supervision or co-operation from an agency such as the Provincial Conservation authorities or the SANBI Threatened Species Programme.

6. Remote sensing
   A variety of remote sensing techniques using satellite imagery or aerial photography can be used to detect major changes in landscape patterns over time associated with the road, including ribbon development, major erosion impacts, quantifying loss of habitat and detecting changes in wetlands and riparian areas. It may be the only practical way of detecting changes in areas beyond the road corridor that may not be observable from the road itself. This type of exercise is useful if undertaken at time intervals of about 5 years, but is a relatively expensive undertaking. A single remote sensing study approximately five years after the construction of the road would suffice to provide basic information on ongoing impacts, but it is recommended that this is repeated regularly after this initial 5 year period.

6.7 Ecological sustainability of the project

This section of the report provides an overall evaluation of the ecological sustainability of the proposed project and identified feasible alternatives in light of the assessment of potential impacts. The guidelines used for reviewing the significance of impacts are based on the potential to jeopardise ecological sustainability and are as follows:

1. they lead to loss of biological diversity - species, ecosystems
2. they threatened key ecological processes
3. they exceed thresholds, capacities, safe minimum standards, regenerative and/or assimilative capacities of natural systems
4. they threaten life support systems
5. they threaten protected, important, unique, sensitive, irreplaceable, stressed, highly dynamic, rare or special areas
6. they exacerbate human-induced climate change
7. they lead to irreversible loss of natural capital
8. impacts are unknown or uncertain; inadequate knowledge or information to predict them with confidence
9. they lead to substantial negative cumulative impacts.

[1] BACI = Before, After, Control, Impact. This can be further improved used more advanced statistical methods to control for outside and random temporal and spatial factors.

These guidelines are discussed separately below.

6.7.1 Loss of biological diversity

Biodiversity consists of all living organisms, including those from terrestrial and aquatic ecosystems, as well as the ecosystem complexes of which they are a part. This includes genes, species, ecosystems and landscapes and the ecological processes that allow these biodiversity elements to persist over time. Two questions can be asked to address the issue of potential loss of biodiversity, (1) Will any species become extinct or classified in a higher conservation category due to the construction or operation of the road? and (2) Will any vegetation types become more threatened?

The species most likely at risk of becoming extinct are those that are already categorised as threatened (see Appendix 1 and Results section 4.2). On the basis of known information and results of the study reported above, no known threatened species populations will be directly affected by the construction of the road. Some of them occur deep within gorges, or areas that are inaccessible for other reasons. The species at greatest risk to the increased accessibility of remote habitats are the cycads, which are targeted as horticultural specimens. Of the four species of cycad in the greenfields area that are currently on the Red List, all have a wider distribution than the study area and it would require the removal of all individuals of these species from the greenfields area for there to be a justification for a change in conservation status. It is more likely that only those individuals that become visible from the new road would be removed and this will not result in a change in conservation status.

Table 6.42 lists species that need special consideration during EMPRs and that may be directly or indirectly affected by the proposed road.

Table 6.42: Threatened (Red List) plant species needing special attention in formulation of EMPRs.

Taxon	Global Status	Effect:	Action needed:
Clivia robusta	VU	Indirect	EMPR consideration
Leucospermum innovans	EN	Unknown, may be direct	Search and map
Phylica natalensis	VU	Unknown, may be direct	Search and map
Psoralea abbottii	VU	Unknown, may be direct	Search and map
Tephrosia pondoensis	VU	Indirect	EMPR consideration
Watsonia bachmannii	VU	Indirect	EMPR consideration
Watsonia inclinata	VU	Indirect	Conservation measures and mitigation against secondary impacts
Watsonia pondoensis	EN	Indirect	EMPR consideration

The vegetation types within the greenfields section are listed in Table 6.43 with conservation status of each. There are two vegetation types that could become increasingly threatened, namely Pondoland-Ugu Sandstone Coastal Sourveld and Transkei Coastal Belt. The Transkei Coastal Belt covers an area of 177 300 ha of which an additional almost 20% (35 637 ha) would have to be transformed to result in a change in conservation status. The evaluation of impacts between Ndwalane and Ntafufu (Section 6.3.4) indicates that approximately 300 ha of an approximately 920 ha patch of forest is at risk. Even if this entire block were lost, it would not result in a reclassification of the conservation status of this vegetation type. This is not a justification for destroying this patch of forest, but an attempt to answer the question posed above. The extent of the indirect impacts is not known with any confidence, but, given the protected status of all forests in South Africa, it is unlikely that indirect impacts would become

uncontrollable (assuming effective law enforcement). Forests within the Transkei Coastal Belt vegetation type are restricted to a 9 km section of new road - all other areas of forest within this vegetation type along the proposed route are already exposed to existing roads. If every fragment of forest within 2 km of the road is completely cleared (a worst-case scenario) then this will lead to approximately 920 hectares of forest being lost, insufficient to lead to a change in status of the vegetation type as a whole (will change the remaining percentage from 80.1% to 79.6%).

Pondoland-Ugu Sandstone Coastal Sourveld covers a total area of 130 300 ha in South Africa of which an additional almost 10% (13 030 ha) would have to be transformed to result in a change in conservation status (from Vulnerable to Endangered). The evaluation of impacts between Lusikisiki and Mthamvuna River (Section 6.3.6) indicates that approximately 952 ha of this vegetation type is at direct risk from construction of the road (SANRAL preferred route) and potentially another 2 000 - 11 800 ha from indirect impacts (note that the confidence in the assessment of this indirect impact is low, but a precautionary approach is adopted here). Once again, this is not a justification for destroying this vegetation, but it does indicate that the conservation status of Pondoland-Ugu Sandstone Coastal Sourveld is at risk. Assuming that 50% of the potential indirect impacts do occur, this will not result in a change in conservation status of Pondoland-Ugu Sandstone Coastal Sourveld. However, if 100% of the assessed potential indirect impacts do occur then the vegetation type would be on the borderline of re-classification to Endangered (with approximately 60.8% area remaining), especially due to the fact that so little is inside formal conservation areas.

For alternative route 1b, approximately 2 500 ha of Pondoland-Ugu Sandstone Coastal Sourveld is at risk from construction of the road (direct and indirect impacts). If this proportion of the vegetation type were lost, there would be 62% remaining. This may still be sufficient for re-classification, if little is conserved.

Table 6.43: Vegetation types occurring within the two greenfields sections of the proposed N2 Pondoland road.

Vegetation type	Conservation category	Original extent (ha)
Pondoland-Ugu Sandstone Coastal Sourveld	Vulnerable (70.9% remaining)	130 300
Scarp Forest	Least Threatened (but protected)	12 441
Eastern Valley Bushveld	Least Threatened	1 068 200
Transkei Coastal Belt	Vulnerable (80.1% remaining)	177 300

The broad assessment is that the proposed development of the road could potentially lead to some loss of biological diversity: it is unlikely to lead to a change in conservation status of any species but may lead to a change in conservation status of a vegetation type (Pondoland-Ugu Sandstone Coastal Sourveld).

6.7.2 Threaten key ecological processes

Ecological processes are actions or events that shape landscapes by linking abiotic and biological elements. These may be natural disturbances, such as fire, or ongoing processes, such as carbon sequestration and nutrient cycling. They are responsible for providing many of the ecological goods and services that we rely on to survive. Major ecological processes include the following:

- photosynthesis (carbohydrate production, carbon sequestration, oxygen production)
- nutrient flow and conversion
- energy flow through food webs (herbivory, carnivory, decomposition)
- disturbance (fire, grazing, burrowing)
- water cycling
- pollination, seed dispersal

The road may potentially affect ecological function in three ways, namely (1) by loss of habitat in which processes occur or by changes in the nature of such habitats, e.g. species composition change, alien invasion, (2) by forming a barrier to lateral or linear flows of water, nutrients or fire or movement of animals vital to ecological processes, or (3) by modifying the way in which processes occur or the timing of such processes, e.g. more rapid runoff or overland flow or increased incidence of fire.

The impact assessment indicates that in the greenfields section of the proposed road, the most significant potential direct impacts are usually loss of habitat, invasion by alien plants, increased runoff and disruption of the flow of nutrients and materials. The latter three can be controlled by implementing various mitigation measures and loss of habitat directly affects a small proportion of the overall landscape and potentially a larger portion of the landscape indirectly (which may be significant). At a local scale, the road may therefore threaten some key ecological process. Due to the high number of marsh wetlands in the path of Alternative 1b, this alternative may have a greater impact on key ecological processes.

At a more regional scale this effect is more difficult to assess. Water and nutrient transport happens primarily within river and wetland systems. Most of these are proposed to be crossed by significant bridge structures that will not impede water-flow. This is not the case for Alternative 1b, where a significant number of wetlands may be crossed at their sources. Overland migration and movement of organisms is likely to be significantly affected by a wide road. For approximately half the greenfields length of the proposed road, the alignment is along the boundary of the PCE. Plants and many animals are little affected by small fragments of cultivation and settlement. They have evolved to disperse/range across patches of unsuitable habitat, but the continuous barrier posed by a highway and its associated zones of disturbance and related impacts, is much more problematic for maintaining ecosystem processes across landscapes. The proposed road is therefore thought to provide a barrier that may result in dispersal and migration processes in a coastal-inland direction being affected.

6.7.3 Exceed thresholds

Ecological thresholds can be viewed as critical periods in time when plant community and soil processes undergo significant and persistent changes in response to particular management or natural factors. Such changes are common when resistance and resilience are compromised. Once processes have changed and a new state is indicated, there is a very low probability that the ecosystem will return to its original state without costly management intervention. Resistance is the degree of disturbance (for instance, grazing) that a plant community or soil can tolerate before it changes to another state. Resilience is the time it takes for a plant community or soil to return to its original state when the disturbance (for example, drought) is suspended.

At a landscape scale the most critical threshold that has been identified in the assessment process is loss of habitat, whereas at a local scale compositional changes due to alien invasion, disturbance, modification of processes (e.g. drainage, runoff) have been identified as being more important. The impact assessments indicate that there is a risk of exceeding thresholds at a local scale. At a local scale, the potential impacts of greatest concern, including alien invasion, increased runoff and disruption of the flow of nutrients and materials, may occur and thus result in thresholds being exceeded, but these can be controlled by the implementation of mitigation measures (assuming management commitment and effective monitoring and reporting).

At a regional scale it is possible that thresholds will be exceeded (primarily loss of habitat due to direct and indirect impacts). This is evaluated in section 6.4.1 above, where it is shown that

the loss of habitat within Pondoland-Ugu Sandstone Coastal Sourveld could lead to a change in conservation status from Vulnerable to Endangered, which indicates that the threshold beyond which ecosystem processes and patterns can be maintained is being approached.

6.7.4 Threaten life support systems

Life support systems are linked to ecosystem function, which depends on ecological processes. The most important life support systems include water, oxygen and food. These depend on adequate habitat in functional condition and the maintenance of production, hydrological function and other ecological processes. The factors that may threaten these include loss of habitat, invasion by alien plants, increased runoff and disruption of the flow of nutrients and materials. The latter three can be controlled by implementing various mitigation measures (assuming management commitment and effective monitoring and reporting to enforcement agencies), whereas loss of habitat potentially affects a moderate proportion of the overall landscape. At a local scale, the road may therefore threaten some key ecological process linked to life support systems, but this effect dissipates quickly with distance from the road. At a more regional scale this effect is less significant and unlikely to be critically important.

6.7.5 Threaten protected, important, unique, sensitive or irreplaceable areas

The PCE and its associated flora have been identified as an important, unique and irreplaceable area. On a national scale of high vulnerability to a wide range of threats, the "Maputaland-Pondoland area" has been ranked second of all ecosystems in South Africa out of a total of nine areas (Boshoff & Wilson 2005). Some of the unique elements associated with the PCE include scarp forest, wetlands (various types), rocky areas within grasslands, open grasslands, river gorges, red dune areas close to the coast and many others. In fact, it is the unique geology of this area associated with the geomorphology that has led to the development of a set of unique ecosystems that are found in this area. Endemic and threatened plant species of PCE are spread amongst these different ecosystem types and, although some, e.g. forest, have high numbers of endemic species relative to others, most of the PCE ecosystems harbour unique floristic features of interest. Various proposals have been mooted to provide protection for this unique area. Components of the PCE, e.g. forests, are already afforded some protection under national legislation.

The impact assessment identifies that Pondoland grasslands (including a variety of plant communities) are potentially at risk from the road and its associated impacts. It has been assessed that the road does not significantly reduce the opportunity to undertake effective conservation, biodiversity conservation planning or establish conservation areas within the PCE (section 6.3.3 above), but such conservation management would have to be effectively implemented in order to lower the potential risk to the PCE. The potential threat of the road to protected, important, unique, sensitive, irreplaceable areas is therefore potentially significant, especially in the absence of effective conservation management.

6.7.6 Exacerbate human-induced climate change

The road itself will not induce climate change since it will not generate significant amounts of greenhouse gases or result in an overall significant change in the albedo of the regional landscape. It is also unlikely to provide a barrier for species migration in response to climate change: the proposed alignment of the road in the greenfields section occurs near to a natural landscape break between two main geological formations. Any potential shifts in the geographical ranges of species in response to climate change would probably be restricted by this natural barrier more so than by the road. The proposed road cannot therefore be considered potentially responsible for exacerbating human-induced climate change.

6.7.7 Lead to irreversible loss of natural capital

Natural capital is a metaphor for the mineral, plant, and animal formations of the Earth's biosphere when viewed as a means of production of oxygen, water filter, erosion preventer, or provider of other ecosystem services (http://en.wikipedia.org/wiki). UNEP defines natural capital as the amount and quality of natural ecosystems.

Any major development within a greenfields area will result in the irreversible loss of some areas of natural ecosystems, even if only 1 ha is involved (if the definition is applied strictly). The current project is no exception and will lead to the direct loss of approximately 952 ha of grassland in greenfields areas as well as some forest and other miscellaneous areas. It is difficult to assess whether this amount of loss is significant or not or whether this is significant irrespective of the amount of natural habitat lost without mapping the extent of each habitat type within the entire PCE. It is only possible to assess the significance of loss of habitat within habitat sub-types if they are mapped for the entire PCE. However, the habitats taken together represent natural capital and, irrespective of whether 1 ha or 2 952 ha are lost, it is still classified as an irreversible loss of natural capital. Due to the highly sensitive nature of the PCE as a whole, any loss of habitat may be considered to be incremental reduction in the ecological viability of the area. The road may therefore be considered to lead to irreversible loss of natural capital that is potentially significant.

6.7.8 Impacts are unknown or uncertain

The process for identifying potential impacts included a literature review, a review of similar projects and the combined expertise of a number of specialists involved in the previous and current EIA processes for the current proposed project. There is therefore high confidence in the belief that potential direct impacts are known. Potential indirect impacts are also known with moderate to high confidence, although confidence is reduced for impacts over long time scales. There is some uncertainty about impacts in the study area in the absence of the road project taking place due to social factors.

6.7.9 Lead to substantial negative cumulative impacts

These are the total effects, both direct and indirect, on a given resource or ecosystem of all actions taken. The NEMA EIA Regulations define cumulative impacts as "the impact of an activity that in itself may not be significant but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area".

Cumulative impacts include some of the secondary and indirect impacts already assessed, e.g. fragmentation and ribbon development. These direct and indirect impacts have been estimated to potentially lead to 2 932 ha of Pondoland-Ugu Sandstone Coastal Sourveld being lost, sufficient to result in the vegetation type being reclassified into a higher conservation category. From the point of view of the botanical receiving environment, the outcome of additional cumulative impacts in the long-term may be further loss of habitat, loss of biodiversity and species of special concern and decline in habitat quality. The secondary impact of greatest concern is strip / ribbon development. It is well-known that ribbon development occurs where a new road traverses communal areas, as can be seen within various parts of the Eastern Cape. The remote areas of the greenfields section of the proposed road currently have relatively dispersed settlement patterns. This is likely to change with the construction of the road. There are therefore potentially severe cumulative impacts associated with strip / ribbon development. The road may therefore lead to substantial negative cumulative impacts.

There are also additional cumulative impacts arising from existing and future impacts of current and reasonably foreseeable future developments. These include (but are not limited to) the following projects:

1. Proposed coastal meander route.
2. Proposed mining at Xolobeni.
3. Mzamba has been identified as a gateway to the Eastern Cape. Various proposals to attract tourists will be established around the node.
4. Msikaba and Mbotyi have been identified as tourism nodes along the coast. Link routes are proposed from the proposed N2 toll road to these nodes. Link points (intersections) have been identified as distribution points.
5. Access to coastal resorts from the proposed N2 toll road will attract more development, either controlled or uncontrolled, at the coastal nodes and/or along the coast.

It is difficult to predict the cumulative impact of the proposed road, its possible secondary impacts and the impacts of the projects listed above, but in section 6.4.5 (above) it is estimated that the road and its secondary impacts (including possible strip and nodal development) could lead to sufficient loss of habitat to result in Pondoland-Ugu Sandstone Coastal Sourveld being re-categorised as an Endangered vegetation type. It is likely that the additional projects would further exacerbate this loss of habitat and make it more likely that habitat loss would lead to re-categorisation of the vegetation type.

6.7.10 Assessment of ecological sustainability

The construction and operation of the road may lead to the irreversible loss of some natural habitat and there are some potential secondary impacts that may lead to reclassification of Pondoland-Ugu Sandstone Coastal Sourveld to a higher conservation category. There may therefore be some "irreversible loss of natural capital" and possibly, "loss of biological diversity" through direct habitat loss associated with the Pondoland-Ugu Sandstone Coastal Sourveld. There is also a direct risk of impacts on important, unique, sensitive or irreplaceable areas.

Table 6.44: Assessment of the proposed N2 Pondoland road with respect to various ecological sustainability indicators.

Sustainability factor	Effect of road
1. lead to loss of biological diversity - species, ecosystems	Could potentially lead to some loss of biological diversity: unlikely to lead to change in conservation status of any species but may lead to change in conservation status of a vegetation type (Pondoland-Ugu Sandstone Coastal Sourveld) if all secondary impacts are realised. Consideration of Alternative 1b may still result in a change in conservation status in time.
2. threaten key ecological processes	At a local scale, the road may threaten some key ecological process (increased runoff and disruption of the flow of nutrients and materials). This will occur to a greater degree for Alternative 1b. At a regional scale the road may disrupt dispersal and migration processes in a coastal-inland direction.
3. exceed thresholds, capacities, safe minimum standards, regenerative and/or assimilative	At a local scale, potential impacts (alien invasion, increased runoff and disruption

capacities of natural systems	of the flow of nutrients and materials) may result in thresholds being exceeded, but these can be controlled by the implementation of mitigation measures. At a regional scale the loss of habitat within Pondoland-Ugu Sandstone Coastal Sourveld could lead to a change in conservation status (VU to EN), which indicates that the threshold beyond which ecosystem processes and patterns can be maintained is being approached. This effect may be marginally less for Alternative 1b.
4. threaten life support systems	At a local scale, the road may threaten some key ecological process linked to life support systems, but this effect dissipates quickly with distance from the road. At a more regional scale this effect is less significant.
5. threaten protected, important, unique, sensitive, irreplaceable, stressed, highly dynamic, rare or special areas	The potential threat of the road to *protected, important, unique, sensitive, irreplaceable areas* (the Pondoland Centre of Endemism and all its unique components) is potentially significant, especially in the absence of effective conservation management in the area. The effect is the same for Alternative 1b.
6. exacerbate human-induced climate change	The proposed road cannot be considered potentially responsible for exacerbating human-induced climate change.
7. lead to irreversible loss of natural capital	Due to the highly sensitive nature of the PCE as a whole, any loss of habitat may be considered to be incremental reduction in the ecological viability of the area. There will be loss of habitat due to direct and indirect impacts by the proposed road which may be considered to be irreversible loss of natural capital that is potentially significant. Alternative 1b will cause this to a lesser extent.
8. impacts are unknown or uncertain; inadequate knowledge or information to predict them with confidence	There is high confidence in the belief that potential direct impacts are known. There is some uncertainty about impacts in the study area in the absence of the road project taking place.
9. lead to substantial negative cumulative impacts.	Construction of the road may lead to substantial negative secondary impacts primarily associated with strip / ribbon development and fragmentation and the impacts associated with this. Alternative 1b will cause this to a lesser extent. Cumulative impacts due to additional proposed projects in the study area make habitat loss more likely and impacts more serious, especially on components of the

	PCE. The proposed project is therefore likely to lead to significant negative cumulative impacts.

Of the eight criteria evaluated (excluding the degree of uncertainty in impacts), the assessment of proposed road leads to six sustainability criteria returning a negative assessment. On this basis, the proposed road is not considered to be ecologically sustainable. However, if secondary impacts can be controlled and conservation measures can be put in place to effectively protect core components of the PCE then the assessment of five of these criteria may be reversed / become insignificant and the proposed road could then be considered to be ecologically sustainable.

For four of the criteria, Alternative 1b (Coastal Mzamba route) will affect these criteria to a lesser extent and for one criterion, Alternative 1b will have a slightly greater effect (see Table 6.44).

7. DISCUSSION AND CONCLUSIONS

7.1 Description of the affected environment

The entire study area falls within the Maputaland-Pondoland-Albany Hotspot (MPA Hotspot). Much of the vegetation of the MPA has been destroyed or severely degraded. Most plant endemic species in the MPA are confined to grassland, the most seriously threatened vegetation type in the MPA region. The Pondoland Centre of Endemism is one of the three foci of endemism within the MPA Hotspot, and is an area of high endemism and high diversity. The Pondoland Centre of Endemism is edaphically defined and restricted to sandstone-derived soils, primarily of the Msikaba Formation. The vegetation of the Pondoland Centre consists primarily of grasslands, with forests restricted primarily to river gorges. It is renowned for containing high numbers of endemic species and is considered to be South Africa's second-most diverse floristic area after the fynbos region. The location of the proposed project within this defined hotspot and area of high conservation value means that potential impacts have to be carefully evaluated with respect to their effect on the maintenance of floristic patterns within these areas.

The recently completed new national vegetation map undertaken by SANBI (Mucina & Rutherford, 2006) provides better resolution information on vegetation patterns in the region than either Acocks or Low and Rebelo. The distribution of vegetation types along this route are shown in Figure 3 (Durban to Port St. Johns) and Figure 4 (Port St. Johns to East London). According to this description, the existing N2 road (excluding the proposed greenfields section) between Durban and East London passes through (in order of appearance) KwaZulu-Natal Coastal Belt, Pondoland-Ugu Sandstone Coastal Sourveld, Northern Coastal Forest, Scarp Forest, Ngongoni Veld, Eastern Valley Bushveld, Transkei Coastal Belt, Southern Mistbelt Forest, Bhisho Thornveld, Mthatha Moist Grassland, Albany Coastal Belt and Buffels Thicket. There are four vegetation types in the greenfields study area between Lusikisiki and Port Edward, namely Ngongoni Veld, Pondoland-Ugu Sandstone Coastal Sourveld, Scarp Forest and Eastern Valley Bushveld. These vegetation types are briefly described below. The intention of this section of the report is to describe in broad terms the vegetation types that have been mapped for this part of the country in order to contextualise the study. The information provided in these descriptions is as given in Mucina & Rutherford (2006).

Detailed examination of the plant communities and landscape units was undertaken for the greenfields section. A number of vegetation structural types may be found in this area, including secondary and altered landcover types. These have been mapped in detail and floristic sampling has been undertaken over two seasons to describe these plant communities. These patterns are not described in detail here, but provide an invaluable source of information for defining sensitive areas, undertaking conservation planning and evaluating impacts on sensitive areas.

An updated list of historical occurrences of Red List plant species was obtained from the Threatened Species Programme of SANBI (South African National Biodiversity Institute) for those parts of the country across which the proposed route traverses. This list was limited to areas along the proposed route between East London and Isipingo where there was sufficient natural habitat that may be affected by the proposed project. The list is important in identifying those plant species for which there is conservation concern and for which potential impacts need to be carefully controlled.

Although there are existing conservation areas, large parts of the MPA region are inadequately protected. This is especially true of the Pondoland area where only a few very small

conservation areas are present. Grasslands, woody grasslands, and coastal forests and thickets are of the habitats that are the most inadequately protected. The low rates of conservation in the study area make it difficult to undertake any other environmental management.

7.2 Identification of risk sources

In order to understand the potential issues associated with construction of the road through the greenfields section, an extensive literature review was undertaken to identify the possible risks associated with construction of a road through a previously untransformed landscape. Risks identified as being relevant to the present proposal include the following (including construction and operation phases, direct and indirect risks):

1. Selection of alignment position.
2. Road engineering design, including use and position of bridges, culverts and viaducts, roadside drainage and storm-water management, slope angle and material properties of cuts and fills.
3. Clearing of land for new road construction.
4. Clearing of land for new interchanges and new toll plazas.
5. Widening of existing roads.
6. Construction and access of haul roads.
7. Establishment of borrow and spoil areas.
8. Storage of materials required for road construction.
9. Chemical contamination of the soil by construction vehicles and machinery.
10. Construction and operation of construction camps.
11. Biological and chemical pollution at construction camps
12. Chemical contamination of the soil, air or water by motor vehicles
13. Strip/ribbon development
14. Increased accessibility of remote habitats
15. Reduction in resilience / loss of ecosystem function of plant communities and ecosystems
16. Disruption of the flow of nutrients and materials

7.3 Impact description and assessment

Impacts were assessed for each item of infrastructure for each of the seven major sections of road between East London and Durban. The results of this assessment are summarised here.

7.3.1 Impacts along the route corridor

Section 1: Gonubie Interchange to Ngobozi

This is an existing national road that is to be upgraded. With mitigation, the construction of the Ngobozi mainline toll plaza, upgrading of intersections and widening of roads will be unlikely to result in any impacts of medium or high significance.

Section 2: Ngobozi to Mthatha (Ngqeleni)

This is an existing national road that is to be upgraded. With mitigation, the construction of the Candu mainline toll plaza, upgrading of intersections, widening of roads and construction of the new carriageway bridges at the Mthatha and Corana Rivers will be unlikely to result in any impacts of medium or high significance.

Section 3: Mthatha to Ndwalane

This is an existing national road that is to be upgraded. With mitigation, the construction of the Ndwalane mainline toll plaza, upgrading of intersections, widening of roads and widening of the bridge at the Mngazi River will be unlikely to result in any impacts of medium or high significance.

Section 4: Ndwalane to Ntafufu River

This is a new greenfields section of road. With mitigation measures, the construction of the road from Ndwalane to Ntafufu River will result in impacts of medium significance, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat", "increased accessibility of remote habitats" and "reduction in resilience/stability of ecosystems". The construction of the alternative road from Ndwalane to Ntafufu River (alternative 1b) will also result in impacts of medium or high significance, namely "fragmentation of habitat", "increased accessibility of remote habitats" and "disruption of the flow of nutrients and materials". From a botanical perspective, the alternative alignment is potentially less likely to lead to significant impacts on forests (although both alignments will affect forests to some extent). The alternative alignment (1b) will have significant impacts on floodplain and riparian areas that could affect areas upstream and downstream of the alignment. From a broader ecological perspective, the SANRAL preferred alignment is favoured over the alternative alignment. With mitigation, construction of the new high-level bridge over the Mzimvubu River will be unlikely to result in any impacts of medium or high significance. With mitigation, construction of the Ndwalane mainline toll plaza will result in an impact of medium significance, namely "loss of habitat", which is unavoidable and a local impact.

Section 5: Ntafufu River to Lusikisiki (Magwa Intersection)

This is an existing national road that is to be upgraded. With mitigation, the construction or upgrading of intersections, widening of roads and widening of the bridge at the Mzintlava River will be unlikely to result in any impacts of medium or high significance

Section 6: Lusikisiki to Mthamvuna River

This is a new greenfields section of road. With mitigation, the proposed construction of the entire road from Lusikisiki to Mthamvuna River will result in impacts of medium or high significance, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat", "loss of species of special concern", "strip development", "increased accessibility of remote habitats" and "reduction in resilience/stability of ecosystems". There are a number of alternative alignments along portions of this route. These were also individually assessed and are discussed in more detail in section 6.3.2 (below).

There are a number of new bridges to be constructed along this greenfields alignment. These were individually assessed, as follows:

1. With mitigation, the new bridge over the Msikaba River will result in impacts of medium or high significance, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat", "loss of species of special concern" and "increased accessibility of remote habitats".
2. With mitigation, the new bridge over the Mthentu River will result in impacts of medium or high significance, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat", "loss of species of special concern" and "increased accessibility of remote habitats".
3. With mitigation, the new bridge over the Kwadlambu River will result in impacts of medium or high significance, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat", "loss of species of special concern", "increased runoff", "Reduction in resilience/stability of ecosystems" and "disruption of the flow of nutrients and materials".

4. With mitigation, the new bridge over the Mnyameni River will result in impacts of medium significance, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat", and "increased runoff".
5. With mitigation, the new bridge over the Kulumbe River will result in impacts of medium significance, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat", and "increased runoff".
6. With mitigation, the new bridge over the Mpahlane River will result in impacts of medium significance, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat", and "increased runoff".
7. With mitigation, the new bridge over the Mzamba River will result in impacts of medium significance, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat", and "increased runoff".

There is one large interchange and a number of smaller intersections along the proposed greenfields alignment as well as a proposed mainline toll plaza. With mitigation, the new R61 interchange, new intersections with district roads and the new Mthenthu mainline toll plaza will be unlikely to result in any impacts of medium or high significance, except for potential ribbon development associated with the presence of the new road.

Section 7: Mthamvuna River to Isipingo Interchange
This is an existing national road that is to be upgraded. With mitigation, the widening of roads and widening of bridge at the Amanzimtoti River and will be unlikely to result in any impacts of medium or high significance. Construction of the new Park Rynie and Isipingo mainline toll plazas and Port Edward, Southbroom and Adams Road Interchanges will not result in any impacts on the botanical receiving environment

7.3.2 Comparison of proposed alternatives

Alternative 1b
There are two possibilities for crossing the Mzimvubu River, the SANRAL preferred alignment and the alternative alignment (alignment 1b). A summary of the significance of potential impacts (after mitigation) of the SANRAL preferred alignment in comparison to the alternative alignment for this section of road is given in Table 7.1 (below). The SANRAL preferred alignment will result in fragmentation of the forest area through which it travels, although there is existing disturbance and transformation within this alignment that has already affected this forested area. The forest also tends to become more thicket-like closer to the proposed bridge over the Mzimvubu River and true forest only occurs closer to the existing R61. The alternative alignment leads to less fragmentation of forest, but introduces potential permanent impacts on the floodplain of the Mzimvubu River that are considered to be a more serious ecological impact. It also tends to affect true forest, rather than tall thicket. The SANRAL preferred alignment is therefore favoured over the alternative alignment along this section. This is consistent with the previous EIA study, where the SANRAL preferred route (Alternative 1e) was nominated as the preferred alignment based on the environmental investigations undertaken during the previous EIA.

Table 7.1: Summary of the significance of potential impacts (with mitigation measures) of the two alternative alignments within the greenfields section from Ndwalane to Ntafufu River.

Impact	Significance	
	SANRAL preferred route	Alternative 1b
Direct loss of habitat	LOW	MEDIUM
Loss of biodiversity	LOW	MEDIUM
Fragmentation of habitat	MEDIUM	MEDIUM

Loss of species of special concern	LOW	LOW
Increased runoff & drainage, soil erosion, silt loads & sedimentation	LOW	VERY LOW
Invasion by alien weeds & invader plants	LOW	LOW
Pollution at construction camps	VERY LOW	VERY LOW
Increased risk of veld fires	VERY LOW	VERY LOW
Vehicular pollution of soil, air or water	LOW	LOW
Strip development	LOW	LOW
Increased accessibility of remote habitats	MEDIUM	MEDIUM
Reduction in resilience/stability of ecosystems	LOW	MEDIUM
Disruption of the flow of nutrients and materials	HIGH	LOW

Alternative 2a

There are two alternatives for passing the village of Ntafufu, the proposed route and alternative 2a. A summary of the significance of potential impacts (after mitigation) of the SANRAL preferred alignment in comparison to the alternative alignment for this section of road is given in Table 7.2 (below). The proposed construction of the alternative road at Ntafufu (alternative 2a) will not result in loss of habitat, since the entire alternative alignment is through cultivated areas. There will, however, be a bridge construction at an existing stream crossing, which may result in impacts on ecological processes associated with the riparian/wetland habitat. The proposed alignment may result in a small amount of habitat loss, but this is in a degraded area close to an existing village. Either alignment is therefore acceptable from a botanical impact point of view.

Table 7.2: Summary of the significance of potential impacts (with mitigation measures) of the two alternative alignments within the greenfields section from Ndwalane to Ntafufu River at the village of Ntafufu.

Impact	Significance	
	SANRAL preferred route	**Alternative 2a**
Direct loss of habitat	n/a	n/a
Loss of biodiversity	n/a	n/a
Fragmentation of habitat	n/a	n/a
Loss of species of special concern	n/a	n/a
Increased runoff & drainage, soil erosion, silt loads & sedimentation	LOW	LOW
Invasion by alien weeds & invader plants	LOW	LOW
Pollution at construction camps	VERY LOW	VERY LOW
Increased risk of veld fires	VERY LOW	VERY LOW
Vehicular pollution of soil, air or water	LOW	LOW
Strip development	LOW	LOW
Increased accessibility of remote habitats	LOW	LOW
Reduction in resilience/stability of ecosystems	LOW	LOW
Disruption of the flow of nutrients and materials	LOW	LOW

Alternatives 5e and 5g

There are three alternatives for approaching and crossing the Msikaba River gorge, the SANRAL preferred alignment and alternatives 5e and 5g. A summary of the significance of potential impacts (after mitigation) of the SANRAL preferred alignment in comparison to the alternative alignments for this section of road is given in Table 7.3 (below). The valley in which these three alignments occur is very high in habitat diversity and any of the three alignments is going to have significant impacts on biodiversity and species of special concern, as follows:

1. With mitigation, the new road alternative at Msikaba bridge crossing (alternative 5e) will result in impacts of medium or high significance, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat", "loss of species of special concern", "increased runoff", "strip development", "increased accessibility of remote habitats", "reduction in resilience/stability of ecosystems" and "disruption of the flow of nutrients and materials".
2. With mitigation, the new road alternative at Msikaba bridge crossing (alternative 5g) will result in impacts of medium or high significance, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat", "loss of species of special concern", "increased runoff", "strip development", "increased accessibility of remote habitats", "reduction in resilience/stability of ecosystems" and "disruption of the flow of nutrients and materials".

The three alignments have similar impacts, but 5e introduces greater potential impacts on forests and traverses some steep slopes from which there may be serious erosion problems. Alternative 5e is therefore the least favoured alignment for this section. The SANRAL preferred alignment crosses a greater number of rocky habitats and wetlands than the other two options. It is within these rocky habitats that great biodiversity is found and in which it is more likely to find species of special concern. The SANRAL preferred alignment has therefore been assessed as having marginally higher impacts on biodiversity and potentially greater impacts on species of special concern than alternative 5g, although both are relatively similar in terms of impacts.

Table 7.3: Summary of the significance of potential impacts (with mitigation measures) of the two alternative alignments within the greenfields section from Lusikisiki to Mthamvuna River at the crossing of the Msikaba River gorge.

Impact	Significance		
	SANRAL preferred route	**Alternative 5e**	**Alternative 5g**
Direct loss of habitat	HIGH	HIGH	HIGH
Loss of biodiversity	HIGH	HIGH	MEDIUM
Fragmentation of habitat	MEDIUM	MEDIUM	MEDIUM
Loss of species of special concern	MEDIUM	MEDIUM	MEDIUM
Increased runoff & drainage, soil erosion, silt loads & sedimentation	MEDIUM	MEDIUM	MEDIUM
Invasion by alien weeds & invader plants	LOW	LOW	LOW
Pollution at construction camps	VERY LOW	VERY LOW	VERY LOW
Increased risk of veld fires	VERY LOW	VERY LOW	VERY LOW
Vehicular pollution of soil, air or water	LOW	LOW	LOW
Strip development	MEDIUM	MEDIUM	MEDIUM
Increased accessibility of remote habitats	HIGH	HIGH	HIGH
Reduction in resilience/stability of ecosystems	MEDIUM	MEDIUM	MEDIUM
Disruption of the flow of nutrients and materials	MEDIUM	MEDIUM	MEDIUM

Alternative 9d_5

There are two alternative alignments for the crossing of the Mtentu River, the SANRAL preferred alignment and alignment 9d_5. A summary of the significance of potential impacts (after mitigation) of the SANRAL preferred alignment in comparison to the alternative alignment for this section of road is given in Table 7.4 (below). With mitigation, the new road

alternative (alternative 9d_5) will result in impacts of medium or high significance, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat", "loss of species of special concern", "increased runoff", "strip development", "increased accessibility of remote habitats" and "reduction in resilience/stability of ecosystems". These impacts are the same as for the SANRAL preferred alignment for this section of route. From a botanical perspective, there is no obvious preference between the two alignments. The SANRAL preferred alignment is marginally favoured due to being slightly further inland.

Table 7.4: Summary of the significance of potential impacts (with mitigation measures) of the two alternative alignments within the greenfields section from Lusikisiki to Mthamvuna River at the crossing of the Mtentu River gorge.

Impact	Significance	
	SANRAL preferred route	**Alternative 9d_5**
Direct loss of habitat	HIGH	HIGH
Loss of biodiversity	HIGH	HIGH
Fragmentation of habitat	MEDIUM	MEDIUM
Loss of species of special concern	MEDIUM	MEDIUM
Increased runoff & drainage, soil erosion, silt loads & sedimentation	MEDIUM	MEDIUM
Invasion by alien weeds & invader plants	LOW	LOW
Pollution at construction camps	VERY LOW	VERY LOW
Increased risk of veld fires	VERY LOW	VERY LOW
Vehicular pollution of soil, air or water	LOW	LOW
Strip development	MEDIUM	MEDIUM
Increased accessibility of remote habitats	MEDIUM	MEDIUM
Reduction in resilience/stability of ecosystems	MEDIUM	MEDIUM
Disruption of the flow of nutrients and materials	LOW	LOW

Alternatives 10e and 10a

There are three alternative routes for crossing the Mnyameni River (SANRAL preferred alignment, alternative 10e and alternative 10a). A summary of the significance of potential impacts (after mitigation) of the SANRAL preferred alignment in comparison to the alternative alignments for this section of road is given in Table 7.5 (below). With mitigation, the SANRAL preferred alignment at Mnyameni River (alternative 10c) will result in impacts of medium or high significance, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat", "loss of species of special concern", "increased runoff", "increased accessibility of remote habitats" and "reduction in resilience/stability of ecosystems". With mitigation, the new road alternative at Mnyameni River (alternative 10e) will result in impacts of medium or high significance, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat", "loss of species of special concern", "increased runoff", "strip development", "increased accessibility of remote habitats" and "reduction in resilience/stability of ecosystems". With mitigation, the new road alternative at Mnyameni River (alternative 10a) will result in impacts of medium or high significance, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat", "loss of species of special concern", "increased runoff", "strip development", "increased accessibility of remote habitats" and "reduction in resilience/stability of ecosystems". Due to the more transformed nature of the habitat along the SANRAL preferred alignment (10c), there will be fewer residual impacts following mitigation than for alternatives 10e and 10a, namely "increased runoff" and "increased accessibility of remote habitats".

Table 7.5: Summary of the significance of potential impacts (with mitigation measures) of the two alternative alignments within the greenfields section from Lusikisiki to Mthamvuna River at the crossing of the Mnyameni River gorge.

Impact	Significance		
	SANRAL preferred route	Alternative 10e	Alternative 10a
Direct loss of habitat	MEDIUM	HIGH	HIGH
Loss of biodiversity	MEDIUM	HIGH	HIGH
Fragmentation of habitat	MEDIUM	HIGH	MEDIUM
Loss of species of special concern	MEDIUM	MEDIUM	MEDIUM
Increased runoff & drainage, soil erosion, silt loads & sedimentation	MEDIUM	MEDIUM	MEDIUM
Invasion by alien weeds & invader plants	LOW	LOW	LOW
Pollution at construction camps	VERY LOW	VERY LOW	VERY LOW
Increased risk of veld fires	VERY LOW	VERY LOW	VERY LOW
Vehicular pollution of soil, air or water	LOW	LOW	LOW
Strip development	MEDIUM	MEDIUM	MEDIUM
Increased accessibility of remote habitats	MEDIUM	MEDIUM	MEDIUM
Reduction in resilience/stability of ecosystems	MEDIUM	MEDIUM	MEDIUM
Disruption of the flow of nutrients and materials	LOW	LOW	LOW

Coastal Mzamba route

This is an alternative alignment between the Mtentu River and the Mthamvuna River. A summary of the significance of potential impacts (after mitigation) of the SANRAL preferred alignment in comparison to the alternative alignments for this section of road is given in Table 7.6 (below). With mitigation, the new Coastal Mzamba road alternative will result in impacts of medium or high significance, namely "loss of habitat", "loss of biodiversity", "fragmentation of habitat", "loss of species of special concern", "increased runoff", "strip development", "increased accessibility of remote habitats" and "disruption of the flow of nutrients and materials". The Coastal Mzamba alignment appears to be attractive from the point of view of shifting the road outside the area planned as forming part of the Pondoland Park. However, it introduces a number of impacts assessed as having potentially very high significance due to the high number of source wetlands in this area. The SANRAL preferred alignment for this same section of route crosses the wetlands lower down where they have already formed channelled stream beds, either on sandy or rocky bottoms.

Table 7.6: Summary of the significance of potential impacts (with mitigation measures) of the two alternative alignments within the greenfields section from Lusikisiki to Mthamvuna River for the section from Mnyameni River to Mthamvuna River.

Impact	Significance	
	Proposed route	Coastal Mzamba route
Direct loss of habitat	LOW	HIGH
Loss of biodiversity	LOW	LOW
Fragmentation of habitat	LOW	HIGH
Loss of species of special concern	LOW	LOW
Increased runoff & drainage, soil erosion, silt loads & sedimentation	LOW	MEDIUM
Invasion by alien weeds & invader plants	LOW	LOW
Pollution at construction camps	VERY LOW	VERY LOW
Increased risk of veld fires	VERY LOW	VERY LOW

Vehicular pollution of soil, air or water	LOW	LOW
Strip development	MEDIUM	MEDIUM
Increased accessibility of remote habitats	MEDIUM	MEDIUM
Reduction in resilience/stability of ecosystems	LOW	MEDIUM
Disruption of the flow of nutrients and materials	LOW	MEDIUM

7.3.3 Impacts beyond the route corridor

Impacts associated with easier access to sensitive habitats

The proposed new roads between Ndwalane and Ntafufu and between Lusikisiki and Mthamvuna River will provide easier access to previously remote habitats that will promote higher rates of harvesting of, for example, medicinal plants, forest products, rare species and horticultural plants. The potential impact is likely to be on target species rather than on whole ecosystems, but whole ecosystems may suffer as a consequence. The two main potential impacts are "loss of biodiversity" and "loss of species of special concern". Increased disturbance of these habitats may also cause "increased invasion by alien species" and severe resource harvesting may eventually result in loss of habitat. Although travel in the PCE is quite difficult, the fact is that there are few places that are currently inaccessible.

Impacts associated with a reduction in the extent of components of the Pondoland Centre of Endemism

Direct impacts will not result in Pondoland-Ugu Sandstone Coastal Sourveld being reclassified into a higher conservation category, but indirect and/or cumulative impacts may result in this vegetation type being reclassified from Vulnerable to Endangered. Some Transkei Coastal Belt forest will be lost between Ndwalane and Ntafufu, but this is insufficient to lead to a change in the conservation status of this vegetation type. Indications are that no species of special concern are likely to be impacted upon directly by construction of the proposed road to such an extent that they are re-categorised into a higher conservation category.

Impacts associated with a reduction in the opportunity to undertake effective conservation, biodiversity conservation planning or establish conservation areas in the region

The proposed road does not have a major direct impact on the potential to undertake conservation planning in the PCE area, especially if the Coastal Mzamba alignment is selected

Impacts associated with fragmentation of habitat and barriers to movement due to the road cutting through areas of untransformed natural habitat

GIS analysis indicates that the PCE is already moderately fragmented and that neither the SANRAL preferred or Coastal Mzamba alignment causes a great increase in the overall number of patches or perimeter to area ratio relative to the current situation or a large decrease in the proportion of the PCE that is not directly influenced by a disturbance zone. The proposed new road marginally reduces the proportion of the PCE occupied by the largest patch of untransformed vegetation (which includes the Mkambati and Tracor area). The proposed road is itself, however, a more significant barrier than those currently found within the study area. The continuous barrier posed by a highway and its associated zones of disturbance and related impacts, is much more problematic for maintaining ecosystem processes across these areas than the current disturbances found there. Plants and many animals are little affected by small fragments of cultivation and settlement. They have evolved to disperse/range across patches of unsuitable habitat. From this point of view, the fragmentation caused by the SANRAL preferred route is more severe than that posed by the Coastal Mzamba alignment.

Impacts associated with the potential for ribbon development along new roads and in areas that become accessible from new roads

There are six sites within the PCE where there is a high likelihood of expansion of settlements due to the existing presence of roads and settlements and the proposed provision of intersections. Assuming that these expand on average by approximately 100-200 ha, this will result in approximately 600-1200 ha of direct habitat loss. Strip development may also result along the coastline due to improved access resulting in increased coastal development. Assuming limited controls on coastal development and approximately 50 ha per site in the medium term, it is possible that up to 800 ha could become developed as resorts along the coast. The combined potential loss of habitat due to ribbon development and coastal resort development may be sufficient to reclassify Pondoland-Ugu Sandstone Coastal Sourveld from Vulnerable to Endangered vegetation type.

Impacts associated with the reduction in resilience/stability of plant communities and ecosystems due to impacts generated by the new road

Secondary impacts, e.g. alien invasions, habitat fragmentation, and reduction in area of remaining patches, may promote reduction in resilience/stability of plant communities and ecosystems. If these secondary impacts can be controlled, then the overall impact on ecosystem resilience by the road will probably not be significant.

Impacts associated with the disruption of the linear flow of nutrients and materials by road infrastructure leading to the interruption of biogeochemical cycles

If mitigation measures for direct impacts on linear flows can be implemented then the overall impact on the linear flow of nutrients and materials by the road will probably not be significant. This would involve simple design issues, which would be relatively easy to implement, and potentially some additional construction costs.

7.3.4 Summary of potential impacts on the Pondoland Centre of Endemism

One of the terms of reference was to assess the potential impacts of the proposed project in terms of the overall conservation/ecosystem/biodiversity value of the Pondoland Centre of Endemism (and proposed Pondoland/Wild Coast National Park). It is clear from published information on the PCE that it has a high conservation / biodiversity value (e.g. Abbott et al. 2000, Cooper & Swart 1992, Cawe et al. 1994, Dahlgren & van Wyk 1988, Hartmann 1991, Johnson & Cawe 1987, Johnson & Hutchings 1989, Meter 1998, Shackleton 1989, Shackleton et al. 1991, Sim 1900, van Wyk 1990a, 1990b, 1994, von Breitenbach & von Breitenbach 1983) and that it has been identified as having high conservation priority (e.g. Driver et al. 2005, Steenkamp et al. 2004). Any impact that reduces the overall area of the PCE, reduces the ecological integrity of the area or results in losses of key biodiversity components is potentially serious.

Table 7.7 provides a summary of direct, local impacts due to the road (the significance of impacts is after mitigation measures are applied - for full assessment see sections 5.1.4.1 and 5.1.4.2). It can be seen that the proposed route may have medium to very high impacts on habitat, biodiversity and fragmentation of habitat.

Section 5.2.3 of this report is an assessment of the impacts associated with a reduction in the opportunity to undertake effective conservation, biodiversity conservation planning or establish conservation areas in the region. The assessment indicates that the SANRAL preferred alignment potentially reduces the core area of the proposed park to 88% of its planned area and the Coastal Mzamba alignment would result in this included proportion becoming almost 97% of the desired area.

From these and other components of the report it is clear that the proposed road has the potential to cause direct impacts that will affect the overall conservation/ecosystem/biodiversity value of the Pondoland Centre of Endemism (and proposed Pondoland/Wild Coast National Park).

Table 7.7: Summary of the significance of potential impacts (with mitigation measures) of the SANRAL preferred alignment within the greenfields section from Lusikisiki to Mthamvuna River.

Impact	Significance
Direct loss of habitat	HIGH
Loss of biodiversity	MEDIUM
Fragmentation of habitat	HIGH
Loss of species of special concern	MEDIUM
Increased runoff & drainage, soil erosion, silt loads & sedimentation	LOW
Invasion by alien weeds & invader plants	LOW
Pollution at construction camps	VERY LOW
Increased risk of veld fires	VERY LOW
Vehicular pollution of soil, air or water	LOW
Strip development	HIGH
Increased accessibility of remote habitats	HIGH
Reduction in resilience/stability of ecosystems	MEDIUM
Disruption of the flow of nutrients and materials	LOW

7.4 Mitigation and monitoring

A number of mitigation measures have been proposed to avoid or minimise impacts on the botanical receiving environment. These include measures to:

1. avoid sensitive habitats and species of special concern,
2. minimise damage to sensitive habitats,
3. control alien invasions,
4. control runoff and erosion,
5. guide rehabilitation and revegetation.

These mitigation measures cannot, however, reduce the direct loss of habitat associated with the construction of a new road, only limit the extent of that direct impact to some degree. The secondary impacts are of greatest concern and these require the greatest long-term commitment from a variety of role players as well as long-term monitoring to ensure that they are applied.

A number of monitoring approaches are given to detect impacts as they occur, monitor the application and efficacy or mitigation measures and to monitor the health of adjacent ecosystems, biodiversity, processes and populations of species of special concern that may be directly impacted by the proposed road. These include:

1. Visual assessments,
2. Sampling of simple functional attributes of the landscape to detect ecological functioning,
3. Monitoring of alien plants,
4. Permanent floristic monitoring sites,
5. Population studies on species of special concern,
6. Remote sensing of landscape changes beyond the route corridor.

7.5 Ecological sustainability of the project

An assessment was made to evaluate the ecological sustainability of the proposed project using a list of guidelines.

The proposed development of the road could potentially lead to some *loss of biological diversity*. It is unlikely to lead to a change in conservation status of any species but may lead to a change in conservation status of a vegetation type (Pondoland-Ugu Sandstone Coastal Sourveld).

The road may threaten some local scale *ecological process*. At a regional scale the proposed road is thought to provide a barrier that may result in dispersal and migration processes in a coastal-inland direction being affected, but is unlikely to affect regional scale movement of water or nutrients through the landscape.

There is a risk of *exceeding thresholds* at a local scale (primarily loss of habitat due to direct and indirect impacts), but these can be controlled by the implementation of mitigation measures (assuming management commitment and effective monitoring and reporting). There is less risk of exceeding thresholds at a regional scale, except for the overall loss of habitat due to direct and indirect impacts: the loss of habitat within Pondoland-Ugu Sandstone Coastal Sourveld could lead to a change in conservation status from Vulnerable to Endangered, which indicates that the threshold beyond which ecosystem processes and patterns can be maintained is being approached.

At a local scale, the road may *threaten some key ecological process* linked to life support systems, but this effect dissipates quickly with distance from the road and is unlikely to be important at a regional scale.

Pondoland grasslands are potentially at risk from the road and its associated impacts. The potential threat of the road to *protected, important, unique, sensitive, irreplaceable areas* is therefore potentially significant in the absence of effective conservation management of the area.

The proposed road cannot be considered potentially responsible for *exacerbating human-induced climate change*.

The proposed road will lead to the direct loss of areas of grassland in greenfields areas as well as some forest, which is considered by definition to be *irreversible loss of natural capital*. Due to the highly sensitive nature of the PCE as a whole, any loss of habitat may be considered to be incremental reduction in the ecological viability of the area. The road may therefore be considered to lead to irreversible loss of natural capital that is potentially significant.

It is not considered likely that there are any *impacts that are unknown or uncertain* although there is some uncertainty about impacts in the study area due to social factors in the absence of the road project taking place.

It is very difficult to attribute *substantial negative cumulative impacts* to the presence of the new road rather than current trends within the PCE area. It is estimated that the road and its secondary impacts (including possible strip and nodal development) could lead to sufficient loss of habitat to result in Pondoland-Ugu Coastal Sourveld being re-categorised as an Endangered vegetation type. It is likely that other proposed projects in the area would further exacerbate

this loss of habitat and make it more likely that habitat loss would lead to re-categorisation of the vegetation type.

In conclusion, on the basis of the above criteria, the proposed road may be considered not to be ecologically sustainable. However, if secondary impacts can be controlled and conservation measures can be put in place to effectively protect core components of the PCE then the assessment of five of these criteria may be reversed / become insignificant and the proposed road could then be considered to be ecologically sustainable.

7.6 Long-term management of impacts and conservation within the PCE

Depending on the assumptions made (e.g. the width of the potentially impacted area alongside the road) the road can be shown to have different levels of impact on the greenfields area. A narrow impact zone will result in impacts of low significance on the PCE and the proposed Pondoland Park area, whereas assuming a wider impact zone results in significant impacts on the PCE and the proposed Pondoland Park.

Mitigation measures for some potential impacts within the PCE are directly dependant on long-term commitment to managing these impacts by the agency that will eventually manage the proposed road. The long-term significance of some impacts depends on commitments (SANRAL, contractors) as well as institutional capacity (DEAT, Provincial Nature Conservation Dept.).

Management of long-term impacts requires external pressure to ensure that proposed management measures meet stated objectives. This depends largely on capacity within government agencies (National Departments, Provincial Departments, law enforcement agencies) and a system to ensure effective monitoring, reporting and reaction to developing impacts. There may be strong social, political or economic reasons to ignore potential impacts and secondary impacts at a provincial or national government level, but this would ignore the States commitment to protecting biodiversity. These institutional functions need to operate effectively to ensure that management of impacts takes place over the long-term.

It is recommended that, in the event of the road construction taking place, an external agency be involved in the long-term monitoring of the impacts and management of the affected areas. Alternatively, a body such as the Auditor General could play a role in this capacity. The purpose would be to have an external agency monitoring the overall environmental management for the area and ensuring that government departments perform their duties with regards to enforcement.

Currently, there has been a failure to develop effective conservation measures within the PCE despite strategic assessments and conservation assessments in the region identifying the remaining areas of the PCE as having a very high conservation value. Ironically, the absence of conservation within the PCE has resulted in some potential impacts from the proposed road being significant which would not be significant had such conservation measures existed. The proposed N2 road through the PCE may accelerate (in the short term) ecological degradation due to secondary impacts, but the absence of the implementation of an effective conservation plan will ultimately have the same result.

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APPENDIX 1: Endemic species; medicinal species and threatened, rare and declining species.

Endemics or near-endemics of the Pondoland Centre of Endemism.
Endemic/near endemic plant species: From previous EIA botanical study (Lubke & Avis 2002).

FAMILY	PONDOLAND ENDEMICS	NEAR ENDEMICS
Aloaceae		*Gasteria croucheri,*
Amaryllidaceae	*Cyrtanthus mackenii var. mackenii, C. epiphyticus; Clivia robusta*	*Crinum moorei*
Anacardiaceae	*Rhus pondoensis, Rhus acocksii, R. rudatisii*	*Smodingium argutum, Rhus grandidens*
Apiaceae	*Centella graminifolia, Peucedanum natalense*	
Apocynaceae		*Carissa wyliei*
Araliaceae	*Cussonia nicholsonii*	*Seemannaralia gerrardii*
Arecaceae	*Jubaeopsis caffra*	
Asclepiadaceae	*Schizoglossum atropurpureum, Pachycarpus coronarius, Asclepias peltigera, A. patens, A. praemorsa, Brachystelma australe, B. kerzneri, B. tenellum, Orbea speciosa*	*Miraglossum anomalum, Huernia hystrix var. parvula*
Asphodelaceae	*Kniphofia coddiana, K. rooperi, K. drepanophylla*	
Asteraceae	*Helichrysum pannosum, H. populifolium, Senecio medley-woodii, S. glanduloso-lanosus, S. rhyncholaenus, S. erubescens var. incisus, Euryops leiocarpus, Tarchonanthus trilobus var. trilobus*	*Cineraria albicans, Relhania pungens*
Balsaminaceae	*Impatiens flanaganae*	
Begoniaceae	*Begonia homonyma, B. geranioides, B. rudatisii, B. dregei*	
Bignoniaceae	*Podranea ricasoliana*	
Brassicaceae	*Heliophila subulata*	
Bruniaceae	*Raspalia trigyna*	
Celastraceae	*Pseudosalacia streyi, Maytenus oleosa, M. abbottii, Gymnosporia vanwykii, Gymnosporia bachmannii, Putterlickia retrospinosa, Catha abbottii*	*Maytenus cordata, M. filiformis*
Crassulaceae	*Crassula streyi, C. multicava subsp. floribunda, C. obovata var. dregeana, C. sarmentosa var. integrifolia*	*Crassula inandensis,*
Cyperaceae	*Fimbristylis variegata*	
Ericaceae	*Erica abbottii, E. cubica* var. *natalensis*	
Euphorbiaceae	*Euphorbia ericoides, E. franksiae, E. woodii, Acalypha* sp. nov. (*Scott-Shaw 636* NU)	*Phyllanthus cedrelifolius, Excoecaria simii, Euphorbia bupleurifolia*
Fabaceae	*Tephrosia pondoensis, Podalyria velutina, P. burchelli, P. reticulata, P. orbicularis, Eriosema umtamvunense, E. luteopetalum, E. latifolium, E. dregei, Tephrosia bachmannii, Bauhinia natalensis, Lotononis viminea, Lotononis bachmanniana, Aspalathus gerrardii, Psoralea*	*Caesalpinia bonduc, Indigofera rubroglandulosa, I. hilaris, Otholobium stachyerum*

	abbottii	
Flacourtiaceae	*Pseudoscolopia polyantha*	
Gentianaceae	*Chironia albiflora*	
Geraniaceae	*Monsonia natalensis*	*Geranium subglabrum, G. sparsiflorum*
Gesneriaceae	*Streptocarpus porphyrostachys, S. modestus, S. formosus, S. trabeculatus, S. prolixus*	*Streptocarpus haygarthii, S. johannis, S. primulifolius, S. rexii,*
Icacinaceae	*Apodytes abbottii*	
Iridaceae	*Aristea platycaulis, Watsonia mtamvunae, W. pondoensis, W. inclinata, W. bachmannii*	*Moraea sp., Dietes iridioides, Dierama, Tritonia, Crocosmia, Anomatheca, Hesperantha, Schizostylis, Gladiolus*
Lamiaceae	*Plectranthus oertendahlii, P. ernstii, P. praetermissus, P. purpuratus, P. oribiensis, P. hilliardiae, P. saccatus var. pondoensis, P. aliciae, P. reflexus, Syncolostemon rotundifolius, S. ramulosum, Stachys comosa,*	*P. saccatus var. longitubus, P. malvinus, Tinnea galpinii, Stachys rudatisii,*
Lauraceae	*Dahlgrenodendron natalense, Cryptocarya wyliei, Cassytha pondoensis*	*Ocotea kenyensis, Cryptocarya latifolia, C. myrtifolia,*
Lentibulariaceae	*Utricularia sandersonii*	
Lomariopsidaceae		
Melastomataceae	*Memecylon bachmannii*	
Meliaceae	*Turraea streyi*	*Turraea pulchella,*
Mesembryanthemaceae	*Lampranthus stipulaceus*	
Moraceae		*Ficus bizanae*
Myrtaceae	*Eugenia umtamvunensis, E.verdoorniae, E.erythrophylla, E. sp. nov. A, B & C, Syzygium pondoense*	*Eugenia simii*
Oliniaceae	*Olinia radiata*	
Orchidaceae		*Liparis remota, Disa similes, D. caffra, D. versicolor, D. sagittalis, D. stachyoides, D. nervosa, Polystachya tessellata, Tridactyle bicaudata, Stenoglottis woodii, Rangaeris muscicola, Ypsilopus erectus*
Periplocaceae	*Raphionacme palustris*	
Piperaceae	*Peperomia rotundifolia*	
Polygalaceae	*Polygala esterae (= P. gazensis)*	
Proteaceae	*Leucadendron pondoense, L. spissifolium subsp. oribinum, L. spissifolium subsp. natalense, Leucospermum innovans*	
Restionaceae	*Calopsis paniculata*	
Rhamnaceae	*Colubrina nicholsonii, Phylica natalensis*	
Rhynchocalycaceae	*Rhynchocalyx lawsonioides*	
Rubiaceae	*Eriosemopsis subanisophylla, Tricalysia africana, Alberta magna, Canthium vanwykii, Pavetta bowkeri, Anthospermum streyi*	*Pavetta kotzei*
Sapindaceae	*Atalaya natalensis*	
Sapotaceae	*Manilkara nicholsonii*	
Scrophulariaceae	*Zaluzianskya angustifolia, Dermatobotrys*	

	saundersii, Craterostigma nanum var. nanum, Selago peduncularis	
Sterculiaceae	*Cola natalensis*	
Thymelaeaceae	*Struthiola pondoensis, Englerodaphne ovalifolia*	*Gnidia triplinervis*
Tiliaceae	*Grewia pondoensis*	
Violaceae	*Rinorea domatiosa*	
Vitaceae	*Cyphostemma rubroglandulosa*	
Zamiaceae		*Encephalartos caffer, E. laevifolius*
Zingiberaceae		*Siphonochilus aethiopicus*

Biogeographically important taxa of the Pondoland Centre (Source: Mucina et al. 2006b)

Biogeographically Important Taxa (grasslands) ([C]coastal belt element; [E]eastern isolated occurrence; [F]generic fynbos element; [N]northern distribution limit; [S]southern distribution limit) Geoxylic Suffutex: *Gymnosporia vanwykii*C. Graminoids: *Loudetia simplex*S (d), *Calopsis paniculata*F, *Tetraria robusta*E,F. Herbs: *Helichrysum auriceps*S, *H. natalitium*S, *H. pannosum*S, *Senecio dregeanus*S, *S. rhyncholaenus*S, *Stenoglottis woodii*S, *Asclepias patens*C, *Berkheya insignis*S, *Disperis woodii*C, *Eriosema acuminatum*C, *Helichrysum acutatum*S, *H. longifolium*C, *Kniphofia rooperi*C, *Peucedanum natalense*C, *Roella glomerata*F,C. Low Shrubs: *Senecio medley-woodii*S, *Gnidia woodii*S (d), *Agathosma ovata*F, *Erica aspalathifolia*F,C, *E. natalensis*F, *E. natalitia*F, *Gnidia coriacea*N, *Muraltia lancifolia*F, *Pseudarthria hookeri*F, S, *Relhania pungens*F, *Stangeria eriopus*C, *Syncolostemon rotundifolius*C. Small Trees & Tall Shrubs: *Faurea saligna*S (d), *Protea roupelliae* subsp. *roupelliae*F (d), *Encephalartos caffer*N, *Loxostylis alata*F, *Polygala gazensis* (isolated populations; also Inyanga), *Protea caffra* subsp. *caffra*F, *P. simplex*F, *Sclerocroton integerrimum*S.

100 most important medicinal plant species occurring in the Pondoland Centre of Endemism.

Sources:

CUNNINGHAM, A.B. 1988. An investigation of the herbal medicine trade in Natal/KwaZulu. Investigational Report No. 29. Institute of Natural Resources, Pietermaritzburg.

POOLEY, E. 1998. A field guide to wild flowers Kwazulu-Natal and the Eastern Region. Natal Flora Publications Trust, Durban.

VAN WYK, VAN OUDTSHOORN, B. & GERICKE, N. 1997. Medicinal Plants of South Africa. Briza, Pretoria.

WILLIAMS, V.L. 2003. Hawkers of health: an investigation of the Faraday Street traditional medicine market in Johannesburg. Report to Gauteng Directorate for Nature Conservation, DACEL.

Acacia karroo
Acokanthera oppositifolia
Adenia gummifera
Agapanthus africanus
Alberta magna
Albizia adianthifolia
Aloe ferox
Aloe linearifolia
Anemone fanninii
Artemisia afra
Aster bakeranus
Bauhinia bowkeri
Begonia dregei
Begonia homonyma
Bersama lucens
Berula erecta
Boophone disticha
Bowiea volubilis subsp. volubilis
Bulbine natalensis
Capparis tomentosa
Cassipourea flanaganii
Cassipourea gummiflua
Catha edulis
Centella asiatica
Chironia baccifera
Clivia gardenii
Clivia miniata var. miniata
Clivia robusta
Cotyledon orbiculata
Crinum macowanii
Crinum moorei
Croton sylvaticus
Cryptocarya latifolia
Cryptocarya myrtifolia
Cryptocarya woodii
Curtisia dentata
Dioscorea dregeana
Dodonaea angustifolia
Drimia altissima
Drimia robusta
Ekebergia capensis
Elaeodendron zeyheri
Embelia ruminata
Encephalartos altensteinii
Encephalartos caffer
Encephalartos natalensis
Encephalartos villosus
Erythrina lysistemon
Euclea undulata
Eucomis autumnalis
Euphorbia woodii
Faurea macnaughtonii
Garcinia gerrardii
Gasteria croucheri
Gnidia kraussiana
Gomphocarpus fruticosus
Gunnera perpensa
Haemanthus deformis
Harpephyllum caffrum
Heteromorpha arborescens
Hypoxis hemerocallidea
Ilex mitis
Knowltonia vesicatoria
Leonotis leonurus
Lippia javanica
Loxostylis alata
Merwilla plumbea
Ocotea bullata
Olea europaea
Pelargonium luridum
Pelargonium sidoides
Pellaea calomelanos
Pentanisia prunelloides
Pittosporum viridiflorum
Plumbago auriculata
Polygala fruticosa
Prunus africana
Pterocelastrus rostratus
Pteroxylon obliquum
Rapanea melanophloeos
Rauvolfia caffra
Rhoicissus tridentata
Salix mucronata
Sansevieria hyacinthoides
Scabiosa columbaria
Schotia brachypetala
Senecio serratuloides
Stangeria eriopus
Strychnos henningsii
Syzigium cordatum
Tarchonanthus camphoratus
Typha capensis
Valeriana capensis
Vernonia oligocephala
Withania somnifera
Xysmalobium undulatum
Zantedeschia aethiopica
Zanthoxylum capense
Zanthoxylum capense
Ziziphus mucronata

CONFIDENTIAL: THIS PART OF THE APPENDIX CONTAINS HIGHLY SENSITIVE INFORMATION AND MAY NOT APPEAR IN ANY PUBLIC DOCUMENT

Sources:

Threatened, rare and declining plant species: From SANBI Threatened Species Programme and includes all plant taxa for which there is some conservation concern. (See: www.sanbi.org for further details).

Red List Status according to IUCN Ver. 3.1 (IUCN, 2001) (J.E. Victor pers. comm., Threatened Species Programme, SANBI, 2007).

Family	Taxon	Global Status	Distribution	Habitat
RUBIACEAE	Alberta magna	VU B1ab(ii,iii,v) + 2ab(ii.iii.v)	**SENSITIVE INFORMATION - NOT AVAILABLE TO PUBLIC**	**SENSITIVE INFORMATION - NOT AVAILABLE TO PUBLIC**
RUBIACEAE	Anthospermum streyi	NT D2		
IRIDACEAE	Aristea platycaulis	VU D2		
FABACEAE	Bauhinia bowkeri	NT D2		
BEGONIACEAE	Begonia dregei	EN C2a(i)		
BEGONIACEAE	Begonia homonyma	NT B		
APOCYNACEAE	Brachystelma kerzneri	VU D2		
APOCYNACEAE	Brachystelma tenellum	NT D2		
RHIZOPHORACEAE	Cassipourea flanaganii	VU A4acd; B2ab(v)		
GENTIANACEAE	Chironia albiflora	LC Rare-Sparse		
AMARYLLIDACEAE	Clivia robusta	VU B1ab(iii,v)		
RHAMNACEAE	Colubrina nicholsonii	VU D1		
CRASSULACEAE	Crassula obovata var. dregeana	VU D2		
CRASSULACEAE	Crassula streyi	LC Rare-Sparse		
VITACEAE	Cyphostemma rubroglandulosum	LC Rare-Sparse		
LAURACEAE	Dahlgrenodendron natalense	VU B1ab(iv,v); C1		
MESEMBRYANTHE	Delosperma	DD D		

MACEAE	pondoense			
ZAMIACEAE	Encephalartos altensteinii	VU A2acd; C1		
ZAMIACEAE	Encephalartos caffer	NT A2		
ZAMIACEAE	Encephalartos ghellinckii	VU C1		
ZAMIACEAE	Encephalartos natalensis	NT A2ad		
ERICACEAE	Erica abbottii	VU D2		
FABACEAE	Eriosema dregei	NT D2		
FABACEAE	Eriosema latifolium	DD T		
FABACEAE	Eriosema umtamvunense	VU D2		
MYRTACEAE	Eugenia simii	VU B1ab(iii,v)		
MYRTACEAE	Eugenia umtamvunensis	LC Rare-Sparse		
MYRTACEAE	Eugenia verdoorniae	LC Rare-Sparse		
EUPHORBIACEAE	Euphorbia woodii	VU B1ab(ii,iii,iv,v)		
ASPHODELACEAE	Gasteria croucheri	NT B1ab(v)		
IRIDACEAE	Gladiolus oppositiflorus	LC Declining		
BALSAMINACEAE	Impatiens flanaganiae	VU D2		
ARECACEAE	Jubaeopsis caffra	EN B1ab(ii,iii,v) + 2ab(ii,iii,v)		
ASPHODELACEAE	Kniphofia coddiana	NT B1ab(iii)		
ASPHODELACEAE	Kniphofia drepanophylla	LC Rare-Sparse		
MESEMBRYANTHEMACEAE	Lampranthus fugitans	VU D2		
PROTEACEAE	Leucadendron pondoense	VU B1ab(ii,iii,iv,v) + 2ab(ii,iii,iv,v)		
PROTEACEAE	Leucadendron spissifolium	NT		

	subsp. natalense			
PROTEACEAE	Leucadendron spissifolium subsp. oribinum	VU B1ab(i,ii,iii,iv,v) + 2ab(i,ii,iii,iv,v)		
PROTEACEAE	Leucospermum innovans	EN B1a(i)b(ii,iii,v) + 2a(i)b(ii,iii,v)		
CELASTRACEAE	Lydenburgia abbottii	EN B1ab(iii) + 2ab(iii)		
SAPOTACEAE	Manilkara nicholsonii	EN B1ab(ii,iii,v)		
CELASTRACEAE	Maytenus abbottii	EN B1ab(v); C2(i); D		
CELASTRACEAE	Maytenus oleosa	VU B1ab(ii,iii,v)		
LAURACEAE	Ocotea bullata	EN A2b		
RHAMNACEAE	Phylica natalensis	VU B1ab(iii)		
LAMIACEAE	Plectranthus ernstii	NT D2		
LAMIACEAE	Plectranthus oribiensis	LC Rare		
LAMIACEAE	Plectranthus praetermissus	VU D2		
PRIONIACEAE	Prionium serratum	LC Declining		
CELASTRACEAE	Pseudosalacia streyi	VU B1ab(iii,v)		
FABACEAE	Psoralea abbottii	VU B1ab(i,ii,iii,iv,v) + 2ab(i,ii,iii,iv,v)		
BRUNIACEAE	Raspalia trigyna	CR D		
RHYNCHOCALYCACEAE	Rhynchocalyx lawsonioides	NT B1ab(i,ii,iii,iv,v) + 2ab(i,ii,iii,iv,v)		
VIOLACEAE	Rinorea domatiosa	NT B1ab(ii,v)		
APOCYNACEAE	Riocreuxia alexandrina	CR PE		

STANGERIACEAE	Stangeria eriopus	NT		
GESNERIACEAE	Streptocarpus formosus	LC Rare-Sparse		
GESNERIACEAE	Streptocarpus lilliputana	VU D2		
GESNERIACEAE	Streptocarpus modestus	LC Rare		
GESNERIACEAE	Streptocarpus porphyrostachys	NT D2		
FABACEAE	Tephrosia bachmannii	NT D2		
FABACEAE	Tephrosia pondoensis	VU B1ab(i,ii,iii) + 2ab(i,ii,iii)		
RUBIACEAE	Tricalysia africana	NT D2		
IRIDACEAE	Watsonia bachmannii	VU B1ab(iii,v)		
IRIDACEAE	Watsonia inclinata	VU D2		
IRIDACEAE	Watsonia mtamvunae	VU D2		
IRIDACEAE	Watsonia pondoensis	EN B1ab(i,ii,iii,iv,v)		

APPENDIX 2: Preliminary alphabetical checklist of plant species recorded in the study area from the quarter degree grids 3129BB, 3129BC, 3129BD, 3130AA.
Data sources: ACKDAT, PRECIS, Hoare (unpublished field data); Lubke et al (unpublished field data). Species taxonomy is according to Germishuizen & Meyer (2003).

Abildgaardia hygrophila
Abildgaardia ovata (Burm. f.) Kral
Abildgaardia variegata (Gordon-Gray) K. Lye
Abrus laevigatus E. Mey.
Abrus precatorius L. subsp. africanus Verdc.
Abutilon sonneratianum (Cav.) Sweet
Acacia ataxacantha
Acacia caffra (Thunb.) Willd.
Acacia karroo
Acacia longifolia (Andr.) Willd. *
Acacia mearnsii De Wild.
Acacia melanoxylon R. Br. *
Acacia robusta Burch. subsp. robusta
Acalypha ecklonii Baill.
Acalypha glabrata Thunb. var. glabrata
Acalypha glandulifolia Burchinger ex Meisn.
Acalypha peduncularis
Acalypha peduncularis E. Mey. ex Meisn.
Acalypha petiolaris Hochst.
Acalypha punctata Meisn.
Acalypha punctata Meisn. var. punctata
Acalypha schinzii
Acalypha wilmsii Pax ex Prain & Hutch.
Acanthospermum australe (Loefl.) Kuntze *
Acanthospermum glabratum (DC.) Wild*
Acanthospermum hispidum DC.*
Achyranthes aspera L. var. aspera *
Achyranthes aspera L. var. sicula L.*
Achyropsis avicularis (E.Mey.ex Moq.) Hook.f.
Achyropsis leptostachya
Acokanthera oblongifolia (Hochst.) Codd
Acokanthera oppositifolia (Lam.) Codd
Acridocarpus natalitius Juss. var. linearifolius Launert
Acridocarpus natalitius Juss. var. natalitius
Acroceras macrum Stapf
Acrolophia cochlearis (Lindl.) Schltr. & Bolus
Acrostichum aureum L.
Adenia gummifera (Harv.) Harms var. gummifera
Adenocline acuta (Thunb.) Baill.
Adenocline pauciflora
Adenopodia spicata
Adenostemma viscosum
Adiantum capillus-veneris L.
Adiantum raddianum Presl *
Aeollanthus buchnerianus Briq.
Aeollanthus parvifolius
Aeollanthus rehmannii Gürke
Aerangis mystacidii (Rchb.f.) Schltr.
Aerobryopsis capensis (C. Moll.) Fleisch.
Aeschynomene micrantha DC.
Aeschynomene uniflora E. Mey. var. uniflora
Agapanthus campanulatus Leighton subsp. patens
Agapanthus campanulatus subsp. campanulatus
Agapanthus caulescens subsp. angustifolius
Agapanthus praecox subsp. orientalis
Agathisanthemum chlorophyllum (Hochst.) Brem.
Agathosma ovata
Ageratum conyzoides L.*
Ageratum houstonianum Mill.*
Agrostis lachnantha Nees var. lachnantha
Aizoon canariense L.
Ajuga ophrydis
Alberta magna
Albizia adianthifolia var. adianthifolia
Albuca collina Baker
Albuca fastigiata (L. f.) Dryand.
Albuca nelsonii N.E. Br.
Albuca setosa Jacq.
Alectra capensis Thunb.
Alectra orobanchoides Benth.
Alectra sessiliflora (Vahl) Kuntze var. sessiliflora
Alepidea comosa
Alepidea gracilis Dummer
Alepidea longifolia subsp. angusta
Alepidea longifolia var. longifolia
Alepidea natalensis J.M.Wood & M.S.Evans
Alisma plantago-aquatica L.
Allocassine laurifolia (Harv.) N.K.B. Robson
Allophylus africanus P.Beauv. subsp. africanus
Allophylus decipiens (Sond.) Radlk.
Allophylus dregeanus (Sond.) De Winter
Allophylus melanocarpus (Sond.) Radlk.
Allophylus natalensis (Sond.) De Winter
Alloteropsis semialata subsp. eckloniana
Aloe arborescens Miller
Aloe barberiae T.-Dyer
Aloe candelabrum Berger
Aloe ferox Mill.
Aloe linearifolia Berger
Aloe maculata All.
Aloe minima Baker
Aloe myriacantha (Haw.) Schult. & J.H. Schult.
Aloe pluridens Haw.
Alternanthera pungens H.B.K. *
Alysicarpus rugosus (Willd.) DC. subsp. perennirufus
Amaranthus hybridus L. var. hybridus *
Amaranthus spinosus L.*
Ambrosia artemisiifolia L.*
Anacampseros rufescens (Harv.) Sweet
Anagallis huttonii Harv.
Anastrabe integerrima E. Mey. ex Benth.
Andrachne ovalis (E.Mey. ex Sond.) Müll.Arg.
Andropogon appendiculatus Nees
Andropogon eucomus Nees
Andropogon festuciformis Rendle
Andropogon schirensis
Aneilema aequinoctiale (Beauv.) Loudon
Aneilema dregeanum Kunth
Aneilema hockii De Wild.
Anemia dregeana Kunze
Anemone caffra (Eckl. & Zeyh.) Harv.
Anemone fanninii Harv.ex Mast.
Angraecum pusillum Lindl.
Anisochaeta mikanioides DC.
Anisodontea scabrosa (L.) Bates
Annesorhiza flagellifolia Burtt Davy
Annesorhiza nuda (Aiton) B.L.Burtt
Anomodon pseudotristis (Müll.Hal.) Kindb.
Anredera cordifolia (Ten.) Steenis*
Anthericum cooperi Bak.
Anthericum galpinii Bak.
Anthericum saundersiae Bak.
Antherotoma naudini Hook.f.
Anthospermum galpinii Schltr.
Anthospermum herbaceum L.f.
Anthospermum hispidulum E. Mey. ex Sond.
Anthospermum littoreum L. Bol.
Anthospermum streyi Puff
Antidesma venosum E.Mey. ex Tul.
Apium graveolens L.
Apium prostratum Vent.
Apodytes abbottii Potgieter & A.E.van Wyk
Apodytes dimidiata E. Mey. ex Arn. subsp. dimidiata
Aponogeton natalensis Oliv.
Aptenia cordifolia (L. f.) Schwant. var. cordifolia
Arachniodes foliosa (C. Chr.) Schelpe
Archidium ohioense Schimp. ex Müll.Hal.
Arctotheca calendula (L.) Levyns
Arctotheca populifolia (Berg.) T. Norl.
Arctotis arctotoides (L.f.) O.Hoffm.
Argemone ochroleuca Sweet subsp. ochroleuca*
Argyrolobium amplexicaule (E.Mey.) Dummer
Argyrolobium harveyanum Oliv.
Argyrolobium humile E.Phillips
Argyrolobium marginatum H.Bol.
Argyrolobium pilosum Harv.
Argyrolobium rotundifolium T.J.Edwards
Argyrolobium rupestre (Eckl. & Zeyh.) Walp.
Argyrolobium tomentosum (Andr.) Druce
Argyrolobium tuberosum Eckl. & Zeyh.
Argyrolobium woodii Duemmer
Aristea abyssinica Pax
Aristea angolensis Baker subsp. angolensis
Aristea cognata N.E. Br. ex Weim.
Aristea compressa Buchinger ex Bak.
Aristea ecklonii Baker
Aristea flexicaulis Baker
Aristea gerrardii Weim.

Aristea platycaulis Baker
Aristea schizolaena Harv. ex Baker
Aristea torulosa Klatt
Aristea woodii N.E.Br.
Aristida junciformis subsp. galpinii
Aristida junciformis Trin. & Rupr. subsp. junciformis
Artemisia afra Jacq. ex Willd.
Arundinella nepalensis Trin.
Asclepias albens (E.Mey.) Schltr.
Asclepias fallax
Asclepias hastata (E.Mey.) Schltr.
Asclepias praemorsa Schltr.
Ascolepis capensis (Kunth) Ridley
Aspalathus chortophila Eckl. & Zeyh.
Aspalathus gerrardii Bolus
Aspalathus kougaensis
Aspalathus laricifolia Berg. subsp. canescens (L.) Dahlg.
Aspalathus rubens Thunb.
Aspalathus setacea
Aspalathus setacea Eckl. & Zeyh.
Aspalathus spinosa L. subsp. spinosa
Aspalathus uniflora
Asparagus africanus (Lam.) Oberm.
Asparagus asparagoides (L.) Willd.
Asparagus cooperi (Bak.) Oberm.
Asparagus densiflorus (Kunth) Oberm.
Asparagus falcatus (L.) Oberm.
Asparagus laricinus (Burch.) Oberm.
Asparagus macowanii (Bak.) Oberm.
Asparagus natalensis (Bak.) Oberm.
Asparagus plumosus Baker
Asparagus racemosus (Willd.) Oberm.
Asparagus setaceus (Kunth) Oberm.
Asparagus subulatus (Thunb.) Oberm.
Asparagus virgatus (Bak.) Oberm.
Aspidoglossum carinatum (Schltr.) Kupicha
Aspidoglossum woodii (Schltr.) Kupicha
Aspidonepsis diploglossa Nicholas & Goyder
Aspilia natalensis (Sond.) Wild
Asplenium aethiopicum subsp. aethiopicum
Asplenium anisophyllum Kunze
Asplenium dregeanum Kunze subsp. dregeanum
Asplenium erectum Bory ex Willd.
Asplenium gemmiferum Schrad.
Asplenium inaequilaterale Willd.
Asplenium lunulatum Swartz
Asplenium monanthes L.
Asplenium prionitis Kunze
Asplenium rutifolium (Berg.) Kunze
Asplenium sandersonii Hook.
Asplenium simii Braithw. & Schelpe
Asplenium splendens Kunze subsp. splendens
Asplenium x flexuosum Schrad.
Aster bakerianus Burtt Davy ex C.A.Sm.
Aster harveyanus Kuntze
Aster squamatus (Spreng.) Hieron.
Asystasia gangetica subsp. micrantha
Asystasia varia N.E. Br.
Atalaya natalensis R.A. Dyer
Athrixia phylicoides DC.
Athyrium scandicinum (Willd.) C.Presl
Atrichum androgynum (Müll.Hal.) A.Jaeger
Avicennia marina (Forssk.) Vierh.
Axonopus affinis Chase
Azima tetracantha Lam.
Bachmannia woodii (Oliv.) Gilg
Bacopa monnieri (L.)Pennell
Baphia racemosa (Hochst.) Bak.
Barbula bolleana (Müll.Hal.) Broth.
Barbula indica (Hook.) Spreng.
Barleria gueinzii Sond.
Barleria meyerana Nees
Barleria obtusa Nees
Barleria ovata E.Mey. ex Nees
Basananthe sandersonii (Harv.) W.J.de Wilde
Bauhinia galpinii N.E.Br.
Bauhinia natalensis Oliv. ex Hook.
Becium filamentosum
Becium grandiflorum var. obovatum
Becium obovatum (E.Mey. ex Benth.) N.E.Br. subsp. obovatum var. galpinii (Gürke) N.E.Br.
Becium obovatum (E.Mey. ex Benth.) N.E.Br. subsp. obovatum var. obovatum
Begonia cucullata Willd.*
Begonia dregei Otto & A.Dietr.
Begonia homonyma Steud.
Begonia sutherlandii Hook f.
Behnia reticulata (Thunb.) Didr.
Beilschmiedia natalensis J.H.Ross
Berkheya bergiana Soederb.
Berkheya bipinnatifida (Harv.) Roessl. subsp. bipinnatifida
Berkheya discolor (DC.) O.Hoffm. & Muschl.
Berkheya erysithales (DC.) Roessl.
Berkheya insignis (Harv.) Thell.
Berkheya maritima Wood & Evans
Berkheya multijuga (DC.) Roessler
Berkheya rhapontica (DC.) Hutch. & Burtt Davy subsp. aristosa (DC.) Roessler var. aristosa
Berkheya rhapontica subsp. rhapontica
Berkheya robusta Bohnen ex Roessl.
Berkheya setifera DC.
Berkheya speciosa (DC.) O. Hoffm. subsp. speciosa
Berkheya speciosa (DC.) O.Hoffm. subsp. ovata Roessler
Berkheya speciosa subsp. lanceolata
Berkheya sphaerocephala (DC.) Roessl.
Berkheya umbellata DC.
Bersama lucens (Hochst.) Szyszyl.
Bersama stayneri Phill.
Bersama swinnyi E.Phillips
Bersama tysoniana Oliv.
Berula erecta (Hudson) Cov. Subsp. thunbergii
Bidens bipinnata L. *
Bidens biternata (Lour.) Merrill & Scherff *
Bidens pilosa L. *
Blechnum attenuatum (Swartz) Mett. var. giganteum (Kaul
Blechnum australe L. subsp. australe
Blechnum australe var. aberrans
Blechnum capense Burm. f.
Blechnum punctulatum Sw. var. intermedium Sim
Blechnum punctulatum Sw. var. krebsii (Kunze) Sim
Blechnum punctulatum Sw. var. punctulatum
Blechnum tabulare (Thunb.) Kuhn
Blepharis integrifolia var. integrifolia
Blepharis obtusisepala Oberm.
Blotiella glabra (Bory) R.M.Tryon
Blotiella natalensis (Hook.) R.M.Tryon
Blumea cafra (DC.) O. Hoffm.
Blumea mollis (D. Don) Merr.
Bonatea speciosa (L.f.) Willd. var. speciosa
Boophone disticha (L.f.) Herb.
Bothriochloa bladhii (Retz.) S.T. Blake
Brachiaria arrecta (Hack. ex T.Durand & Schinz) Stent
Brachiaria chusqueoides (Hack.) Clayton
Brachiaria deflexa (Schumach.) C.E.Hubb ex Robyns
Brachiaria serrata (Thunb.) Stapf
Brachycorythis inhambanensis (Schltr.) Schltr.
Brachycorythis ovata Lindl. subsp. ovata
Brachycorythis pubescens Harv.
Brachylaena discolor DC. var. discolor
Brachylaena elliptica (Thunb.) DC.
Brachylaena glabra (L.f.) Druce.
Brachylaena uniflora Harv.
Brachystelma australe R.A. Dyer
Brachystelma blepharanthera H.Huber
Brachystelma kerzneri Peckover
Brachystelma sp.nov. (=Nicholas 2356 [4?])
Brachystelma tenellum
Brachystelma vahrmeijeri R.A. Dyer
Breutelia diffracta Mitt.
Bridelia micrantha (Hochst.) Baill.
Briza maxima L. *
Bromus catharticus Vahl *
Brownleea coerulea Harv. ex Lindl.
Brownleea parviflora Harv. ex Lindl.
Bruguiera gymnorrhiza (L.) Lam.
Brunsvigia grandiflora Lindl.
Bryoerythrophyllum campylocarpum
Bryum andicola Hook.

Bryum apiculatum Schwägr.
Bryum argenteum Hedw.
Bryum pycnophyllum (Dixon) Mohamed
Bryum viridescens Welw. & Duby
Buchnera dura Benth.
Buchnera longespicata Schinz
Buddleja dysophylla (Benth.) Radlk.
Buddleja pulchella N.E.Br.
Buddleja saligna Willd.
Bulbine abyssinica A. Rich.
Bulbine asphodeloides (L.) Spreng.
Bulbine frutescens (L.) Willd.
Bulbine latifolia (L. f.) Roem. & Schult.
Bulbine sp.nov. (Abbott 2123, Cloete)
Bulbophyllum sandersonii (Oliv.) Reichb. f.
Bulbophyllum scaberulum (Rolfe) Bolus var. scaberulum
Bulbophyllum scaberulum (Rolfe) H. Bol.
Bulbostylis boeckeleriana (Schweinf.) Beetle
Bulbostylis contexta (Nees) Bodard
Bulbostylis contexta (Nees) M.Bodard
Bulbostylis densa (Wall.) Hand.-Mazz. subsp. densa
Bulbostylis hispidula (Vahl) R. Haines
Bulbostylis humilis (Kunth) C.B. Cl.
Bulbostylis oritrephes (Ridl.) C.B.Clarke
Bulbostylis schoenoides (Kunth) C.B.Clarke
Bulbostylis scleropus C.B.Clarke
Bulbostylis sp. (=Strey 10330)
Burchellia bubalina (L.f.) Sims
Buxus macowanii Oliv.
Buxus natalensis (Oliv.) Hutchinson
Caesalpinia bonduc (L.) Roxb.
Caesalpinia decapetala (Roth) Alston*
Caesia contorta (L. f.) Dur. & Schinz
Calanthe sylvatica (Thouars) Lindl.
Callicostella tristis (Müll.Hal.) Broth.
Callilepis laureola DC.
Callilepis leptophylla Harv.
Calodendrum capense (L. f.) Thunb.
Calopsis paniculata (Rottb.) Desv.
Calpurnia aurea (Ait.) Benth.
Campuloclinum macrocephalum (Less.)DC. *
Canavalia bonariensis Lindl. *
Canavalia maritima (Aubl.) Thouars
Canna indica L.*
Canthium ciliatum (Klotzsch) Kuntze
Canthium inerme (L.f.) Kuntze
Canthium mundianum Cham. & Schlechtd.
Canthium setiflorum Hiern subsp. setiflorum
Canthium spinosum (Klotzsch) Kuntze
Canthium suberosum Codd
Canthium vanwykii Tilney & Kok
Capparis brassii DC.
Capparis fascicularis DC. var. zeyheri (Turcz.) Toelken
Capparis fascicularis var. fascicularis
Capparis sepiaria L. var. citrifolia (Lam.) Toelken
Capparis tomentosa Lam.
Capsicum frutescens L.
Cardamine africana L.
Cardiospermum halicacabum var. microcarpum
Cardiospermum halicacabum L.*
Cardotiella secunda (Müll.Hal.) Vitt
Carex clavata Thunb.
Carex zuluensis C.B.Clarke
Carissa bispinosa (L.) Desf. ex Brenan subsp. zambesiensis Kupicha
Carissa bispinosa (L.) Desf. ex Brenan subsp. bispinosa
Carissa macrocarpa (Eckl.) A.DC.
Carissa sp. nov.
Carissa wyliei N.E. Br.
Carpha glomerata (Thunb.) Nees
Carpobrotus dimidiatus (Haw.) L. Bol.
Casearia gladiiformis Mast.
Casearia sp. nov.
Cassine aethiopica Thunb.
Cassine papillosa (Hochst.) Kuntze
Cassine peragua L. subsp. peragua
Cassinopsis ilicifolia (Hochst.) Kuntze
Cassinopsis tinifolia Harv.
Cassipourea flanaganii(Schinz) Alston
Cassipourea gerrardii (Schinz) Alston
Cassipourea gummiflua var. verticillata
Cassytha filiformis L.
Cassytha pondoensis Engl. var. pondoensis
Catagonium nitens subsp. maritimum
Catha abbottii A.E.van Wyk & M.Prins
Catha edulis (Vahl) Forssk. ex Endl.
Catunaregam spinosa (Thunb.) Tirveng. subsp. spinosa
Celosia trigyna L.
Celtis africana Burm.f.
Celtis durandii Engl.
Celtis gomphophylla Baker
Centella asiatica (L.) Urb.
Centella coriacea Nannfd.
Centella glabrata L. var. glabrata
Centella glabrata L. var. natalensis Adamson
Centella graminifolia Adamson
Centella virgata (L.f.) Drude var. congesta Adamson
Cephalaria armerioides Szabó
Cephalaria attenuata (L.f.) Roem. & Schult.
Cephalaria decurrens (Thunb.) Roem. & Schult.
Cephalaria oblongifolia (Kuntze) Szabó
Cephalaria pungens Szabó
Cephalaria sp (=Strey 8366)
Cephalomanes rigidum (Sw.) K.Iwats.
Ceratiosicyos laevis (Thunb.) A. Meeuse
Ceratotheca triloba (Bernh.) Hook. f.
Ceropegia carnosa E. Mey.
Ceropegia distincta subsp. haygarthii
Ceropegia linearis E.Mey. subsp. linearis
Ceropegia racemosa N.E.Br. subsp. setifera (Schltr.)
Cestrum laevigatum Schltdl.*
Ceterach cordatum (Thunb.) Desv.
cf. Asarum sp.*
Chaetacanthus burchellii Nees
Chaetacanthus setiger (Pers.) Lindl.
Chaetacme aristata Planch.
Chamaecrista capensis (Thunb.) E. Mey. var. flavescens (T
Chamaecrista comosa E.Mey. var. comosa
Chamaecrista mimosoides (L.) Greene
Chamaecrista plumosa var. erecta
Chamaecrista plumosa var. plumosa
Chamaecrista stricta E.Mey.
Chamaesyce hirta (L.) Millsp.
Cheilanthes bergiana Schltdl.
Cheilanthes capensis (Thunb.) Swartz
Cheilanthes concolor
Cheilanthes deltoidea Kunze
Cheilanthes hirta var. brevipilosa
Cheilanthes hirta var. nemorosa
Cheilanthes inaequalis var. buchananii
Cheilanthes multifida subsp. lacerata
Cheilanthes parviloba (Swartz) Swartz
Cheilanthes viridis (Forssk.) Sw. var. glauca (Sim) Schelpe & N.C.Anthony
Cheilanthes viridis (Forssk.) Sw. var. macrophylla (Kunze) Schelpe & N.C.Anthony
Cheilanthes viridis (Forssk.) Sw. var. viridis
Chenopodium ambrosioides L. *
Chionanthus foveolatus (E. Mey.) Stearn subsp. foveolatus
Chionanthus foveolatus (E.Mey.) Stearn subsp. tomentellus (I.Verd.) Stearn
Chionanthus peglerae (C.H. Wr.) Stearn
Chironia albiflora Hilliard
Chironia baccifera L.
Chironia krebsii Griseb.
Chironia laxa Gilg
Chironia purpurascens (E.Mey.) Benth. & Hook.f. subsp. purpurascens
Chloris gayana Kunth
Chloris pycnothrix Trin.
Chloris virgata Swartz
Chlorophytum angulicaule (Baker) Kativu
Chlorophytum bowkeri Bak.
Chlorophytum comosum (Thunb.) Jacques
Chlorophytum cooperi (Baker) Nordal
Chlorophytum krookianum Zahlbr.
Chlorophytum modestum Bak.
Chlorophytum saundersiae (Baker) Nordal
Choristylis rhamnoides

Christella dentata (Forssk.) Holttum
Christella gueinziana (Mett.) Holttum
Chromolaena odorata (L.) R.M.King & H.Rob.*
Chrysanthemoides incana
Chrysanthemoides monilifera (L.) Norl. subsp. pisifera (L.) Norl.
Chrysanthemoides monilifera (L.) Norl. subsp. rotundata (DC.) Norl.
Chrysanthemoides monilifera subsp. canescens
Chrysocoma ciliata L.
Chrysophyllum viridifolium Wood & Franks
Ciclospermum leptophyllum (Pers.) Eichler
Cineraria albicans N.E.Br.
Cineraria decipiens Harv.
Cineraria deltoidea Sond.
Cineraria geraniifolia DC.
Cineraria lobata L'Herit.
Cirsium vulgatre (Savi) Ten. *
Cissampelos mucronata A.Rich.
Cissampelos torulosa E. Mey. ex Harv.
Cissus fragilis E.Mey. ex Kunth
Citrus sp.*
Clausena anisata (Willd.) Hook.f. ex Benth. var. anisata
Clematis brachiata Thunb.
Clerodendrum glabrum E. Mey. var. glabrum
Clerodendrum glabrum E.Mey.
Clerodendrum myricoides (Hochst.) Vatke
Clerodendrum triphyllum var. triphyllum
Cliffortia linearifolia Eckl. & Zeyh.
Cliffortia odorata L.f.
Cliffortia paucistaminea Weim. var. paucistaminea
Cliffortia serpyllifolia Cham. & Schltdl.
Cliffortia strobilifera Murray
Clivia gardenii Hook.
Clivia miniata (Lindl.) Regel
Clivia miniata (Lindl.) Regel var. miniata
Clivia nobilis Lindl.
Clivia robusta B.G.Murray, Ran, De Lange, Hammett, Truter & Swanevelder
Clutia abyssinica Jaub. & Spach var. abyssinica
Clutia affinis Sond.
Clutia alaternoides L. var. alaternoides
Clutia cordata Bernh.
Clutia disceptata Prain
Clutia hirsuta E. Mey. ex Sond. var. hirsuta
Clutia laxa Eckl. ex Sond.
Clutia mollis Pax
Clutia monticola S.Moore var. monticola
Clutia natalensis Bernh. ex Krauss
Clutia platyphylla Pax & K.Hoffm.
Clutia pulchella L. var. franksiae Prain
Clutia pulchella L. var. obtusata Sond.
Clutia pulchella L. var. pulchella
Clutia sp.nov. (= Hitchins 775)
Clutia virgata Pax & K. Hoffm.
Cnestis natalensis (Hochst.) Planch. & Sond.
Cnestis polyphylla Lam.
Coccinia adoensis (A. Rich.) Cogn.
Coccinia palmata (Sond.) Cogn.
Coccinia rehmannii Cogn.
Coddia rudis (E.Mey. ex Harv.) Verdc.
Coelorachis capensis Stapf
Coix lacryma-jobi L.*
Cola natalensis Oliv.
Coleotrype natalensis C.B. Cl.
Colpoon compressum Berg.
Colubrina nicholsonii A.E.van Wyk & Schrire
Combretum bracteosum (Hochst.) Brandis
Combretum edwardsii Exell
Combretum erythrophyllum (Burch.) Sond.
Combretum kraussii Hochst.
Combretum moggii Exell
Commelina africana L. var. africana
Commelina africana L. var. africana
Commelina africana L. var. lancispatha C.B. Cl.
Commelina benghalensis L.*
Commelina diffusa Burm. f.
Commelina eckloniana Kunth
Commelina erecta L.
Commelina modesta Oberm.
Commiphora harveyi (Engl.) Engl.
Commiphora neglecta Verdoorn
Commiphora woodii Engl.
Conostomium natalense (Hochst.) Bremek. var. glabrum
Conostomium natalense (Hochst.) Bremek. var. natalense
Convolvulus farinosus L.
Convolvulus natalensis Bernh. apud Krauss var. natalensis
Convolvulus natalensis Bernh. ex Krauss
Conyza albida Spreng.*
Conyza attenuata DC.
Conyza bonariensis (L.) Cronq.*
Conyza chilensis Spreng.*
Conyza obscura DC.
Conyza pinnata (L.f.) Kuntze
Conyza scabrida DC.
Conyza ulmifolia (Burm. f.) Kuntze
Cordia caffra Sond.
Coronopus didymus (L.) Sm.*
Corycium dracomontanum Parkman & Schelpe
Corycium nigrescens Sond.
Corymborkis corymbis Thouars
Cotula australis (Spreng.) Hook.f.
Cotula coronopifolia L.
Cotula hispida (DC.) Harv.
Cotula nigellifolia var. nigellifolia
Cotyledon orbiculata L. var. oblonga (Haw.) DC.
Cotyledon orbiculata L. var. orbiculata
Crabbea hirsuta Harv.
Crabbea nana Nees
Crabbea ovalifolia Fical. & Hiern
Crabia zimmermannii (Harms) Dunn
Crassocephalum crepidioides (Benth.) S.Moore
Crassocephalum x picridifolium (DC.) S.Moore
Crassula alba Forssk. var. alba
Crassula alba Forssk. var. parvisepala (Schonl.) Toelken
Crassula capitella Thunb. subsp. meyeri (Harv.) Toelken
Crassula cultrata L.
Crassula dependens Bolus
Crassula ericoides Haw. subsp. ericoides
Crassula flanaganii Schonl. & Bak. f.
Crassula multicava Lem. subsp. floribunda
Crassula multicava Lem. subsp. multicava
Crassula natalensis Schönland
Crassula nudicaulis L. var. nudicaulis
Crassula obovata Haw. var. dregeana (Harv.) Toelken
Crassula obovata Haw. var. obovata
Crassula orbicularis L.
Crassula orbiculata L. var. oblonga (Haw.) DC.
Crassula ovata (Mill.) Druce
Crassula pellucida L. subsp. alsinoides (Hook. f.) Toelken
Crassula pellucida L. subsp. brachypetala (Drege ex Ha
Crassula pellucida L. subsp. marginalis (Dryand. in Ai
Crassula perfoliata L. var. heterotricha (Schinz) Toelken
Crassula perforata Thunb.
Crassula sarmentosa Harv. var. integrifolia Toelken
Crassula sarmentosa Harv. var. sarmentosa
Crassula sediflora var. sediflora
Crassula setulosa Harv. var. setulosa
Crassula southii Schonl. subsp. sphaerocephala
Crassula streyi Toelken
Crassula vaginata Eckl. & Zeyh. subsp. vaginata
Crassula vaginata subsp. minuta
Craterostigma sp. nov. (Abbott 1909)
Crepidomanes melanotrichum (Schltdl.) J.P.Roux
Crinum moorei Hook.f.
Crocosmia aurea (Pappe ex Hook.) Planch. subsp. aurea
Crossandra greenstockii
Crotalaria capensis Jacq.
Crotalaria dura subsp. dura
Crotalaria globifera E.Mey.
Crotalaria lanceolata E.Mey. subsp. lanceolata
Crotalaria macrocarpa E.Mey subsp. macrocarpa
Crotalaria natalensis Bak. f.
Crotalaria natalitia Meisn. var. natalitia
Crotalaria obscura DC.
Crotalaria pallida Ait. var. pallida
Crotalaria virgulata Klotzsch subsp. grantiana (Harv.) P
Croton sylvaticus Hochst.
Cryptocarya latifolia Sond.
Cryptocarya myrtifolia Stapf

Cryptocarya woodii Engl.
Cryptocarya wyliei Stapf
Cryptolepis capensis Schltr.
Cryptolepis oblongifolia (Meisn.) Schltr.
Ctenitis lanuginosa (Willd. ex Kaulf.) Copel.
Ctenium concinnum Nees
Ctenomeria capensis (Thunb.) Harv. ex Sond.
Cucumis hirsutus Sond.
Cunonia capensis L.
Cuscuta campestris Yunck.*
Cuscuta cassytoides Nees ex Engelm.
Cussonia nicholsonii Strey
Cussonia sphaerocephala Strey
Cussonia spicata Thunb.
Cussonia thyrsiflora Thunb.
Cussonia zuluensis Strey
Cyanotis speciosa (L.f.) Hassk.
Cyathea dregei Kunze
Cyathocoma bachmannii (Kük.) C.Archer
Cyathula cylindrica Moq.
Cycnium adonense E. Mey. ex Benth. subsp. adonense
Cycnium racemosum Benth.
Cycnium tubulosum (L.f.) Engl. subsp. tubulosum
Cymbopogon excavatus (Hochst.) Stapf ex Burtt Davy
Cymbopogon nardus (L.) Rendle
Cymbopogon plurinodis (Stapf) Stapf ex Burtt Davy
Cymbopogon validus (Stapf) Stapf ex Burtt Davy
Cynanchum ellipticum (Harv.) R.A. Dyer
Cynanchum gerrardii (Harv.) Liede
Cynanchum natalitium Schltr.
Cynanchum obtusifolium L. f. var. obtusifolium
Cynodon dactylon (L.) Pers.
Cynoglossum geometricum Bak. & C.H.Wr.
Cynoglossum lanceolatum Forssk.
Cyperus albostriatus Schrad.
Cyperus articulatus L.
Cyperus austro-africanus C.Archer & Goet. sp. nov. ined.
Cyperus brevis Boeck.
Cyperus capensis (Steud.) Endl.
Cyperus congestus Vahl
Cyperus cyperoides (L.) Kuntze subsp. cyperoides
Cyperus cyperoides (L.) Kuntze subsp. pseudoflavua
Cyperus difformis L.
Cyperus distans L. f.
Cyperus dives Delile
Cyperus dubius Rottb.
Cyperus immensus C.B. Cl.
Cyperus leptocladus Kunth
Cyperus longus L. var. longus
Cyperus macrocarpus (Kunth.) Boeck.
Cyperus natalensis Hochst.
Cyperus obtusiflorus Vahl var. obtusiflorus
Cyperus obtusiflorus Vahl var. sphaerocephalus (Vahl) Ku
Cyperus owanii Boeck.
Cyperus prolifer Lam.
Cyperus pseudovestitus (C.B.Clarke) Kük.
Cyperus pulcher Thunb.
Cyperus rubicundus Vahl
Cyperus rupestris Kunth var. amnicola (Kunth) Kük.
Cyperus rupestris Kunth var. rupestris
Cyperus sexangularis Nees.
Cyperus solidus Kunth
Cyperus sp. (= Mariscus uitenhagensis Steud.)
Cyperus sphaerospermus Schrad.
Cyperus textilis Thunb.
Cyperus vorsteri K.L.Wilson
Cyphia elata Harv. var. elata
Cyphostemma cirrhosum
Cyphostemma hypoleucum
Cyphostemma natalitium (Szyszyl.) J. V.D. Merwe
Cyphostemma woodii (Gilg & Brandt) Descoings
Cyrtanthus brachyscyphus Baker
Cyrtanthus breviflorus Harv.
Cyrtanthus contractus N.E.Br.
Cyrtanthus epiphyticus J.M.Wood
Cyrtanthus mackenii Hook.f. var. cooperi
Cyrtanthus mackenii Hook.f. var. mackenii
Cyrtanthus sanguineus (Lindl.) Walp.
Cyrtanthus sp. nov. (Abbott 4412)
Cyrtomium caryotideum var. micropterum
Cyrtorchis arcuata (Lindl.) Schltr. subsp. arcuata
Cystopteris fragilis (L.) Bernh.
Dactylis glomerata L.
Dactyloctenium aegyptium (L.) Beauv.
Dactyloctenium australe Steud.
Dahlgrenodendron natalense
Dais cotinifolia L.
Dalbergia armata E. Mey.
Dalbergia multijuga E.Mey.
Dalbergia obovata E.Mey.
Dalechampia capensis A.Spreng.
Dalechampia volubilis E. Mey. ex Baill.
Dasispermum suffruticosum (P.J.Bergius) B.L.Burtt
Datura metel L. *
Davalia denticulata var. denticulata
Davallia chaerophylloides (Poir.) Steud.
Deinbollia oblongifolia (E.Mey.ex Arn.) Radlk.
Delosperma caespitosum L. Bol. forma caespitosum
Delosperma caespitosum L.Bolus
Delosperma carterae L.Bolus
Delosperma concavum L. Bol.
Delosperma cooperi (Hook.f.) L.Bolus
Delosperma galpinii L. Bol.
Delosperma herbeum (N.E. Br.) N.E. Br.
Delosperma lavisiae L. Bol.
Delosperma lebomboense (L.Bolus) Lavis
Delosperma lineare L. var. lineare
Delosperma pallidum L.Bolus
Delosperma rogersii (Schönland & A.Berger) L.Bolus
Delosperma sp. cf nov. (Cloete 4821, 6300)
Delosperma sp. nov. (Abbott 954 and others)
Delosperma subincanum (Haw.) Schwantes
Delosperma subpetiolatum L.Bolus
Delosperma tradescantioides (A.Berger) L.Bolus
Delosperma velutinum L. Bol.
Dermatobotrys saundersii Bolus ex Oliv.
Desmodium dregeanum Benth.
Desmodium incanum DC.
Desmodium repandum (Vahl) DC.
Desmodium setigerum (E.Mey.) Benth. ex Harv.
Diandrochloa namaquensis (Nees) De Winter
Dianthus crenatus Thunb.
Dianthus mooiensis subsp. mooiensis var. dentatus
Dianthus thunbergii forma thunbergii
Dianthus zeyheri Sond. subsp. natalensis S.S.Hooper
Diaphananthe xanthopollinia (Reichb.f.)Summerh.
Diascia racemulosa Benth.
Dichilus reflexus (N.E. Br.)A.L. Schutte
Dichrocephala integrifolia subsp. integrifolia
Dichrostachys cinerea subsp. nyassana
Dicliptera clinopodia Nees
Dicliptera heterostegia Presl ex Nees
Dicliptera zeylanica Nees
Diclis reptans Benth.
Dicranella subsubulata (Hampe ex Müll.Hal.) A.Jaeger
Didymodoxa caffra (Thunb.) Friis & Wilmot-Dear
Dierama argyreum L. Bol.
Dierama atrum N.E.Br.
Dierama dissimile Hilliard
Dierama igneum Klatt
Dierama reynoldsii
Dierama robustum N.E. Br.
Dietes bicolor (Steud.) Sweet ex Klatt
Dietes butcheriana Gerstn.
Dietes grandiflora N.E. Br.
Dietes iridioides (L.) Sweet ex Klatt
Digitaria diagonalis (Nees) Stapf var. diagonalis
Digitaria eriantha Steud.
Digitaria longiflora (Retz.) Pers.
Digitaria natalensis Stent
Digitaria sanguinalis (L.) Scop.
Digitaria setifolia Stapf
Digitaria thouarsiana (Flüggé) A.Camus
Diheteropogon amplectens (Nees) Clayton var. amplectens
Diheteropogon filifolius (Nees) Clayton
Dimorphotheca caulescens Harv.
Dimorphotheca fruticosa (L.) Less.
Dioscorea cotinifolia Kunth

Dioscorea crinita Hook. f.
Dioscorea diversifolia Griseb.
Dioscorea dregeana (Kunth) T.Durand & Schinz
Dioscorea retusa Mast.
Dioscorea rupicola Kunth
Dioscorea sylvatica Eckl. var. sylvatica
Diospyros dichrophylla (Gand.) De Winter
Diospyros lycioides Desf. subsp. lycioides
Diospyros lycioides Desf. subsp. sericea
Diospyros natalensis (Harv.) Brenan subsp. natalensis
Diospyros pallens
Diospyros scabrida var. cordata
Diospyros scabrida var. scabrida
Diospyros simii (Kuntze) De Winter
Diospyros villosa var. villosa
Diospyros villosa var. parvifolia
Diospyros whyteana (Hiern) F.White
Dipcadi marlothii Engl.
Dipcadi viride (L.) Moench
Disa baurii Bolus
Disa brevicornis (Lindl.) Bolus
Disa caffra Bolus
Disa chrysostachya Swartz
Disa crassicornis Lindl.
Disa nervosa Lindl.
Disa polygonoides Lindl.
Disa sagittalis (L.f.) Sw.
Disa similis Summerh.
Disa stachyoides Rchb.f.
Disa tripetaloides (L.f.) N.E.Br.
Disa versicolor Rchb.f.
Disa woodii Schltr.
Disparago ericoides (Berg.) Gaertn.
Disparago tortilis (DC.) Sch.Bip.
Disperis anthoceros Rchb.f. var. anthoceros
Disperis lindleyana Rchb.f.
Disphyma sp.
Dissotis canescens (E.Mey. ex R.A.Graham) Hook.f.
Dissotis princeps var. candolleana
Distephanus angulifolius (DC.) H.Rob. & B.Kahn
Dodonaea angustifolia L.f.
Dolichos falciformis E.Mey.
Dolichos sericeus E. Mey. subsp. sericeus
Dolichos trilobus L. subsp. transvaalicus Verdc.
Dombeya burgessiae Gerr. ex Harv.
Dombeya cymosa Harvey
Dombeya tiliacea (Endl.) Planch.
Doryopteris concolor (Langsd. & Fisch.) Kuhn
Dovyalis caffra (Hook. f. & Harv.) Hook. f.
Dovyalis longispina (Harv.) Warb.
Dovyalis lucida Sim
Dovyalis rhamnoides (Burch. ex DC.) Burch. & Harv.
Dovyalis zeyheri (Sond.) Warb.
Dracaena aletriformis (Haw.) Bos
Dregea floribunda E. Mey.
Drimia calcarata (Baker) Stedje
Drimia cooperi (Baker) Baker
Drimia cyanelloides (Baker) J.C.Manning & Goldblatt
Drimia depressa (Baker) Jessop
Drimiopsis burkei Bak.
Drimiopsis lachenalioides (Bak.) Jessop
Drimiopsis maculata Lindl.
Drimiopsis maxima Bak.
Droguetia ambigua Wedd.
Droguetia iners (Forssk.) Schweinf. subsp. iners
Droguetia woodii N.E. Br.
Drosera burkeana Planch.
Drosera collinsiae N.E. Br. ex Burtt Davy
Drosera cuneifolia L. f.
Drosera madagascariensis DC.
Drosera natalensis Diels
Drymaria cordata subsp. diandra
Dryopteris inaequalis (Schlechtd.) Kuntze
Drypetes arguta (Müll.Arg.) Hutch.
Drypetes gerrardii Hutch. var. gerrardii
Duvernoia adhatodoides E.Mey. ex Nees
Echinochloa colona (L.) Link
Echinochloa crus- pavonisn
Echinochloa crus-galli (L.) Beauv.*
Echinochloa pyramidalis (Lam.) Hitchc. & Chase
Ectropothecium regulare (Brid.) A.Jaeger
Ehretia rigida (Thunb.) Druce
Ehrharta calycina J.E. Sm. var. calycina
Ehrharta erecta Lam. var. erecta
Ehrharta erecta Lam. var. natalensis Stapf
Ehrharta rehmannii Stapf subsp. rehmannii
Ehrharta sp. (Fish 6088)
Ehrharta villosa Schult.f. var. maxima Stapf
Ekebergia capensis Sparrm.
Ekebergia pterophylla (C.DC.) Hofmeyr
Elaeodendron croceum (Thunb.) DC.
Elaphoglossum acrostichoides (Hook. & Grev.) Schelpe
Elaphoglossum angustatum (Schrad.) Hieron.
Elaphoglossum macropodium (Fée) T.Moore
Eleocharis caduca (Delile) Schult.
Eleocharis dregeana Steud.
Eleocharis limosa (Schrad.) Schult.
Eleocharis variegata (Poir.) C.Presl
Eleusine coracana (L.) Gaertn. subsp. africana
Eleusine indica (L.) Gaertn. subsp. indica
Elionurus muticus (Spreng.) Kunth
Embelia ruminata (E.Mey. ex A.DC.) Mez
Empodium elongatum (Nel) B.L. Burtt
Encephalartos altensteinii Lehm.
Encephalartos caffer (Thunb.) Lehm.
Encephalartos ghellinckii Lem.
Encephalartos laevifolius Stapf & Burtt Davy
Encephalartos natalensis R.A.Dyer & I.Verd.
Encephalartos villosus Lem.
Endostemon obtusifolius (E.Mey. ex Benth.) N.E.Br.
Englerodaphne ovalifolia (Meisn.) E.Phillips
Englerophytum natalense (Sond.) T.D.Penn.
Equisetum ramosissimum Desf.
Eragrostis acraea De Winter
Eragrostis capensis (Thunb.) Trin.
Eragrostis ciliaris (L.) R. Br.
Eragrostis curvula (Schrad.) Nees
Eragrostis heteromera Stapf
Eragrostis inamoena K.Schum.
Eragrostis nindensis Fical. & Hiern
Eragrostis patens Oliv.
Eragrostis pilosa (L.) Beauv.
Eragrostis plana Nees
Eragrostis racemosa (Thunb.) Steud.
Eragrostis rigidior Pilg.
Eragrostis sabulosa (Steud.) Schweick.
Eragrostis tenuifolia (A.Rich.) Steud.
Erianthemum dregei (Eckl. & Zeyh.) Tiegh.
Erica abbottii E.G.H.Oliv.
Erica aspalathifolia Bolus var. aspalathifolia
Erica caffra L. var. caffra
Erica caffrorum H. Bol. var. caffrorum
Erica cerinthoides L. var. barbertona (Galpin) H. Bol.
Erica cerinthoides L. var. cerinthoides
Erica cubica L.
Erica cubica L. var. coronifera Bolus
Erica cubica L. var. cubica
Erica cubica L. var. natalensis H. Bol.
Erica dracomontana E.G.H. Oliver
Erica evansii
Erica leucopelta Tausch
Erica natalensis Dulfer
Erica natalitia Bolus
Erica natalitia Bolus var. natalitia
Erica natalitia H. Bol. var. brevipedicellata Dulfer
Erica oatesii Rolfe var. oatesii
Erica woodii H. Bol.
Eriocaulon abyssinicum Hochst.
Eriocaulon africanum Hochst.
Eriocaulon dregei Hochst.
Eriocaulon ruhlandii Schinz
Eriocaulon schlechteri Ruhland
Eriochloa meyeriana (Nees) Pilg. subsp. meyeriana
Eriochrysis pallida Munro
Eriosema acuminatum (Eckl. & Zeyh.) C.H.Stirt.
Eriosema burkei Benth.
Eriosema cordatum E.Mey.
Eriosema dregei E.Mey.

Eriosema kraussianum Meisn.
Eriosema latifolium (Benth. ex Harv.) C.H.Stirt.
Eriosema luteopetalum C.H.Stirt.
Eriosema parviflorum E.Mey. subsp. parviflorum
Eriosema preptum C.H.Stirt.
Eriosema salignum E.Mey.
Eriosema simulans C.H.Stirt.
Eriosema squarrosum (Thunb.) Walp.
Eriosema streyi C.H.Stirt.
Eriosema umtamvunense C.H.Stirt.
Eriosemopsis subanisophylla Robyns
Eriospermum abyssinicum Bak.
Eriospermum cooperi Baker var. cooperi
Eriospermum cooperi Baker var. natalense
Eriospermum mackenii (Hook. f.) Bak. subsp. galpinii
Eriospermum mackenii (Hook.f.) Baker subsp. mackenii
Erlangea misera
Erythrina caffra Thunb.
Erythrina humeana Spreng.
Erythrina latissima E.Mey.
Erythrina lysistemon Hutch.
Erythrina xdyeri Hennesy
Erythrococca berberidea Prain
Erythrococca menyharthii (Pax) Prain
Erythrococca natalensis Prain
Erythrococca sp. nov. (Hitchins 775)
Erythroxylum emarginatum Thonn.
Erythroxylum pictum E.Mey. ex Sond.
Ethulia conyzoides L.f.
Ethulia conyzoides L.f. subsp. conyzoides
Eucalyptus grandis W.Hill ex Maiden
Euclea crispa (Thunb.) Gürke subsp. crispa
Euclea natalensis A.DC. subsp. natalensis
Euclea polyandra (L. f.) E. Mey. ex Hiern
Euclea racemosa Murray subsp. macrophylla (E.Mey. ex A.DC.) F.White
Euclea schimperi (A. DC.) Dandy var. schimperi
Euclea undulata Thunb. var. myrtina (Burch.) Hiern
Euclea undulata Thunb. var. undulata
Eucomis autumnalis (Mill.) Chitt.
Eucomis autumnalis subsp. autumnalis
Eugenia albanensis Sond.
Eugenia capensis (Eckl. & Zeyh.) Sond. subsp. capensis
Eugenia capensis (Eckl. & Zeyh.) Sond. subsp. gueinzii
Eugenia erythrophylla Strey
Eugenia gueinzii Sond.
Eugenia natalitia Sond.
Eugenia simii Duemmer
Eugenia sp. nov. C (Abbott s.n.)
Eugenia umtamvunensis Van Wyk
Eugenia uniflora L.*
Eugenia verdoorniae A.E.van Wyk
Eugenia woodii Dummer
Eugenia zeyheri (Harv.) Harv.
Eulalia villosa (Thunb.) Nees
Eulophia angolensis (Rchb.f.) Summerh.
Eulophia clavicornis Lindl. var. clavicornis
Eulophia clavicornis Lindl. var. nutans (Sond.) A.V. Hall
Eulophia clitellifera (Reichb. f.) H. Bol.
Eulophia ensata Lindl.
Eulophia foliosa (Lindl.) H. Bol.
Eulophia hians Spreng. var. hians
Eulophia hians Spreng. var. nutans (Sond.) S.Thomas
Eulophia leontoglossa Rchb.f.
Eulophia odontoglossa Reichb. f.
Eulophia ovalis Lindl. subsp. ovalis
Eulophia parviflora (Lindl.) A.V.Hall
Eulophia speciosa (R. Br. ex Lindl.) H. Bol.
Eulophia streptopetala Lindl.
Eulophia tenella Rchb.f.
Euphorbia bupleurifolia Jacq.
Euphorbia dumosa E. Mey. ex Boiss.
Euphorbia epicyparissias
Euphorbia epicyparissias var. epicyparissias
Euphorbia ericoides Lam.
Euphorbia franksiae N.E. Br.
Euphorbia grandidens Haw.
Euphorbia gueinzii Boiss. var. albovillosa (Pax) N.E. Br.
Euphorbia gueinzii Boiss. var. gueinzii
Euphorbia heterophylla L.
Euphorbia kraussiana Bernh. var. erubescens N.E. Br.
Euphorbia kraussiana Bernh. var. kraussiana
Euphorbia natalensis Bernh.
Euphorbia stellispina Haw. var. stellispina
Euphorbia striata Thunb. var. striata
Euphorbia tetragona Haw.
Euphorbia tirucalli L.
Euphorbia triangularis Desf.
Euphorbia woodii N.E.Br.
Euryops brachypodus (DC.) B.Nord.
Euryops brevipapposus M.D.Hend.
Euryops chrysanthemoides (DC.) B.Nord.
Euryops leiocarpus (DC.) B.Nord.
Euryops pedunculatus N.E. Br.
Eustachys paspaloides
Evolvulus alsinoides (L.) L. var. linifolius (L.) Bak.
Excoecaria simii (Kuntze) Pax
Falkia repens L. f.
Faurea macnaughtonii E.Phillips
Felicia erigeroides DC.
Felicia filifolia (Vent.) Burtt Davy subsp. filifolia
Felicia muricata (Thunb.) Nees
Festuca costata Nees
Festuca scabra Vahl
Ficinia dasystachys C.B.Clarke
Ficinia fascicularis Nees
Ficinia gracilis Schrad.
Ficinia laciniata (Thunb.) Nees
Ficinia stolonifera Boeck.
Ficus bizanae Hutch. & Burtt Davy
Ficus burtt-davyi Hutch.
Ficus craterostoma Warb. ex Mildbr. & Burret
Ficus glumosa Delile
Ficus ingens (Miq.) Miq. var. ingens
Ficus natalensis Hochst. subsp. natalensis
Ficus sp.*
Ficus sur Forssk.
Ficus thonningii Blume
Fimbristylis complanata (Retz.) Link
Fimbristylis dichotoma (L.) Vahl
Fimbristylis ferruginea (L.) Vahl
Fimbristylis obtusifolia (Lam.) Kunth
Fimbristylis variegata Gordon-Gray
Fissidens borgenii Hampe
Fissidens erosulus (Müll.Hal.) Paris
Fissidens ovatus Brid.
Fissidens palmifolius (P.Beauv.) Broth.
Flagellaria guineensis Schumach.
Floscopa glomerata (Willd. ex Schult. & Schult.f.) Hassk.
Fockea tugelensis N.E. Br.
Foeniculum vulgare Mill. var. vulgare*
Freesia laxa subsp. laxa
Fuirena ecklonii Nees
Fuirena hirsuta (P.J.Bergius) P.L.Forbes
Fuirena pubescens (Poir.) Kunth var. pubescens
Funaria hygrometrica Hedw.
Galinsoga parviflora Cav. *
Galopina aspera
Galopina circaeoides Thunb.
Galopina tomentosa Hochst.
Galtonia princeps (Baker) Decne.
Garcinia gerrardii Harv. ex Sim
Gardenia thunbergia L.f.
Garuleum album S.Moore
Gasteria croucheri (Hook.f.) Baker
Gazania krebsiana Less. subsp. krebsiana
Gazania krebsiana Less. subsp. serrulata
Gazania linearis (Thunb.) Druce var. linearis
Gazania rigens (L.) Gaertn. var. rigens
Gazania rigens (L.) Gaertn. var. uniflora (L.f.) Roessler
Genlisea hispidula Stapf
Genlisea hispidula Stapf subsp. hispidula
Geranium flanaganii R.Knuth
Geranium ornithopodon Eckl. & Zeyh.
Geranium sparsiflorum R.Knuth
Geranium subglabrum Hilliard & B.L.Burtt
Gerbera ambigua (Cass.) Sch.Bip.
Gerbera piloselloides (L.) Cass.
Gerbera viridifolia (DC.) Sch. Bip.

Gerrardanthus macrorhizus Harv.ex Benth.& Hook.f.
Gerrardanthus tomentosus Hook. f.
Gerrardina foliosa Oliv.
Gladiolus carneus Delaroche
Gladiolus dalenii Van Geel subsp. dalenii
Gladiolus ecklonii Lehm.
Gladiolus longicollis Baker subsp. longicollis
Gladiolus longicollis Baker subsp. platypetalus (Baker) Goldblatt & J.C.Manning
Gladiolus longicollis Baker subsp. platypetalus (Baker) Goldblatt & J.C.Manning
Gladiolus oppositiflorus Herb.
Gladiolus permeabilis Delaroche subsp. wilsonii (Bak.) G.
Gladiolus wilsonii (Baker) Goldblatt & J.C.Manning
Gleichenia polypodioides (L.) Sm.
Gleichenia umbraculifera (Kunze) T.Moore
Gloriosa superba L.
Gnaphalium pensylvanicum Willd. *
Gnidia anthylloides (L.f.) Gilg
Gnidia burchellii (Meisn.) Gilg
Gnidia caffra (Meisn.) Gilg
Gnidia calocephala (C.A.Mey.) Gilg
Gnidia coriacea Meisn.
Gnidia kraussiana Meisn. var. kraussiana
Gnidia macropetala Meisn.
Gnidia myrtifolia C.H.Wright
Gnidia nodiflora Meisn.
Gnidia polyantha Gilg
Gnidia pulchella Meisn.
Gnidia styphelioides Meisn.
Gnidia triplinervis Meisn.
Gnidia wilmsii (C.H.Wright) Engl.
Gnidia woodii C.H.Wright
Gomphocarpus fruticosus (L.) W.T.Aiton
Gomphocarpus physocarpus E.Mey.
Gomphrena celosioides Mart. *
Gonioma kamassi E.Mey.
Graderia scabra (L.f.) Benth.
Grammatotheca bergiana (Cham.) C.Presl var. bergiana
Grevillea robusta *
Grewia caffra Meisn.
Grewia hispida Harv.
Grewia lasiocarpa E.Mey. ex Harv.
Grewia occidentalis L. var. occidentalis
Grewia pondoensis Burret
Gunnera perpensa L.
Gymnosporia bachmannii Loes.
Gymnosporia buxifolia (L.)
Gymnosporia filiformis Davidson
Gymnosporia grandifolia (Davison) M.Jordaan
Gymnosporia harveyana Loes. subsp. harveyana
Gymnosporia heterophylla (Eckl. & Zeyh.) Loes.
Gymnosporia mossambicensis (Klotzsch) Loes
Gymnosporia nemorosa (Eckl. & Zeyh.) Szyszyl.
Gymnosporia procumbens (L.f.) Loes.
Gymnosporia pubescens (N.Robson) Jordaan
Gymnosporia rubra (Harv.) Loes.
Gymnosporia uniflora Davidson
Gymnosporia vanwykii (R.H.Archer) M.Jordaan
Habenaria chlorotica Reichb. f.
Habenaria ciliosa Lindl.
Habenaria clavata (Lindl.) Reichb. f.
Habenaria dives Rchb.f.
Habenaria dregeana Lindl.
Habenaria falcicornis subsp. falcicornis
Habenaria falcicornis subsp. caffra
Habenaria lithophila Schltr.
Habenaria malacophylla Rchb.f.
Habenaria pseudociliosa Schelpe ex J.C. Manning
Habenaria tysonii H. Bol.
Habenaria woodii Schltr.
Haemanthus albiflos Jacq.
Haemanthus montanus Bak.
Hakea sericea Schrad. & J.C.Wendl.
Halleria lucida L.
Harpephyllum caffrum Bernh. ex Krauss
Harpochloa falx (L.f.) Kuntze
Harveya coccinea (Harv.) Schltr.
Harveya silvatica Hilliard & Burtt
Harveya speciosa Bernh.
Hebenstretia comosa Hochst.
Hebenstretia dura Choisy
Heimia myrtifolia Cham. & Schlechtd.
Helichrysum acutatum DC.
Helichrysum adenocarpum DC. subsp. adenocarpum
Helichrysum allioides Less.
Helichrysum appendiculatum (L.f.) Less.
Helichrysum argyrolepis Macowan
Helichrysum asperum (Thunb.) Hilliard & Burtt var. appresifolium
Helichrysum aureoniten
Helichrysum aureum (Houtt.) Merr. var. aureum
Helichrysum aureum (Houtt.) Merr. var. monocephalum
Helichrysum auriceps Hilliard
Helichrysum cephaloideum DC.
Helichrysum chionosphaerum DC.
Helichrysum cymosum (L.) D. Don subsp. calvum Hilliard
Helichrysum cymosum (L.) D.Don subsp. cymosum
Helichrysum decorum DC.
Helichrysum diffusum DC.
Helichrysum ecklonis Sond.
Helichrysum felinum Less.
Helichrysum foetidum (L.) Moench var. foetidum
Helichrysum griseum Sond.
Helichrysum herbaceum (Andrews) Sweet
Helichrysum infaustum J.M.Wood & M.S.Evans
Helichrysum krebsianum Less.
Helichrysum lepidissimum S.Moore
Helichrysum longifolium DC.
Helichrysum miconiifolium DC.
Helichrysum mimetes S. Moore.
Helichrysum mixtum (Kuntze) Moeser var. mixtum
Helichrysum natalitium DC.
Helichrysum nudifolium (L.) Less. var. nudifolium
Helichrysum odoratissimum (L.) Sweet
Helichrysum oxyphyllum DC.
Helichrysum pallidum DC.
Helichrysum panduratum O.Hoffm. var. panduratum
Helichrysum pannosum DC.
Helichrysum pilosellum
Helichrysum pilosellum (L.f.) Less.
Helichrysum platypterum DC.
Helichrysum populifolium DC.
Helichrysum ruderale Hilliard & B.L.Burtt
Helichrysum rugulosum
Helichrysum scitulum Hilliard & Burtt
Helichrysum simillimum DC.
Helichrysum spiralepis Hilliard & B.L.Burtt
Helichrysum subglomeratum Less.
Helichrysum teretifolium (L.) D.Don
Helichrysum umbraculigerum Less.
Helictotrichon hirtulum (Steud.) Schweick.
Helinus integrifolius (Lam.) Kuntze
Heliophila brassicifolia Eckl. & Zeyh.
Heliophila elongata (Thunb.) DC.
Heliophila rigidiuscula Sond.
Heliophila scandens Harv.
Heliophila subulata Burch. ex DC.
Helixanthera subcylindrica (Sprague) Danser
Helixanthera woodii (Schltr. & K.Krause) Danser
Hemarthria altissima (Poir.) Stapf & C.E. Hubb.
Hemizygia elliottii
Hermannia grandistipula
Hesperantha baurii Baker subsp. baurii
Hesperantha hygrophila Hilliard & Burtt
Hesperantha lactea Baker
Hesperantha modesta Baker
Heteromorpha arborescens (Spreng.) Cham. & Schltdl. var. arborescens
Heteromorpha trifoliata (Wendl.) Eckl. & Zeyh.
Heterophyllium sp.
Heteropogon contortus (L.) Roem. & Schult.
Heteropyxis natalensis Harv.
Hewittia malabarica (L.) Suresh
Hewittia sublobata (L. f.) Kuntze
Heywoodia lucens Sim
Hibiscus aethiopicus L. var. aethiopicus
Hibiscus aethiopicus L. var. ovatus Harv.
Hibiscus calyphyllus Cav.

Hibiscus diversifolius Jacq. subsp. diversifolius
Hibiscus fuscus Garcke
Hibiscus ludwigii Eckl. & Zeyh.
Hibiscus meyeri Harv. subsp. meyeri
Hibiscus pedunculatus L.f.
Hibiscus platycalyx Mast.
Hibiscus rosa-sinensis L. *
Hibiscus schizopetalus (Mast.) Hook.f.
Hibiscus sp. nov. (=Strey 6513)
Hibiscus surattensis L.
Hibiscus tiliaceus L. subsp. tiliaceus
Hibiscus trionum L.
Hibiscus vitifolius L. subsp. vitifolius
Hilliardia zuurbergensis (Oliv.) B.Nord.
Hippobromus pauciflorus (L. f.) Radlk.
Hippocratea delagoensis Loes.
Hippocratea schlechteri Loes. var. pegleriae Loes.
Histiopteris incisa (Thunb.) J. Sm.
Holomitrium cylindraceum (P.Beauv.) Wijk & Margad. var. cucullatum (Besch.) Wijk & Margad.
Holothrix orthoceras (Harv.) Reichb. f.
Homalium dentatum (Harv.) Warb.
Homalium rufescens Benth.
Hookeriopsis pappeana (Hampe) Jaeg.
Hookeriopsis utacamundiana (Mont.) Broth.
Huernia hystrix (Hook.f.) N.E.Br. var. parvula
Huperzia dacrydoides
Huperzia gnidioides (L.f.) Trevis.
Huperzia verticillata (L.f.) Trevis.
Hybanthus capensis (Thunb.) Engl.
Hybanthus enneaspermus (L.) F.Muell. var. enneaspermus
Hybanthus enneaspermus (L.) F.Muell. var. pseudocaffer Grey-Wilson
Hydrocotyle bonariensis Lam.
Hyparrhenia anamesa Clayton
Hyparrhenia cymbaria (L.) Stapf
Hyparrhenia filipendula (Hochst.) Stapf var. filipendula
Hyparrhenia filipendula (Hochst.) Stapf var. pilosa (Hochst.) Stapf
Hyparrhenia hirta (L.) Stapf
Hyparrhenia schimperi (A. Rich.) Stapf
Hyperacanthus amoenus (Sims) Bridson
Hypericum aethiopicum Thunb. subsp. aethiopicum
Hypericum aethiopicum Thunb. subsp. sonderi (Bredell) N.Robson
Hypericum lalandii Choisy
Hypericum natalense Wood & Evans
Hypericum sp.nov (=Strey 7663) [or 7443?]
Hypnum cupressiforme Hedw. var. cupressiforme
Hypochoeris radicata L.
Hypodontium dregei (Hornsch.) Müll.Hal.
Hypodontium pomiforme (Hook.) Müll.Hal.
Hypoestes aristata (Vahl) Soland. ex Roem. & Schult. var. aristata
Hypoestes forskaolii (Vahl) R.Br.
Hypolepis sparsisora (Schrad.) Kuhn
Hypopterygium laricinum (Hook.) Brid.
Hypopterygium tamarisci (Sw.) Brid. ex Müll.Hal.
Hypoxis acuminata Baker
Hypoxis angustifolia Lam. var. angustifolia
Hypoxis angustifolia Lam. var. buchananii Baker
Hypoxis argentea Harv. ex Baker var. argentea
Hypoxis argentea Harv. ex Baker var. sericea Baker
Hypoxis colchicifolia Baker
Hypoxis filiformis Baker
Hypoxis flanaganii Baker
Hypoxis gerrardii Baker
Hypoxis hemerocallidea Fisch. & C.A. Mey.
Hypoxis interjecta Nel
Hypoxis longifolia Baker
Hypoxis ludwigii Baker
Hypoxis membranacea Baker x angustifolia Lam.
Hypoxis multiceps Buchinger ex Bak.
Hypoxis rigidula Bak. var. rigidula
Hypoxis rigidula var. pilosissima
Hypoxis sobolifera Jacq.
Hypoxis villosa L. f. var. obliqua (Jacq.) Bak.
Hypoxis villosa L.f. var. villosa
Hyptis pectinata (L.) Poit.
Ilex mitis (L.) Radlk. var. mitis
Ilysanthes dubia (L.) Bernh.
Impatiens flanaganae Hemsl.
Impatiens hochstetteri Warb. subsp. hochstetteri
Imperata cylindrica (L.) Raeusch.
Indigastrum fastigiatum (E.Mey.) Schrire
Indigofera aff. zeyheri Spreng. ex Eckl. & Zeyh.
Indigofera braamtonyi
Indigofera dregeana E. Mey.
Indigofera eriocarpa E.Mey.
Indigofera fastigiata E. Mey.
Indigofera filipes Benth. ex Harv.
Indigofera foliosa E.Mey.
Indigofera grata E. Mey.
Indigofera hedyantha Eckl. & Zeyh.
Indigofera herrstreyi Schrire
Indigofera hilaris Eckl. & Zeyh. var. hilaris
Indigofera jucunda Schrire
Indigofera longipes N.E. Br.
Indigofera micrantha E.Mey.
Indigofera natalensis Bolus
Indigofera pondoense Schrire
Indigofera rostrata Bolus
Indigofera rubroglandulosa Germish.
Indigofera sordida Benth. ex Harv.
Indigofera sp. (= van Hoepen 89)
Indigofera spicata Forssk. var. spicata
Indigofera stricta L.f.
Indigofera torulosa E. Mey.
Indigofera tristis E.Mey.
Indigofera velutina E.Mey.
Indigofera williamsonii (Harv.) N.E. Br.
Indigofera woodii H. Bol. var. laxa H. Bol.
Indigofera woodii H. Bol. var. woodii
Indigofera zeyheri Spreng. ex Eckl. & Zeyh.
Indogofera cylindrica DC.
Inulanthera calva (Hutch.) Kallersjo
Inulanthera dregeana (DC.) Kallersjo
Inulanthera leucoclada (DC.) Källersjö
Ipomea indica (Burm. F.) Merr.*
Ipomoea alba L.*
Ipomoea bathycolpos
Ipomoea bolusiana Schinz subsp. pinnatipartita Verdc.
Ipomoea cairica (L.) Sweet
Ipomoea congesta R.Br. *
Ipomoea crassipes Hook.
Ipomoea ficifolia Lindl.
Ipomoea indica (Burm.f.) Merr.
Ipomoea magnusiana Schinz var. magnusiana
Ipomoea mauritiana Jacq.
Ipomoea obscura (L.) Ker-Gawl. var. fragilis (Chois
Ipomoea pellita Hallier f.
Ipomoea pes-caprae (L.) R.Br. subsp. brasiliensis (L.) Ooststr.
Ipomoea plebeia R. Br. subsp. africana A. Meeuse
Ipomoea purpurea (L.) Roth *
Ipomoea simplex Thunb.
Ipomoea wightii (Wall.) Choisy
Ischaemum fasciculatum Brongn.
Ischnolepis natalensis (Schltr.) Venter
Ischyrolepis schoenoides (Kunth) H.P.Linder
Ischyrolepis setiger (Kunth) Linder
Isoglossa ciliata (Nees) Lindau
Isoglossa cooperi C.B.Clarke
Isoglossa delicatula C.B. Cl.
Isoglossa eckloniana (Nees) Lindau
Isoglossa grantii C.B.Clarke
Isoglossa hypoestiflora Lindau
Isoglossa ovata (Nees) Lindau
Isoglossa prolixa (Nees) Lindau
Isoglossa stipitata C.B. Cl.
Isoglossa woodii C.B.Clarke
Isolepis cernua (Vahl) Roem. & Schult.
Isolepis costata (Boeck.) A. Rich. var. costata
Isolepis fluitans (L.) R.Br. var. fluitans
Isolepis prolifer R. Br.
Isopterygium strangulatum (Hampe ex Müll.Hal.) Broth.
Jamesbrittenia sp.
Jasminum multipartitum Hochst.
Jasminum streptopus E. Mey.
Jatropha variifolia Pax
Jubaeopsis caffra Becc.
Juncus dregeanus Kunth
Juncus effusus L.

Juncus exsertus Buchen. subsp. exsertus
Juncus kraussii Hochst. subsp. kraussii
Juncus lomatophyllus Spreng.
Juncus oxycarpus E.Mey. ex Kunth
Juncus rigidus Desf.
Justicia betonica L.
Justicia campylostemon (Nees) T.Anderson
Justicia flava (Vahl.) Vahl.
Justicia petiolaris (Nees) T. Anders. subsp. bowiei (C.
Justicia petiolaris (Nees) T.Anders subsp. petiolaris
Justicia petiolaris (Nees)T. Anderson subsp. incerta (C.B.Clarke)Immelman
Justicia protracta (Nees) T. Anders. subsp. rhodesiana (S. Moore) Immelman
Justicia protracta (Nees) T.Anderson subsp. protracta
Kalanchoe crenata (Andr.) Haw.
Kalanchoe paniculata Harv.
Kalanchoe rotundifolia (Haw.) Haw.
Kedrostis foetidissima (Jacq.) Cogn.
Kedrostis hirtella (Naud.) Cogn.
Keetia gueinzii (Sond.) Bridson
Kiggelaria africana L.
Kleinia fulgens Hook. f.
Kniphofia coddiana Cufod.
Kniphofia drepanophylla Baker
Kniphofia fibrosa Bak.
Kniphofia laxiflora Kunth
Kniphofia linearifolia Baker
Kniphofia littoralis Codd
Kniphofia parviflora Kunth
Kniphofia rooperi (T.Moore) Lem.
Knowltonia bracteata Harv.ex Zahlbr.
Knowltonia brevistylis Szyszyl.
Knowltonia capensis (L.) Huth
Koeleria capensis (Steud.) Nees
Kohautia amatymbica Eckl. & Zeyh.
Kyllinga alata Nees
Kyllinga alba
Kyllinga elatior Kunth
Kyllinga odorata Vahl
Lablab purpureus (L.) Sweet subsp. uncinatus Verdc.
Lactuca capensis Thunb.
Lactuca indica L.*
Lagenaria sphaerica (Sond.) Naud.
Lampranthus blandus (Haw.) Schwant.
Lampranthus fugitans L.Bolus
Lampranthus sp. nov. (Abbott 3476)
Lampranthus spectabilis (Haw.) N.E.Br.
Lampranthus stipulaceus (L.) N.E. Br.
Lantana camara L. *
Lantana rugosa Thunb.
Laportea grossa (Wedd.) Chew
Laportea peduncularis (Wedd.) Chew
Laurembergia repens (L.) P.J.Bergius subsp. brachypoda (Welw. ex Hiern) Oberm.
Lauridia tetragona (L.f.) R.H.Archer
Ledebouria apertiflora (Baker) Jessop
Ledebouria cooperi (Hook.f.) Jessop
Ledebouria floribunda (Bak.) Jessop
Ledebouria revoluta (L.f.) Jessop
Leersia hexandra Sw.
Leonotis leonurus (L.) R.Br.
Leonotis ocymifolia (Burm.f.) Iwarsson var. raineriana (Vis.) Iwarsson
Lepidium bonariense L.
Lepisorus schraderi (Mett.) Ching
Leucadendron pondoense A.E.van Wyk
Leucadendron spissifolium (Salisb. ex Knight) I.Williams subsp. natalense (Thode & Gilg) I.Williams
Leucadendron spissifolium (Salisb. ex Knight) I.Williams subsp. oribinum I.Williams
Leucadendron spissifolium (Salisb. ex Knight) I.Williams subsp. spissifolium
Leucas lavandulifolia Sm.
Leucobryum acutifolium (Mitt.) Cardot
Leucoloma rehmannii (Müll.Hal.) Rehmann ex Paris
Leucoloma syrrhopodontoides Broth.
Leucospermum innovans Rourke
Lichtensteinia interrupta (Thunb.) E. Mey. ex Sond.
Lichtensteinia kolbeana Bolus
Lindernia sp.
Lindsaea ensifolia Swartz
Linum thunbergii Eckl. & Zeyh.
Liparis bowkeri Harv.
Liparis remota J. Stewart & Schelpe
Lippia javanica (Burm.f.) Spreng.
Litanthus pusillus Harv.
Littonia modesta Hook.
Lobelia anceps L.f.
Lobelia caerulea Hook. var. caerulea
Lobelia caerulea Hook. var. macularis (C.Presl) E.Wimm.
Lobelia chamaedryfolia (C.Presl) A.DC.
Lobelia chinensis Lour.
Lobelia coronopifolia L.
Lobelia erinus L.
Lobelia flaccida (C.Presl) A.DC. subsp. flaccida
Lobelia malowensis E.Wimm.
Lobelia patula L.f.
Lobelia preslii A. DC.
Lobelia pteropoda (C.Presl) A.DC.
Lobelia tomentosa L.f.
Lobelia vanreenensis (Kuntze) K. Schum.
Lopholaena dregeana DC.
Lopidium pennaeforme (Brid.) Fleisch.
Lopidium struthiopteris (Brid.) M.Fleisch.
Lotononis alpina (Eckl. & Zeyh.) B.-E.van Wyk subsp. multiflora (Eckl. & Zeyh.) B.-E.van Wyk
Lotononis bachmanniana Dummer
Lotononis corymbosa (E.Mey.) Benth.
Lotononis eriocarpa (E.Mey.) B.-E.van Wyk
Lotononis listii Polhill
Lotononis meyeri (C.Presl) B.-E.van Wyk
Lotononis pulchra Dummer
Lotononis umbellata Benth.
Lotononis viminea (E.Mey.) B.-E.van Wyk
Lotononis wilmsii Dummer
Lotus discolor E.Mey. subsp. discolor
Loudetia simplex (Nees) C.E.Hubb.
Loxostylis alata A.Spreng. ex Rchb.
Ludwigia octovalvis (Jacq.) Raven subsp. sessiliflora
Ludwigia stolonifera (Guill. & Perr.) Raven
Lycium acutifolium E.Mey. ex Dunal
Lycopodiella caroliniana (L.) Pic.Serm.
Lycopodiella cernua (L.) Pic.Serm.
Lycopodiella sarcocaulon
Lygodium japonicum Swartz *
Lygodium kerstenii Kuhn
Macaranga capensis (Baill.) Benth. ex Sim
Mackaya bella Harv.
Macrochaetium hexandrum (Nees) Pfeiffer
Macrocoma tenuis (Hook. & Grev.) Vitt subsp. tenuis
Macromitrium lebomboense Van Rooy
Macromitrium serpens (Hook. & Grev.) Brid.
Macrothelypteris torresiana (Gaudich.) Ching*
Macrotyloma axillare (E. Mey.) Verdc. var. axillare
Maerua cafra (DC.) Pax
Maerua juncea Pax subsp. crustata (Wild) Wild
Maerua racemulosa (A.DC.) Gilg & Gilg-Ben.
Maerua rosmarinoides (Sond.) Gilg & Ben.
Maesa alnifolia Harv.
Maesa lanceolata Forssk.
Malvastrum coromandelianum (L.) Garcke *
Manihot dulcis Pax *
Manilkara concolor (Harv.) Gerstner
Manilkara nicholsonii A.E.van Wyk
Manulea parviflora Benth. var. parviflora
Marattia fraxinea J.E. Sm. ex J.F. Gmel. var. salicifolia (Schrad.) C.Chr.
Marattia fraxinea Sm.
Margaritaria discoidea (Baill.) G.L.Webster var. nitida
Margaritaria discoidea (Baill.) Webster var. discoidea
Margaritaria discoidea (Baill.) Webster var. fagifolia
Marsilea capensis A. Br.
Matricaria nigellifolia DC. var. nigellifolia
Matricaria nigellifolia DC. var. tenuior DC.
Matricaria zuurbergensis Oliv.
Maytenus abbottii Van Wyk
Maytenus acuminata (L.f.) Loes. var. acuminata
Maytenus cordata (E.Mey. ex Sond.) Loes.

Maytenus nemorosa
Maytenus oleoides
Maytenus oleosa A.E.van Wyk & R.H.Archer
Maytenus peduncularis (Sond.) Loes.
Maytenus procumbens (L.f.) Loes.
Maytenus tenuispina (Sond.) Marais
Maytenus undata (Thunb.) Blakelock
Maytenus vanwykii Archer
Melanthera scandens subsp. dregei
Melasma scabrum P.J.Bergius var. scabrum
Melhania didyma Eckl. & Zeyh.
Melia azedarach L. *
Melinis nerviglumis (Franch.) Zizka
Melinis repens (Willd.) Zizka subsp. repens
Memecylon bachmannii Engl.
Memecylon natalense Markg.
Merwilla plumbea (Lindl.) Speta
Microchloa caffra Nees
Micrococca capensis (Baill.) Prain
Microglossa mespilifolia (Less.) B.L. Robinson
Microgramma lycopodioides (L.) Copel.
Microgramma mauritiana (Willd.) Tardieu
Microsorium punctatum (L.) Copel.
Microsorium scolopendrium (Burm. f.) Copel.
Microsorum punctatum (L.) Copel.
Microsorum scolopendria (Burm.f.) Copel.
Mikania capensis DC.
Mikania natalensis
Millettia grandis (E.Mey.) Skeels
Millettia sutherlandii
Mimusops caffra E.Mey. ex A.DC.
Mimusops obovata Nees ex Sond.
Mirabilis jalapa L.*
Miscanthus capensis (Nees) Anderss.
Miscanthus junceus (Stapf) Pilg.
Mitriostigma axillare Hochst.
Mittenothamnium ctenidioides (Dixon) Schelpe
Mohria caffrorum (L.) Desv. var. caffrorum
Mohria caffrorum (L.) Desv. var. ferruginea J.E. & S
Momordica balsamina L.
Momordica foetida Schumach.
Monanthotaxis caffra (Sond.) Verdc.
Monocymbium ceresiiforme (Nees) Stapf
Monopsis decipiens (Sond.) Thulin
Monopsis scabra (Thunb.) Urb.
Monopsis stellarioides (Presl) Urb. subsp. stellarioides
Monopsis unidentata (Dryand.) E. Wimm. subsp. intermedia
Monopsis unidentata (Dryand.) E.Wimm. subsp. laevicaulis
Monopsis unidentata (Dryand.) E.Wimm. subsp. unidentata
Monsonia angustifolia E.Mey. ex A.Rich.
Monsonia emarginata
Monsonia grandifolia Knuth
Monsonia natalensis R.Knuth
Montanoa hibiscifolia Benth.*
Moraea brevistyla (Goldbl.) Goldbl.
Moraea elliotii Baker
Moraea graminicola Oberm. subsp. notata Goldblatt
Moraea inclinata Goldbl.
Moraea spathulata (L.f.) Klatt
Moraea stricta Baker
Morella cordifolia (L.) Killick
Morella pilulifera Rendle
Morella serrata (Lam.) Killick
Morus alba L. var. alba*
Mundulea sp.
Muraltia lancifolia Harv.
Muraltia lancifolia Harv.
Muraltia saxicola Chodat
Myrsine africana L.
Mystacidium aliceae H. Bol
Mystacidium capense (L.f.) Schltr.
Mystacidium venosum Harv.ex Rolfe
Mystroxylon aethiopicum (Thunb.) Loes. subsp. aethiopicum
Nectaropetalum capense (Bolus) Stapf & Boodle
Nectaropetalum zuluense (Schönland) Corbishley
Nemesia albiflora N.E.Br.
Nemesia caerulea Hiern
Nemesia denticulata (Benth.) Grant ex Fourc.
Nemesia melissifolia Benth.
Neonotonia wightii (Arn.) Lackey
Nephrolepis exaltata (L.) Schott *
Nerine angustifolia (Baker) Baker
Nerine appendiculata Baker
Nesaea radicans Guill. & Perr. var. floribunda (Sond.) A. Fernandes
Nicandra physalodes (L.) Gaertn. *
Nidorella auriculata DC.
Noltea africana (L.) Reichb. f.
Nothoscordum gracile (Ait.) Stearn
Nuxia congesta R.Br. ex Fresen.
Nuxia floribunda Benth.
Nymphaea capensis Thunb. var. capensis
Nymphaea nouchali Burm.f. var. caerulea (Savigny) Verdc.
Nymphaea nouchali Burm.f. var. ovalifolia (Conard) Verdc.
Nymphoides indica (L.) Kuntze subsp. occidentalis
Nymphoides thunbergiana (Griseb.) Kuntze
Obetia tenax (N.E. Br.) Friis
Ochna arborea Burch. ex DC. var. arborea
Ochna arborea Burch. ex DC. var. oconnorii (Phill.) Du Toit
Ochna gamostigmata Du Toit
Ochna natalitia (Meisn.) Walp.
Ochna serrulata (Hochst.) Walp.
Ocotea bullata (Burch.) Baill.
Ocotea kenyensis (Chiov.) Robyns & R.Wilczek
Octoblepharum albidum Hedw.
Oedera squarrosa (L.) Anders. & Bremer
Oenothera glazioviana Micheli
Oenothera indecora Cambess. subsp. indecora *
Oenothera jamesii Torr. & Gray *
Oenothera laciniata Hill. *
Oenothera parodiana Munz subsp. parodiana *
Oenothera rosea L'H,rit. ex Ait. *
Oenothera villosa Thunb.*
Olax dissitiflora Oliv.
Oldenlandia affinis (Roem. & Schult.) DC. subsp. fugax
Oldenlandia affinis (Roem.& Schult.) DC.
Oldenlandia cephalotes (Hochst.) Kuntze
Oldenlandia corymbosa L.
Oldenlandia herbacea (L.) Roxb. var. herbacea
Oldenlandia rosulata K.Schum. var. rosulata
Oldenlandia rupicola (Sond.) Kuntze var. rupicola
Oldenlandia tenella (Hochst.) Kuntze
Olea capensis L. subsp. capensis
Olea capensis L. subsp. enervis (Harv. ex C.H.Wright) I.Verd.
Olea capensis L. subsp. macrocarpa (C.H.Wright) I.Verd.
Olea woodiana Knobl.
Oleandra distenta Kunze
Olinia radiata Hofmeyr & E.Phillips
Olinia ventosa (L.) Cufod.
Olyra latifolia L.*
Oncinotis inandensis Wood & Evans
Oncinotis tenuiloba Stapf
Ophioglossum reticulatum L.
Ophrestia oblongifolia (E.Mey.) H.M.L.Forbes var. oblongifolia
Ophrestia oblongifolia (E.Mey.) H.M.L.Forbes var. velutinosa
Oplismenus hirtellus (L.) P.Beauv.
Oplismenus undulatifolius (Ard.) Roem. & Schult.
Opuntia monacantha Haw.*
Opuntia vulgaris Mill.*
Oricia bachmannii (Engl.) I.Verd.
Ornithogalum graminifolium Thunb.
Ornithogalum juncifolium Jacq. var. juncifolium
Ornithogalum longibracteatum Jacq.
Ornithogalum ornithogaloides (Kunth) Oberm.
Ornithogalum paludosum Baker
Ornithogalum tenuifolium F.Delaroche subsp. tenuifolium
Orthosiphon suffrutescens (thonn.) J.K. Morton
Orthostichopsis subimbricata (Hampe) Broth.
Osmunda regalis L.
Osteospermum caulescens Harv.
Osteospermum fruticosum (L.) T. Norl.
Osteospermum grandidentatum DC.
Osteospermum imbricatum subsp. nervatum var. helichrysoides
Osteospermum imbricatum. subsp. nervatum var. nervatum
Osteospermum sp. (=Strey 8891, 5908)
Osyridicarpus schimperianus (Hochst. ex A.Rich.) A.DC.
Osyris compressa (P.J.Bergius) A.DC.
Osyris lanceolata Hochst. & Steud.
Otholobium polyphyllum (Eckl. & Zeyh.) C.H.Stirt.

Othonna natalensis Sch.Bip.
Oxalis bifurca Lodd. var. bifurca
Oxalis corniculata L. *
Oxalis purpurata Jacq.
Oxalis semiloba Sond.
Oxalis smithiana Eckl. & Zeyh.
Oxyanthus speciosus DC. subsp. gerrardii (Sond.) Bridson
Oxygonum dregeanum Meisn. subsp. dregeanum
Oxygonum dregeanum Meisn. subsp. streyi Germish.
Oxyrhachis gracillima (Baker) C.E.Hubb.
Pachycaris albens (E.Mey.) Nicholas & Goyder
Pachycarpus asperifolius Meisn.
Pachycarpus concolor E. Mey.
Pachycarpus confusum (Scott Elliot) Nicholas
Pachycarpus coronarius E. Mey.
Pachycarpus grandiflorus (L.f.) E.Mey. subsp. grandiflorus
Pachycarpus natalensis N.E.Br.
Pachycarpus orbicularis E. Mey.
Pachystigma bowkeri Robyns
Pachystigma cymosum Robyns
Pachystigma macrocalyx (Sond.) Robyns
Pancovia columella Cav.
Panicum aequinerve Nees
Panicum deustum Thunb.
Panicum dregeanum Nees
Panicum ecklonii Nees
Panicum fluviicola Steud.
Panicum hymeniochilum Nees
Panicum laticomum Nees
Panicum maximum Jacq.
Panicum natalense Hochst.
Panicum parvifolium Lam.
Panicum repens L.
Panicum subalbidum Kunth
Papillaria africana (Müll.Hal.) A.Jaeger
Paspalum dilatatum Poir.*
Paspalum distichum L.
Paspalum scrobiculatum L.
Paspalum urvillei Steud. *
Passerina filiformis L.
Passerina montivaga C.L.Bredenkamp & A.E.van Wyk
Passerina rigida Wikstr.
Passerina rubra C.H. Wr.
Passiflora edulis Sims *
Passiflora subpeltata Ortega*
Paulforstera patens (N.E.Br.) Nicholas
Pavetta bowkeri Harv.
Pavetta capensis (Houtt.) Bremek. subsp. komghensis (Bremek.) Kok
Pavetta galpinii Bremek.
Pavetta gracilifolia Bremek.
Pavetta inandensis Bremek.
Pavetta lanceolata Eckl.
Pavetta natalensis Sond.
Pavetta revoluta Hochst.
Pavonia burchellii (DC.) R.A. Dyer
Pavonia columella Cav.
Peddiea africana Harv.
Pelargonium alchemilloides (L.) L'H,rit.
Pelargonium capitatum (L.) L'Hér.
Pelargonium grossularioides (L.) L'Hér.
Pelargonium luridum (Andrews) Sweet
Pelargonium odoratissimum (L.) L'H,rit.
Pelargonium panduriforme Eckl. & Zeyh.
Pelargonium pulverulentum Colvill ex Sweet
Pellaea calomelanos (Sw.) Link var. calomelanos
Pellaea dura (Willd.) Hook.
Penaea cneorum Meerb. subsp. ovata
Pennisetum purpureum Schumach. *
Pennisetum unisetum (Nees) Benth.
Pentanisia angustifolia (Hochst.) Hochst.
Pentanisia prunelloides subsp. latifolia
Pentanisia prunelloides subsp. prunelloides
Peperomia blanda (Jacq.) H.B.K. var. leptostachya
Peperomia retusa (L.f.) A.Dietr. var. bachmannii (C.DC.) Düll
Peperomia retusa (L.f.) A.Dietr. var. retusa
Peperomia rotundifolia (L.) Kunth
Peperomia tetraphylla (G. Forst.) Hook. & Arn.
Peponium mackenii (Naud.) Engl.
Pereskia aculeata Mill.*
Peristrophe cernua Nees
Peristrophe natalensis T. Anders
Persicaria attenuata (R.Br.) Soják subsp. africana K.L.Wilson
Persicaria decipiens (R.Br.) K.L.Wilson
Persicaria hydropiper (L.) Spach. *
Persicaria lapathifolia (L.) S.F. Gray *
Persicaria serrulata (Lag.) Webb & Moq.
Petopentia natalensis (Schltr.) Bullock
Peucedanum caffrum (Meisn.) E.Phillips
Peucedanum capense (Thunb.) Sond. var. capense
Peucedanum natalense (Sond.) Engl.
Peucedanum platycarpum E. Mey.
Phacelurus franksae (J.M. Wood) Clayton
Phalaris arundinacea L.*
Pharnaceum thunbergii Adamson
Phaulopsis imbricata (Forssk.) Sweet subsp. imbricata
Philenoptera sutherlandii (Harv.) Schrire
Philonotis africana (Müll.Hal.) Rehmann ex Paris
Philonotis dregeana (Müll.Hal.) A.Jaeger
Philonotis hastata (Duby) Wijk & Margad.
Philoptera sutherlandii Harv.
Phoenix reclinata Jacq.
Phragmites australis (Cav.) Steud.
Phragmites mauritianus Kunth
Phyla nodiflora (L.) Greene var. nodiflora
Phylica natalensis Pillans
Phylica paniculata Willd.
Phyllanthus cedrelifolius I.Verd.
Phyllanthus glaucophyllus Sond.
Phyllanthus maderaspatensis L.
Phyllanthus meyerianus Müll.Arg.
Phyllanthus myrtaceus Sond.
Phyllanthus nummulariifolius Poir.
Phyllanthus reticulatus Poir.
Phymaspermum acerosum (DC.) Kallersjo
Phymaspermum sp.
Phymaspermum villosum (Hilliard) Kallersjo
Phymaspermum woodii (Thell.) Kallersjo
Physalis angulata L. *
Physalis peruviana L. *
Physcomitrium spathulatum var. spathulatum
Phytolacca dioica L. *
Phytolacca dodecandra L'Hér.
Phytolacca octandra L.
Pilotrichella pandurifolia (Müll.Hal.) A.Jaeger
Pimpinella caffra (Eckl. & Zeyh.) D.Dietr.
Pinus radiata D.Don. *
Piper capense L.f. var. capense
Pittosporum viridiflorum Sims
Pityrogramma calomelanos (L.) Link var. aureoflava (Hook.) Weath. ex Bailey*
Plagiomnium rhynchophorum (Hook.) Kop. var. reidii
Plantago lanceolata L. *
Plantago longissima Decne.
Plantago major L. *
Platycerium sp. cf. bifurcatum *
Plecostachys polifolia (Thunb.) Hilliard & Burtt
Plecostachys serpyllifolia (P.J.Bergius) Hilliard & B.L.Burtt
Plectranthus aliciae (Codd) Van Jaarsv. & T.J.Edwards
Plectranthus ambiguus (Bolus) Codd
Plectranthus ciliatus E.Mey. ex Benth.
Plectranthus ecklonii Benth.
Plectranthus ernstii Codd
Plectranthus fruticosus L'Hér.
Plectranthus grallatus Briq.
Plectranthus var. woodii Plectranthus hadiensis subsp. tomentosus
Plectranthus hilliardiae Codd subsp. australis
Plectranthus hilliardiae Codd subsp. hilliardiae
Plectranthus laxiflorus Benth.
Plectranthus madagascariensis (Pers.) Benth. var. aliciae Codd
Plectranthus madagascariensis (Pers.) Benth. var. madagascariensis
Plectranthus malvinus Van Jaarsveld & T.J. Edwards
Plectranthus neochilus Schltr.
Plectranthus oertendahlii Th. Fr. Jr.
Plectranthus oribiensis Codd
Plectranthus petiolaris E.Mey. ex Benth.
Plectranthus praetermissus Codd
Plectranthus reflexus E.J.vJ & T.J.Edwards
Plectranthus saccatus Benth. Subsp. pondensis

Plectranthus saccatus Benth. var. longitubus Codd
Plectranthus saccatus Benth. var. saccatus
Plectranthus spicatus E. Mey. ex Benth.
Plectranthus strigosus Benth.
Plectranthus verticillatus (L.f.) Druce
Plectranthus zuluensis T.Cooke
Plectroniella armata (K.Schum.)Robyns
Pleopeltis macrocarpa (Bory ex Willd.) Kaulf.
Pleopeltis macrocarpa (Bory ex Willd.) Kaulf. var. macrocarpa
Pleopeltis schraderi (Mett.) Tardieu
Pleurostylia capensis (Turcz.) Loes.
Plumbago auriculata Lam.
Poa annua L.
Poa binata Nees
Podalyria cf. velutina Burch. ex Benth.
Podalyria velutina Burch. ex Benth.
Podocarpus falcatus (Thunb.) R.Br. ex Mirb.
Podocarpus henkelii Stapf ex Dallim. & Jacks.
Podocarpus latifolius (Thunb.) R.Br. ex Mirb.
Podranea ricasoliana (Tanfani) Sprague
Pollichia campestris Ait.
Polygala amatymbica Eckl. & Zeyh.
Polygala capillaris E. Mey. ex Harv.
Polygala capillaris E.Mey. ex Harv. subsp. capillaris
Polygala confusa Macowan
Polygala esterae Chod.
Polygala fruticosa P.J.Bergius
Polygala gazensis Baker f.
Polygala gerrardii Chod.
Polygala gracilenta Burtt Davy
Polygala hispida Burch. ex DC.
Polygala hottentotta C.Presl
Polygala houtboshiana Chodat
Polygala macowaniana Paiva
Polygala myrtifolia L. var. myrtifolia
Polygala ohlendorfiana Eckl. & Zeyh.
Polygala producta N.E.Br.
Polygala refracta DC.
Polygala rehmannii Chod.
Polygala serpentaria Eckl. & Zeyh.
Polygala transvaalensis Chodat subsp. transvaalensis
Polygala uncinata E. Mey. ex Meisn.
Polygala virgata Thunb. var. decora (Sond.) Harv.
Polygala virgata Thunb. var. virgata
Polypodium polypodioides (L.) Hitchc. subsp. ecklonii (Kunze
Polypogon monspeliensis (L.) Desf. *
Polypogon strictus Nees
Polypogon viridis (Gouan) Breistr.
Polystachya concreta (Jacq.) Garay & Sweet
Polystachya fusiformis (Thouars) Lindl.
Polystachya pubescens (Lindl.) Rchb.f.
Polystachya sandersonii Harv.
Polystachya tessellata Lindl.
Polystichum transkeiense W.Jacobsen
Porothamnium stipitatum (Mitt.) Touw ex De Sloover
Porotrichum madagassum Kiaer ex Besch.
Porotrichum usagarum Mitt.
Portulacaria afra Jacq.
Potamogeton crispus L.
Potamogeton schweinfurthii A.W. Benn.
Potamogeton thunbergii Cham. & Schlechtd.
Pouzolzia parasitica (Forssk.) Schweinf.
Premna mooiensis (H. Pearson) Pieper
Prionium serratum (L.f.) Drège ex E.Mey.
Priva meyeri Jaub. & Spach var. meyeri
Prosphytochloa prehensilis (Nees) Schweick.
Protea caffra Meisn. subsp. caffra
Protea roupelliae Meisn. subsp. roupelliae
Protea simplex E.Phillips
Protorhus longifolia (Bernh.) Engl.
Prunus africana (Hook.f.) Kalkman
Psammotropha mucronata (Thunb.) Fenzl var. foliosa Adamson
Psammotropha mucronata (Thunb.) Fenzl var. mucronata
Psammotropha myriantha Sond.
Pseudarthria hookeri Wight & Arn. var. hookeri
Pseudechinolaena polystachya (Kunth) Stapf
Pseudognaphalium luteo-album (L.) Hilliard & B.L.Burtt
Pseudognaphalium undulatum (L.) Hilliard & Burtt
Pseudosalacia streyi Codd
Pseudoschoenus inanis (Thunb.)Oteng-Yeb.
Pseudoscolopia polyantha Gilg
Psidium cattleianum Sabine *
Psidium guajava L.*
Psilotum nudum (L.) P.Beauv.
Psoralea abbottii C.H.Stirton
Psoralea affinis Eckl. & Zeyh.
Psoralea glabra E.Mey.
Psoralea latifolia (Harv.) C.H.Stirt.
Psoralea pinnata L.
Psychotria capensis (Eckl.) Vatke subsp. capensis var. capensis
Psydrax locuples (K. Schum.) Bridson
Psydrax obovata (Eckl. & Zeyh.) Bridson subsp. elliptica Psydrax obovata (Eckl. & Zeyh.) Bridson subsp. obovata
Ptaeroxylon obliquum (Thunb.) Radlk.
Pteridium aquilinum (L.) Kuhn subsp. aquilinum
Pteris buchananii Baker ex Sim
Pteris catoptera Kunze
Pteris catoptera Kunze var. catoptera
Pteris dentata Forssk.
Pterocelastrus echinatus N.E.Br.
Pterocelastrus rostratus (Thunb.) Walp.
Pterocelastrus tricuspidatus (Lam.) Walp.
Pterogoniadelphus assimilis (Müll.Hal.) Ochyra & Zijlstra
Ptychomitrium crispatum (Hedw.) A.Jaeger
Pulicaria scabra (Thunb.) Druce
Pupalia lappacea (L.) A.Juss. var. lappacea
Putterlickia pyracantha
Putterlickia retrospinosa A.E.van Wyk & Mostert
Putterlickia verrucosa (E.Mey. ex Sond.) Szyszyl.
Pycnostachys reticulata (E.Mey.) Benth.
Pycreus intactus (Vahl) J.Raynal
Pycreus macranthus (Boeck.) C.B. Cl.
Pycreus mundii Nees
Pycreus nitidus (Lam.) J.Raynal
Pycreus oakfortensis C.B.Clarke
Pycreus polystachyos (Rottb.) P.Beauv. var. polystachyos
Pycreus unioloides (R.Br.) Urb.
Pyrrhobryum spiniforme (Hedw.) Mitt.
Pyrrosia africana (Kunze) F.Ballard
Quisqualis parviflora Gerrard ex Sond.
Rabdosiella calycina (Benth.) Codd
Racopilum capense Müll.Hal. ex Broth.
Rafnia elliptica Thunb.
Rafnia elliptica Thunb.
Rangaeris muscicola (Rchb.f.) Summerh.
Ranunculus capensis Thunb.
Ranunculus multifidus Forssk.
Rapanea melanophloeos (L.) Mez
Raphionacme galpinii Schltr.
Raphionacme hirsuta (E.Mey.) R.A.Dyer
Raphionacme palustris Venter & Verhoefen
Raphionacme velutina Schltr.
Raspalia trigyna (Schltr.) Duemmer
Rauvolfia caffra Sond.
Rawsonia lucida Harv. & Sond.
Relhania pungens L'H,rit. subsp. trinervis (Thunb.)
Relhania pungens L'Hér. subsp. angustifolia (DC.) K.Bremer
Relhania pungens L'Hér. subsp. pungens
Rendlia altera (Rendle) Chiov.
Resnova humifusa (Baker) U.& D.Müll.-Doblies
Restio distichus Rottb.
Restio sejunctus Mast.
Restio triticeus Rottb.
Rhamnus prinoides L'Hér.
Rhinacanthus gracilis Klotzsch
Rhinacanthus gracilis Klotzsch var. latilabiatus K.Balkwill
Rhipsalis baccifera (J.S.Muell.) Stearn subsp. baccifera
Rhipsalis baccifera (Roem. & Schult.) Stapf subsp. mauritiana
Rhodobryum keniae (Müll.Hal.) Broth.
Rhodobryum roseum (Hedw.) Limpr.
Rhodocoma capensis Nees ex Steud.
Rhoicissus digitata (L.f.) Gilg & M.Brandt
Rhoicissus rhomboidea (E.Mey. ex Harv.) Planch.
Rhoicissus tomentosa (Lam.) Wild & R.B.Drumm.
Rhoicissus tridentata (L.f.) Wild & R.B.Drumm. subsp. cuneifolia
Rhoicissus tridentata (L.f.) Wild & R.B.Drumm. subsp. tridentata
Rhus acocksii Moffett
Rhus carnosula Schönland

Rhus chirindensis Baker f.
Rhus crenata Thunb.
Rhus dentata Thunb.
Rhus discolor E.Mey. ex Sond.
Rhus fastigata Eckl. & Zeyh.
Rhus gerrardii (Harv. ex Engl.) Diels
Rhus lucida L. forma lucida
Rhus natalensis Bernh. ex Krauss
Rhus nebulosa Schonl.
Rhus nebulosa Schönland forma nebulosa
Rhus pallens Eckl. & Zeyh.
Rhus pentheri Zahlbr.
Rhus pondoensis Schönland
Rhus pyroides Burch. var. gracilis (Engl.) Burtt Davy
Rhus pyroides Burch. var. integrifolia (Engl.) Moffett
Rhus pyroides Burch. var. pyroides
Rhus refracta Eckl. & Zeyh.
Rhus rehmanniana Engl. in A.& C.DC. subsp. rehmanniana
Rhus rehmanniana Engl. var. glabrata (Sond.) Moffett
Rhus rogersii Schönland
Rhus sp.nov. cf R. rigida
Rhynchelytrum nerviglume (Franch.) Chiov.
Rhynchocalyx lawsonioides Oliv.
Rhynchosia calvescens Meikle
Rhynchosia caribaea (Jacq.) DC.
Rhynchosia cooperi (Harv. ex Baker f.) Burtt Davy
Rhynchosia harmsiana Schltr. ex Zahlbr. var. harmsiana
Rhynchosia hirsuta Eckl. & Zeyh.
Rhynchosia minima (L.) DC. var. prostrata (Harv.) Mei
Rhynchosia pentheri Schltr. ex Zahlbr. var. pentheri
Rhynchosia sordida (E.Mey.) Schinz
Rhynchosia totta (Thunb.) DC. var. totta
Rhynchosia villosa (Meisn.) Druce
Rhynchospora barrosiana Guagl.
Rhynchospora brownii Roem. & Schult.
Rhynchospora corymbosa (L.) Britton
Rhynchospora corymbosa (L.) Britton var. corymbosa
Rhynchospora holoschoenoides (Rich.) Herter
Rhynchospora perrieri Cherm.
Rhynchospora spectabilis Hochst. ex Krauss
Rhytachne rottboellioides Desv.
Richardia brasiliensis Gomes *
Ricinus communis L.*
Rinorea angustifolia (Thouars) Baill.
Rinorea angustifolia (Thouars) Baill. subsp. natalensis
Rinorea domatiosa A.E.van Wyk
Riocreuxia torulosa Decne.
Rivina humilis L. *
Robsonodendron eucleiforme (Eckl. & Zeyh.) R.H.Archer
Roella glomerata A.DC.
Rorippa nudiuscula Thell.
Rotheca hirsuta (Hochst.) R.Fern.
Rothmannia capensis Thunb.
Rothmannia globosa (Hochst.) Keay
Rubia cordifolia L. subsp. conotricha (Gand.) Verdc.
Rubia petiolaris DC.
Rubus immixtus C.E. Gust.
Rubus pinnatus Willd.
Rubus rigidus J.E. Sm.
Rubus rosifolius J.E. Sm. *
Ruellia cordata Thunb.
Ruellia malacophylla C.B. Cl.
Rumex crispus L. *
Rumex dregeanus Meisn. subsp. dregeanus
Rumex rhodesius Rech.f.
Rumex sagittatus Thunb.
Rumohra adiantiformis (G.Forst.) Ching
Ruttya ovata Harv.
Sacciolepis indica (L.) Chase
Sacciolepis spiciformis (A.Rich.) Stapf
Salacia gerrardii Harv. ex Sprague
Salix mucronata Thunb. subsp. capensis (Thunb.) Immelman
Samolus porosus (L.f.) Thunb.
Samolus valerandi L.
Sandersonia aurantiaca Hook.
Sanicula elata Buch.-Ham. ex D. Don
Sansevieria hyacinthoides (L.) Druce
Sapium ellipticum (Hochst.) Pax
Sapium integerrimum (Hochst.) J. Leonard
Sarcocornia natalensis var. natalensis
Sarcostemma viminale (L.) R. Br.
Satyrium cristatum Sond. var. cristatum
Satyrium hallackii Bolus subsp. ocellatum (Bolus) A.V.Hall
Satyrium longicauda Lindl. var. longicauda
Satyrium parviflorum Swartz
Satyrium sphaerocarpum Lindl.
Satyrium trinerve Lindl.
Scabiosa columbaria L.
Scadoxus membranaceus (Baker) Friis & Nordal
Scadoxus multiflorus (Martyn) Raf. subsp. katharinae
Scadoxus puniceus (L.) Friis & Nordal
Scaevola plumieri (L.) Vahl
Schefflera umbellifera (Sond.) Baill.
Schistostephium crataegifolium (DC.) Fenzl ex Harv.
Schistostephium flabelliforme Less.
Schistostephium heptalobum (DC.) Oliv. & Hiern
Schistostephium rotundifolium (DC.) Fenzl ex Harv.
Schizachyrium sanguineum (Retz.) Alston
Schizaea pectinata (L.) Sw.
Schizaea tenella Kaulf.
Schizocarphus nervosus (Burch.) Van der Merwe
Schizochilus zeyheri Sond.
Schizoglossum atropurpureum E.Mey. subsp. virens
Schizoglossum bidens E. Mey. subsp. pachyglossum
Schizoglossum bidens E.Mey. subsp. bidens
Schizoglossum cordifolium E.Mey.
Schlotheimia ferruginea (Bruch ex Hook. & Grev.) Brid.
Schoenoplectus scirpoideus (Schrad.) J.Browning
Schoenoxiphium cf. sparteum (Wahlenb.) C.B.Clarke
Schoenoxiphium lanceum (Thunb.) Kuekenth.
Schoenoxiphium lehmannii (Nees) Steud.
Schoenoxiphium sparteum (Wahlenb.) C.B.Clarke
Schotia brachypetala Sond.
Schotia capitata Bolle
Schotia latifolia Jacq.
Schrebera alata (Hochst.) Welw.
Scilla natalensis Planch.
Scilla nervosa (Burch.) Jessop
Scirpus ficinioides Kunth
Scleria angusta Nees ex Kunth
Scleria aterrima (Ridl.) Napper
Scleria bulbifera Hochst. ex A.Rich.
Scleria dieterlenii Turrill
Scleria distans Poir.
Scleria distans Poir. var. distans
Scleria greigiifolia (Ridl.) C.B.Clarke
Scleria melanomphala Kunth
Scleria natalensis C.B.Clarke
Scleria nutans Willd. ex Kunth
Scleria woodii C.B.Clarke
Sclerocarya birrea (A. Rich) Hochst. subsp. caffra (Sond.) Kokwaro
Sclerochiton harveyanus Nees
Sclerocroton integerrimum (Hochst.) J.Léonard
Scolopia flanaganii (Bolus) Sim
Scolopia mundii (Eckl. & Zeyh.) Warb.
Scolopia sp. (= van Wyk 6069)[6049?]
Scolopia zeyheri (Nees) Harv.
Scutia myrtina (Burm.f.) Kurz
Sebaea bojeri Griseb.
Sebaea filiformis Schinz
Sebaea grandis (E.Mey.) Steud.
Sebaea rehmannii Schinz
Secamone alpini Schult.
Secamone filiformis (L. f.) J.H. Ross
Secamone gerrardii Harv. ex Benth.
Seemannaralia gerrardii (Seemann) Harms
Selaginella caffrorum (Milde) Hieron.
Selaginella caffrorum (Milde) Hieron. var. caffrorum
Selaginella dregei (C.Presl) Hieron.
Selaginella kraussiana (Kunze) A.Braun ex Kuhn
Selaginella mittenii Baker
Selago elongata Hilliard
Selago hyssopifolia E. Mey.
Selago hyssopifolia E.Mey. subsp. hyssopifolia
Selago peduncularis E.Mey.
Selago trinervia E. Mey.
Selago woodii Rolfe
Sematophyllum brachycarpum (Hampe) Broth.

Sematophyllum sp.
Sematophyllum sphaeropyxis (Müll.Hal.) Broth.
Sematophyllum subpinnatum (Brid.) E.Britton
Sematophyllum wageri C.H.Wright ex Wager
Senecio affinis DC.
Senecio albanensis DC. var. doroniciflorus (DC.) Harv.
Senecio albensis DC. Var. doroniciflorus (DC.) Harv.
Senecio arenarius Thunb.
Senecio barbatus DC.
Senecio brachypodus DC.
Senecio brevidentatus M.D.Hend.
Senecio bryoniifolius Harv.
Senecio bupleuroides DC.
Senecio caudatus DC.
Senecio chrysocoma Meerb.
Senecio citriceps Hilliard & Burtt
Senecio coronatus (Thunb.) Harv.
Senecio decurrens DC.
Senecio deltoideus Less.
Senecio discodregeanus Hilliard & B.L.Burtt
Senecio erubescens Aiton var. erubescens
Senecio erubescens Aiton var. incisus DC.
Senecio glaberrimus DC.
Senecio glanduloso-lanosus Thell.
Senecio gregatus Hilliard
Senecio helminthioides (Sch. Bip.) Hilliard
Senecio inaequidens
Senecio latifolius DC.
Senecio linifolius L.
Senecio lygodes Hiern
Senecio macrocephalus DC.
Senecio macroglossoides Hilliard
Senecio macroglossus DC.
Senecio madagascariensis Poir.
Senecio medley-woodii Hutch.
Senecio natalicola Hilliard
Senecio oxyodontus DC.
Senecio oxyriifolius DC.
Senecio panduriformis Hilliard
Senecio pellucidus DC.
Senecio polyanthemoides Sch.Bip.
Senecio pterophorus DC.
Senecio purpureus L.
Senecio quinquelobus (Thunb.) DC.
Senecio retrorsus DC.
Senecio rhyncholaenus DC.
Senecio sandersonii Harv.
Senecio serratuloides DC. var. serratuloides
Senecio speciosus Willd.
Senecio tamoides DC.
Senecio umgeniensis Thell.
Senecio variabilis Sch.Bip.
Senna floribunda (Cav.)H.S. Irwin & R.C Barneby
Senna septemtrionalis (Viv.) Irwin & Barneby*
Sesbania bispinosa (Jacq.) W.F. Wight var. bispinosa*
Sesbania punicea (Cav.) Benth.*
Sesbania sesban (L.) Merr. subsp. sesban var. nubica Chiov.
Setaria incrassata (Hochst.) Hack.
Setaria lindenbergiana (Nees) Stapf
Setaria megaphylla (Steud.) T.Durand & Schinz
Setaria plicatilis (Hochst.) Hack. ex Engl.
Setaria rigida Stapf
Setaria sphacelata (Schumach.) Moss var. sphacelata
Setaria sphacelata (Schumach.) Stapf & C.E.Hubb. ex M.B.Moss var. sericea (Stapf) Clayton
Setaria sphacelata (Schumach.) Stapf & C.E.Hubb. ex M.B.Moss var. sphacelata
Setaria sphacelata (Schumach.) Stapf & C.E.Hubb. ex M.B.Moss var. torta (Stapf) Clayton
Shirakiopsis elliptica (Hochst.) Esser
Sida dregei Burtt Davy
Sida rhombifolia L.
Sida ternata L. f.
Sideroxylon inerme L. subsp. inerme
Sigesbeckia orientalis L.*
Sigridia viridiflorum (E.Mey.) Nicholas
Silene bellidioides Sond.
Silene burchellii Otth
Silene burchellii Otth var. burchellii
Silene clandestina Jacq.
Silene gallica L.
Silene primuliflora Eckl. & Zeyh.
Silene primuliflora Eckl. & Zeyh. var. primuliflora
Siphonoglossa leptantha (Nees) Immelman subsp. leptantha
Siphonoglossa nkandlaensis Immelman
Sisyranthus barbatus (Turcz.) N.E.Br.
Sisyranthus fanniniae N.E. Br.
Sisyranthus imberbis Harv.
Sisyranthus saundersiae N.E.Br.
Sisyranthus virgatus E.Mey.
Smilax anceps Willd.
Smithia erubescens (E.Mey.) Baker f.
Smodingium argutum E.Mey. ex Sond.
Solanum aculeastrum Dun.
Solanum aculeatissimum Jacq.
Solanum americanum Mill.
Solanum didymanthum Dun.
Solanum duplo-sinuatum Klotzsch
Solanum geniculatum Drège ex Dunal
Solanum giganteum Jacq.
Solanum hispidum Pers.*
Solanum incanum L.
Solanum linnaeanum Hepper & Jaeger
Solanum mauritianum Scop.*
Solanum nigrum L.*
Solanum nodiflorum Jacq.
Solanum retroflexum Dun.
Solanum rigescens Jacq.
Solanum seaforthianum Andr.*
Solanum terminale Forssk.
Solanum terminale Forssk. subsp. terminale
Solanum tomentosum L.
Sonchus dregeanus
Sonchus integrifolius Harv. var. integrifolius
Sonchus oleraceus L.
Sonchus wilmsii R.E. Fr.
Sopubia mannii Skan var. nov.
Sopubia simplex (Hochst.) Hochst.
Sorghum bicolor (L.) Moench subsp. arundinaceum
Sorghum halepense (L.) Pers. *
Spathodea campanulata*
Spermacoce natalensis Hochst.
Sphagnum africanum Welw. & Dub.
Sphagnum capense Hornsch.
Sphagnum truncatum Hornsch.
Sphedamnocarpus pruriens (Juss.) Szyszyl. var. pruriens
Sphenostylis erecta (Baker.f.) Hutch. ex Baker.f. subsp. erecta
Sphenostylis marginata E.Mey. subsp. marginata
Spilanthes mauritiana (Pers.) Dc.
Sporobolus africanus (Poir.) Robyns & Tournay
Sporobolus centrifugus (Trin.) Nees
Sporobolus fimbriatus (Trin.) Nees
Sporobolus natalensis (Steud.) Dur. & Schinz
Sporobolus pyramidalis P.Beauv.
Sporobolus subtilis Kunth
Sporobolus subulatus Hack.
Sporobolus virginicus (L.) Kunth
Squamidium brasiliense (Hornsch.) Broth.
Stachys aethiopica L.
Stachys caffra E. Mey. ex Benth.
Stachys erectiuscula Guerke
Stachys graciliflora Presl
Stachys grandifolia E. Mey. ex Benth.
Stachys natalensis Hochst. var. galpinii (Briq.) Codd
Stachys natalensis Hochst. var. natalensis
Stachys nigricans Benth.
Stangeria eriopus (Kunze) Baill.
Stellaria media (L.) Vill.
Stenochlaena tenuifolia (Desv.) T.Moore
Stenoglottis fimbriata Lindl.
Stenoglottis woodii Schltr.
Stenosemis angustifolia E. Mey. ex Sond.
Stenostelma involucratum (Decne.) Nicholas
Stenotaphrum secundatum (Walter) Kuntze
Stephania abyssinica (Quart.-Dill. & A.Rich.) Walp. var. tomentella
Stereophyllum radiculosum (Hook.) Mitt.
Stiburus alopecuroides (Hack.) Stapf
Stoebe vulgaris Levyns

Strelitzia nicolai Regel & Koern.
Streptocarpus baudertii Britten
Streptocarpus formosus (Hilliard & B.L.Burtt) T.J.Edwards
Streptocarpus haygarthii N.E. Br. ex C.B. Cl.
Streptocarpus johannis Britten
Streptocarpus modestus L.L.Britten
Streptocarpus polyanthus Hook. subsp. polyanthus
Streptocarpus polyanthus Hook. subsp. verecundus Hilliard
Streptocarpus porphyrostachys Hilliard
Streptocarpus primulifolius Gand. subsp. formosus
Streptocarpus primulifolius Gand. subsp. primulifolius
Streptocarpus rexii (Hook.) Lindl.
Streptocarpus trabeculatus Hilliard
Striga asiatica (L.) Kuntze
Striga bilabiata (Thunb.) Kuntze subsp. bilabiata
Striga elegans Benth.
Strophanthus speciosus (Ward & Harv.) Reber
Struthiola macowanii C.H.Wright
Struthiola pondoensis Gilg ex C.H.Wright
Strychnos decussata (Pappe) Gilg
Strychnos henningsii Gilg
Strychnos madagascariensis Poir.
Strychnos mitis S.Moore
Strychnos spinosa Lam.
Strychnos usambarensis Gilg
Suregada africana (Sond.) Kuntze
Suregada procera (Prain) Croizat
Sutera floribunda (Benth.) Kuntze
Sutera kraussiana (Bernh. ex Krauss) Hiern
Sutera noodsbergensis Hiern
Sutera pallescens Hiern
Sutera platysepala Hiern
Sutera polelensis Hiern. subsp. polelensis
Synadenium cupulare (Boiss.) L.C.Wheeler
Syncolostemon argenteus N.E. Br.
Syncolostemon densiflorus Benth.
Syncolostemon macranthus (Guerke) Ashby
Syncolostemon parviflorus E. Mey. ex Benth. var. lanceolatus
Syncolostemon parviflorus E.Mey. ex Benth. var. parviflorus
Syncolostemon ramulosus E.Mey. ex Benth.
Syncolostemon rotundifolius E.Mey. ex Benth.
Syrrhopodon gaudichaudii Mont.
Syzygium cordatum Hochst. ex C.Krauss subsp. cordatum
Syzygium gerrardii (Harv. ex Hook.f.) Burtt Davy
Syzygium guineense (Willd.) DC.
Syzygium pondoense Engl.
Tabernaemontana sp.
Tabernaemontana ventricosa Hochst. ex A.DC.
Tagetes minuta L.*
Tapinanthus gracilis Toelken & Wiens
Tapinanthus kraussianus (Meisn.) Tiegh. subsp. kraussianus
Tapinanthus kraussianus (Meisn.) V. Tieghem subsp. transvaalensis (Sprague) Wiens
Tapinanthus natalitius (Meisn.) Danser subsp. natalitius
Tapinanthus natalitius (Meisn.) Danser subsp. zeyheri
Tapura fischeri Engl.
Taraxacum officinale
Tarchonanthus camphoratus L.
Tarchonanthus trilobus DC. var. trilobus
Tarenna pavettoides (Harv.) Sim subsp. pavettoides
Teclea gerrardii I.Verd.
Teclea natalensis (Sond.) Engl.
Tecoma stans Juss. *
Tecomaria capensis (Thunb.) Spach subsp. capensis
Teedia lucida (Sol.) Rudolphi
Telosma africana (N.E. Br.) N.E. Br.
Tenaris rubella E.Mey.
Tenrhynea phylicifolia (DC.) Hilliard & B.L.Burtt
Tephrosia acaciifolia Baker
Tephrosia albissima H.M.L.Forbes subsp. albissima
Tephrosia bachmannii Harms
Tephrosia cf. noctiflora Bojer ex Baker
Tephrosia diffusa (E. Mey.) Harv.
Tephrosia glomeruliflora Meisn. subsp. glomeruliflora
Tephrosia grandiflora (Aiton) Pers.
Tephrosia kraussiana Meisn.
Tephrosia macropoda (E. Mey.) Harv. var. macropoda
Tephrosia macropoda (E.Mey.) Harv. var. diffusa
Tephrosia macropoda (E.Mey.) Harv. var. macropoda
Tephrosia multijuga R.G.N. Young
Tephrosia polystachya E. Mey. var. hirta Harv.
Tephrosia polystachya E. Mey. var. longidens H. M. Forbes
Tephrosia polystachya E.Mey. var. polystachya
Tephrosia pondoensis (Codd) Schrire
Tephrosia purpurea (L.) Pers. subsp. canescens (E. Mey.) Brummitt
Tephrosia shiluwanensis Schinz
Tephrosia vogelii Hook.f.
Teramnus labialis (L.f.) Spreng. subsp. labialis
Tetradenia riparia (Hochst.) Codd
Tetraria capillacea (Thunb.) C.B.Clarke
Tetraria cuspidata (Rottb.) C.B.Clarke var. cuspidata
Tetraria macowaniana B.L. Burtt
Teucrium kraussii Codd
Thelypteris confluens (Thunb.) Morton
Thelypteris dentata (Forssk.) E. St.John
Thelypteris gueinziana (Mett.) Schelpe
Thelypteris interrupta (Willd.) K. Iwats.
Thelypteris pozoi (Lag.) Morton
Themeda triandra Forssk.
Thesium acutissimum A.DC.
Thesium angulosum DC.
Thesium asterias A.W.Hill
Thesium cupressoides A.W.Hill
Thesium funale L.
Thesium impeditum A.W. Hill.
Thesium lineatum
Thesium natalense Sond.
Thesium pallidum A.DC.
Thesium squarrosum L.f.
Thesium triflorum Thunb.
Thevetia peruviana (Pers.) K.Schum.*
Thuidium matarumense Besch.
Thunbergia alata Sims
Thunbergia atriplicifolia E. Mey. ex Nees x T. capensis Retz
Thunbergia atriplicifolia E.Mey. ex Nees
Thunbergia capensis Retz.
Thunbergia dregeana Nees
Thunbergia natalensis Hook.
Thunbergia neglecta Sond.
Thunbergia purpurata Harv. ex C.B.Clarke
Tibouchina granulosa Cogn.*
Tinnea galpinii Briq.
Tithonia diversifolia (Hemsl.) A.Gray*
Tithonia rotundifolia (Mill.) Blake *
Todea barbara (L.) T.Moore
Tolpis capensis (L.) Sch.Bip.
Torilis arvensis (Huds.) Link *
Trachyandra affinis Kunth
Trachyandra asperata Kunth var. nataglencoensis (Kuntze) Oberm.
Trachyandra asperata Kunth var. stenophylla (Bak.) Oberm.
Trachyandra capillata (V. Poelln.) Oberm.
Trachyandra saltii (Bak.) Oberm. var. saltii
Trachypogon spicatus (L.f.) Kuntze
Tradescantia fluminensis Vell.*
Tragia glabrata (Muell. Arg.) Pax & Hoffm. var. glabrata
Trema orientalis (L.) Blume
Trematodon divaricatus Bruch
Tricalysia africana (Sim) Robbr.
Tricalysia capensis (Meisn. ex Hochst.) Sim var. capensis
Tricalysia capensis (Meisn. ex Hochst.) Sim var. galpinii
Tricalysia lanceolata (Sond.) Burtt Davy
Tricalysia sonderiana Hiern
Trichilia dregeana Sond.
Trichilia emetica subsp. emetica
Trichocladus crinitus (Thunb.) Pers.
Trichocladus ellipticus Eckl. & Zeyh. subsp. ellipticus
Trichocladus grandiflorus Oliv.
Trichomanes borbonicum Bosch
Trichomanes inopinatum (Pichi-Serm.) JEB
Trichomanes melanotrichum Schlechtd.
Trichomanes reptans Sw.
Trichomanes rigidum Swartz
Trichopteryx dregeana Nees
Trichostomum brachydontium Bruch
Tridactyle bicaudata (Lindl.) Schltr. subsp. bicaudata
Tridactyle bicaudata (Lindl.) Schltr. subsp. rupestris H.P.Linder
Tridactyle tridentata (Harv.) Schltr.
Trifolium africanum Ser. var. africanum

Trifolium burchellianum Ser. subsp. burchellianum
Triglochin bulbosa L.
Triglochin striata Ruíz & Pav.
Trimeria grandifolia (Hochst.) Warb. subsp. grandifolia
Tristachya leucothrix Trin. ex Nees
Tristachya rehmannii Hack.
Tritonia disticha (Klatt) Baker subsp. disticha
Tritonia disticha (Klatt) Baker subsp. rubrolucens
Tritonia lineata (Salisb.) Ker Gawl. var. lineata
Tritonia parvula N.E. Br.
Tritonia sp. nov. (Abbott 1549)
Triumfetta pilosa Roth var. effusa (E.Mey. ex Harv.) Wild
Triumfetta pilosa var. tomentosa
Triumfetta rhomboidea Jacq.
Triumfetta rhomboidea Jacq. var. rhomboidea
Tulbaghia acutiloba Harv.
Tulbaghia cernua Avé-Lall.
Tulbaghia leucantha Baker
Turraea floribunda Hochst.
Turraea obtusifolia Hochst.
Tylophora anomala N.E. Br.
Tylophora cordata (Thunb.) Druce
Tylophora flanaganii Schltr.
Tylophora lycioides (E. Mey.) Decne.
Tylophora umbellata Schltr.
Typha capensis (Rohrb.) N.E.Br.
Urelytrum agropyroides (Hack.) Hack.
Urera trinervis (Hochst. apud Krauss) Friis & Immel
Urginea capitata (Hook.) Bak.
Urginea delagoensis Bak.
Urginea modesta Bak.
Urginea rubella Bak.
Urochloa mosambicensis (Hack.) Clayton
Urospermum picroides (L.) Scolopi ex F.W. Schmidt
Ursinia tenuifolia (L.) Poir. subsp. tenuifolia
Ursinia tenuiloba DC.
Urtica urens L.
Utricularia arenaria A. DC.
Utricularia firmula Welw. ex Oliv.
Utricularia inflexa Forssk.
Utricularia livida E.Mey.
Utricularia prehensilis E.Mey.
Utricularia sandersonii Oliv.
Utricularia stellaris L. f.
Utricularia subulata L.
Uvaria caffra E. Mey.ex Sond.
Uvaria lucida Benth.
Vangueria esculenta S. Moore
Vangueria infausta Burch. subsp. infausta
Vangueria randii S. Moore subsp. chartacea (Robyns) Verdc.
Vepris lanceolata (Lam.) G. Don
Verbena bonariensis L. *
Verbena officinalis L. *
Verbena tenuisecta Briq. *
Verbena venosa Gill. & Hook.*
Vernonia angulifolia
Vernonia anisochaetoides Sond.
Vernonia capensis (Houtt.) Druce
Vernonia crataegifolia
Vernonia dregeana Sch.Bip.
Vernonia galpinii Klatt
Vernonia hirsuta (DC.) Sch.Bip. ex Walp.
Vernonia natalensis Sch. Bip. ex. Walp.
Vernonia neocorymbosa Hilliard
Vernonia oligocephala (DC.) Sch.Bip. ex Walp.
Vernonia tigna Klatt
Vesicularia galerulata (Duby) Broth.
Vigna luteola (Jacq.) Benth.
Vigna nervosa Markoetter
Vigna unguiculata (L.) Walp. subsp. stenophylla
Vigna unguiculata (L.) Walp. subsp. unguiculata
Vigna vexillata (L.) A. Rich. var. angustifolia
Vigna vexillata (L.) A.Rich. var. ovata (E.Mey.) B.J.Pienaar
Vigna vexillata (L.) A.Rich. var. vexillata
Viscum anceps E.Mey. ex Sprague
Viscum combreticola Engl.
Viscum obovatum Harv.
Viscum obscurum Thunb.
Viscum triflorum DC. subsp. nervosum (Hochst. ex A.Rich.) M.G.Gilbert
Vitellariopsis marginata (N.E.Br.) Aubrév.
Vitex sp.
Vittaria isoetifolia Bory
Voacanga thouarsii Roem. & Schult.
Wahlenbergia capillacea (L. f.) A. DC. subsp. capillacea
Wahlenbergia denticulata (Burch.) A. DC.
Wahlenbergia denudata A.DC.
Wahlenbergia huttonii (Sond.) Thulin
Wahlenbergia krebsii Cham. subsp. krebsii
Wahlenbergia madagascariensis A. DC.
Wahlenbergia paucidentata Schinz
Wahlenbergia pinnata Compton
Wahlenbergia sp. nov. (Abbott 1954)
Wahlenbergia undulata (L.f.) A.DC.
Walafrida rotundifolia (L. f.) Rolfe
Watsonia angusta Ker Gawl.
Watsonia bachmannii L. Bol.
Watsonia confusa Goldblatt
Watsonia densiflora Baker
Watsonia inclinata Goldblatt
Watsonia meriana (L.) Mill.
Watsonia mtamvunae Goldblatt
Watsonia pillansii L.Bolus
Watsonia pondoensis Goldblatt
Weissia controversa Hedw.
Wimmerella bifida
Wurmbea kraussii Baker
Xanthium spinosum L. *
Xanthium strumarium L. *
Ximenia caffra Sond. var. natalensis Sond.
Xylotheca krausiana Hochst.
Xymalos monospora (Harv.) Baill.
Xyris anceps Lam. var. anceps
Xyris capensis Thunb.
Xyris natalensis L.A.Nilsson
Xysmalobium involucratum (E.Mey.) Decne.
Xysmalobium undulatum (L.) Ait. f.
Youngia japonica (L.) DC. *
Ypsilopus erectus (Cribb) Cribb & J. Stewart
Zaluzianskya angustifolia Hilliard & B.L.Burtt
Zaluzianskya capensis (L.) Walp.
Zaluzianskya elongata Hilliard & Burtt
Zaluzianskya maritima (L. f.) Walp.
Zaluzianskya pachyrrhiza Hilliard & Burtt
Zaluzianskya sp. nov.
Zantedeschia aethiopica (L.) Spreng.
Zantedeschia albomaculata (Hook.) Baill. subsp. albomaculata
Zanthoxylum capense (Thunb.) Harv.
Zanthoxylum davyi (I.Verd.) P.G.Waterman
Zehneria parvifolia (Cogn.) J.H. Ross
Zehneria scabra (L.f.) Sond. subsp. scabra
Ziziphus mucronata Willd. subsp. mucronata
Zornia capensis Pers. subsp. capensis
Zornia linearis E.Mey.
Zornia milneana Mohlenbr.
Zostera capensis Setch.

APPENDIX 3: External peer review of specialist vegetation and flora study

This review is reproduced below in its entirety and then repeated in table form to show how comments were addressed:

External peer review of specialist vegetation and flora study for the proposed N2 Wild Coast Toll Highway for the report by David Hoare Consulting CC dated 14 September 2007 by CR Scott-Shaw, 11 Vlei Road Hilton 3245

033 3434933
robss@kznwildlife.com
2nd April 2008

Comment on sections of the report in the context of the reviewer's Terms of Reference 1 to 8 in the appointment letter of 29 February 2008.

3.1 4th para: What is the state or condition of the untransformed part of the P-USCS? This has been commented on for KZN Coastal Belt – it important to state how degraded much of the PUSCS is to emphasise the importance of the remaining area. Note update in name of veg type – "Ugu" replaces "natal".

5 th para: Scarp Forest should be split into 3 at the veg type level (as Mucina & Geldenhuys did). You should describe Pondoland Scarp Forest and Transkei Coastal Forest if applicable. The Pondoland Scarp Forest is a narrowly endemic; has high conservation status. It is more meaningful to use the smaller unit.

3.2 A description of populations of special concern appears to be lacking. See 3.3 below.
3.2.3 Given the importance of these communities they should be described in more detail. Their potentially rich and diverse species composition is what this veg type is renowned for. At least list some common and rare plants.

3.2.4 The extent and nature of current degradation requires comment. This is particularly important to this grassland community because on the severe competitive ability of *Aristida* when allowed to become dominant. last sentence: *Indigofera hilaris* is not a Pondoland endemic!?

3.3 The rare and endangered species potential to occur in various habitats along the Greenfield routes needs to be quantified. The ToR requires description of populations of some species. Were any forthcoming? If not these could be obtained from botanists who know the area and the popular literature. One thinks of *Leucodendron pondoense* for example. Consultation with other botanists with known expertise of the area appears lacking.

Section 4 Identification of risk sources. This has been very adequately assessed.
Section 5.1 Impact description and assessment. This has been adequately assessed. (Note some repetition of measures on pages 141,146)

5.2 Impacts beyond the route corridor and 5.3 mitigation measures: These have been adequately assessed.

section 5.4 - from page 162 [ToR 8 - evaluate the ecological sustainability of ……and identified feasible alternatives (in association with…)]

5.4.1 INADEQUATE – COMMENTS FOLLOW
Ecosystems have not been discussed. Vegetation types appear to have been used as ecosytems but this is not explained. In any case they are not very appropriate to use at this scale – being described and mapped at a subcontinental scale e.g. broad habitat types or sub-communities of the veg types would be useful. Those listed in Figure 3 could have been used and expanded upon in addition to the veg types.

The question posed asking if species will be classified in a higher conservation category has not been answered for Vulnerable and near threatened. They are important and require the same scrutiny. Table 43 should include them.

The mention of "distance from alignment" (of 2.6 km) for one species should be applied to all important species and elaborated upon – at least for the "hotspot areas". This could be very useful in helping the public review the final report with more objectivity e.g. they could better understand which species could be affected along the alignment. It is a TOR to assess potential impacts of alignments on species. This may be essential because the locations of the red-listed species has not been provided elsewhere in this report.

There are 7 not 4 cycads in the greater greenfields area (add E. villosus, E. laevifolius and stangeria).

The cycads could move up a threat category if habitat degradation increased or persisted. 2 (or4) of them are grassland cycads with known poor recruitment under frequent fire regimes (not only "if individuals were removed").

Table 44: the appropriate name (since 2006) is Pondoland Scarp Forest (one of 3 split from Scarp Forest)

It is misleading to quote the areas of the vegetation types in this way. These are historical (original) areas. Providing current untransformed areas gives a more accurate indication of the potential percentage loss related to the proposed road and its secondary impacts. Also consider that a change in status of a veg type can occur with severe degradation (in addition to transformation). Why are land-cover maps not used to estimate some of the transformation?

The precautionary approach (top para; page 164) shows that the P-USCS veg type will increase to Endangered! It would be reasonable for the public to expect this approach in deriving veg type areas and potential status changes – if not, then it would need to be demonstrated otherwise by e.g. use of other data (not nec. relevant to these TORs'). (e.g. National Land-cover maps could easily be beefed-up with the aerial photographs and buffers incorporated).

"The extent of the indirect impacts is not known" is not accurate: a scenario similar to the grasslands will apply with increased accessibility.

5.4.3 para 2:
Do thresholds apply to "loss of habitat"? Perhaps treat this separately such as in the section of loss of biological diversity. Consider deleting the first part of the first sentence because you state in the next sentence that there is a risk of exceeding thresholds at a local scale.

5.4.5
Highlighting the PCE in this context is well and good but surely there are fine-scale features that are worthy of discussion. Consider: deep gorges; free-flowing rivers; wilderness areas.

5.4.7
It would be informative to expand on the: "952 ha of grassland"; "some forest"; "miscellaneous areas". At least provide the area (ha's) and allocate them to grassland subtypes and forest types. If this is done elsewhere then make reference to it, after all this is a focal issue for the greenfields section. Add the 2000 ha from indirect impact. Do the same for each veg type. Experts on this could be consulted to quantify this fully. Check Durban Ethekwini Metro web site. Subsequent studies may expand on this data.

5.4.9
I fail to accept (understand?) the statements here – specifically: "it would be difficult to attribute these to the presence of the new road". It is commonly known that low-income ribbon development occurs where a new road traverses communal areas. The remote areas of the greenfields section have dispersed settlement patterns now. The potentially severe cumulative impacts centred on ribbon development are associated with the road with high confidence.

5.4.10
The assessment and the conclusions needs to be applied for specific sensitive parts of the route and especially the two route options through the northern greenfields section Clarity is needed as to which section you refer to. A comparison of the ecological sustainability of the routes (separately) would be useful if not essential.

6.1 4th para:
This list is not adequate. The appendix mainly lists species in the Endangered and Critically Endangered categories. All the categories are important. Some species have been omitted. Recent records (including sightings) of all Red List species (including Data Deficient) should be obtained. It is especially pertinent to consult botanists with local knowledge and local and provincial institutions/herbaria. Species observed in this study should be listed. Species listed for specific sites such as Mtentu bridge EIA by other consultants require listing and comment .

6.3.3 4th para:
In the context of potential impact to the area in the proposed park between about the Mthentu toll plaza and Mzamba bridge there are two shortcomings in the consultants document: (1) It is fairly irrelevant to use fragmentation in comparing the two routes. Plants and many animals are little affected by small fragments of cultivation and settlement. They have evolved to disperse/range across patches of unsuitable habitat. (2) However the continuous barrier posed by a highway and its associated zones of disturbance and related impacts, is much more problematic for maintaining ecosystem processes across these areas. The area is a proposed national park with many globally important assets. Size of free-ranging area is critically important for ecological integrity. The loss of much of the area available for creating and maintaining a viable park is a key issue for the final choice of route. This section needs to be expanded upon, supported by better data, with attention to barriers and to the areas of habitats that stand to be lost or saved, depending on the route choice.

6.4 to 6.6 These are adequately covered.

References
Some inconsistency and minor error in the five citations of Strelitzia 19.

Appendix 1
7th line under sources: replace "Sekhukhuneland….." with "Pondoland….". Replace UNITRA with WSU.
Clivia robusta habitat given as "Afromontane forest…" Correct habitat description.

Raspalia trigyna and others species – current known locations are not enough – give historic locations and potential habitat. These are as important because this is often an anomaly of under-collected areas and herbaria not recording sightings.

Endemics table: some species are very out of place e.g. *Protea subvestita and P welwitschii; Cryptocarya latifolia* and *C. myrtifolia*.

Biogeographically important taxa: requires careful selection of those really applicable to the study area, and deletion of species distributions inaccurately assessed.

A second appendix of some of your species lists combined with those of other surveys and collectors would add considerable value. Sightings by botanists are valuable too. Such a list or table could also act as an inventory plant collections along the route. I do not suggest including the floras done for specific areas away from the route e.g. Elize Cloete's lists for Mkambati.

Overall comment
Key uncertainties or risks and/or assumptions underpinning the assessment have been highlighted.
Alternate viewpoints concerning issues presented in the report have been suggested by me. The reasons have been provided in the paragraphs above. These mostly relate to the detail and scale at which some impacts are evaluated. The recommendations of the study are generally sound and defensible. The technical content and assessment methodology is credible.

Terms of Reference evaluation – see Table below

Terms of Reference – summary of specialist's compliance

Specialist Terms of Reference	Comment on compliance
Identify spring flora of …..and analyse…	Completed fieldwork and analyses used indirectly to support descriptions, but not presented in report. The site/sample/plot data and supporting lists and stats are needed to guide decision on which zones (and potentially alignments) to avoid.
A description of populations of special concern	These are lacking at the local scale of route alignments (esp. w.r.t. greenfields). Consultation with other botanists with known expertise of the area appears lacking.
..description of extent and ….identify ….pressures and threats	Adequately presented.
Assess potential impacts…on species with…; on medicinal and….	Generally adequately presented.
Assess potential impacts….conservation value…of PCE and PARK	Impacts well selected and investigated however poorly addressed in conclusions with probably inadequate quantification – a summary table would highlight the important impacts.
Describe inter-relationships….assess potential impact on….persistence of ecosystems	It is fairly irrelevant to use fragmentation in comparing the two routes This section (e.g.6.3.3 pp) needs to be redone supported by better data
Incorporate quantitative criteria…ecosystem	Adequately presented.

sensitivity	
Assess…indirect impacts…on vegetation and ecosystems	Generally adequately presented.
evaluate the ecological sustainability of ……and identified feasible alternatives (in association with……..)	Detail provided above. The section on loss of biological diversity is lacking in detail and accuracy. These sections are adequate: ..processes …thresholds …life support …areas...climate change…uncertainty The sections on natural capital and cumulative impacts present questionable statements. Section 5.4.10 The assessment and the conclusions needs to be applied for specific sensitive parts of the route and especially the two route options through the northern greenfields section.
GeneralTerms of Reference	
Describe and….identify sensitive areas	Adequately addressed
Undertake field surveys	Addressed; more detail desirable (see notes above)
Identify legislative and permit requirements	Adequately addressed
Assess cumulative effects…	Addressed with some issues/interpretation outstanding
Signifcance rating…of impacts	Adequately addressed; are reasonable and reliable.
Mitigation measures …..	Adequately addressed
Recommend appropriate moniroting and review….	Adequately addressed

REVIEWERS COMMENT	RESPONSE
3.1 4th para: What is the state or condition of the untransformed part of the P-USCS? This has been commented on for KZN Coastal Belt – it important to state how degraded much of the PUSCS is to emphasise the importance of the remaining area. Note update in name of veg type – "Ugu" replaces "natal".	The updated name of the vegetation type was already used in this report - no errors were found in naming and no changes are therefore required. The intention of this section of the report was to describe in broad terms the vegetation types that have been mapped for this part of the country in order to contextualise the study. The information provided in these descriptions is as given in Mucina & Rutherford 2006. I have added a comment about the general levels of degradation in PUSCS, but detailed assessments of condition were intended for later sections of the report.
5 th para: Scarp Forest should be split into 3 at the veg type level (as Mucina & Geldenhuys did). You should describe Pondoland Scarp Forest and Transkei Coastal Forest if applicable. The Pondoland Scarp Forest is a narrowly endemic; has high conservation status. It is more meaningful to use the smaller unit.	According to the GIS map provided by SANBI with the publication on vegetation types (Mucina & Rutherford 2006), the vegetation is mapped as "Scarp Forest". Within this publication (Mucina & Rutherford 2006 chapter), no reference is made to sub-divisions of Scarp Forest. Scarp Forest is not therefore divided, as indicated by the reviewer. The only reference to Pondoland Scarp Forest is to state that "The Pondoland Scarp Forest is a core vegetation unit of the Pondoland Centre of Endemism", although Scarp Forest is described as having a much wider distribution (and is not therefore endemic). I have modified the report to reflect the statement that this vegetation type is a core vegetation unit of the PCE, but have not divided Scarp Forest. Transkei Coastal Forest is mapped as "Transkei Coastal Belt" and is described as a separate vegetation type in the publication by Mucina & Rutherford and in this report (Section 3.1 para 5). No changes are made in this report and the unit is retained as it stands.
3.2 A description of populations of special concern appears to be lacking. See 3.3 below.	Description added as section to the report (expansion of section 3.3)

3.2.3 Given the importance of these communities they should be described in more detail. Their potentially rich and diverse species composition is what this veg type is renowned for. At least list some common and rare plants.	Descriptions of vegetation units have been expanded to include common and conspicuous species.
3.2.4 The extent and nature of current degradation requires comment. This is particularly important to this grassland community because on the severe competitive ability of *Aristida* when allowed to become dominant. last sentence: *Indigofera hilaris* is not a Pondoland endemic!?	Information was from Mucina at al (2006), but I checked with SANBI and you are right, it has a countrywide distribution.
3.3 The rare and endangered species potential to occur in various habitats along the Greenfield routes needs to be quantified. The ToR requires description of populations of some species. Were any forthcoming? If not these could be obtained from botanists who know the area and the popular literature. One thinks of *Leucodendron pondoense* for example. Consultation with other botanists with known expertise of the area appears lacking.	*The following term of reference refers: • Detailed description and indication of the locations of populations of "species of special concern". According to the original proposal that was accepted by CCA Environmental in response to the above TOR, this was largely to be a desktop survey because it would have taken about a month of extensive fieldwork to accurately locate and map all threatened species along the alignment. According to the proposal: "Species of special concern will include threatened species, species with limited ranges, ephemeral and seasonal species, and known medicinal plants. Research will be undertaken to provide descriptions of the known distributions of these species [DONE] to supplement information obtained from fieldwork [i.e. fieldwork which was intended for habitat description]. These descriptions will provide a key input into the sensitivity assessment." During fieldwork, habitats that were likely to contain threatened species were sampled, and this was taken into consideration in the vegetation map and sensitivity analyses. Information for rare and endangered species was obtained from the SANBI Threatened Species Programme, who collect anecdotal information from local specialists, local and provincial herbaria and local and provincial

	authorities. It was never intended to interview all botanists with local expertise as this (1) would have overlapped with the activities of the Threatened Species Programme, who were undertaking assessments of all threatened plant species and have the resources and mandate to approach various local experts, and (2) may have taken a long time and there was no guarentee of co-operation (certain local expertise that I met with were clearly expecting to be financially remunerated for the information, and this was not provided for by the budget). If further more detailed mapping and location of threatened species is required, this will entail a new study and require very large budget, that could also include budget for obtaining data from local experts. However, the impacts on known populations of threatened species have been assessed according to current known distribution and if any further populations were to be located through field work, it would have an impact on the status of the species (often when further populations of plants are discovered, the status is downgraded). According to advice from SANBI and GDACE staff members, no locality data of threatened species may be put in any report that will be viewed by the public, because of the sensitivity of this information. Thus the relevant distribution and habitat information is listed in part of Appendix 1 that will not be available to the public, and locality details of threatened species are kept to a minimum in the report.
Section 4 Identification of risk sources. This has been very adequately assessed.	No action required.
Section 5.1 Impact description and assessment. This has been adequately assessed. (Note some repetition of measures on pages 141,146)	Repetition of measures corrected.
5.2 Impacts beyond the route corridor and 5.3 mitigation measures: These have been adequately	No action required.

assessed.	
section 5.4 - from page 162 [ToR 8 - evaluate the ecological sustainability of ……and identified feasible alternatives (in association with…)]5.4.1 INADEQUATE – COMMENTS FOLLOW	See actions below.
Ecosystems have not been discussed. Vegetation types appear to have been used as ecosytems but this is not explained. In any case they are not very appropriate to use at this scale – being described and mapped at a subcontinental scale e.g. broad habitat types or sub-communities of the veg types would be useful. Those listed in Figure 3 could have been used and expanded upon in addition to the veg types.	The description of ecosystems has been expanded upon.
The question posed asking if species will be classified in a higher conservation category has not been answered for Vulnerable and near threatened. They are important and require the same scrutiny. Table 43 should include them.	Done.
The mention of "distance from alignment" (of 2.6 km) for one species should be applied to all important species and elaborated upon – at least for the "hotspot areas". This could be very useful in helping the public review the final report with more objectivity e.g. they could better understand which species could be affected along the alignment. It is a TOR to assess potential impacts of alignments on species. This may be essential because the locations of the red-listed species has not been provided elsewhere in this report.	
There are 7 not 4 cycads in the greater greenfields area (add E. villosus, E. laevifolius and stangeria).	Stangeria is classified as NT (according to the SANBI TSP website) and was not considered further due to being of lesser conservation concern. E. villosus is classified as Least Concern (not of conservation concern) and was not considered in the assessment. According to SANBI, E. laevifolius was not flagged as an Eastern Cape or Pondoland species, possibly because it occurs from the Umtamvuna River northwards, and was not therefore included in the assessments. I have added it to the list, but it does not occur along the greenfields alignment, according to SANBI.
The cycads could move up a threat category if habitat degradation increased or persisted. 2 (or4)	Comment noted.

of them are grassland cycads with known poor recruitment under frequent fire regimes (not only "if individuals were removed").	
Table 44: the appropriate name (since 2006) is Pondoland Scarp Forest (one of 3 split from Scarp Forest)	I disagree, see comment above (2nd row of this table).
It is misleading to quote the areas of the vegetation types in this way. These are historical (original) areas. Providing current untransformed areas gives a more accurate indication of the potential percentage loss related to the proposed road and its secondary impacts. Also consider that a change in status of a veg type can occur with severe degradation (in addition to transformation). Why are land-cover maps not used to estimate some of the transformation?	Landcover maps were used by SANBI to assess the original conservation status of the vegetation types (see Driver et al. 2005). Using the same landcover map (the only one that existed at the time this report was compiled) will produce the exact same result as SANBI. Obtaining an updated assessment of transformation and degradation requires mapping from **recent, geo-referenced** aerial photographs (or similar). Such recent aerial photos were not available for the entire Pondoland area at the time this assessment was undertaken.
The precautionary approach (top para; page 164) shows that the P-USCS veg type will increase to Endangered! It would be reasonable for the public to expect this approach in deriving veg type areas and potential status changes – if not, then it would need to be demonstrated otherwise by e.g. use of other data (not nec. relevant to these TORs'). (e.g. National Land-cover maps could easily be beefed-up with the aerial photographs and buffers incorporated).	Obtaining an updated assessment of transformation and degradation requires mapping from **recent, geo-referenced** aerial photographs (or similar). These were not available for the entire Pondoland area at the time this assessment was undertaken. In addition, the areas calculated to undertake this assessment were based on **assumed future habitat loss** due to impacts from the road and not current patterns of habitat loss.
"The extent of the indirect impacts is not known" is not accurate: a scenario similar to the grasslands will apply with increased accessibility.	Hypothetical tranformation rates are used to demonstrate the point.
5.4.3 para 2: Do thresholds apply to "loss of habitat"? Perhaps treat this separately such as in the section of loss of biological diversity. Consider deleting the first part of the first sentence because you state in the next sentence that there is a risk of exceeding thresholds at a local scale.	Section revised to read more clearly.
5.4.5 Highlighting the PCE in this context is well and good but surely there are fine-scale features that are worthy of discussion. Consider: deep gorges; free-flowing rivers; wilderness areas.	would be possible to describe (verbally) some of these unique features (and the section has been slightly expanded to do so), but to understand the potential impact of the road on each of these unique features would require that each of them is mapped in detail so that the potential impacts of the road on each of these is

	quantitatively assessed. This is not possible without mapping in detail from recent aerial photographs, the ENTIRE PCE. It is, in any case, stated that "The potential threat of the road to *protected, important, unique, sensitive, irreplaceable areas* is therefore potentially significant, especially in the absence of effective conservation management"
5.4.7 It would be informative to expand on the: "952 ha of grassland"; "some forest"; "miscellaneous areas". At least provide the area (ha's) and allocate them to grassland subtypes and forest types. If this is done elsewhere then make reference to it, after all this is a focal issue for the greenfields section. Add the 2000 ha from indirect impact. Do the same for each veg type. Experts on this could be consulted to quantify this fully. Check Durban Ethekwini Metro web site. Subsequent studies may expand on this data.	The point is that there will be some loss of natural capital, whether it is 1 ha or 2 952 ha. It is only possible to assess the significance of loss of habitat within habitat sub-types if they are mapped for the entire PCE, which was not in the terms of reference for this study. However, the definitition of natural capital does not require that it is broken doen into habitat types - whether one lists them as different habitat types or not, in combination they are still classified as natural capital. The section has been expanded to try to make this point more clear.
5.4.9 I fail to accept (understand?) the statements here – specifically: "it would be difficult to attribute these to the presence of the new road". It is commonly known that low-income ribbon development occurs where a new road traverses communal areas. The remote areas of the greenfields section have dispersed settlement patterns now. The potentially severe cumulative impacts centred on ribbon development are associated with the road with high confidence.	Comment noted and section revised to accommodate this point of view.
5.4.10 The assessment and the conclusions needs to be applied for specific sensitive parts of the route and especially the two route options through the northern greenfields section Clarity is needed as to which section you refer to. A comparison of the ecological sustainability of the routes (separately) would be useful if not essential.	Section 5.4.10 now has a summary table. Where there are differences between the route alternatives, these are now indicated. It is not possible to evaluate the significance of effects on specific sensitive parts of the route without understanding how these relate to the PCE as a whole, which is not possible without mapping the entire PCE in detail for each habitat type. This is not possible without using recent geo-referenced aerial photography.
6.1 4th para: This list is not adequate. The appendix mainly lists species in the Endangered	See Results section 4.2 where information has been added to deal

and Critically Endangered categories. All the categories are important. Some species have been omitted. Recent records (including sightings) of all Red List species (including Data Deficient) should be obtained. It is especially pertinent to consult botanists with local knowledge and local and provincial institutions/herbaria. Species observed in this study should be listed. Species listed for specific sites such as Mtentu bridge EIA by other consultants require listing and comment .	with this. Vulnerable and Orange list species now added. According to advice from SANBI and GDACE staff members, no locality data of threatened species may be put in any report that will be viewed by the public, because of the sensitivity of this information. Thus the relevant distribution and habitat information is listed in part of Appendix 1 that will not be available to the public, and locality details of threatened species are kept to a minimum in the report.
6.3.3 4th para: In the context of potential impact to the area in the proposed park between about the Mthentu toll plaza and Mzamba bridge there are two shortcomings in the consultants document: (1) It is fairly irrelevant to use fragmentation in comparing the two routes. Plants and many animals are little affected by small fragments of cultivation and settlement. They have evolved to disperse/range across patches of unsuitable habitat. (2) However the continuous barrier posed by a highway and its associated zones of disturbance and related impacts, is much more problematic for maintaining ecosystem processes across these areas. The area is a proposed national park with many globally important assets. Size of free-ranging area is critically important for ecological integrity. The loss of much of the area available for creating and maintaining a viable park is a key issue for the final choice of route. This section needs to be expanded upon, supported by better data, with attention to barriers and to the areas of habitats that stand to be lost or saved, depending on the route choice.	This is a fair comment which I had not considered before. The assessment of the two alignments from the point of view of maintaining a viable park is presented in section 5.2.3 and illustrated in Figure 2 and takes into account the differences in position of the two alignments. The barrier effect of the road is considered in other sections of the report, where relevant.
6.4 to 6.6 These are adequately covered.	No action required.
References: Some inconsistency and minor error in the five citations of Strelitzia 19.	Citations checked and corrected, where necessary.
Appendix 1	
7th line under sources: replace "Sekhukhuneland….." with "Pondoland….". Replace UNITRA with WSU.	Done.
Clivia robusta habitat given as "Afromontane forest…" Correct habitat description.	Done
Raspalia trigyna and others species – current known locations are not enough – give historic locations and potential habitat. These are as important because this is often an anomaly of under-collected areas and herbaria not recording sightings.	Done

Endemics table: some species are very out of place e.g. *Protea subvestita and P welwitschii; Cryptocarya latifolia* and *C. myrtifolia*.	This data was from a reliable source (previous EIA done by CES), so it was not thought necessary to check. Corrected and more accurate data obtained to supplement.
Biogeographically important taxa: requires careful selection of those really applicable to the study area, and deletion of species distributions inaccurately assessed.	The information given for the Pondoland grassland in this report is published from a reputable source (Mucina et al), therefore one needs to trust the source.
A second appendix of some of your species lists combined with those of other surveys and collectors would add considerable value. Sightings by botanists are valuable too. Such a list or table could also act as an inventory plant collections along the route. I do <u>not</u> suggest including the floras done for specific areas away from the route e.g. Elize Cloete's lists for Mkambati.	List now included.
Overall comment	
Key uncertainties or risks and/or assumptions underpinning the assessment have been highlighted.	No action required.
Alternate viewpoints concerning issues presented in the report have been suggested by me. The reasons have been provided in the paragraphs above. These mostly relate to the detail and scale at which some impacts are evaluated. The recommendations of the study are generally sound and defensible. The technical content and assessment methodology is credible.	Alternative viewpoints noted in relevant sections. No further action required.
Terms of Reference evaluation	
<u>Identify spring flora of …..and analyse…</u>: Completed fieldwork and analyses used indirectly to support descriptions, but not presented in report. The site/sample/plot data and supporting lists and stats are needed to guide decision on which zones (and potentially alignments) to avoid.	Report re-structured to make information more obvious.
<u>A description of populations of special concern</u>: These are lacking at the local scale of route alignments (esp. w.r.t. greenfields). Consultation with other botanists with known expertise of the area appears lacking.	See comment above*
<u>..description of extent and ….identify ….pressures and threats</u>: Adequately presented.	No action required
<u>Assess potential impacts…on species with…; on medicinal and….</u>: Generally adequately presented.	No action required
<u>Assess potential impacts….conservation value…of PCE and PARK</u>: Impacts well selected and investigated however poorly addressed in conclusions with probably inadequate quantification – a summary table would highlight the important	A section summarising this component, including a summary table, has been added to the "Discussion and Conclusions" section of the report.

impacts.	
Describe inter-relationships….assess potential impact on….persistence of ecosystems : It is fairly irrelevant to use fragmentation in comparing the two routes This section (e.g.6.3.3 pp) needs to be redone supported by better data	I think the fragmentation analysis is valid and gives an indication of edge effects, vulnerability to exotic invasions, etc. It does not take into account the quality of different barrier types, but that was not the purpose of the analysis. The nature of fragmentation in the study area is similar and due to similar factors (primarily cultivation and rural habitation). The road is therefore a more significant barrier, but still only introduces one new "edge".
Incorporate quantitative criteria…ecosystem sensitivity: Adequately presented.	No action required
Assess…indirect impacts…on vegetation and ecosystems : Generally adequately presented.	No action required
evaluate the ecological sustainability of ……and identified feasible alternatives (in association with……..): Detail provided above. The section on loss of biological diversity is lacking in detail and accuracy. These sections are adequate: ..processes …thresholds …life support …areas...climate change…uncertainty The sections on natural capital and cumulative impacts present questionable statements. Section 5.4.10 The assessment and the conclusions needs to be applied for specific sensitive parts of the route and especially the two route options through the northern greenfields section.	The sections on natural capital and cumulative impacts have been revised and section 5.4.10 now has a summary table. Where there are differences between the route alternatives, these are now indicated. It is not possible to evaluate the significance of effects on specific sensitive parts of the route without understanding how these relate to the PCE as a whole, which is not possible without mapping the entire PCE in detail for each habitat type. This is not possible without using recent geo-referenced aerial photography.
GeneralTerms of Reference	
Describe and….identify sensitive areas: Adequately addressed	No action required
Undertake field surveys: Addressed; more detail desirable (see notes above)	A section was added to the report to describe the results of the field surveys.
Identify legislative and permit requirements: Adequately addressed	No action required
Assess cumulative effects…: Addressed with some issues/interpretation outstanding	Section 5.4.9 revised to accommodate comments.
Signifcance rating…of impacts: Adequately addressed; are reasonable and reliable.	No action required
Mitigation measures ….. : Adequately addressed	No action required
Recommend appropriate moniroting and review….: Adequately addressed	No action required