Figure 40: Alien invader tree species (Acacia species) found abundant along the riparian feature within the Ntabelanga Dam study area.

5.8 MEDICINAL FLORAL SPECIES

Medicinal floral species are not necessarily indigenous species, with many of them regarded as alien invasive weeds. The medicinal species are all commonly occurring species and are no confined to the study area.

Table 19 presents a list of floral species with traditional value, plant parts traditionally used and their main applications, which were identified during the site assessment.

Table 19: Traditional medicinal plants identified during the field assessment. Medicinal applications and application methods are also presented (van Wyk and Wink, 2004; van Wyk et al., 2009).

Species	Name	Plant parts used	Medicinal uses
Acacia karroo	Sweet thorn	Bark, leaves and gum	Remedy for diarrhoea and dysentery.
Aloe marlothii	Mountain aloe	Leaves and roots	Leaf and root decoctions used for roundworm infestations, stomach problems and horse sickness.
Ammi visnaga	Visnaga / bishop's weed	Ripe fruits	Compounds from this plant, or synthetic derivatives are used as muscle relaxants in the preventive treatment of asthma, spastic bronchitis and angina pectoris (sudden chest pain resulting from a lack of oxygen to the heart muscle). Fruits are traditionally used to clean teeth and to treat numerous other ailments, including intestinal colic, the pain of kidney stones and as diuretic.
Helichrysum nudifolium	Everlasting	Leaves, twigs and sometimes the roots	Many ailments are treated, including coughs, colds, fever, infections, headache and menstrual pains. It is a popular ingredient in wound dressing.
Taraxacum officinale	Dandelion	Fresh or dried leaves, roots	Fresh or dried roots, leaves or both. The young leaves are eaten as a salad while roots collected in autumn are dried and roasted as a coffee substitute. Traditionally used as a diuretic, bitter tonic.

Species	Name	Plant parts used	Medicinal uses
Aloe ferox	Bitter aloe	Leaves and roots	Used in traditional human and animal medicines. The leaves and roots, boiled in water, are taken as a laxative, but also for arthritis, eczema, conjunctivitis, hypertension and stress.
Pellaea calomelanos	Hard fern	Leaves and rhizomes	Leaves are smoked for head colds, chest colds and asthma. Decoctions of rhizomes are traditionally used to treat boils and abscesses, and for intestinal parasites.
Tagetes minuta	Tall khaki bush	Leaves, flowers	The repellent properties of essential oil have been known for a long time and were found to be effective in preventing sheep from becoming infected with blow-fly larvae. Many gardeners use warm water extracts of the fresh plant to keep roses and other garden plants free from insects and fungal diseases. The essential oil is used in perfumery and as a flavourant in food, beverages and tobacco.
Typha capensis	Bulrush	Rhizomes	Used for venereal diseases during pregnancy to ensure an easy delivery, and for dysmennorhoea, diarrhoea, dysentery and to enhance male potency and libido.
Zantedeschia species	Arum lily	Tubers and leaves	The plant is boiled and eaten in rural areas. Tubers are eaten by pigs, porcupines, and fruit by birds. Leaves used traditionally to treat headaches and as a poultice.
Ziziphus mucronata	Buffalo thorn	Roots; bark or leaves used separately or in combination.	Warm bark infusions (sometimes together with roots or leaves added) are used as expectorants (also as emetics) in cough and chest problems, while root infusions are a popular remedy for diarrhoea and dysentery. Decoctions of roots and leaves (or chewed leaves) are applied externally to boils, sores and glandular swellings, to promote healing and as an analgesic.

Figure 41: Medicinal species located within the study area e.g. *Zantedeschia* species, *Acacia karroo, Aloe ferox* and *Ammi visnaga*.

5.9 FLORAL COMMUNITY ASSESSMENT

Floral communities can provide information regarding the ecological status of the habitat units within the study area. If the species composition is quantitatively determined and characteristics of all components of the floral community are taken into consideration, it is possible to determine the PES of the portion of land represented by the assessment point. Any given grass species is specifically adapted to specific growth conditions. This sensitivity to specific conditions make grasses good indicators of veld conditions.

The sections below summarise the dominant grass species identified within the transects with their associated habitats and optimal growth conditions with reference to the **Table 20** and **Figures 42-57** below. It should be noted that transect locations were chosen within all areas moderately representative of vegetation in a good condition. Transformed vegetation due to the edge effects from the existing roads, the road upgrade and the primary and secondary pipeline areas was not assessed using this method. These areas were however assessed using the VIS (see section below).

Table 20: Grouping of grasses (van Oudtshoorn, 2006).

Pioneer	Hardened, annual plants that can grow in very unfavourable conditions. In time improves growth conditions for perennial grasses.
Subclimax	Weak perennials denser than pioneer grasses. Protects soils leading to more moisture, which leads to a denser stand, which deposits more organic material on the surface. As growth conditions improve climax grasses are replaced by subclimax grasses.
Climax	Strong perennial plants adapted to optimal growth conditions.
Decreaser	Grasses abundant in good veld.
Increaser I	Grasses abundant in underutilized veld.
Increaser II	Grasses abundant in overgrazed veld.
Increaser III	Grasses commonly found in overgrazed veld.

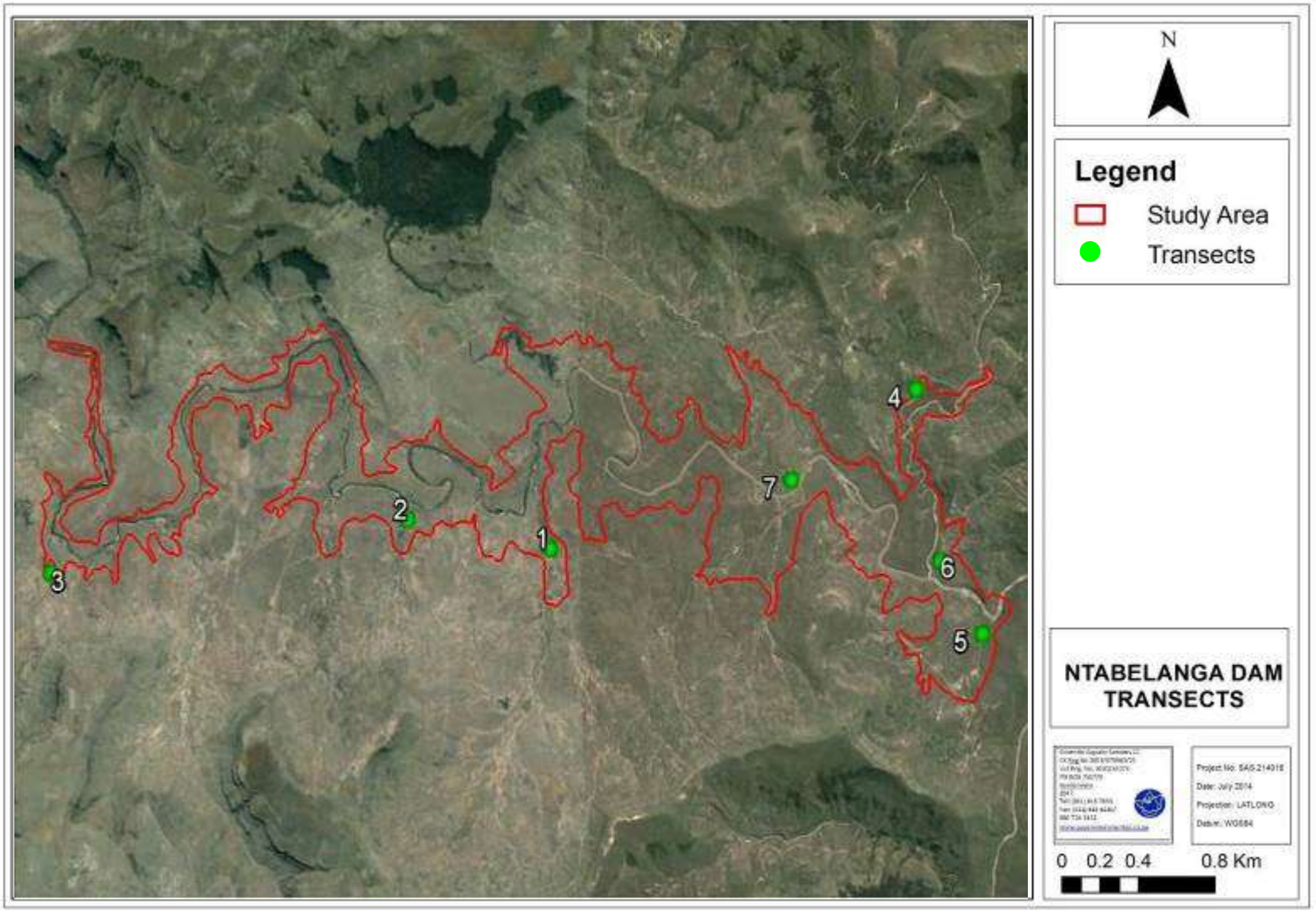


Figure 42: Digital satellite image depicting the location of transects within the Ntabelanga Dam study area.

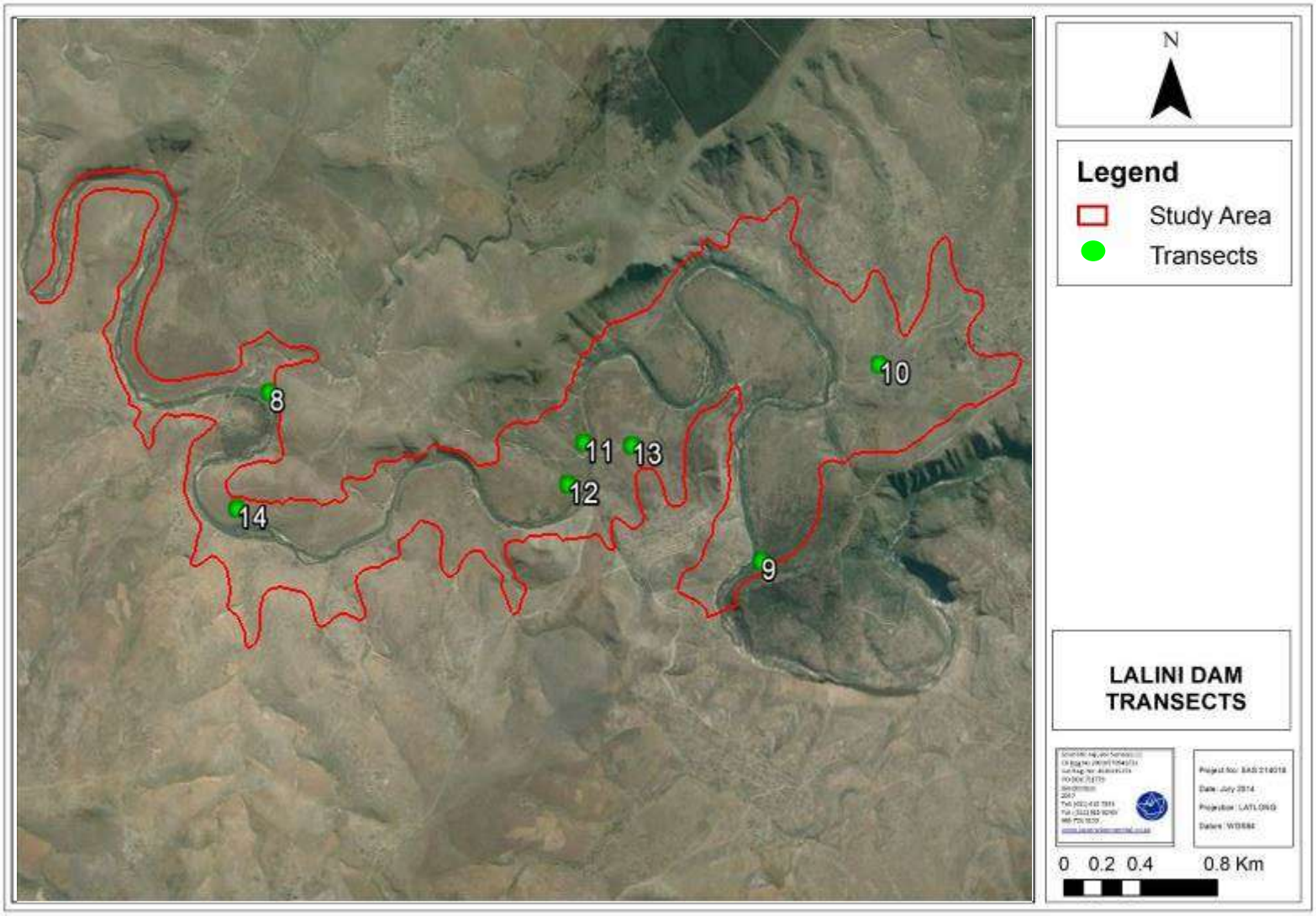


Figure 43: Digital satellite image depicting the location of transects within the Lalini Dam study area.

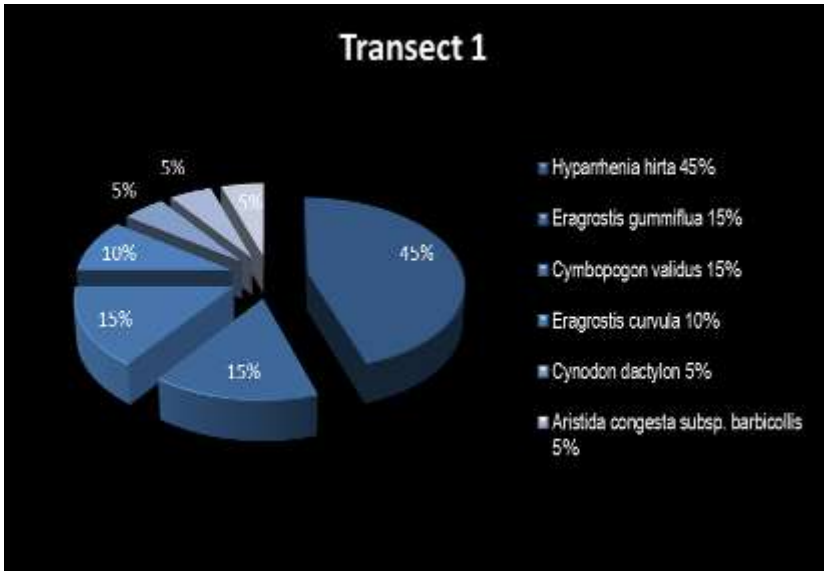


Figure 44: Transect 1.

Transect 1 –Grassland / Acacia Thornveld habitat

- *Hyparrhenia hirta* (Common thatching grass) [Increaser I, Climax grass]. Grows well in drained soil, especially gravelly soil, in open grassland, as well as in bushveld. It is often found in disturbed places such as old cultivated lands and road reserves. It is also sometimes found along riversides on heavier soil.
- *Eragrostis gummiflua* (Gum grass) [Subclimax; Increaser II grass]. Gum grass grows in open grassland and bushveld; often in road reserves and in other places where disturbance has taken place. It often grows in damp places such as seepage areas and where water collects. It mostly grows in sandy and gravelly soil.
- *Cymbopogon validus* (Giant Turpentine Grass) [Climax grass, Increaser I]: Grows in open veld in damp soil on slopes, roadsides and in vleis. Mostly occurs in parts with a high rainfall.
- *Eragrostis curvula* (Weeping love grass) [Increaser II, subclimax, climax grass]. Usually grows in disturbed places such as old cultivated land and along roadsides, mostly in well-drained fertile soil. It is associated with regions with a high rainfall with overgrazed and trampled veld.
- *Cynodon dactylon* (Couch grass) [Pioneer grass; Increaser II]. Couch grass grows in all types of soil. It is found in disturbed places such as road reserves, gardens and cultivated lands; often also in damp places.
- Aristida *congesta var barbicollis* (Spreading three-awn) [Pioneer Grass, Increaser II]. Spreading three-awn occurs in disturbed places and bare patches in overgrazed veld. Grows in all soil types, particularly loam soil.

Conclusion: The three dominant species occurring within the Grassland/*Acacia* Thornveld area are *Hyparrhenia hirta*, *Eragrostis gummiflua* and *Cymbopogon validus*. These species usually grow in open grassland and bushveld areas. *Hyparrhenia hirta* and *Cymbopogon validus* are climax grasses, indicating that they are strong perennial species that can adapt to growth conditions. *Eragrostis curvula* grows in places that are more disturbed, as was the case in areas associated with transformation (bush encroachment). The dominance of *Hyparrhenia hirta* points to the potential formation of a pseudoclimax community, which is of lower ecological value.

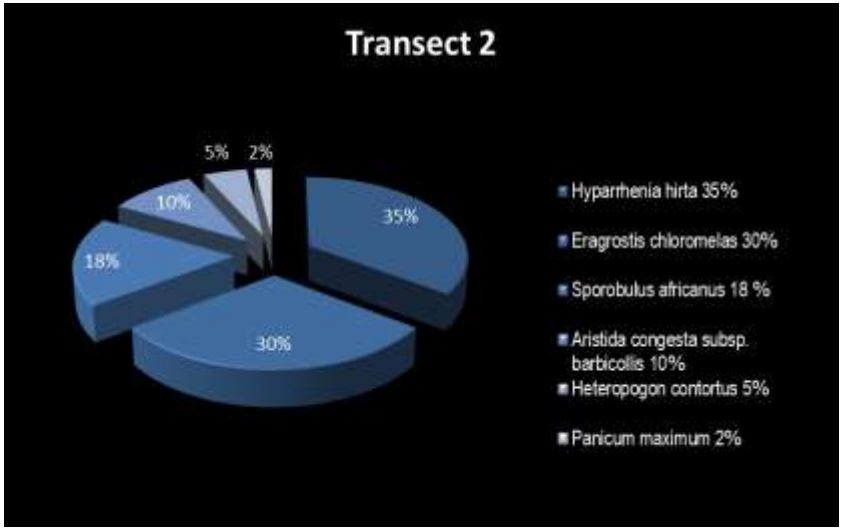


Figure 45: Transect 2.

Transect 2 – Grassland / Acacia Thornveld habitat

- *Hyparrhenia hirta* (Common thatching grass) [Increaser I, Climax grass]. Grows well in drained soil, especially gravelly soil, in open grassland, as well as in bushveld. It is often found in disturbed places such as old cultivated lands and road reserves. It is also sometimes found along riversides on heavier soil.
- *Eragrostis chloromelas* (Narrow curly leaf) [Increaser II, subclimax and climax grass]. Curly leaf grows on stony slopes in sandy and loam soil. It is more common in open grassland than in the bushveld.
- *Sporobolus africanus* (Ratstail dropseed) [Increaser III; Subclimax grass]. Ratstail dropseed grows in disturbed places such as road reserves and trampled veld, as well as near streams and other damp places. It is mostly found in compacted damp soil such as near water points and kraals.
- Aristida *congesta var barbicollis* (Spreading three-awn) [Pioneer Grass, Increaser II]. Spreading three-awn occurs in disturbed places and bare patches in overgrazed veld. Grows in all soil types, particularly loam soil.
- *Heteropogon contortus* (Spear grass) [Increaser II]. Grows especially in gravelly and other well drained soil. It often grows on slopes and disturbed places such as road reserves where it forms dense stands.
- *Panicum maximum* (Guinea Grass) [Subclimax/ climax grass, Decreaser]. Guinea grass grows in shade under trees and shrubs. Grows well under moist conditions in fertile soil, often adjacent to streams. Also utilises other growing conditions.

Conclusion: *Hyparrhenia hirta* and *Eragrostis chloromelas* were the two dominant species within this transect unit. These species usually grow in open grassland areas and in bushveld areas. The remainder of the graminoid species located within this transect unit are mostly species that are associated with disturbance and overgrazed veld, as was the case in areas closer to the alien proliferation due to overgrazing and alien tree communities.

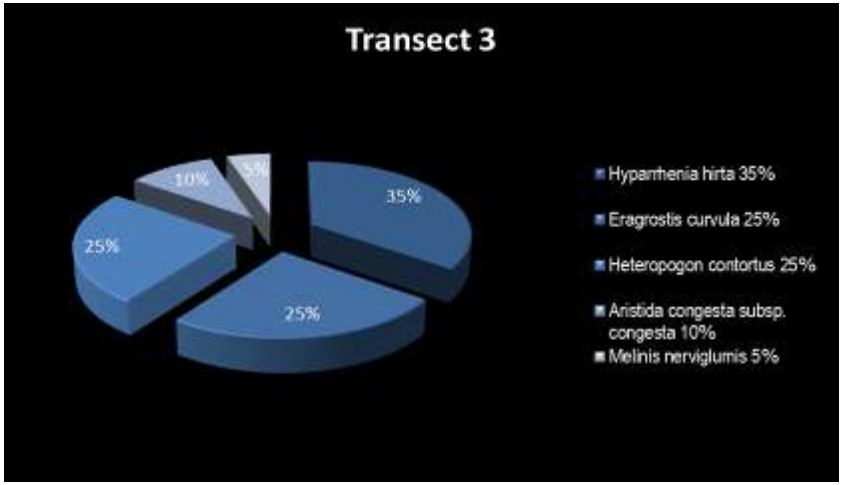


Figure 46: Transect 3.

Transect 3 –Transformed (Grassland) habitat

- *Hyparrhenia hirta* (Common thatching grass) [Increaser I, Climax grass]. Grows well in drained soil, especially gravelly soil, in open grassland, as well as in bushveld. It is often found in disturbed places such as old cultivated lands and road reserves. It is also sometimes found along riversides on heavier soil.
- *Eragrostis curvula* (Weeping love grass) [Increaser II, subclimax, climax grass]. Usually grows in disturbed places such as old cultivated land and along roadsides, mostly in well-drained fertile soil. It is associated with regions with a high rainfall with overgrazed and trampled veld.
- *Heteropogon contortus* (Spear grass) [Increaser II]. Grows especially in gravelly and other well drained soil. It often grows on slopes and disturbed places such as road reserves where it forms dense stands.
- *Aristida congesta* subsp. *congesta* (Tassel Three-awn) [Pioneer grass, Increaser II]: this grass occurs mostly in disturbed places such as old fields, road reserves and bare patches in overutilised veld. It grows in most soil types, but mostly loam soil.
- *Melinis nerviglumis* (Bristle-leaved Rep Top) [Climax grass, Increaser I]. Bristle-leaved red top grows in undisturbed veld shallow, gravelly soil. It usually grows on slopes.

Conclusion: The three dominant species occurring within the transformed grassland area are *Hyparrhenia hirta, Eragrostis curvula* and *Heteropogon contortus*. These species usually grow in grassland areas that have been disturbed. *Hyparrhenia hirta and Hyparrhenia hirta* grow in more disturbed places and overgrazed veld, as was the case in areas closer to the alien proliferation due to overgrazing and historic agricultural activities.

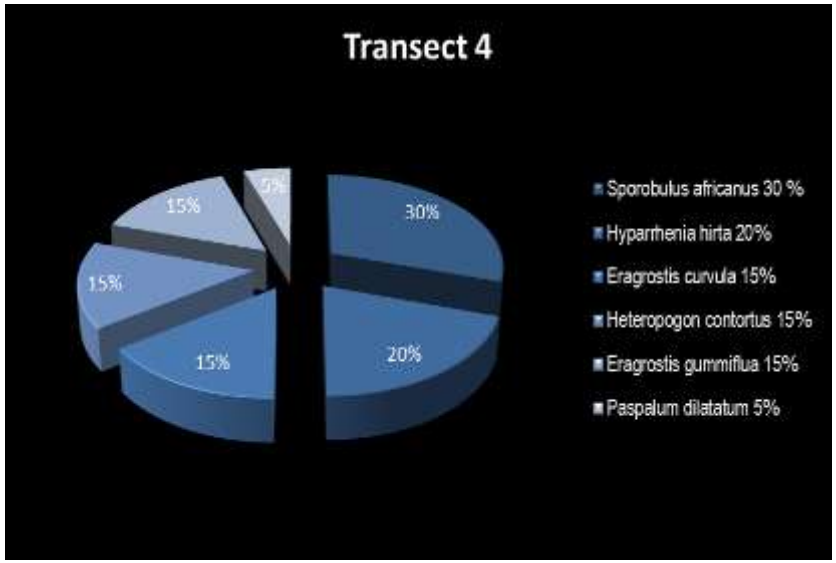
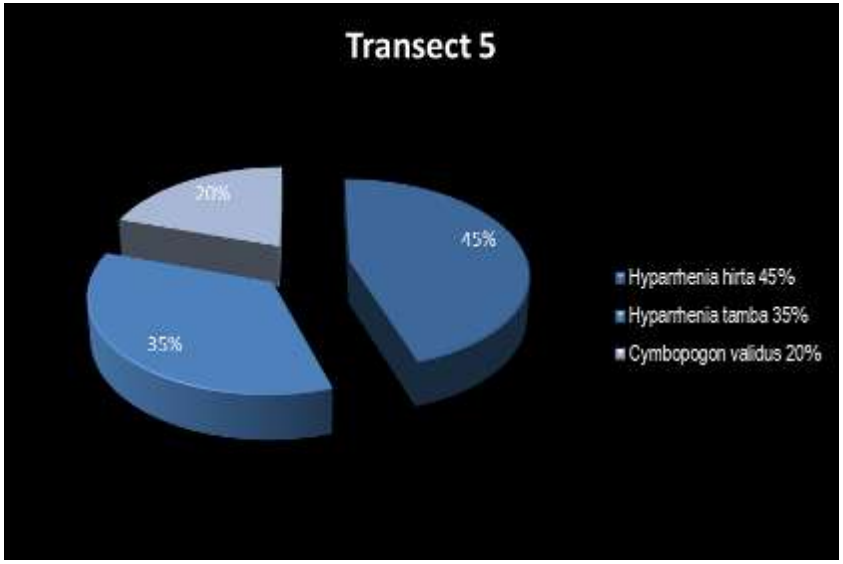


Figure 47: Transect 4.

Transect 4 –Wetland habitat

- *Sporobolus africanus* (Ratstail dropseed) [Increaser III; Subclimax grass]. Ratstail dropseed grows in disturbed places such as road reserves and trampled veld, as well as near streams and other damp places. It is mostly found in compacted damp soil such as near water points and kraals
- *Hyparrhenia hirta* (Common thatching grass) [Increaser I, Climax grass]. Grows well in drained soil, especially gravelly soil, in open grassland, as well as in bushveld. It is often found in disturbed places such as old cultivated lands and road reserves. It is also sometimes found along riversides on heavier soil.
- *Eragrostis curvula* (Weeping love grass) [Increaser II, subclimax, climax grass]. Usually grows in disturbed places such as old cultivated land and along roadsides, mostly in well-drained fertile soil. It is associated with regions with a high rainfall with overgrazed and trampled veld.
- *Heteropogon contortus* (Spear grass) [Increaser II]. Grows especially in gravelly and other well drained soil. It often grows on slopes and disturbed places such as road reserves where it forms dense stands.
- *Eragrostis gummiflua* (Gum grass) [Subclimax; Increaser II grass]. Gum grass grows in open grassland and bushveld; often in road reserves and in other places where disturbance has taken place. It often grows in damp places such as seepage areas and where water collects. It mostly grows in sandy and gravelly soil.
- *Paspalum dilatatum* (Dallis grass) Dallis grass grows in moist places such as marsh areas and near rivers. Occurs mainly in clay and loam soil and is often a weed of gardens and agricultural fields.

Conclusion: *Sporobolus africanus* dominated this transect unit undertaken within the wetland habitat unit. These species are known to grow in in open grassland within disturbed veld or areas with damp soil, such as the area where this transect was undertaken. The other species occurring within this transect unit also indicated on species that grows in more disturbed areas. Alien encroachment and overgrazing has altered the wetland feature and vegetation.



Transect 5 –Transformed (Grassland) habitat

- *Hyparrhenia hirta* (Common thatching grass) [Increaser I, Climax grass]. Grows well in drained soil, especially gravelly soil, in open grassland, as well as in bushveld. It is often found in disturbed places such as old cultivated lands and road reserves. It is also sometimes found along riversides on heavier soil.
- *Hyparrhenia tamba* (Blue thatching grass) [Climax grass; Increaser I]. Blue thatching grass usually grows in road reserves, especially where water collects; otherwise in damp soil next to rivers and vleis.
- *Cymbopogon validus* (Gaint Turpentine Grass) [Climax grass, Increaser I]: Grows in open veld in damp soil on slopes, roadsides and in vleis. Mostly occurs in parts with a high rainfall.

Conclusion: The grass species associated with this transect is mostly associated with disturbance such as old cultivated lands. This area has undergone historic cultivation activities and is currently used for grazing of livestock.

Figure 48: Transect 5.

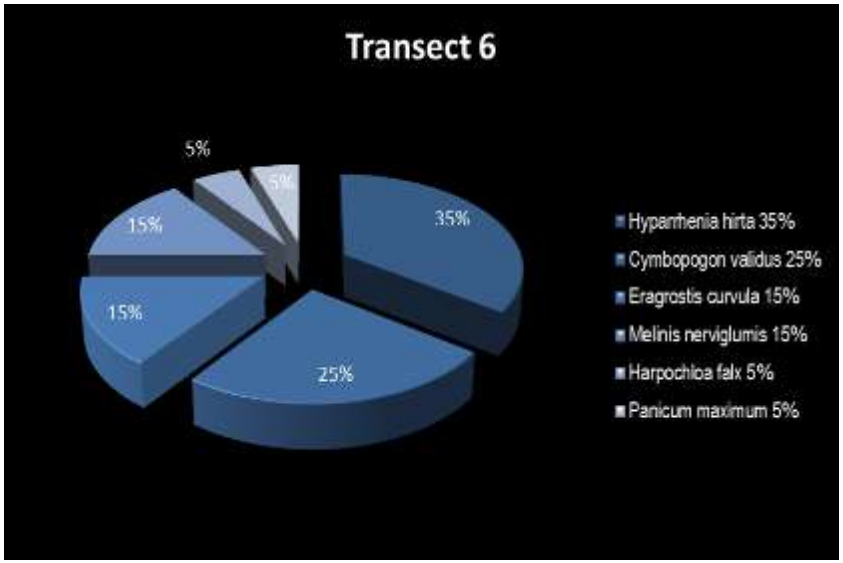


Figure 49: Transect 6.

Transect 6 –Mountain / Rocly Outcrops habitat

- *Hyparrhenia hirta* (Common thatching grass) [Increaser I, Climax grass]. Grows well in drained soil, especially gravelly soil, in open grassland, as well as in bushveld. It is often found in disturbed places such as old cultivated lands and road reserves. It is also sometimes found along riversides on heavier soil.
- *Cymbopogon validus* (Gaint Turpentine Grass) [Climax grass, Increaser I]: Grows in open veld in damp soil on slopes, roadsides and in vleis. Mostly occurs in parts with a high rainfall.
- *Eragrostis curvula* (Weeping love grass) [Increaser II, subclimax, climax grass]. Usually grows in disturbed places such as old cultivated land and along roadsides, mostly in well-drained fertile soil. It is associated with regions with a high rainfall with overgrazed and trampled veld.
- *Melinis nerviglumis* (Bristle-leaved Rep Top) [Climax grass, Increaser I]. Bristle-leaved red top grows in undisturbed veld shallow, gravelly soil. It usually grows on slopes.
- *Harpochloa falx* (Caterpillar Grass) [Climax grass, Increaser I]: This grass species usually grows against rocky slopes in well-drained soil, usually in high-rainfall areas. Mostly in undisturbed grassland.
- *Panicum maximum* (Guinea Grass) [Subclimax/ climax grass, Decreaser]. Guinea grass grows in shade under trees and shrubs. Grows well under moist conditions in fertile soil, often adjacent to streams. Also utilises other growing conditions.

Conclusion: The grass species occurring within this transect unit are classified as climax grasses. Climax grass species are species that are strong perennial species and adapt to growth conditions fairy quickly. Some of the species such as *Melinis nerviglumis* and *Harpochloa falx*.

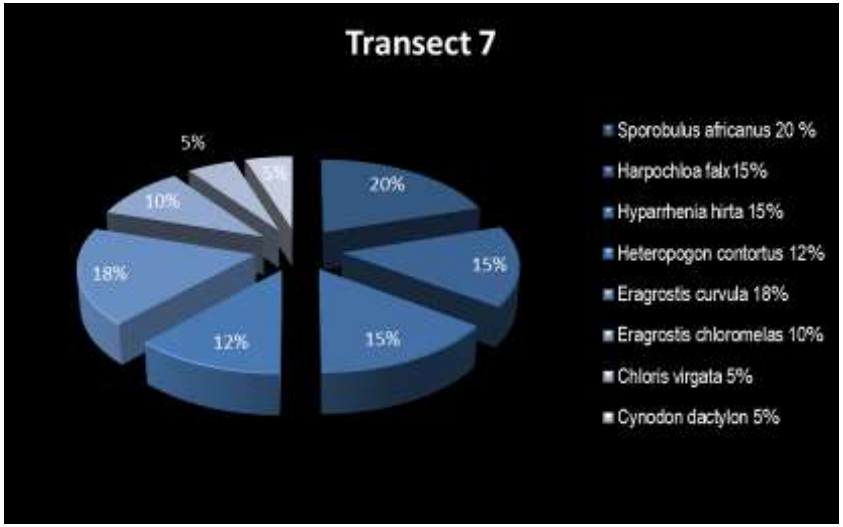
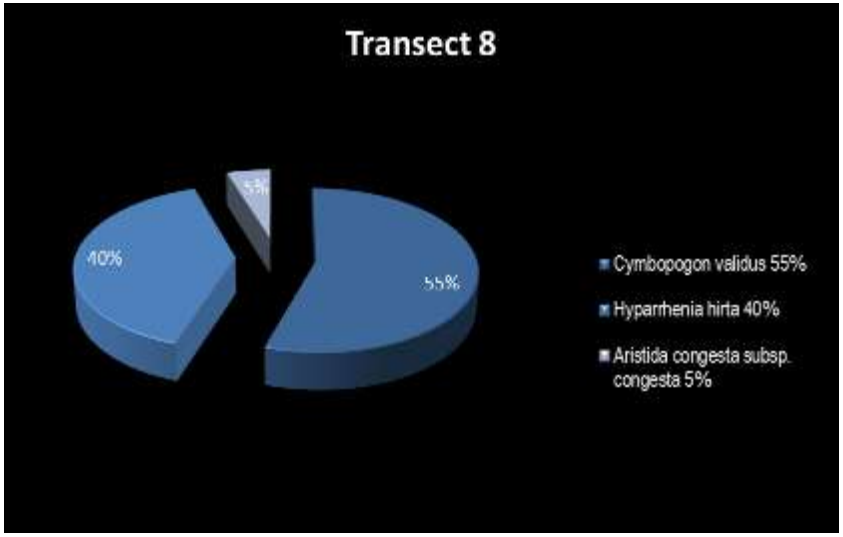


Figure 50: Transect 7.

Transect 7 –Riparian / Wetland habitat

- *Sporobolus africanus* (Ratstail dropseed) [Increaser III; Subclimax grass]. Ratstail dropseed grows in disturbed places such as road reserves and trampled veld, as well as near streams and other damp places. It is mostly found in compacted damp soil such as near water points and kraals.
- *Harpochloa falx* (Caterpillar Grass) [Climax grass, Increaser I]: This grass species usually grows against rocky slopes in well-drained soil, usually in high-rainfall areas. Mostly in undisturbed grassland.
- *Hyparrhenia hirta* (Common thatching grass) [Increaser I, Climax grass]. Grows well in drained soil, especially gravelly soil, in open grassland, as well as in bushveld. It is often found in disturbed places such as old cultivated lands and road reserves. It is also sometimes found along riversides on heavier soil.
- *Heteropogon contortus* (Spear grass) [Increaser II]. Grows especially in gravelly and other well drained soil. It often grows on slopes and disturbed places such as road reserves where it forms dense stands.
- *Eragrostis curvula* (Weeping love grass) [Increaser II, subclimax, climax grass]. Usually grows in disturbed places such as old cultivated land and along roadsides, mostly in well-drained fertile soil. It is associated with regions with a high rainfall with overgrazed and trampled veld.
- *Eragrostis chloromelas* (Narrow curly leaf) [Increaser II, subclimax and climax grass]. Curly leaf grows on stony slopes in sandy and loam soil. It is more common in open grassland than in the bushveld.
- *Chloris virgata* (Feather-top Chloris) [Pioneer grass, Increaser II]: Grows mostly in disturbed places, especially where water collects after rain. It grows in all types of soil, but mostly in clay soil. It can often be seen at the edge of seasonal pans. It is also a common weed in cultivated lands and gardens.
- *Cynodon dactylon* (Couch grass) [Pioneer grass; Increaser II]. Couch grass grows in all types of soil. It is found in disturbed places such as road reserves, gardens and cultivated lands; often also in damp places.

Conclusion: Eight dominant species occurring within the grassland area were noted within this transect area. These species usually grow in open grassland areas, were disturbance has occurred, as was the case in areas associated with transformation (floral alien and invader encroachment). The dominance of *Hyparrhenia hirta* points to the potential formation of a pseudoclimax community, which is of lower ecological value.



Transect 8 –Grassland habitat

- *Cymbopogon validus* (Gaint Turpentine Grass) [Climax grass, Increaser I]: Grows in open veld in damp soil on slopes, roadsides and in vleis. Mostly occurs in parts with a high rainfall.
- *Hyparrhenia hirta* (Common thatching grass) [Increaser I, Climax grass]. Grows well in drained soil, especially gravelly soil, in open grassland, as well as in bushveld. It is often found in disturbed places such as old cultivated lands and road reserves. It is also sometimes found along riversides on heavier soil.
- *Aristida congesta* subsp. *congesta* (Tassel Three-awn) [Pioneer grass, Increaser II]: this grass occurs mostly in disturbed places such as old fields, road reserves and bare patches in overutilised veld. It grows in most soil types, but mostly loam soil.

Conclusion: The dominant grass species of this transect unit was *Cymbopogon validus*, which grows in open veld and on slopes. It is a climax grass, indicating that it will adapt to its surroundings and will grow as long as these conditions prevail. The presence of the other two species indicates that some form of disturbance has occurred due to occasional grazing of livestock from the surrounding communities.

Figure 51: Transect 8.

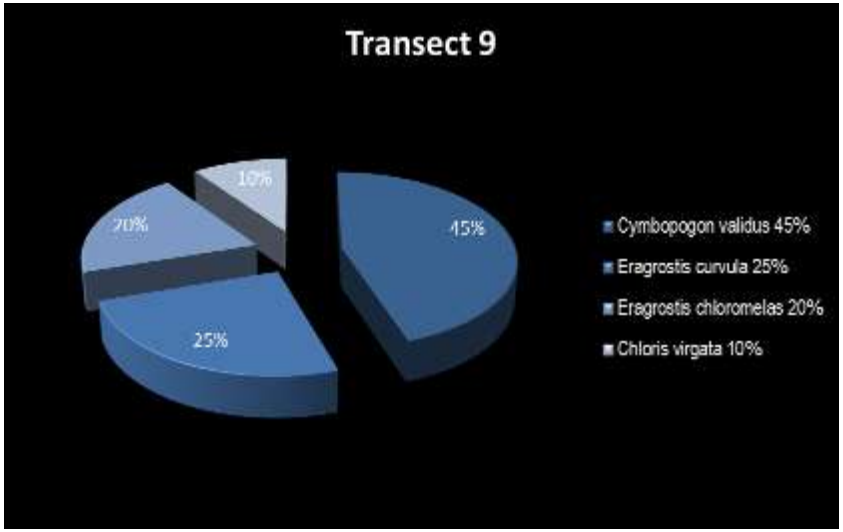


Figure 52: Transect 9.

Transect 9 –Mountain /Rocky Outcrop habitat

- *Cymbopogon validus* (Gaint Turpentine Grass) [Climax grass, Increaser I]: Grows in open veld in damp soil on slopes, roadsides and in vleis. Mostly occurs in parts with a high rainfall.
- *Eragrostis curvula* (Weeping love grass) [Increaser II, subclimax, climax grass]. Usually grows in disturbed places such as old cultivated land and along roadsides, mostly in well-drained fertile soil. It is associated with regions with a high rainfall with overgrazed and trampled veld.
- *Eragrostis chloromelas* (Narrow curly leaf) [Increaser II, subclimax and climax grass]. Curly leaf grows on stony slopes in sandy and loam soil. It is more common in open grassland than in the bushveld.
- *Chloris virgata* (Feather-top Chloris) [Pioneer grass, Increaser II]: Grows mostly in disturbed places, especially where water collects after rain. It grows in all types of soil, but mostly in clay soil. It can often be seen at the edge of seasonal pans. It is also a common weed in cultivated lands and gardens.

Conclusion: *Cymbopogon validus* and *Eragrostis curvula* was the dominant grass species located within this transect area. Due to the extensive woody vegetation occurring within this habitat unit, very few grass species were present. The species present within this transect grow mostly in bushveld areas.

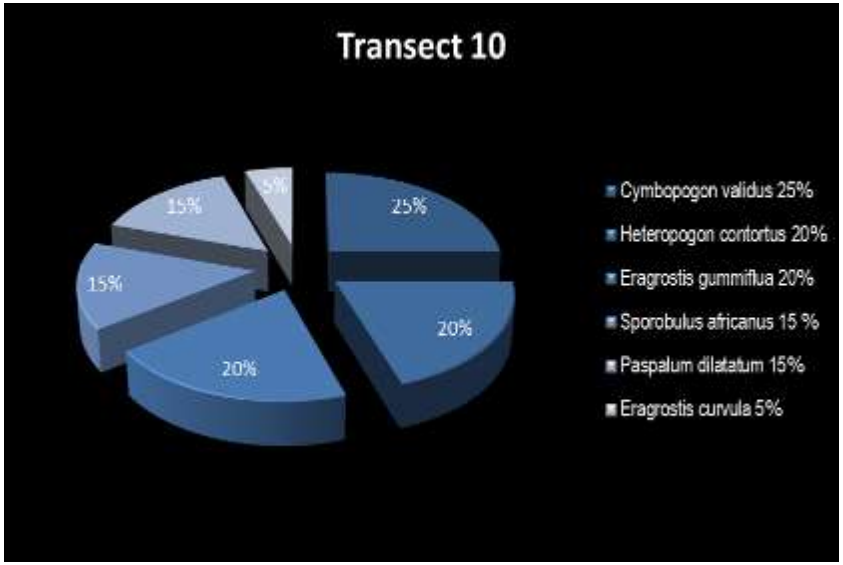


Figure 53: Transect 10.

Transect 10 –Grassland habitat

- *Cymbopogon validus* (Gaint Turpentine Grass) [Climax grass, Increaser I]: Grows in open veld in damp soil on slopes, roadsides and in vleis. Mostly occurs in parts with a high rainfall.
- *Heteropogon contortus* (Spear grass) [Increaser II]. Grows especially in gravelly and other well drained soil. It often grows on slopes and disturbed places such as road reserves where it forms dense stands.
- *Eragrostis gummiflua* (Gum grass) [Subclimax; Increaser II grass]. Gum grass grows in open grassland and bushveld; often in road reserves and in other places where disturbance has taken place. It often grows in damp places such as seepage areas and where water collects. It mostly grows in sandy and gravelly soil.
- *Sporobolus africanus* (Ratstail dropseed) [Increaser III; Subclimax grass]. Ratstail dropseed grows in disturbed places such as road reserves and trampled veld, as well as near streams and other damp places. It is mostly found in compacted damp soil such as near water points and kraals.
- *Paspalum distichum* (Water Couch) [Exotic]: Grows in or near water-bearing places such as dams, rivers and vleis. It is also a weed in cultivated lands in parts with a high rainfall. It grows in any soil, from sandy soil to clay soil.
- *Eragrostis curvula* (Weeping love grass) [Increaser II, subclimax, climax grass]. Usually grows in disturbed places such as old cultivated land and along roadsides, mostly in well-drained fertile soil. It is associated with regions with a high rainfall with overgrazed and trampled veld.

Conclusion: The three dominant species occurring within the grassland area are *Cymbopogon validus*, *Heteropogon contortus* and *Eragrostis gummiflua*. These species usually grow in open grassland areas, alongside roads and areas associated with disturbance. *Eragrostis curvula* and *Paspalum distichum* grows in places that are more disturbed, as was the case in areas associated with transformation (floral alien and invader encroachment).

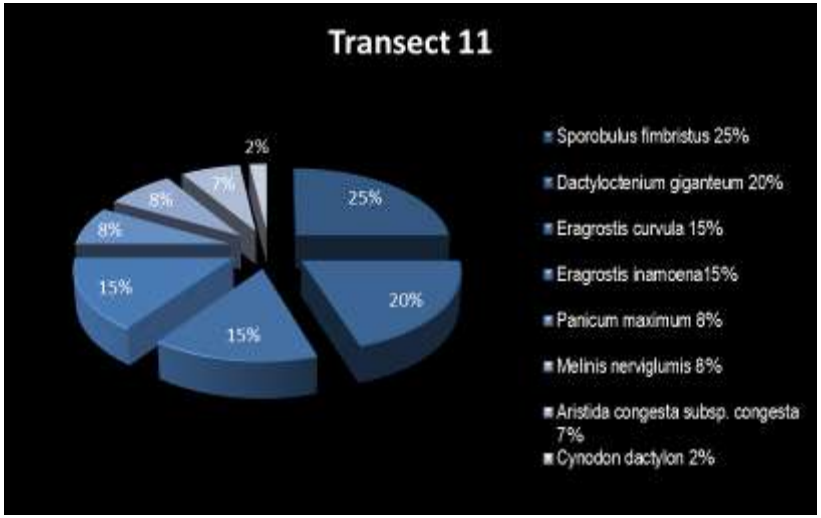
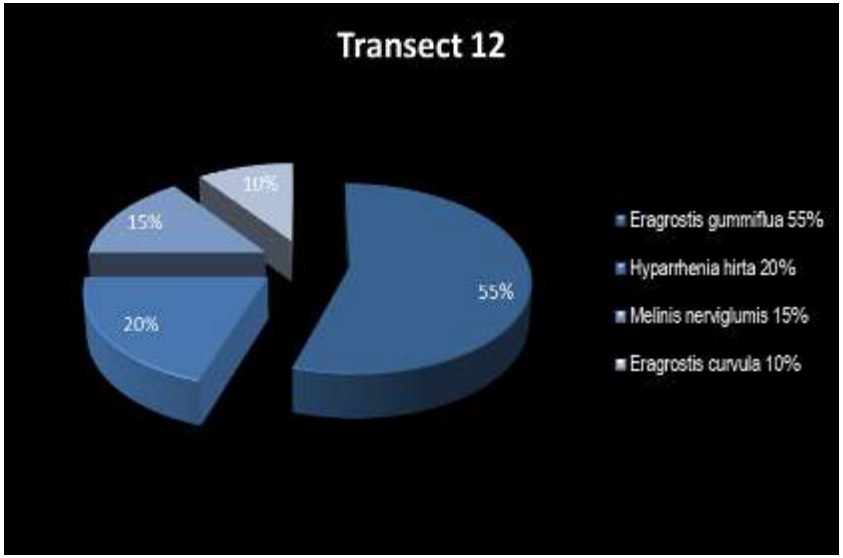


Figure 54: Transect 11.

Transect 11 –Grassland habitat

- *Sporobolus africanus* (Ratstail dropseed) [Increaser III; Subclimax grass]. Ratstail dropseed grows in disturbed places such as road reserves and trampled veld, as well as near streams and other damp places. It is mostly found in compacted damp soil such as near water points and kraals.
- *Dactyloctenium giganteum* (Giant Crowfoot) [Pioneer grass, Increaser II]: Grows mainly in sandveld, especially after droughts, or in disturbed places such as cultivated lands, road reserves or trampled places. It sometimes also grows under trees or on sandy riverbanks. It may form dense dominant stands.
- *Eragrostis curvula* (Weeping love grass) [Increaser II, subclimax, climax grass]. Usually grows in disturbed places such as old cultivated land and along roadsides, mostly in well-drained fertile soil. It is associated with regions with a high rainfall with overgrazed and trampled veld.
- *Eragrostis inamoena* (Tite Grass) [Subclimax grass, Increaser II]: Grows in wet places as vlei edges, seasonal wet patches in the veld, seepage areas and in drainage ditches beside the road. It grows in all soil types.
- *Panicum maximum* (Guinea Grass) [Subclimax/ climax grass, Decreaser]. Guinea grass grows in shade under trees and shrubs. Grows well under moist conditions in fertile soil, often adjacent to streams. Also utilises other growing conditions.
- *Melinis nerviglumis* (Bristle-leaved Rep Top) [Climax grass, Increaser I]. Bristle-leaved red top grows in undisturbed veld shallow, gravelly soil. It usually grows on slopes.
- *Aristida congesta* subsp. *congesta* (Tassel Three-awn) [Pioneer grass, Increaser II]: this grass occurs mostly in disturbed places such as old fields, road reserves and bare patches in overutilised veld. It grows in most soil types, but mostly loam soil.
- *Cynodon dactylon* (Couch grass) [Pioneer grass; Increaser II]. Couch grass grows in all types of soil. It is found in disturbed places such as road reserves, gardens and cultivated lands; often also in damp places.

Conclusion: The three dominant species occurring within the grassland area are *Hyparrhenia hirta*, *Themeda triandra* and *Eragrostis curvula*. These species usually grow in open grassland areas. Thus, the grass community can be described as a climax community, indicating that the grass species will adapt to the optimum growth conditions present within the study area. *Eragrostis curvula* grows in places that are more disturbed, as was the case in areas associated with transformation (floral alien and invader encroachment). Most of the grass species are increaser II species, indicating that these species grow and occur within areas that has been overutilised by grazing activities. These species tend to increase in number when the veld is disturbed and where encroachment of alien tree species was significant.



Transect 12 –Grassland habitat

- *Eragrostis gummiflua* (Gum grass) [Subclimax; Increaser II grass]. Gum grass grows in open grassland and bushveld; often in road reserves and in other places where disturbance has taken place. It often grows in damp places such as seepage areas and where water collects. It mostly grows in sandy and gravelly soil.
- *Hyparrhenia hirta* (Common thatching grass) [Increaser I, Climax grass]. Grows well in drained soil, especially gravelly soil, in open grassland, as well as in bushveld. It is often found in disturbed places such as old cultivated lands and road reserves. It is also sometimes found along riversides on heavier soil.
- *Melinis nerviglumis* (Bristle-leaved Rep Top) [Climax grass, Increaser I]. Bristle-leaved red top grows in undisturbed veld shallow, gravelly soil. It usually grows on slopes.
- *Eragrostis curvula* (Weeping love grass) [Increaser II, subclimax, climax grass]. Usually grows in disturbed places such as old cultivated land and along roadsides, mostly in well-drained fertile soil. It is associated with regions with a high rainfall with overgrazed and trampled veld.

Conclusion: The two dominant species occurring within the transformed grassland area are *Eragrostis gummiflua* and *Hyparrhenia hirta*. These species usually grow in disturbed places in open grassland areas. *Eragrostis spp.* grow in more disturbed places and overgrazed veld, as was the case in areas closer to the alien proliferation due to overgrazing and alien tree communities.

Figure 55: Transect 12.

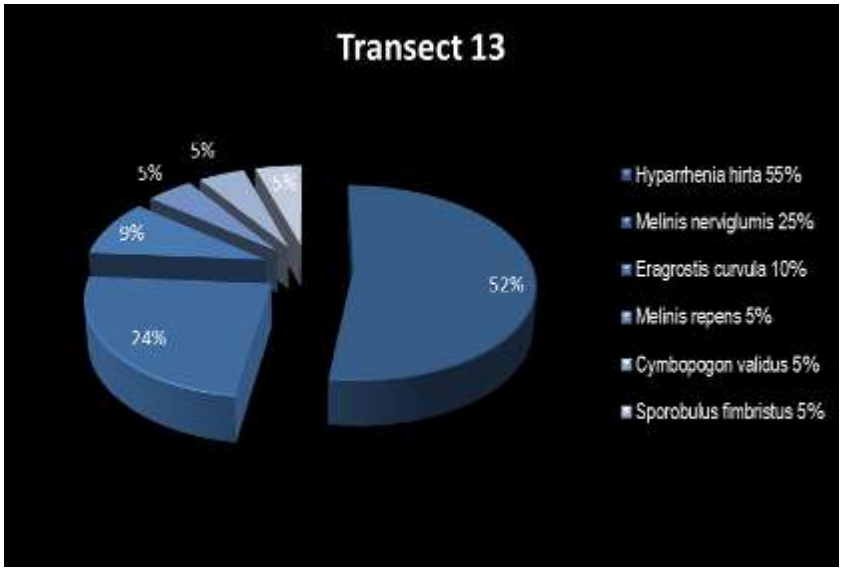


Figure 56: Transect 13.

Transect 13 –Grassland habitat

- *Hyparrhenia hirta* (Common thatching grass) [Increaser I, Climax grass]. Grows well in drained soil, especially gravelly soil, in open grassland, as well as in bushveld. It is often found in disturbed places such as old cultivated lands and road reserves. It is also sometimes found along riversides on heavier soil.
- *Melinis nerviglumis* (Bristle-leaved Rep Top) [Climax grass, Increaser I]. Bristle-leaved red top grows in undisturbed veld shallow, gravelly soil. It usually grows on slopes.
- *Eragrostis curvula* (Weeping love grass) [Increaser II, subclimax, climax grass]. Usually grows in disturbed places such as old cultivated land and along roadsides, mostly in well-drained fertile soil. It is associated with regions with a high rainfall with overgrazed and trampled veld.
- *Melinis repens (*Natal Red top) [Subclimax grass, Increaser II]. Natal red top grows in disturbed places such as roadsides and old cultivated lands (subsp. *repens*) or in sunny dry places (subsp. *grandiflora*), in all soil types, but especially in well drained soil.
- *Cymbopogon validus* (Gaint Turpentine Grass) [Climax grass, Increaser I]: Grows in open veld in damp soil on slopes, roadsides and in vleis. Mostly occurs in parts with a high rainfall.
- *Sporobolus africanus* (Ratstail dropseed) [Increaser III; Subclimax grass]. Ratstail dropseed grows in disturbed places such as road reserves and trampled veld, as well as near streams and other damp places. It is mostly found in compacted damp soil such as near water points and kraals.

Conclusion: The dominant grass species of this transect unit was *Hyparrhenia hirta*, which grows in open veld. It is a climax grass, indicating that it will adapt to its surroundings and will grow as long as these conditions prevail. The presence of the other two species indicates that some form of disturbance has occurred due to occasional grazing of livestock from the surrounding communities.

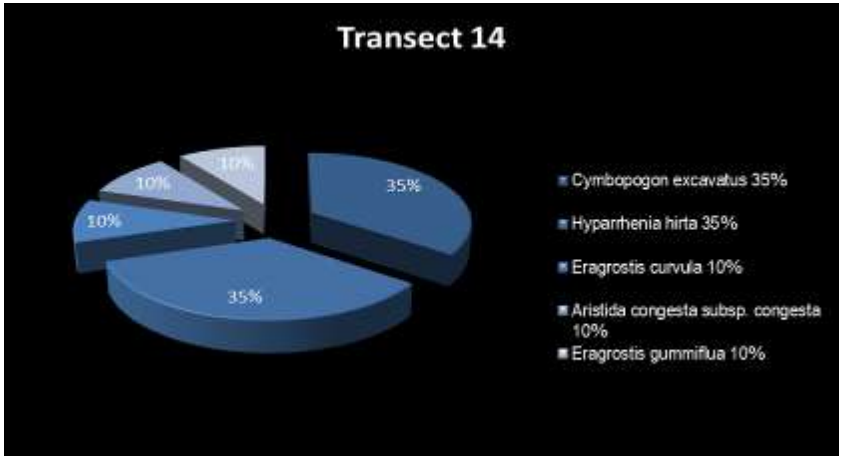


Figure 57: Transect 14.

Transect 14 –Central Grassland habitat

- *Cymbopogon excavatus* (Broad-leaved turpentine grass) [Climax grass; Increaser I]. Broad-leaved turpentine grass grows in most soil types, but especially in sandy and gravelly soil in disturbed as well as undisturbed veld. It often also grows along roadsides.
- *Hyparrhenia hirta* (Common thatching grass) [Increaser I, Climax grass]. Grows well in drained soil, especially gravelly soil, in open grassland, as well as in bushveld. It is often found in disturbed places such as old cultivated lands and road reserves. It is also sometimes found along riversides on heavier soil.
- *Eragrostis curvula* (Weeping love grass) [Increaser II, subclimax, climax grass]. Usually grows in disturbed places such as old cultivated land and along roadsides, mostly in well-drained fertile soil. It is associated with regions with a high rainfall with overgrazed and trampled veld.
- *Aristida congesta* subsp. *congesta* (Tassel Three-awn) [Pioneer grass, Increaser II]: this grass occurs mostly in disturbed places such as old fields, road reserves and bare patches in overutilised veld. It grows in most soil types, but mostly loam soil.
- *Eragrostis gummiflua* (Gum grass) [Subclimax; Increaser II grass]. Gum grass grows in open grassland and bushveld; often in road reserves and in other places where disturbance has taken place. It often grows in damp places such as seepage areas and where water collects. It mostly grows in sandy and gravelly soil.

Conclusion: The two dominant species occurring within the grassland area are *Cymbopogon excavatus* and *Hyparrhenia hirta*. These species usually grow in open grassland areas in disturbed and undisturbed veld. This area has seen some disturbance due to grazing activities but is less than other grassland areas closer to communities and villages. The climax and increaser I grass contributes towards the increase in climax grass species when conditions improve and less grazing takes place.

The dominant species within transects were *Cymbopogon validus, Eragrostis curvula, E. chloromelas and Hyparrhenia hirta*. These species usually grow in open grassland areas. The majority of the grass community is in a combination of sub-climax or climax condition. The proposed construction of the dams, road upgrades and pipelines does not pose a threat to grassland conservation due to the footprint of the proposed project being largely situated in the transformed areas.

5.10 VIS

The information gathered during the assessment of the study area was used to determine the Vegetation Index Score (VIS). Due to variation between the different habitat units within each site, all habitat units were assessed separately. **Table 22** lists the results of each habitat unit.

Table 21: Scoring for the Vegetation Index Score.

VIS	Assessment Class	Description
22 to 25	**A**	Unmodified, natural
18 to 22	**B**	Largely natural with few modifications
14 to 18	**C**	Moderately modified
10 to 14	**D**	Largely modified
5 to 10	**E**	The loss of natural habitat extensive
<5	**F**	Modified completely

Table 22: VIS for each habitat unit assessed.

Habitat unit	Score	Class	Motivation
Mountain/Rocky Outcrops habitat unit	18	**Class B – largely natural with few modifications**	This habitat unit has remained relatively undisturbed and is known to support high levels of biodiversity and is therefore considered of relatively high ecological importance. Although high levels of biodiversity and ecological importance occur within this habitat unit, transformation has occurred in transition areas between the woody mountain habitat and the open veld habitat unit. Protected tree species, *Podocarpus falcatus* and *P. latifolius* were located within this management unit
Riparian/wetland habitat unit	14	**Class C/D – moderately/largely modified**	This habitat unit is characterised by high levels of erosion associated with donga formation. Numerous drainage lines, valley bottom wetlands and seeps are located within the study area.
Transformed habitat unit	5	**Class E – extensive loss of natural habitat**	This habitat unit is associated primarily with community villages' historic cultivated fields and veld overgrazed and trampled by livestock. The ecological functionality and habitat integrity of the Transformed Habitat Unit is regarded as

Habitat unit	Score	Class	Motivation
			being extremely limited.
Transformed(Grassland) habitat unit	10	**Class D/E – largely modified/Extensive loss of natural habitat**	This habitat unit has undergone transformation due to overutilisation of veld by cattle grazing and bush encroachment by *Acacia karroo*.

5.11 RDL FLORAL ASSESSMENT

An assessment considering the presence of any floral species of concern, as well as suitable habitat to support any such species, was undertaken. The complete PRECIS (Pretoria Computer Information Systems) red data plant list for the grid reference (3128BC, 3128BB, 3128BA, 3128BD) was acquired from SANBI. Species listed under NEMBA TOPS and the protected tree list (2012) were also assessed and listed below.

Table 23: IUCN Red Data List Categories – Version 3.1 as supplied by SANBI.

Category	Definition
EX	Extinct
EW	Extinct in the wild
CR	Critically endangered
EN	Endangered
VU	Vulnerable
NT	Near threatened
LC	Least concern
DD	Data deficient
NE	Not evaluated

All species listed under PRECIS categorised as per the list above, except for least concern, data deficient and not available were assessed as part of the POC calculations. Species listed under NEMBA TOPS that has a high likelihood to occur within the surrounding area and habitat was used to calculate the POC of RDL or protected species. The protected tree species list under the National Forest Act, 1998 (Act 84 of 1998) was also referred to as part of the POC calculations.

Table 24: Protected floral species potentially occurring within the area.

Family	Species	Threat status	Common name	Flowering season
ORCHIDACEAE	*Diaphananthe millarii*	Vu	Tree orchid	
ZAMIACEAE	*Encephalartos laevifolius*	CR	Cycad	The cones are produced in May with the male cones shedding pollen during September–November, and the female cones starting to disintegrate during January–March. There are separate male and female plants.
ZAMIACEAE	*Encephalartos natalensis*	NT	Cycad	Male cones the pollen in April to June. Female cones disintegrate

Family	Species	Threat status	Common name	Flowering season
				spontaneously from November to January.
ZAMIACEAE	*Encephalartos lehmannii*	NT	Cycad	-
SAPOTACEAE	*Sideroxylon inerme*	Protected	White milkwood	Summer and autumn (November to April)
PITTOSPORACEAE	*Pittosporum viridiflorum*	Protected	Cheeswood	Early summer (November to December)
PODOCARPACEAE	*Podocarpus falcatus*	Protected	Common yellowwood	Spring to autumn
PODOCARPACEAE	*Podocarpus latifolius*	Protected	Broad-leaf yellowwood	Spring to autumn
ROSACEAE	*Prunus africana*	Vulnerable	African almond	October to May
LAURACEAE	*Ocotea bullata*	Protected	Stinkwood	December to February
CELASTRACEAE	*Catha edulis*	Protected	Bushmans-tea	Late October
CORNACEAE	*Curtisia dentata*	Protected	Assegai	Spring-summer (October to March)
CELASTRACEAE	*Pterocelastrus rostratus*	Declining	Cherry wood	-
GREYIACEAE	*Greyia flanaganii*	Rare	Bottlebrush	Spring (August to October)
IRIDACEAE	*Gladiolus oppositiflorus*	Declining	Gladiolus	
AQUIFOLIACEAE	*Ilex mitis* var. *mitis*	Declining	African holly	Spring or early summer
IRIDACEAE	*Crocosmia masoniorum*	VU	Swan crocosmia	December to January
IRIDACEAE	*Hesperantha hutchingsiae*	Rare	-	-
IRIDACEAE	*Hesperantha ingeliensis*	Rare	-	-
ZAMIACEAE	*Encephalartos friderici-guilielmi*	NT	Cycad	-
RHIZOPHORACEAE	*Cassipourea flanaganii*	EN	Cape onion wood	-
RHIZOPHORACEAE	*Cassipourea malosana*	Declining	Common onion wood	-

The POC of each of the species listed above was calculated (**Table 25**) with reference to habitat suitability found during the assessment.

Table 25: POC for floral species of concern.

Species	Habitat	POC	Motivation
Encephalartos natalensis	Cliffs and either hot, dry slopes or cool, south-facing, often forested slopes. Vryheid to Qumbu and Tabankulu	46%	Although no suitable habitat is available within the study area, *Encephalartos* species were observed further downstream at the Tsitsa waterfall.
Encephalartos lehmannii	Arid, low succulent shrubland on rocky ridges and slopes	46%	
Encephalartos laevifolius	Restricted to high mountain peaks in eastern Mpumalanga and parts of Swaziland	33%	
Diaphananthe millarii	Scarp forest. It is a low level epiphyte in kloof forests and dry scrub, usually in light shade on the underside of branches, 300-700 m	20%	No suitable habitat (forest) areas located within the two dam study areas. A small portion of afromontane forest was located along the road to be upgraded in the Ntabelanga Dam. This area could provide suitable habitat higher up in the forest away from the transformed areas.
Sideroxylon inerme	This species is commonly found in dune forests, almost always in coastal woodlands and also in littoral forests (forests along the sea shore)	0%	No suitable habitat located within the study area. It is unlikely that this tree would occur within the surrounding area.

Species	Habitat	POC	Motivation
Pittosporum viridiflorum	In forest & margins, on rocky outcrops & in bush clumps to 1800m	46%	Rocky outcrops habitat is present within the study area. The altitude of there this species would occur is very high since the average altitude for the rocky outcrops within the footprint are around 950-1050m. Should this species occur in the area, it would be higher up in the mountain and forest areas.
Catha edulis	In bushveld, on rocky outcrops and along streams	53%	Suitable habitat along riparian features and rocky outcrop areas within the Ntabelanga Dam is present. This species was not noted during the site assessments.
Ocotea bullata	Occurs naturally in most of the high forests of South Africa, it is seldom found in the forests on the Eastern Cape, where sneezewood occurs instead	0%	No suitable habitat and distribution within the area
Pterocelastrus rostratus	Not endemic to South Africa. Distributed in Eastern Cape, KwaZulu-Natal, Limpopo and Mpumalanga. It grows in the Forest and is described as forest and montane scrub in forest margins and on mountain sides	20%	No suitable habitat (forest) areas located within the two dam study areas. A small portion of afromontane forest was located along the road to be upgraded in the Ntabelanga Dam. This area could provide suitable habitat higher up in the forest away from the transformed areas
Prunus africana	It is confined to evergreen forests from near the coast to the mist belt and montane forests in KwaZulu-Natal, Eastern Cape, Swaziland, Mpumalanga, Zimbabwe and tropical Africa	6%	No suitable habitat (forest) areas located within the two dam study areas. Portions of afromontane forest were located in the surrounding area. This area could provide suitable habitat higher up in the forest away from the transformed areas
Greyia flanaganii	It is a rare endemic of Eastern Cape, where it is found on the grassy hillsides and among rocks on the steep slopes of the Kei River and its tributaries, the Toise and Kabusi Rivers	6%	Although grassy hillsides are present within the footprint, these areas have been transformed due to overgrazing and historic agricultural activities.
Gladiolus oppositiflorus	*It* is endemic to the summer rainfall regions of the Eastern Cape north of East London to southern KwaZulu-Natal, from the coast to as far inland as the Lesotho border. It is found in rocky areas in open grassland, often among rocks along streams	0%	Due to the transformation of vegetation from overgrazing and historic agricultural activities, little suitable habitat is present within the footprint area for this species to occur.
Curtisia dentata	Evergreen forest from coast to 1800 m.	0%	No suitable habitat of forest areas occur within the study area
Ilex mitis var. *mitis*	Along rivers and streams in forest and thickets, sometimes in the open. Found from sea level to	33%	It is likely that there could be suitable habitat for this species to occur along the main riparian

Species	Habitat	POC	Motivation
	inland mountain slopes. This taxon has experienced notable declines in the Eastern Cape because of bark-stripping for the medicinal plant trade		systems, away from rural communities. These pockets of suitable habitat are very small, thus unlikely to occur within the footprint area.
Crocosmia masoniorum	Endemic to South Africa, distributed in Eastern Cape. The species grows in grassland and is described as Highland sourveld, loam sandstone soils	35%	Suitable grassland along rocky outcrop areas within the Ntabelanga and Lalini Dam is present. This species was not noted during the site assessments
Hesperantha hutchingsiae	Endemic to South Africa, distributed in Eastern Cape. The species grows in grassland and is found as in marshy areas below dolerite rocks.	15%	Grassland and marshy areas occur within the study area. Due to the vegetation transformation within the study area, it is unlikely that this species will occur within the footprint area.
Hesperantha ingeliensis	Endemic to South Africa, distributed in Eastern Cape and KwaZulu-Natal. The species grows in grasslands and is found as marches in montane grassland, in damp cliff crevices or in flat rocky areas	10%	
Encephalartos friderici-guilielmi	Occurs in large numbers on the mountains and rocky slopes in the districts of Queenstown and Cathcart. It also extends eastwards towards Kokstad. The species grows in grassland and amongst other low-growing vegetation	33%	Although no suitable habitat is available within the study area, *Encephalartos* species were observed further downstream at the Tsitsa waterfall
Podocarpus falcatus	Terrestrial, forest areas	100%	Located on within the Ntabelanga Dam study area and road upgrade routes
Podocarpus latifolius	The real yellowwood grows naturally in mountainous areas and forests in the southern, eastern and northern parts of South Africa, extending into Zimbabwe and further north. It is also found on rocky hillsides and mountain slopes but does not get as tall where it is exposed as it does in the forests	100%	Located on within the Ntabelanga Dam study area and road upgrade routes
Cassipourea flanaganii	Endemic to South Africa, and is distributed in Eastern Cape and KwaZulu-Natal.	0%	Very little literature is available on the type of habitat and distribution of this species. As per the specie below, it would occur in forest areas. The study area does not provide suitable forest habitat for this specie to occur.
Cassipourea malosana	Occurs in large numbers on the mountains and rocky slopes in the districts of Queenstown and Cathcart. It also extends eastwards towards Kokstad. The species grows in grassland and amongst other low-growing vegetation	0%	According to literature, this species is not normally found within the area close to the study area but more in forests towards the Transkei. The study area does not provide forest habitat for this species to occur. All forest areas are located outside of the

Species	Habitat	POC	Motivation
			footprint area.

After considering the habitat and literature availability and distribution aspects of the above species, the majority of the species are highly unlikely to occur within the linear development, due to the transformed vegetation from overgrazing, trampling and historic agricultural activities and as such obtained low POC percentages. The only species that have a moderate probability of occurring are *Pittosporum viridiflorum* and *Catha edulis.* However, the severe habitat transformation encountered during the assessment, significantly lowers the probability of these species occurring. The *Encephalartos* species as listed above were not noted during the site assessment within the greater transformed and grassland habitat areas and no suitable habitat were found within the study area. *Encephalartos* species are however more likely to occur within the surrounding area where mountain slopes and gorges occur close to the Tsitsa waterfalls (**Figure 58**) and Lalini HEP and access roads.

Figure 58: *Encephalartos* species located within the mountain slopes close to the Tsitsa waterfalls.

Podocarpus falcatus and *P. latifolius* were located alongside the road upgrade areas within the Ntabelanga Dam, on the northern section of the dam. More *Podocarpus* species were located on the secondary pipeline route south of the town Tsolo. These species is considered protected according to the notice of the list of protected tree species under the National Forests Act, 1998 (Act No. 84 of 1998). Possible mitigation measure would be to re-align the roads to avoid the trees from being removed or permits for the removal of these protected tree species (should it occur within the construction footprint area) need to be obtained at the relevant authorities before any construction activities occur within this area.

5.12 SENSITIVITY

The three focus study areas, namely the Ntabelanga Dam, Lalini Dam and the infrastructure (road upgrades and primary and secondary pipelines) has undergone vegetation transformation due to historic agricultural activities, overgrazed and tramples veld from livestock from the local communities, alien proliferation along the riparian features and bush encroachment due to poor management measures. The **Figures 59-64** below illustrate the sensitivity of the study area.

The following conclusion were made for the management units

- The ecological function and habitat of the Mountain / Rocky Outcrops habitat unit is considered to be moderate to high due to the few disturbances from agricultural activities, overgrazing and alien floral encroachment. In terms of conservation value, the moderate to high ecological functionality, good habitat integrity, the low incidence of bush or alien floral encroachment, combine to increase the ecological sensitivity of this habitat unit.
- A decrease in floral diversity has occurred as a result of the edge effects from ploughing and crop cultivation, overgrazing, trampling by livestock and vegetation clearance causing severe soil erosion. The Grassland / *Acacia* Thornveld habitat unit is considered to have a low ecological sensitivity and low conservation value due to the change in floral species composition and vegetation structure as a result of the above mentioned impacts. This habitat unit is furthermore well represented within the region, and loss thereof as a result of the dam construction will not significantly affect the floral conservation in the region
- The Riparian / Wetland habitat unit is considered to be of high ecological sensitivity due to the contribution of the various wetland and riparian systems to faunal migratory connectivity, wetland ecoservices provision and the habitat provided for floral species. Although large sections along the riparian system are dominated by alien invader floral species, pockets of indigenous tree species exist along the Tsitsa River. Several wetland and riparian features traverse the infrastructure development. Mitigation measures must be implemented best as possible along the construction of the road upgrades and pipelines to erosion, sedimentation and further deterioration of wetland and riparian systems.
- The Transformed (Grassland) habitat unit includes areas where vegetation has been completely transformed by historic and on-going small scale agricultural activities and overgrazing of livestock causing erosion and a decrease in vegetation in these areas. Where vegetation has recovered from historic transformation, very little floral diversity occurs. This habitat unit is not well represented within the region, and loss thereof as a result of the dam construction will not significantly affect the floral conservation in the region.

Podocarpus falcatus and *P. latifolius* were located alongside the road upgrade areas within the Ntabelanga Dam, on the northern section of the dam. More *Podocarpus* species were located on the secondary pipeline route south of the town Tsolo. These species is considered protected according to the notice of the list of protected tree species under the National Forests Act, 1998

(Act No. 84 of 1998). Possible mitigation measure would be to re-align the roads to avoid the trees from being removed or permits for the removal of these protected tree species (should it occur within the construction footprint area) need to be obtained at the relevant authorities before any construction activities occur within this area (**Figure 65**).

Should any RDL or other protected tree species floral species be located along study area during the construction phase, permit for the species must be obtain at the relevant authorities and it should be relocated to habitat areas (where possible) outside of the footprint are with similar characteristics.

Areas of the road upgrade within the Ntabelanga Dam and Lalini Dam are located within the higher altitude areas. Indigenous species such as *Aloe marlothii, Aloe ferox* and *Aloe aborescence* occurred alongside the current road. These and other indigenous species could be relocated should they occur within the road upgrade (new access roads) footprint area.

New access roads are proposed within the Lalini Dam area. The habitat area (Mountain / Rocky Outcrops) where the proposed access roads will be situated is considered sensitive due to the higher floral species diversity and possible suitable habitat for protected species. It is suggested that a walk down be done for the Lalini HEP and access roads prior to the construction phase to identify any important Red Data Listed (RDL), medicinal or protected species. Should any RDL or protected species be located during the walk down, the necessary authorisation should be obtained to remove, relocate or cut and destroy these floral species.

Sections of the power line closer to the Tsitsa River will traverse more sensitive habitat associated with mountain and rocky outcrop habitat. These areas are more sensitive in terms of less vegetation disturbance, increased floral diversity and suitable habitat for important and protected species such as *Podocarpus* and *Encephalartos* species. It is suggested that a walk down be done for the section of the power line closer to the Tsitsa River and Mountain / Rocky Outcrops prior to the construction phase to identify any important Red Data Listed (RDL), medicinal or protected species. Should any RDL or protected species be located during the walk down, the necessary authorisation should be obtained to remove, relocate or cut and destroy these floral species.

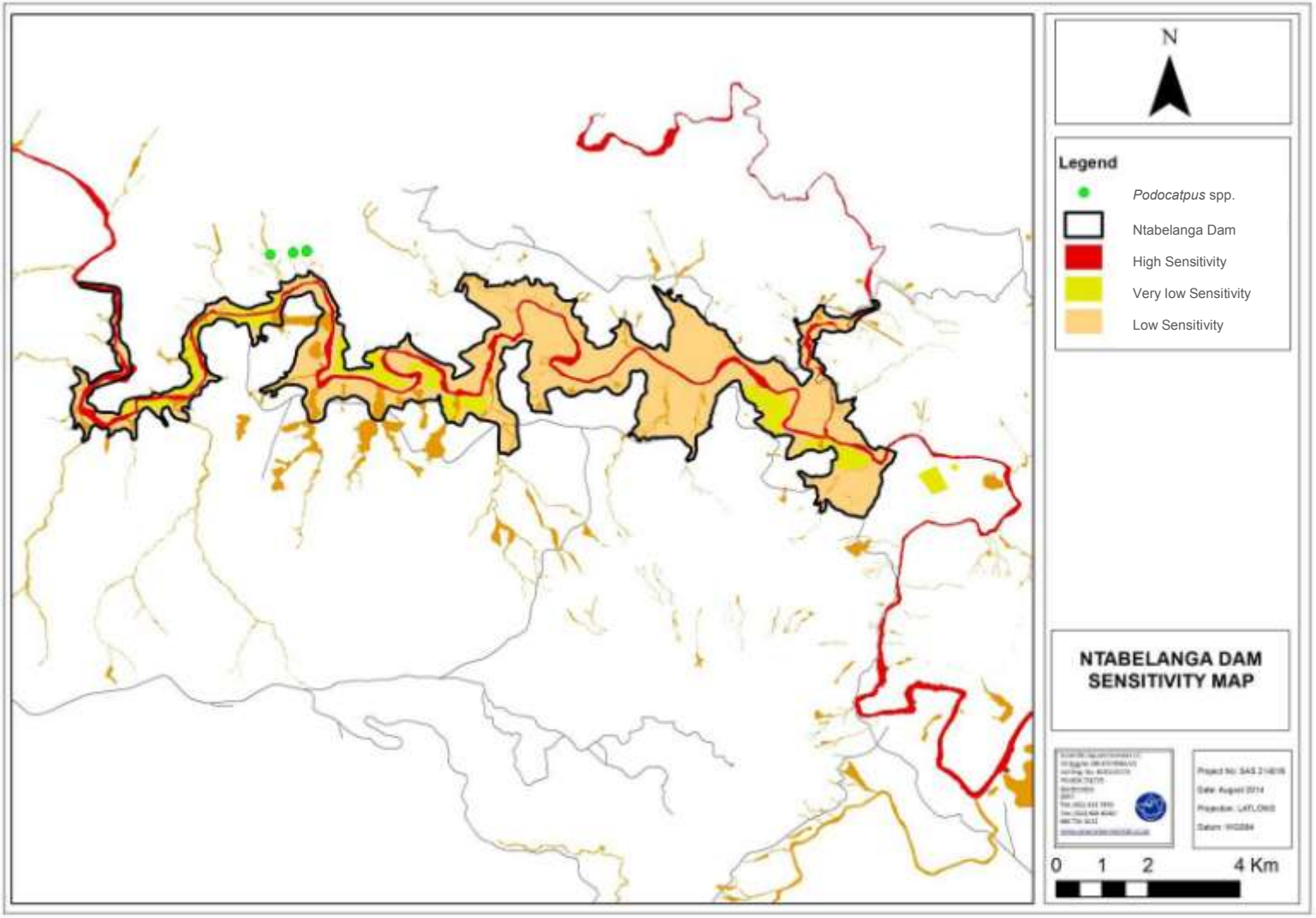


Figure 59: Sensitivity map for the Ntabelanga Dam study area and infrastructure associated with the dam.

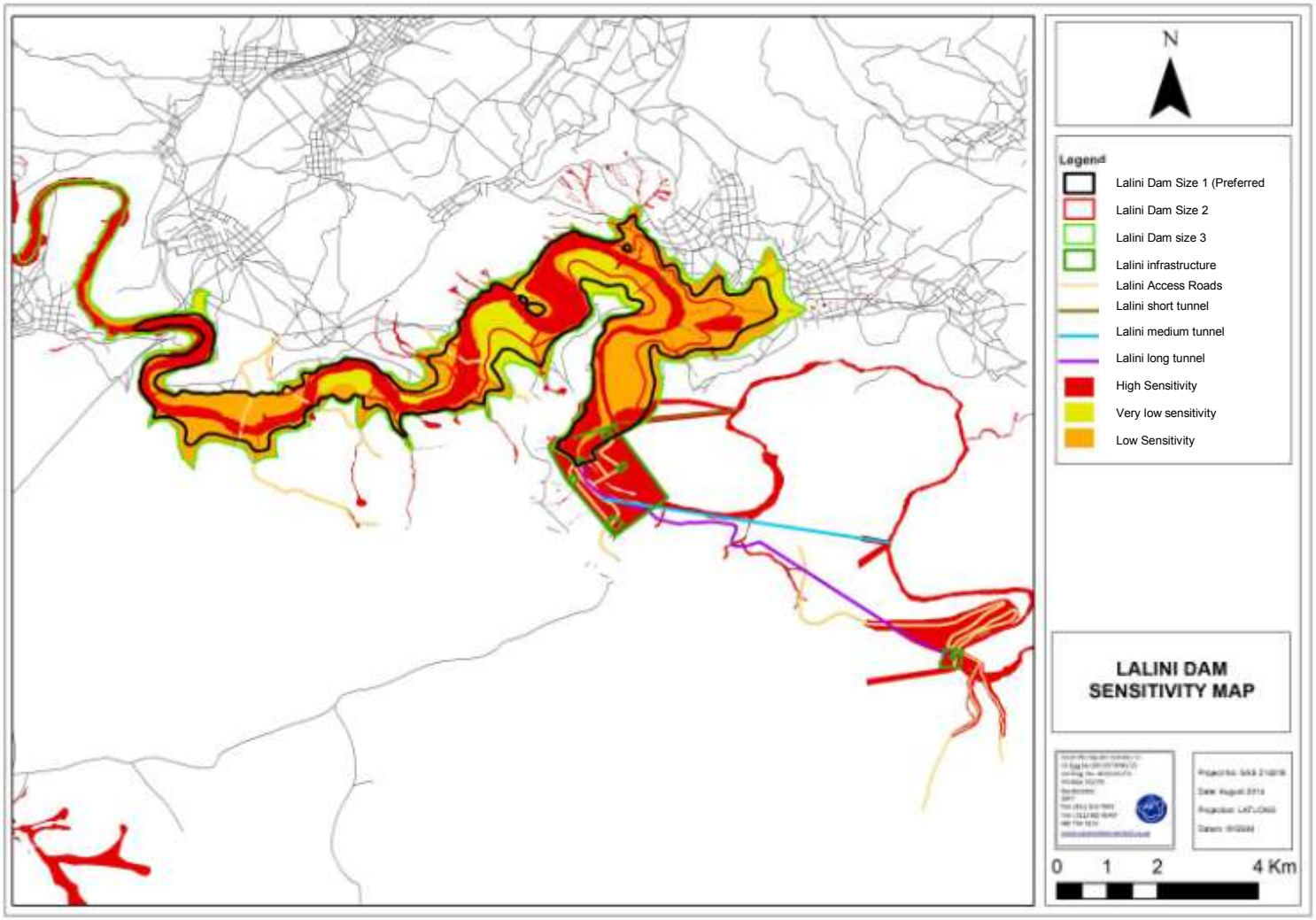


Figure 60: Sensitivity map for the Lalini Dam study area and associated infrastructure.

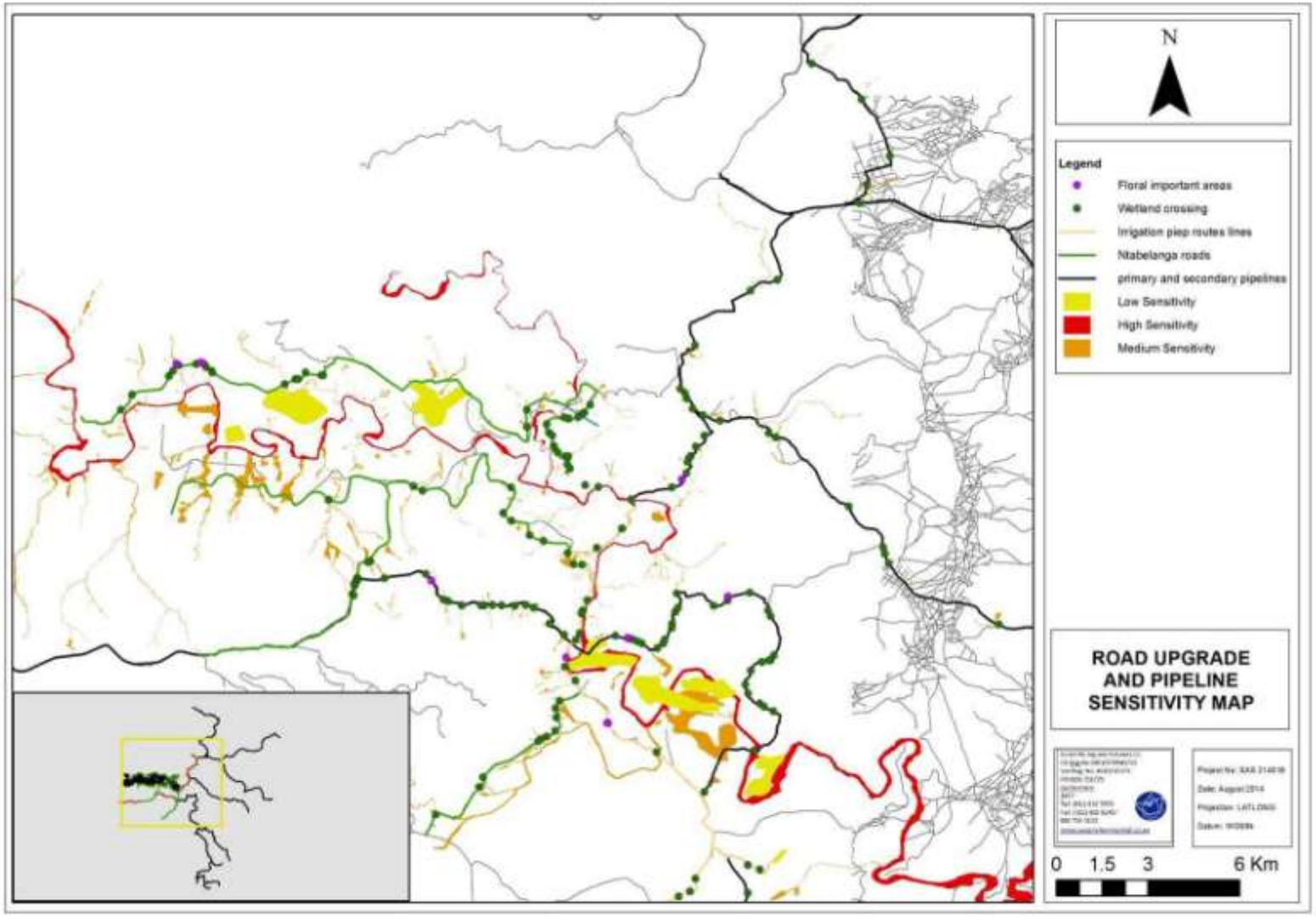


Figure 61: Sensitivity map for the proposed road upgrade and pipelines.

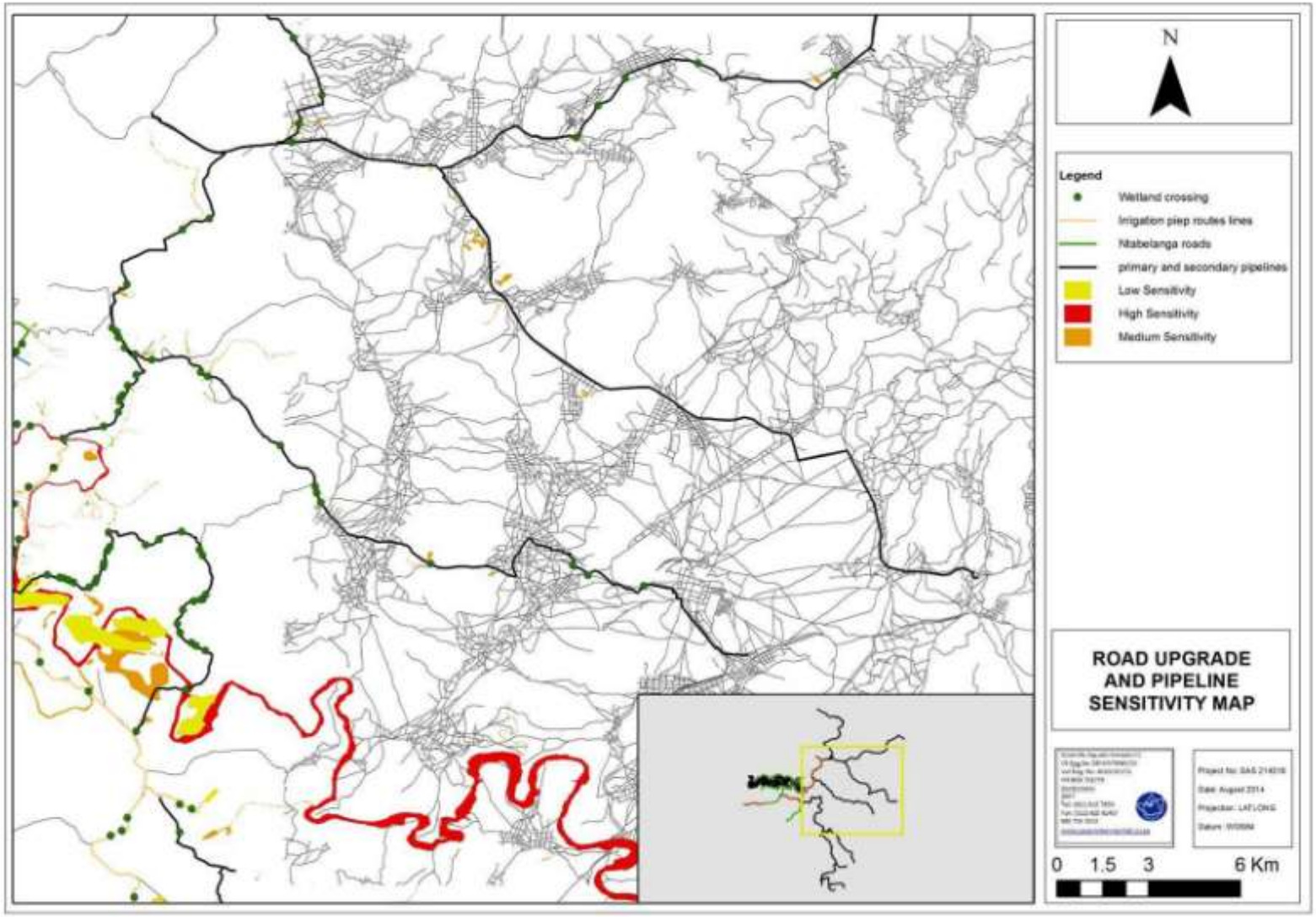


Figure 62: Sensitivity map for the proposed pipelines.

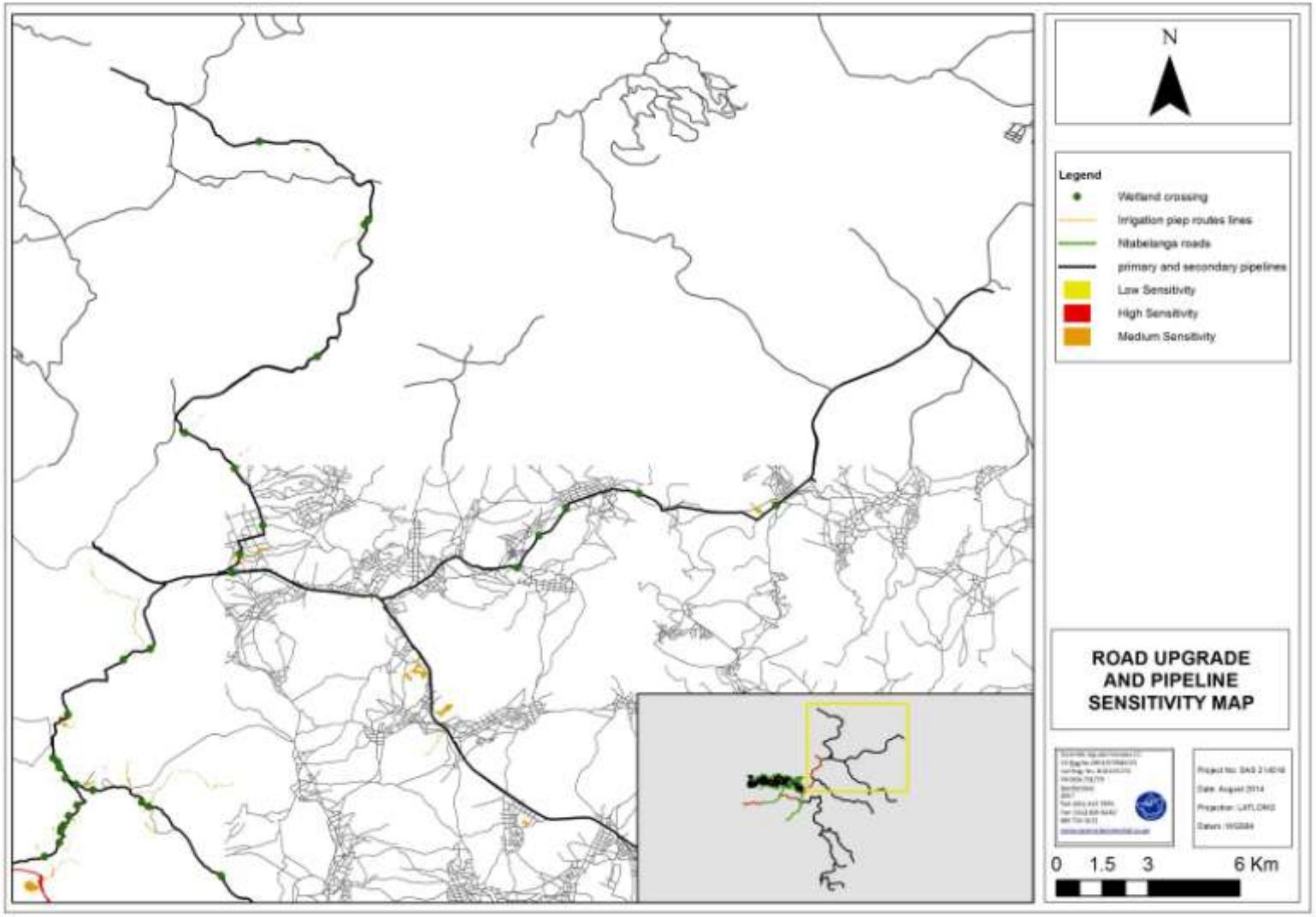


Figure 63: Sensitivity map for the proposed pipelines.

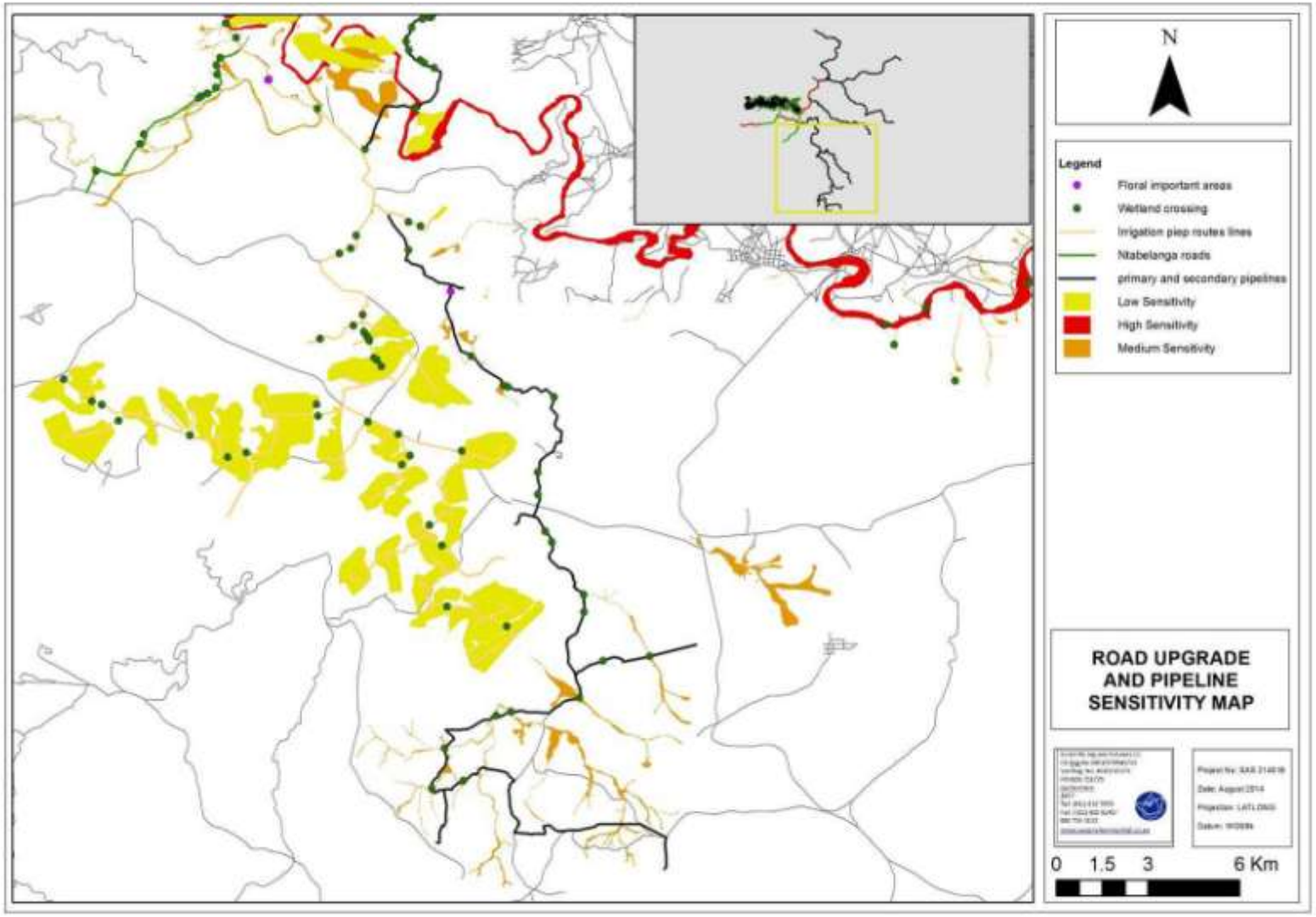


Figure 64: Sensitivity map for the proposed pipelines.

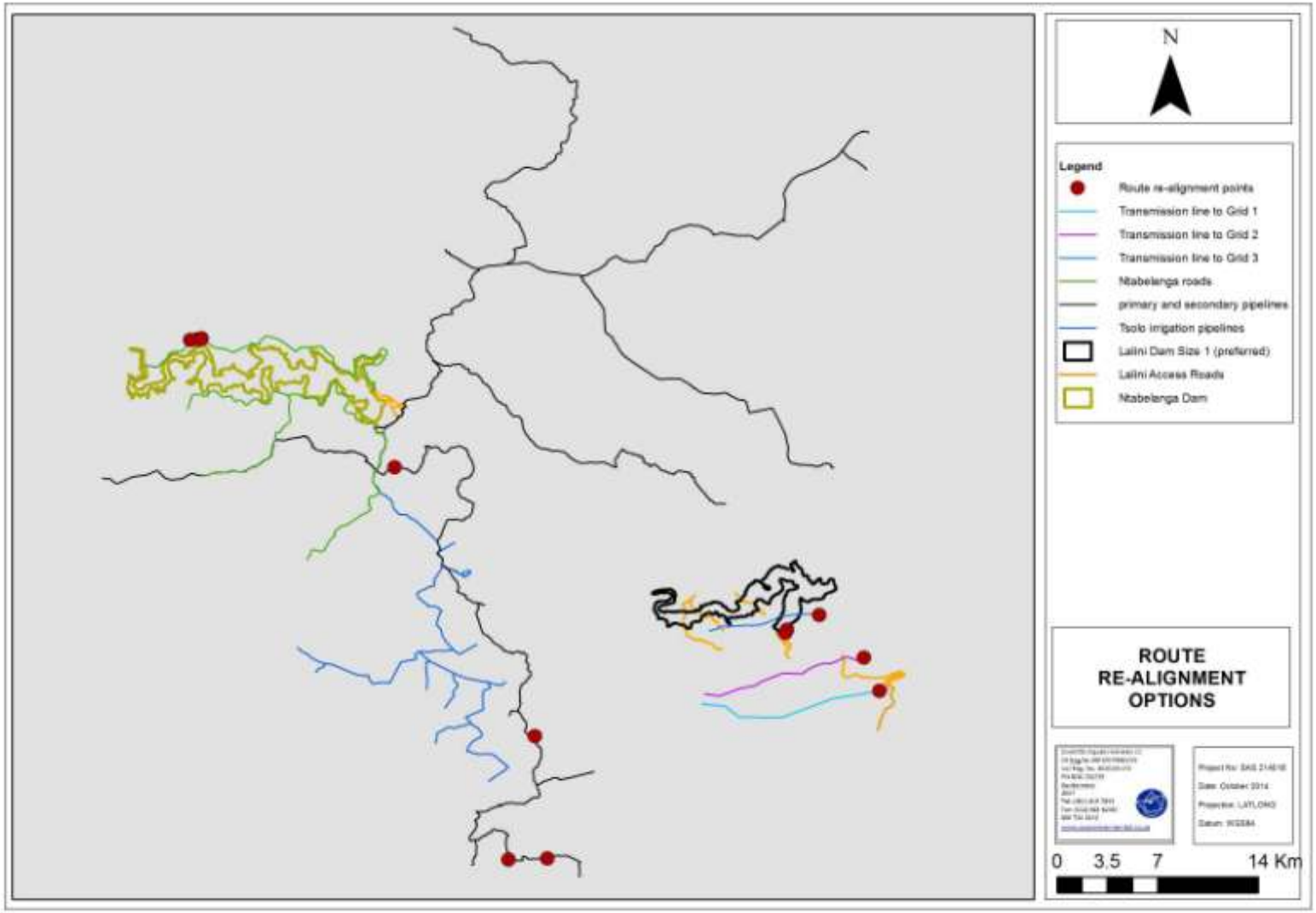


Figure 65: Route re-alignment areas of the proposed road and pipelines where protected tree species or other sensitive floral habitat was located.

6 GENERAL MANAGEMENT AND GOOD HOUSEKEEPING PRACTICES

Latent and general impacts which may impact on the floral ecosystem will include any activities which take place within the study area that may impact on the receiving environment. General impact minimisation measures are highlighted below and are relevant for all sensitive floral related areas identified in this report:

- No fires whatsoever should be allowed within the study area during the construction phase.
- Appropriate sanitary facilities must be provided and all waste removed to an appropriate waste facility.
- No vehicles should be allowed to drive through designated sensitive wetland areas during the eradication of alien and weed species.
- Restrict vehicles to travelling only on designated roadways to limit the ecological footprint of the proposed development activities.
- In the event of a breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practiced to prevent the ingress of hydrocarbons into the topsoil.
- It must be ensured that all roads and construction areas are regularly sprayed with water in order to curb dust generation. This is particularly necessary during the dry season when increased levels of dust generation can be expected. These areas should not be over-sprayed causing water run-off and subsequent sediment loss in the vicinity of the subject property.
- Ensure that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent leakage. Regularly inspect all vehicles for leaks. Re-fuelling must take place on a sealed surface area to prevent ingress of hydrocarbons into topsoil.
- Storage of construction material used during the road upgrade should be localised within designated or selected areas, if possible, to ensure the minimisation of the ecological footprint area and prevent loss of natural habitat along the road.
- All soils compacted as a result of construction activities at the dam walls should be ripped and profiled. Special attention should be paid to alien and invasive control within these areas. Alien and invasive vegetation control should take place to prevent loss of floral habitat.
- No dumping of waste should take place. If any spills occur, they should be immediately cleaned up.
- Prohibit the collection of plant material, outside of the proposed dam basins for medicinal or fire wood use during the construction phase.

7 IMPACT ASSESSMENT FOR DAMS AND ASSOCIATED WATER INFRASTRUCTURE

This Chapter presents the findings of the environmental impact assessment for the dams and associated activities (DEA Ref no. 14/12/16/3/3/2/677).

The activities assessed under this chapter are listed below:

- The Ntabelanga and Lalini Dams;
- Five flow gauging weirs;
- Primary and secondary bulk potable water infrastructure:
  - Primary infrastructure: main water treatment works, including four major treated water pumping stations and three minor treated water pumping stations, main bulk treated water rising mains, and eight Command Reservoirs that will supply the whole region;
  - Secondary distribution lines: conveying bulk treated water from Command Reservoirs to existing and new District Reservoirs;
- Bulk raw water conveyance infrastructure (abstraction, pipelines, one raw water pumping station, one reservoir and two booster pumps) for irrigated agriculture (raw water supply up to field edge);
- Impact of commercial agriculture in earmarked irrigation areas;
- WWTWs at the Ntabelanga and Lalini Dam sites;
- Accommodation for operational staff at the Ntabelanga and Lalini Dam sites;
- Ten construction materials quarries and borrow pits;
- River intake structures and associated works;
- Information centres at the two dam sites; and
- Miscellaneous construction of camps, lay down areas, and storage sites.

7.1 CONSTRUCTION AND FIRST FILLING PHASES

7.1.1 Impact on habitat for floral species

7.1.1.1 Ntabelanga Dam and associated infrastructure

Construction of the Ntabelanga Dam entails the construction of the dam wall, associated infrastructures such as the camp sites, quarries and burrow pits, accommodation for operational staff, WWTW's, information centre and the first filling. The areas associated with these infrastructures are considered of low sensitivity. It must be ensured that only the areas designated for the specific activity are cleared, therefore minimising the overall footprint area of these infrastructures. Where possible, avoid placing any associated infrastructure within the Mountain Rocky Outcrop or Wetland Habitat Units.

Construction of the dam wall would entail the clearance of vegetation, movement of construction vehicles and storage of construction material, leading to the decrease in floral habitat. Infrastructure related to the construction of the dam wall should take place within areas that has undergone historic transformation or with a lower ecological value and function.

Vegetation surrounding the Ntabelanga Dam wall consists of rocky ridge vegetation, mostly indigenous to the area. Little transformation has occurred within this area. Thus it is recommended that as much indigenous vegetation (e.g. young seedlings, *Aloe* species, *Euphorbia* species, *and Cussonia* species) should be relocated, where possible, and as much possible before the construction phase commences. Community members could be involved in this specific phase of the project. During the first filling vegetation located within the footprint area of the full supply level will be submerged under water. Habitat for indigenous floral vegetation along the riparian / wetland areas and the mountain / rocky outcrop areas will be lost.

The impact significance associated with the loss of species habitat is considered to be medium-high prior to implementation of mitigation measures.

7.1.1.2 Lalini Dam and associated infrastructure

The Lalini Dam consists mainly of transformed vegetation due to the surrounding rural communities clearing vegetation for small scale agricultural activities. Thus large sections of the Lalini Dam have undergone vegetation transformation, also caused by overgrazing and trampling of veld by livestock.

More sensitive habitat consisting of a rocky ridge and riparian zone complex, including the *Euphorbia* forest located closer to the dam wall will be affected by the construction of the dam wall and the first filling phase. Vegetation habitat for numerous and sensitive indigenous vegetation will be lost. Infrastructure related to the construction of the dam wall should take place within areas that has undergone historic transformation or with a lower ecological value and function.

Borrow pits / Material sources for the construction of the dam wall must take place within areas that have been historically disturbed in order to ensure that more sensitive or natural vegetation habitat is not lost.

The impact significance associated with the loss of species habitat is considered to be high prior to implementation of mitigation measures.

Another aspect that should be considered is the type of vegetation and the growth of specific floral species such as cremnophytes. These areas floral species, mostly succulents that are associated with cliffs but have distributions that extent to non-cliff habitats. Some species include *Crassula cultrate, C. perforate, C. rupestris, Haemanthus albiflos* and *Portulacaria afra.* Water-holding capacity is important as it directly relates to cliff vegetation. Mostly obligate succulent cremnophytes have a relatively shallow root system and on cliffs that dry out rapidly (van Jaarsveld, 2011). Thus, the aspect of a lower overall flow rate at the Tsitsa waterfall, thus decreasing the amount of mist spray and water availability to the surrounding vegetation on the cliffs or within the gorge needs to be taken into account. It is proposed that a detailed baseline study be conducted to determine the sensitivity of this area before any construction activities commence. Should any medicinal important or RDL species be located within this area during the site assessment, it is recommended that these species identified be rescues and relocated to similar habitat e.g. the upstream waterfall area. Where

applicable, permit applications should be obtained from the relevant authority to rescue and relocate these species.

7.1.1.3 Primary, Secondary Pipelines and Irrigation Pipelines and associated infrastructure

The primary and secondary pipeline will be constructed close to main or existing roads. According to the National List of Threatened Terrestrial Ecosystems (2011) sections of the proposed road upgrades, southern section of the pipelines and small portions of the Lalini Dam fall into a vulnerable ecosystem in terms of the original and remaining extent of the associated vegetation types. Rocky outcrop areas also occurred within these sections.

In terms of vegetation habitat, the edge effects of the existing roads, overgrazed veld and surrounding community villages has transformed the vegetation to the extent that only grass species such as *Eragrostis curvula, E. chloromelas, Hyparrhenia hirta, Sporobulus africanus* and *Cynodon dactylon*, which are associated with more disturbed areas, occur alongside the current access roads. In areas that are associated with disturbance and vegetation clearance, the impact on further transformation of floral habitat of the pipelines will be low, should all possible mitigation measures be implemented.

Infrastructure associated with dams such as the reservoirs, gauging weirs and any bulk raw water conveyance infrastructure must be places within areas that has undergone historic or current floral disturbance. Where possible, avoid placing any associated infrastructure within the Mountain Rocky Outcrop or Wetland Habitat Units.

These irrigation pipelines are mostly situated south of the township of Tsolo. The majority of the sections for the proposed pipelines will be along existing dirt roads. Other vegetation habitat units that the pipelines traverse have been transformed due to historic and on-going small scale agricultural activities, wetland habitat and rocky areas. The northern section of the irrigation pipeline traverses a woody vegetation habitat area that most likely has been dominated by *Acacia* species so some extent that bush encroachment has occurred.

Recommended mitigation (Also refer to general management and good housekeeping practices):

- As far as possible avoid disturbance of Mountain Rocky Outcrops and avoid disturbance of protected floral species when construction activities of the associated dam infrastructure takes place. Should it be evident that protected species within the Mountain Rocky Outcrops will be disturbed permits to cut or destroy these trees must be obtained prior to construction taking place or alternatively, route re-alignment should be considered.
- It is suggested that a walk down be done for the section of the power line closer to the Tsitsa River and Mountain / Rocky Outcrops prior to the construction phase to identify any important Red Data Listed (RDL), medicinal or protected species. Should any RDL or protected species be located during the walk down, the necessary authorisation should be obtained to remove, relocate or cut and destroy these floral species.

- For the Lalini Dam construction, three alternatives were given. The alternatives covering the least amount of floral and especially sensitive floral vegetation and habitat should be considered. Therefore Alternative 2 would be the more preferred alternative.

Impact on habitat for floral species	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Proposed Project with Ntabelanga Dam and associated infrastructure							
Without Mitigation	2 (Local)	2 (Medium term)	4 (High)	3 (Medium)	5 (Definite)	High	Medium-high
With Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	1 (Low)	5 (Definite)	High	Medium-low
Proposed Project with Lalini Dam size 1 (preferred alternative) and associated infrastructure							
Without Mitigation	2 (Local)	2 (Medium term)	4 (High)	5 (High)	5 (Definite)	High	High
With Mitigation	2 (Local)	2 Medium term)	4 (High)	3 (Medium)	5 (Definite)	High	Medium-high
Proposed Project with Lalini Dam size 2 and associated infrastructure							
Without Mitigation	2 (Local)	2 (Medium term)	4 (High)	5 (High)	5 (Definite)	High	High
With Mitigation	2 (Local)	2 Medium term)	3 (Medium)	3 (Medium)	5 (Definite)	High	Medium-high
Proposed Project with Lalini Dam size 3 and associated infrastructure							
Without Mitigation	2 (Local)	2 (Medium term)	5 (Very high)	5 (High)	5 (Definite)	High	High
With Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	3 (Medium)	5 (Definite)	High	Medium-high
Proposed Project with Primary, Secondary Pipelines and Irrigation Pipelines and associated infrastructure							
Without Mitigation	2 (Local)	1 (Short term)	3 (Medium)	3 (Medium)	4 (High)	High	Medium-low
With Mitigation	2 (Local)	1 (Short term)	2 (Low)	3 (Medium)	3 (Medium)	High	Low
Residual Impact: • Proliferation of alien and weed species in disturbed areas will lead to altered vegetation communities. • Loss of floral habitat may lead to altered floral biodiversity. • Increased settlement around the dams will results in further fragmentation and loss of untransformed habitat.							

7.1.2 Impact on floral diversity

7.1.2.1 Ntabelanga Dam and associated infrastructure

The only areas of high floral diversity are within the mountain / rocky outcrop habitat unit. Vegetation clearance for the construction of the dam wall and first filling will decrease the floral diversity within the immediate area. The duration of this impact will be permanent. Due to the permanent duration within the full supply level, it is proposed that indigenous species

be relocated and established in a holding nursery to use as part of rehabilitation around the dam information centres or accommodation areas for the operational staff.

The areas associated with infrastructures (camp sites, quarries and burrow pits, accommodation for operational staff, WWTW's and information centre) are considered of low sensitivity. It must be ensured that only the areas designated for the specific activity are cleared, therefore minimising the overall footprint area of these infrastructures. Where possible, avoid placing any associated infrastructure within the Mountain Rocky Outcrop or Wetland Habitat Units.

The impact significance associated with the loss of species habitat is considered to be high prior to implementation of mitigation measures.

7.1.2.2 Lalini Dam and associated infrastructure

The floral diversity within the Lalini dam, especially around the dam wall, is very high with numerous indigenous woody species. Although during the site assessments, no protected or important floral species were recorded, the habitat is suitable for protected woody vegetation to occur. Construction of the dam wall would entail the clearance of vegetation, movement of construction vehicles and storage of construction material, leading to the decrease in floral diversity.

Borrow pits / Material sources for the construction of the dam wall must take place within areas that have been historically disturbed in order to ensure that more sensitive or natural vegetation habitat is not lost

The impact significance associated with the loss of species diversity is considered to be high prior to implementation of mitigation measures for alternative 1, 2 and alternative 3.

7.1.2.3 Primary, Secondary Pipelines and Irrigation Pipelines and associated infrastructure

The primary and secondary pipeline will be constructed close to main or existing roads. According to the National List of Threatened Terrestrial Ecosystems (2011) sections of the proposed road upgrades, southern section of the pipelines and small portions of the Lalini Dam fall into a vulnerable ecosystem in terms of the original and remaining extent of the associated vegetation types. Rocky outcrop areas also occurred within these sections.

In terms of vegetation habitat, the edge effects of the existing roads, overgrazed veld and surrounding community villages has transformed the vegetation to the extent that only grass species such as *Eragrostis curvula, E. chloromelas, Hyparrhenia hirta, Sporobulus africanus* and *Cynodon dactylon*, which are associated with more disturbed areas, occur alongside the current access roads. In areas that are associated with disturbance and vegetation clearance, the impact on further transformation of floral habitat of the pipelines will be low, should all possible mitigation measure be implemented.

Infrastructure associated with dams such as the reservoirs, gauging weirs and any bulk raw water conveyance infrastructure must be places within areas that has undergone historic or current floral disturbance. Where possible, avoid placing any associated infrastructure within the Mountain Rocky Outcrop or Wetland Habitat Units.

The irrigation pipelines are mostly situated south of the township of Tsolo. The majority of the sections for the proposed pipelines will be along existing dirt roads. Other vegetation habitat units that the pipelines traverse have been transformed due to historic and on-going small scale agricultural activities, wetland habitat and rocky areas. The northern section of the irrigation pipeline traverses a woody vegetation habitat area that seems to be more diverse in floral tree species than the rest of the pipeline route.

Recommended mitigation (Also refer to general management and good housekeeping practices):

- Planning of temporary roads and access routes should take place within areas of lower sensitivity or where historic vegetation transformation has occurred.
- A floral species rescue operation must be implemented, targeting indigenous floral species, where possible.
- Possible re-alignment of infrastructure (such as roads and power lines) should be considered to ensure that less high sensitive areas will be affected by construction.
- A holding nursery should be established for indigenous vegetation suitable for re-planting on rehabilitated surfaces (accommodation for operational staff, information centre). The holding nursery can become an on-going community project.

Impact on floral diversity	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Proposed Project with Ntabelanga Dam and associated infrastructure							
Without Mitigation	2 (Local)	2 (Medium term)	4 (High)	5 (High)	5 (Definite)	High	High
With Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	3 (Medium)	5 (Definite)	High	Medium-high
Proposed Project with Lalini Dam size 1 (preferred alternative) and associated infrastructure							
Without Mitigation	2 (Local)	2 (Medium term)	4 (High)	5 (High)	5 (Definite)	High	High
With Mitigation	2 (Local)	2 Medium term)	3 (Medium)	3 (Medium)	5 (Definite)	High	Medium-high
Proposed Project with Lalini Dam size 2 and associated infrastructure							
Without Mitigation	2 (Local)	2 (Medium term)	4 (High)	5 (High)	5 (Definite)	High	High
With Mitigation	2 (Local)	2 Medium term)	3 (Medium)	3 (Medium)	5 (Definite)	High	Medium-high
Proposed Project with Lalini Dam size 3 and associated infrastructure							
Without Mitigation	2 (Local)	2 (Medium term)	5 (Very high)	5 (High)	5 (Definite)	High	High
With Mitigation	2 (Local)	2 (Medium	4 (High)	3 (Medium)	5 (Definite)	High	Medium-

		term)					high
Proposed Project with Primary, Secondary Pipelines and Irrigation Pipelines and associated infrastructure							
Without Mitigation	2 (Local)	1 (Short term)	3 (Medium)	3 (Medium)	4 (High)	High	Medium-low
With Mitigation	2 (Local)	1 (Short term)	2 (Low)	3 (Medium)	3 (Medium)	High	Low
Residual Impact: • Decrease in floral species diversity may occur due to habitat transformation as a result of construction activities. • Ineffective rehabilitation within the primary and secondary pipelines may lead to permanent transformation of floral habitat. • Proliferation of alien and weed species in disturbed areas will lead to lowered vegetation biodiversity along the pipeline routes.							

7.1.3 Impact on important and protected floral species

7.1.3.1 Ntabelanga Dam and associated infrastructure

The Mountain / Rocky Outcrop habitat located within the Ntabelanga Dam contain numerous indigenous woody vegetation. Although no protected tree species were noted during the site assessments, the probability of occurrence is high, therefore impacting on the important and protected floral communities. It is recommended that indigenous vegetation within the mountain/rocky ridges must be rescued and relocated to similar habitat areas falling outside of the project footprint. No important or protected species were located within transformed vegetation habitat due to overgraze and tramples veld.

The areas associated with infrastructures (camp sites, quarries and burrow pits, accommodation for operational staff, WWTW's and information centre) are considered of low sensitivity. No protected or important floral species were noted during the site assessment. Should any of the protected species listed within this report be located within the specific area designated for these infrastructure, applicable permit approval documents must be required before any other activities takes place.

The duration of this impact will be permanent for the areas affected by the construction of the dam wall and the first filling. The impact significance associated with the loss of species habitat is considered to be medium-high prior to implementation of mitigation measures.

7.1.3.2 Lalini Dam

The ecological function and habitat of the Mountain / Rocky Outcrops habitat unit is considered to be moderate to high due to the few disturbances from agricultural activities, overgrazing and alien floral encroachment. In terms of conservation value, the moderate to high ecological functionality, good habitat integrity, the low incidence of bush or alien floral encroachment, combine to increase the ecological sensitivity of this habitat unit.

No protected or RDL floral or tree species were located during the time of the site assessment but there is a high probability that such species could be present within this habitat unit. The impacts of the loss of protected species will be medium-high to high due to the suitable habitat available for protected woody species to occur.

7.1.3.3 Primary, secondary and irrigation pipelines

Pockets of rocky outcrops or where the pipeline traverses mountain areas were located. These areas were mapped on a desktop level to indicate where vegetation has changed. Although not all areas of the rocky outcrops contained indigenous floral vegetation, these areas are still considered different to the remainder of the habitat units. Mitigation measures when construction of the pipeline takes places should considered these rocky areas and mountain passes and minimise the impacts within these areas.

Due to the severe vegetation transformation within most of the areas along the primary and secondary pipeline route, the low ecological function and state and the low diversity in floral species, the areas set out for the construction of the primary and secondary pipeline route is not considered sensitive. Since the impact of the construction will be of a shorter duration and rehabilitation will be done, the severity of the impact will be lower.

Podocarpus species were located on the secondary pipeline route south of the town Tsolo. These species is considered protected according to the notice of the list of protected tree species under the National Forests Act, 1998 (Act No. 84 of 1998). Permits for the removal of these protected tree species (should it occur within the construction footprint area) need to be obtained at the relevant authorities before any construction activities occur within this area.

The northern section of the irrigation pipeline traverses a woody vegetation habitat area that seems to be more diverse in floral tree species than the rest of the pipeline route. It is possible that protected tree species, favouring afromontane habitat, could occur along the pipeline route or in the surrounding area.

Infrastructure associated with dams such as the reservoirs, gauging weirs and any bulk raw water conveyance infrastructure must be places within areas that has undergone historic or current floral disturbance. Where possible, avoid placing any associated infrastructure within the Mountain Rocky Outcrop or Wetland Habitat Units.

Recommended mitigation (Also refer to general management and good housekeeping practices):

- Re-alignment of infrastructure to avoid protected trees.
- Permits for the removal or destruction of protected tree species (should it occur within the construction footprint area) need to be obtained at the relevant authorities before any construction activities occur within this area.
- A floral species rescue operation should be implemented, targeting indigenous floral species (bulbs and succulent species).
- A holding nursery should be established for indigenous vegetation suitable for re-planting on rehabilitated surfaces (accommodation for operational staff, information centre).

Impact on important and protected floral species	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Proposed Project with Ntabelanga Dam and associated infrastructure							
Without Mitigation	1 (Site)	2 (Medium term)	4 (High)	3 (Medium)	5 (Definite)	High	Medium-high
With Mitigation	1 (Site)	2 (Medium term)	3 (Medium)	3 (Medium)	4 (High)	High	Medium-low
Proposed Project with Lalini Dam size 1 (preferred alternative) and associated infrastructure							
Without Mitigation	2 (Local)	2 (Medium term)	5 (Very high)	5 (High)	5 (Definite)	High	High
With Mitigation	1 (Site)	2 Medium term)	4 (High)	3 (Medium)	5 (Definite)	High	Medium-high
Proposed Project with Lalini Dam size 2 and associated infrastructure							
Without Mitigation	2 (Local)	2 (Medium term)	5 (Very high)	4 (High)	5 (Definite)	High	High
With Mitigation	1 (Site)	2 Medium term)	3 (Medium)	3 (Medium)	5 (Definite)	High	Medium-high
Proposed Project with Lalini Dam size 3 and associated infrastructure							
Without Mitigation	2 (Local)	2 (Medium term)	5 (Very high)	5 (High)	5 (Definite)	High	High
With Mitigation	1 (Site)	2 Medium term)	3 (Medium)	3 (Medium)	5 (Definite)	High	Medium-high
Proposed Project with Primary, Secondary Pipelines and Irrigation Pipelines and associated infrastructure							
Without Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	3 (Medium)	3 (Medium)	High	Medium-low
With Mitigation	1 (Site)	2 Medium term)	2 (Low)	1 (Low)	3 (Medium)	High	Low
Residual Impact: • A decrease in potential RDL/ protected floral species diversity may lead to a loss of species richness over time within the region.							

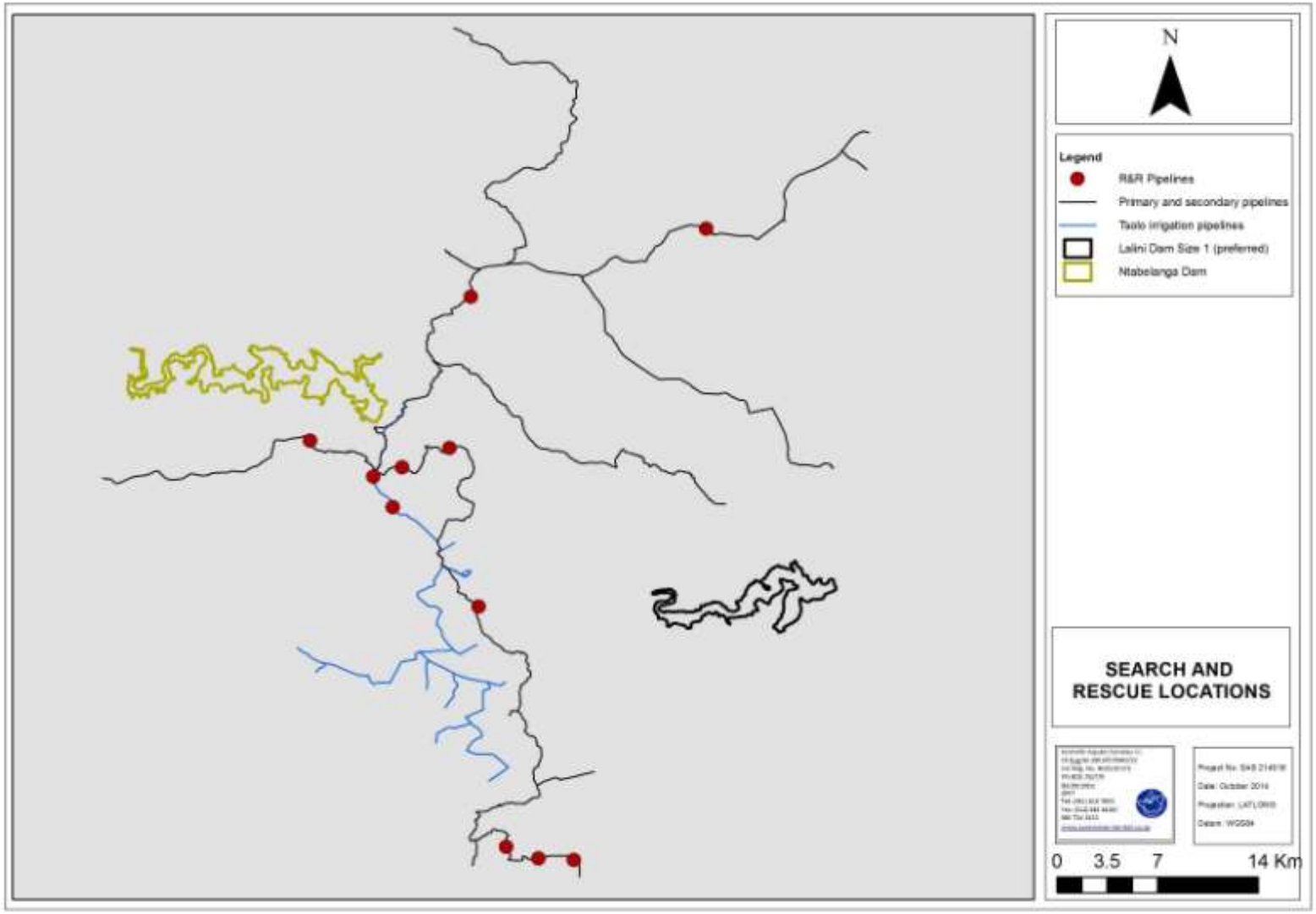


Figure 66: Possible areas identified along the pipeline routes that require search and rescue before construction activities commence.

7.2 OPERATION PHASE

7.2.1 Impact on habitat for floral species

7.2.1.1 Ntabelanga and Lalini Dam

During the operation phase, impacts from the first filling would already have taken place, thus clearing vegetation within the full supply level. During the operation phase water from the dams will be used to generate electricity and base flow and peak flow. Water levels will fluctuate during different times of the year and depending on the demand.

The Ntabelanga Dam levels will most likely vary during the year. Therefore the duration of the impacts will be permanent; the intensity is low due to the impact that has already occurred.

The Lalini Dam water levels will fluctuate, which will slightly impact on the floral habitat. During certain periods, vegetation will be exposed but the duration will not be enough to recover. It is expected that an increase in sedimentation will occur along the banks of the dam.

7.2.1.2 Primary, secondary and irrigation pipelines

During the operational phase no major impacts area expected, should rehabilitation of the affected areas been implemented. It must be ensured that alien proliferation is controlled during the operation phase to ensure that indigenous floral habitat is not lost. During the maintenance of the pipelines, all vehicles should travel on the designated road to limit the ecological footprint and reduce further degradation or loss of floral habitat.

Recommended mitigation (Also refer to general management and good housekeeping practices):

- Ensure that operational related activities are kept strictly within the development footprint.

Impact on habitat for floral species	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Proposed Project with Ntabelanga Dam and associated infrastructure							
Without Mitigation	1 (Site)	5 (Permanent-no mitigation)	2 (Low)	3 (Medium)	5 (Definite)	High	Medium-high
With Mitigation	1 (Site)	5 (Permanent-no mitigation)	2 (Low)	1 (Low)	5 (Definite)	High	Medium-high
Proposed Project with Lalini Dam size 1 (preferred alternative) and associated infrastructure							
Without Mitigation	1 (Site)	5 (Permanent-no mitigation)	2 (Low)	3 (Medium)	5 (Definite)	High	Medium-high
With Mitigation	1 (Site)	5 (Permanent-no mitigation)	2 (Low)	1 (Low)	5 (Definite)	High	Medium-high
Proposed Project with Lalini Dam size 2 and associated infrastructure							
Without Mitigation	1 (Site)	5 (Permanent-	2 (Low)	3 (Medium)	5 (Definite)	High	Medium-

Impact on habitat for floral species	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
		no mitigation)					high
With Mitigation	1 (Site)	5 (Permanent-no mitigation)	2 (Low)	1 (Low)	5 (Definite)	High	Medium-high
Proposed Project with Lalini Dam size 3 and associated infrastructure							
Without Mitigation	1 (Site)	5 (Permanent-no mitigation)	2 (Low)	3 (Medium)	5 (Definite)	High	Medium-high
With Mitigation	1 (Site)	5 (Permanent-no mitigation)	2 (Low)	1 (Low)	5 (Definite)	High	Medium-high
Proposed Project with Primary, Secondary Pipelines and Irrigation Pipelines and associated infrastructure							
Without Mitigation	2 (Local)	1 (Short term)	3 (Medium)	1 (Low)	4 (High)	High	Low
With Mitigation	1 (Site)	1 (Short term)	2 (Low)	1 (Low)	3 (Medium)	High	Low
Residual Impact: • Increased settlement around dams could result in further fragmentation and loss of untransformed habitat. • The loss of floral habitat will lead to altered floral biodiversity.							

7.2.2 Impact on floral diversity

7.2.2.1 Ntabelanga and Lalini Dam

Floral diversity within all habitat units has been decreased as a result of historic and on-going disturbances. The species diversity is however higher within the rocky ridge and mountain areas than that associated with the transformed habitat unit.

The diversity of floral species within the immediate area will be lost during the operational phase within the Ntabelanga and the Lalini Dam. The dams will also act as a barrier disrupting seed dispersal by water (along the river) or animals (across river). No mitigation measures are available to reduce these impacts. Fire can also have an impact, were the natural fire regime across the river is disrupted, affecting species composition and structure of vegetation communities.

Therefore the significance associated with the loss of the floral diversity is considered medium-high.

7.2.2.2 Primary, secondary and irrigation pipelines

The impact significance associated with the loss of species diversity is considered to be low prior to the implementation of mitigation measures. It must be ensured that alien proliferation is controlled during the operation phase to ensure that indigenous floral habitat and diversity is not lost. During the maintenance of the pipelines, all vehicles should travel on the designated road to limit the ecological footprint, reducing the loss of floral habitat and in turn the diversity of species in the area.

Recommended mitigation (Also refer to general management and good housekeeping practices):

- Removal of the alien and weed species encountered within the footprint area must take place in order to comply with existing legislation. An annual monitoring of levels of infestation of the dams by alien floral species must take place.
- Restrict vehicles to travelling only on designated roadways to limit the ecological footprint of the proposed development activities.
- To prevent the erosion of top soils, management measures may include berms, soil traps, hessian curtains and storm water diversion away from areas susceptible to erosion. It must be ensured that topsoil stockpiles are located outside of any wetland areas susceptible to erosion.
- Maintain holding nursery of local indigenous floral species suitable for re-planting during the operational phase.
- Ensure that areas on all sides of the dam are burnt with equal frequency and timing.

Impact on floral diversity	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Proposed Project with Ntabelanga Dam and associated infrastructure							
Without Mitigation	1 (Site)	5 (Permanent-no mitigation)	2 (Low)	1 (Low)	5 (Definite)	High	Medium-high
With Mitigation	1 (Site)	5 (Permanent-no mitigation)	2 (Low)	1 (Low)	5 (Definite)	High	Medium-high
Proposed Project with Lalini Dam size 1 (preferred alternative) and associated infrastructure							
Without Mitigation	2 (Local)	5 (Permanent-no mitigation)	2 (Low)	1 (Low)	5 (Definite)	High	Medium-high
With Mitigation	1 (Site)	5 (Permanent-no mitigation)	2 (Low)	1 (Low)	5 (Definite)	High	Medium-high
Proposed Project with Lalini Dam size 2 and associated infrastructure							
Without Mitigation	1 (Site)	5 (Permanent-no mitigation)	2 (Low)	1 (Low)	5 (Definite)	High	Medium-high
With Mitigation	1 (Site)	5 (Permanent-no mitigation)	2 (Low)	1 (Low)	5 (Definite)	High	Medium-high
Proposed Project with Lalini Dam size 3 and associated infrastructure							
Without Mitigation	1 (Site)	5 (Permanent-no mitigation)	2 (Low)	3 (Medium)	5 (Definite)	High	Medium-high
With Mitigation	1 (Site)	5 (Permanent-no mitigation)	2 (Low)	1 (Low)	5 (Definite)	High	Medium-high
Proposed Project with Primary, Secondary Pipelines and Irrigation Pipelines and associated infrastructure							
Without Mitigation	2 (Local)	1 (Short term)	3 (Medium)	1 (Low)	4 (High)	High	Low
With Mitigation	1 (Site)	1 (Short term)	2 (Low)	1 (Low)	3 (Medium)	High	Low

Residual Impact:

- Permanent loss of floral diversity within the dam footprint area.
- Increased settlement around dams could result in harvesting of floral resources outside of the dam footprint area.

7.2.3 Impact on important and protected floral species

Important floral species located within along the secondary pipeline route should have been removed with valid permits obtained before construction commenced. Habitat will be lost, therefore decreasing the probability of protected and important species to occur.

Alien floral species needs to be controlled and monitored during the life of the operation. Invader Alien Plants can significantly alter the composition, structure and functionality of ecosystems. As a result, they degrade the productive potential of the land; intensify the damage caused by veld fires and flooding, increase soil erosion, and impact on the health of rivers and estuaries. Indigenous species may be reduced in numbers/coverage, or may be lost as a result of alien floral infestations.

Recommended mitigation (Also refer to general management and good housekeeping practices):

- Ensure that operational related activities are kept strictly within the development footprint.
- Restrict vehicles to travelling only on designated roadways to limit the ecological footprint of the proposed development activities.

Impact on important and protected floral species	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Proposed Project with Ntabelanga Dam and associated infrastructure							
Without Mitigation	1 (Site)	2 (Medium term)	4 (High)	3 (Medium)	5 (Definite)	High	Medium-high
With Mitigation	1 (Site)	2 (Medium term)	3 (Medium)	3 (Medium)	4 (High)	High	Medium-low
Proposed Project with Lalini Dam size 1 (preferred alternative) and associated infrastructure							
Without Mitigation	2 (Local)	2 (Medium term)	5 (Very high)	5 (High)	5 (Definite)	High	High
With Mitigation	1 (Site)	2 Medium term)	4 (High)	3 (Medium)	5 (Definite)	High	Medium-high
Proposed Project with Lalini Dam size 2 and associated infrastructure							
Without Mitigation	1 (Site)	2 (Medium term)	4 (High)	3 (Medium)	5 (Definite)	High	Medium-high
With Mitigation	1 (Site)	2 Medium term)	3 (Medium)	3 (Medium)	5 (Definite)	High	Medium-high
Proposed Project with Lalini Dam size 3 and associated infrastructure							
Without Mitigation	1 (Site)	5 (Permanent -no mitigation)	2 (Low)	3 (Medium)	5 (Definite)	High	Medium-high

Impact on important and protected floral species	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
With Mitigation	1 (Site)	5 (Permanent -no mitigation)	2 (Low)	1 (Low)	5 (Definite)	High	Medium-high
Proposed Project with Primary, Secondary Pipelines and Irrigation Pipelines and associated infrastructure							
Without Mitigation	2 (Local)	1 (Short term)	3 (Medium)	1 (Low)	4 (High)	High	Low
With Mitigation	1 (Site)	1 (Short term)	2 (Low)	1 (Low)	3 (Medium)	High	Low
Residual Impact: • A decrease in medicinal or protected floral species diversity may lead to a loss of species richness over time within the region.							

8 IMPACT ASSESSMENT FOR ELECTRICITY GENERATION AND DISTRIBUTION INFRASTRUCTURE

This Chapter presents the findings of the environmental impact assessment for the electricity generation and distribution related activities (DEA Ref no. 14/12/16/3/3/2/678).

The activities assessed under this chapter are listed below:

- Pipeline and Tunnel (including tunnel alternatives) at the proposed Lalini Dam;
- Generation of hydro power and feeding of this power into the existing grid; and
- 18.5km power line from the Lalini Dam tunnel,

8.1 CONSTRUCTION PHASE

8.1.1 Impact on habitat for floral species

The majority of the power lines of all three alternatives will traverse transformed (grassland) habitat units, where grasslands and mostly *Acacia karroo* and *Acacia caffra* occurs. The transformed habitat unit has been significantly disturbed as a result of historic and on-going agricultural activities and overgrazing of veld. The floral habitat within this habitat unit is therefore largely transformed and placement of infrastructure within this habitat unit will most likely have low impact significance.

All three sections of the power line alternatives, closer to the Tsitsa River will traverse more sensitive habitat associated with mountain / afromontane forests and rocky outcrop habitat. Due to the sensitive habitat and diversity of species occurring within these sections, placement of support towers will need to be considered, as indigenous and possible important / protected floral vegetation will be affected. According to the impact assessment results, the power line alternative 1 and 3 will have a much higher impact, even if mitigated due to the power lines crossing larger sections of indigenous and possible protected trees and other floral species. The more preferred power line alternative would be alternative 2 due to a lower impact on the receiving environment. The majority of the power line traverses areas that have undergone vegetation transformation (**Figure 67**).

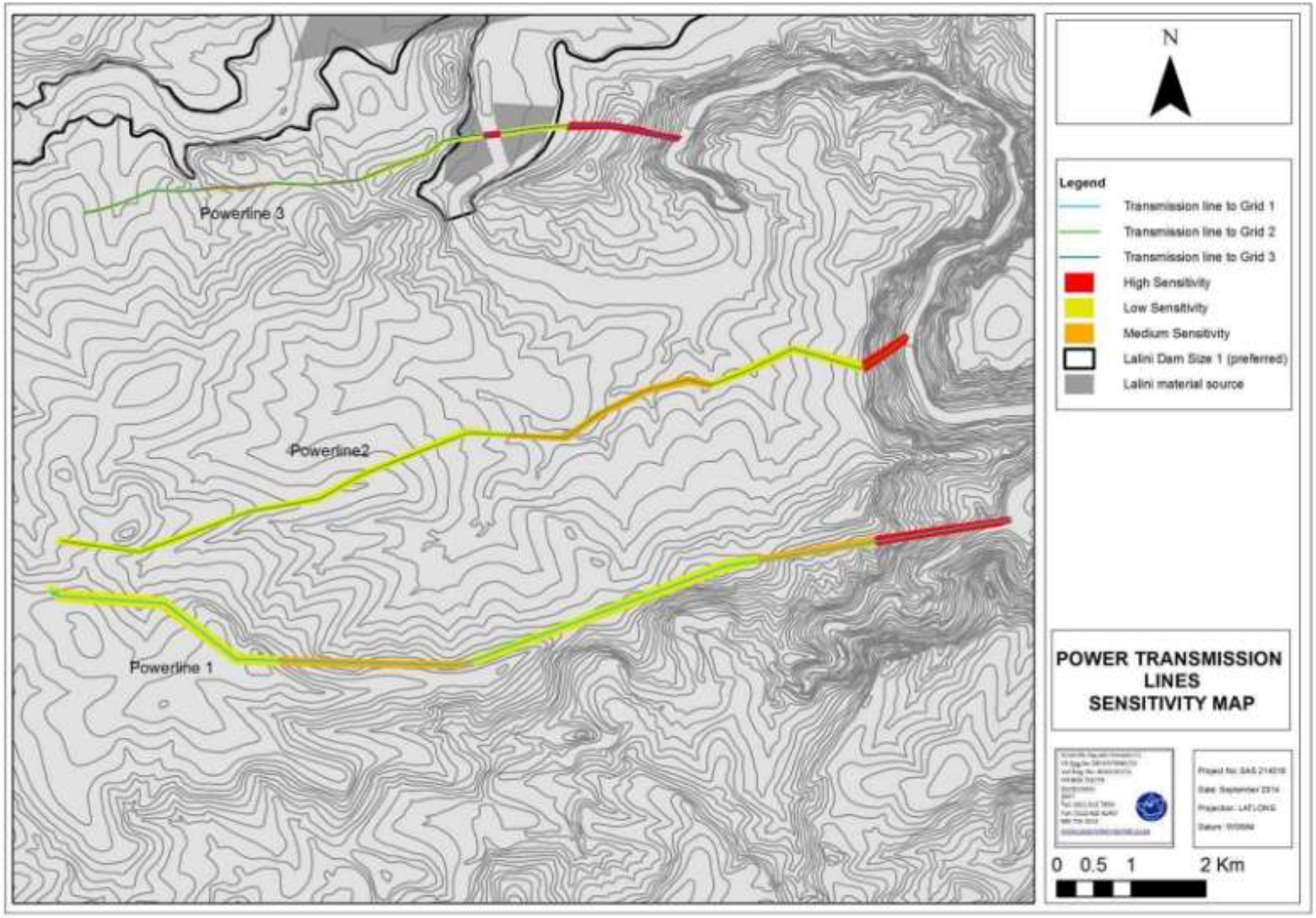


Figure 67: Sensitivity map for the power line transmission lines.

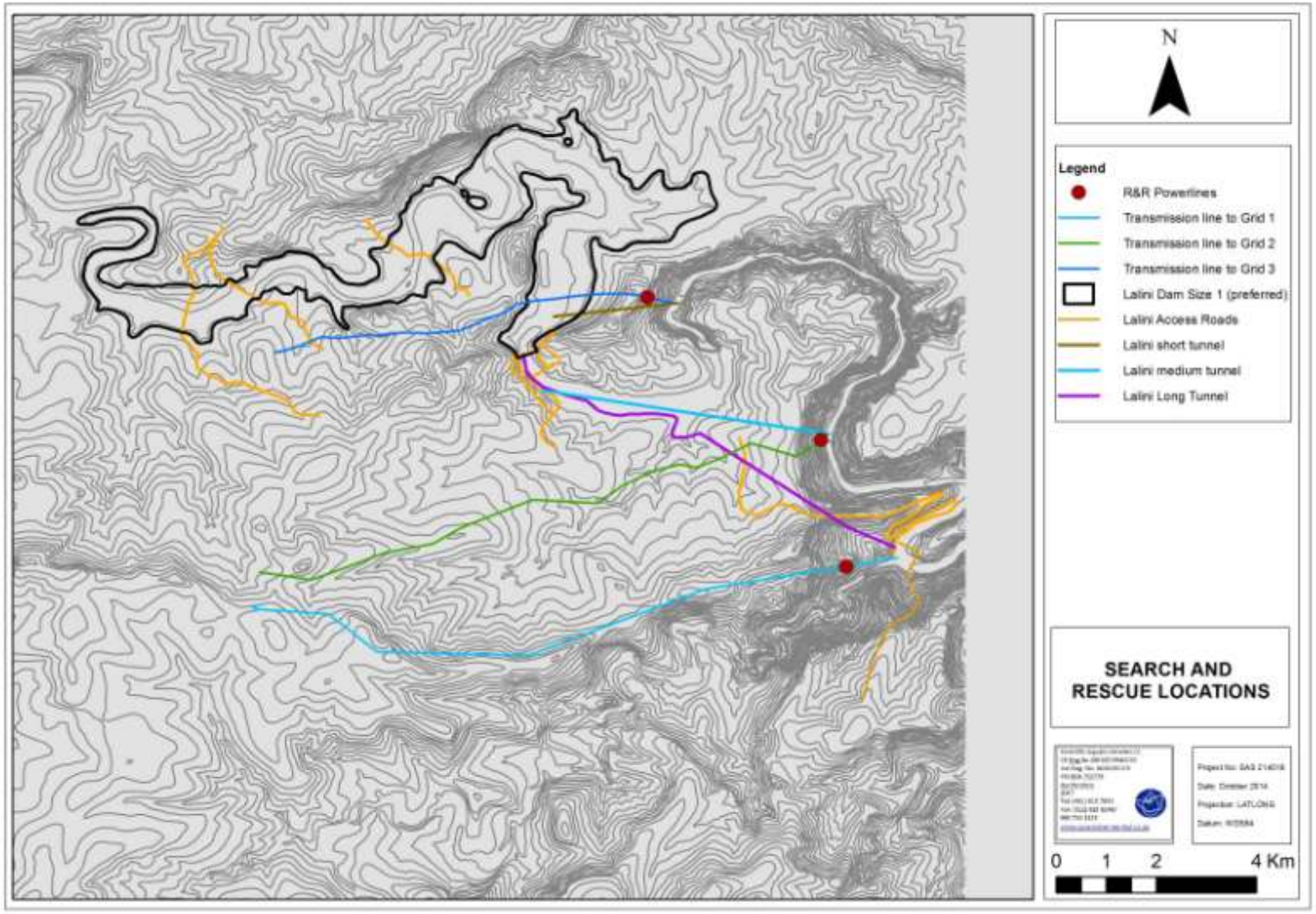


Figure 68: Possible areas identified along the power line routes that require search and rescue before construction activities commence.

Recommended mitigation (Also refer to general management and good housekeeping practices):

- Planning the placement of the support towers should be kept within the low sensitivity areas as far as possible. It is recommended that alternative 2 of the power lines be considered as the more preferred option.
- If possible, avoid placement of infrastructure within rocky outcrop or mountain/afromontane forest habitat units.
- Placement of support towers should remain as small as possible.
- Restrict vehicles as far as possible to travel on designated roadways to limit the ecological footprint of the infrastructure.
- Edge effects of all construction activities, such as erosion and alien plant species proliferation, which may affect floral habitat, need to be strictly managed.
- It must be ensured that construction related waste or spillage and effluent do not affect the immediate and surrounding habitat boundaries.
- In the event of a vehicle breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practiced near the surface to prevent ingress of hydrocarbons into topsoil and subsequent habitat loss.

Impact on habitat for floral species	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Power generation with hydropower short tunnel and power line alternative 1							
Without Mitigation	2 (Local)	2 (Medium term)	5 (Very high)	5 (High)	5 (Definite)	High	High
With Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	5 (High)	4 (High)	High	Medium-high
Power generation with hydropower medium tunnel and Power line alternative 2							
Without Mitigation	2 (Local)	2 (Medium term)	4 (High)	5 (High)	5 (Definite)	High	High
With Mitigation	1 (Site)	2 (Medium term)	3 (Medium)	5 (High)	4 (High)	High	Medium-low
Power generation with hydropower long tunnel and Power line alternative 3							
Without Mitigation	2 (Local)	2 (Medium term)	5 (Very high)	5 (High)	5 (Definite)	High	High
With Mitigation	2 (Local)	2 (Medium term)	4 (High)	5 (High)	4 (High)	High	Medium-high
Residual Impact: • Loss of floral habitat will lead to altered floral biodiversity within the project footprint areas.							

8.1.2 Impact on floral diversity

The floral diversity throughout most of the power line routes has been decreased as a result of historic and on-going disturbances. The species diversity is however higher within the Mountain / afromontane forest closer to the Tsitsa River. The impact significance associated

with the loss of species diversity is considered to be higher for alternatives 1 and 3 prior to implementation of mitigation measures. The impact of loss of species diversity within the transformed habitat unit is expected to be of low significance.

With the implementation of mitigation measures the impact of alternative 2 can be decreased to medium-low significance and alternative 1 and 3 to medium-high significance. The loss of indigenous and possible protected and important tree and other floral species will be very high should the preferred power line route be alternative 1 and 3.

Recommended mitigation (Also refer to general management and good housekeeping practices):

- Planning the placement of the support towers should be kept within the low sensitivity areas as far as possible. It is recommended that alternative 2 of the power lines be considered as the more preferred option.
- Permits for the removal or destruction of protected tree species (should it occur within the construction footprint area) need to be obtained at the relevant authorities before any construction activities occur within the power line route.
- If possible, avoid placement of infrastructure within rocky outcrop or mountain/afromontane forest habitat units.
- Placement of infrastructure should remain as small as possible.
- Restrict vehicles as far as possible to travel on designated roadways to limit the ecological footprint of the infrastructure.
- Edge effects of all construction activities, such as erosion and alien plant species proliferation, which may affect floral habitat, need to be strictly managed.
- It must be ensured that construction related waste or spillage and effluent do not affect the immediate and surrounding habitat boundaries.
- In the event of a vehicle breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practiced near the surface to prevent ingress of hydrocarbons into topsoil and subsequent habitat loss.
- All areas affected by the construction of infrastructure related to the power line should be rehabilitated where possible.

Impact on floral diversity	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Peak power generation with hydropower short tunnel and power line alternative 1							
Without Mitigation	2 (Local)	2 (Medium term)	4 (High)	5 (High)	5 (Definite)	High	High
With Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	5 (High)	4 (High)	High	Medium-high
Peak power generation with hydropower medium tunnel and Power line alternative 2							
Without Mitigation	2 (Local)	2 (Medium term)	4 (High)	5 (High)	5 (Definite)	High	High
With Mitigation	1 (Site)	2 (Medium term)	3 (Medium)	5 (High)	4 (High)	High	Medium-low
Peak power generation with hydropower long tunnel and Power line alternative 3							

Without Mitigation	2 (Local)	2 (Medium term)	5 (Very high)	5 (High)	5 (Definite)	High	High
With Mitigation	2 (Local)	2 (Medium term)	4 (High)	5 (High)	4 (High)	High	Medium-high
Residual Impact: • Permanent loss of floral diversity within areas where construction has taken place. • Alien and invasive species proliferation and bush encroachment into disturbed areas. • Ineffective rehabilitation may lead to permanent loss of floral biodiversity							

8.1.3 Impact on important and protected floral species

Sections of the power line routes traverse mountain and afromontane forest habitat. These areas are more sensitive in terms of less vegetation disturbance, great floral diversity and suitable habitat for important and protected species such as *Podocarpus* and *Encephalartos* species. Vegetation clearance within this sensitive habitat will take place, resulting in the removal of protected and important species. Permit applications for the removal of protected and important species will be required.

The impact associated with important and protected floral species will be high to very high for all three alternative power lines, especially within the mountain /afromontane forest areas prior to mitigation measures being implemented. The significance rating for alternative 2 could be decreased to a slightly lower level should mitigation measures be implemented.

Recommended mitigation (Also refer to general management and good housekeeping practices):

- The proposed power line footprint area should be kept as small as possible and confined to areas presently / historically transformed and which are of a lower ecological importance (**Figure 67**).
- Planning the placement of the support towers should be kept within the low sensitivity areas as far as possible. It is recommended that alternative 2 of the power lines be considered as the more preferred option
- Rescue and relocation of protected species along the power lines within the rocky /mountain areas should take place prior to construction (**Figure 68**).
- Edge effects from construction activities needs to be implemented to ensure no further degradation takes place outside of the power line footprint area.
- Where protected trees will be disturbed, ensure effective relocation of individuals (if possible) to suitable similar habitat.
- Permits for the removal or destruction of protected tree species (should it occur within the construction footprint area) need to be obtained at the relevant authorities before any construction activities occur within the power line route.

Impact on important and protected floral species	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Peak power generation with hydropower short tunnel and power line alternative 1							
Without Mitigation	2 (Local)	3 (Long term)	5 (Very high)	5 (High)	5 (Definite)	High	High
With Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	5 (High)	4 (High)	High	Medium-high
Peak power generation with hydropower medium tunnel and Power line alternative 2							
Without Mitigation	2 (Local)	2 (Medium term)	4 (High)	5 (High)	5 (Definite)	High	High
With Mitigation	1 (Site)	2 (Medium term)	3 (Medium)	5 (High)	4 (High)	High	Medium-low
Peak power generation with hydropower long tunnel and Power line alternative 3							
Without Mitigation	2 (Local)	3 (Long term)	5 (Very high)	5 (High)	5 (Definite)	High	High
With Mitigation	1 (Site)	2 (Medium term)	4 (High)	5 (High)	4 (High)	High	Medium-high
Residual Impact: • A decrease in medicinal floral species diversity may lead to a loss of species richness over time within the region.							

8.2 OPERATION PHASE

8.2.1 Impact on habitat for floral species

During the operational phase no major impacts are expected, should rehabilitation of the affected areas from construction have been implemented. It must be ensured that alien proliferation is controlled during the operation phase to ensure that indigenous floral habitat is not lost. During the maintenance of the access road, all vehicles should travel on the designated road to limit the ecological footprint and reduce further degradation or loss of floral habitat.

With the implementation of mitigation measures the impact of alternative 1 and 3 can be decreased to low significance and alternative 2 to a very low significance. The impact of loss of species diversity within the transformed habitat unit is expected to be of low significance.

Recommended mitigation (Also refer to general management and good housekeeping practices):

- Proliferation of alien and invasive species is expected within any disturbed areas. These species should be eradicated and controlled to prevent their spread beyond the power line. Alien plant seed dispersal within the top layers of the soil within footprint areas, that will have an impact on future rehabilitation, has to be controlled.
- Ensure that operational and maintenance related activities are kept strictly within the development footprint of the power line.

Impact on habitat for floral species	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Peak power generation with hydropower short tunnel and power line alternative 1							
Without Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	3 (Medium)	3 (Medium)	High	Medium-low
With Mitigation	1 (Site)	2 (Medium term)	2 (Low)	3 (Medium)	3 (Medium)	High	Low
Peak power generation with hydropower medium tunnel and Power line alternative 2							
Without Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	3 (Medium)	3 (Medium)	High	Medium-low
With Mitigation	1 (Site)	2 (Medium term)	2 (Low)	1 (Low)	2 (Low)	High	Very low
Peak power generation with hydropower long tunnel and Power line alternative 3							
Without Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	3 (Medium)	3 (Medium)	High	Medium-low
With Mitigation	1 (Site)	2 (Medium term)	2 (Low)	3 (Medium)	3 (Medium)	High	Low
Residual Impact : • Proliferation of alien and weed species in disturbed areas will lead to altered vegetation communities within the power line. • Loss of floral habitat may lead to altered floral biodiversity. • Ineffective rehabilitation may lead to permanent transformation of floral habitat.							

8.2.2 Impact on floral diversity

During the operational phase, the power line maintenance and servicing will take place. To ensure that the ecological footprint does not further decrease, personnel and vehicles should stay on designed roads. Alien invader proliferation and bush encroachment should take place to ensure that alien floral species do not encroach into the surrounding natural areas, specifically the areas associated with a higher floral diversity and sensitivity.

With the implementation of mitigation measures the impact of alternative 1 and 3 can be decreased to low significance and alternative 2 to very-low significance. The impact of loss of species diversity within the transformed habitat unit is expected to be of low significance.

Recommended mitigation (Also refer to general management and good housekeeping practices):

- Proliferation of alien and invasive species is expected within any disturbed areas. These species should be eradicated and controlled to prevent their spread beyond the power and pipeline. Alien plant seed dispersal within the top layers of the soil within footprint areas, that will have an impact on future rehabilitation, has to be controlled.
- Ensure that operational related activities are kept strictly within the development footprint.

Impact on floral diversity	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Peak power generation with hydropower short tunnel and power line alternative 1							
Without Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	3 (Medium)	3 (Medium)	High	Medium-low
With Mitigation	1 (Site)	2 (Medium term)	2 (Low)	3 (Medium)	3 (Medium)	High	Low
Peak power generation with hydropower medium tunnel and Power line alternative 2							
Without Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	3 (Medium)	3 (Medium)	High	Medium-low
With Mitigation	1 (Site)	2 (Medium term)	2 (Low)	1 (Low)	2 (Low)	High	Very low
Peak power generation with hydropower long tunnel and Power line alternative 3							
Without Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	3 (Medium)	3 (Medium)	High	Medium-low
With Mitigation	1 (Site)	2 (Medium term)	2 (Low)	3 (Medium)	3 (Medium)	High	Low
Residual Impact: • Permanent loss of floral diversity within areas where construction has taken place. • Alien and invasive species proliferation and bush encroachment into disturbed areas. • Ineffective rehabilitation may lead to permanent loss of floral biodiversity.							

8.2.3 Impact on important and protected floral species

The majority of the power line (all three alternatives) traverse habitat that is associated with disturbance such as overgrazing and trampling of veld by livestock, bush encroachment and proliferation of alien and invader floral species. These areas are considered to have a low impact on important and protected floral species.

Sections of the power line and hydropower tunnels traverse mountain / afromontane forest habitat. The floral diversity within this habitat unit is high and needs to be maintained during the operational phase, especially larger sections in alternative 1 and 3, traversing sensitive habitat and possible protected tree species. Alien invader proliferation and bush encroachment should take place to ensure that alien floral species do not encroach into the surrounding natural areas, specifically the areas associated with a higher floral diversity and sensitivity.

Recommended mitigation (Also refer to general management and good housekeeping practices):

- Proliferation of alien and invasive species is expected within any disturbed areas. These species should be eradicated and controlled to prevent their spread beyond the power and pipeline. Alien plant seed dispersal within the top layers of the soil within footprint areas, that will have an impact on future rehabilitation, has to be controlled.
- Ensure that operational related activities are kept strictly within the development footprint.

Impact on important and protected floral species	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Peak power generation with hydropower short tunnel and power line alternative 1							
Without Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	3 (Medium)	4 (High)	High	Medium-low
With Mitigation	1 (Site)	2 (Medium term)	2 (Low)	3 (Medium)	3 (Medium)	High	Low
Peak power generation with hydropower medium tunnel and Power line alternative 2							
Without Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	3 (Medium)	3 (Medium)	High	Medium-low
With Mitigation	1 (Site)	2 (Medium term)	2 (Low)	3 (Medium)	2 (Low)	High	Low
Peak power generation with hydropower long tunnel and Power line alternative 3							
Without Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	3 (Medium)	3 (Medium)	High	Medium-low
With Mitigation	1 (Site)	2 (Medium term)	2 (Low)	3 (Medium)	2 (Low)	High	Low
Residual Impact: • A decrease in medicinal or protected and important floral species diversity may lead to a loss of species richness over time within the region.							

9 IMPACT ASSESSMENT FOR ROADS INFRASTRUCTURE

This Chapter presents the findings of the environmental impact assessment for the road infrastructure (DEA Ref no. 14/12/16/3/3/1/1169).

The activities included under this chapter are listed below:

- Upgrading and relocation of roads and bridges within the Ntabelanga and Lalini Dam; and
- The access road to the long tunnel associated with power line alternative 3.

9.1 CONSTRUCTION AND REHABILITATION PHASES

9.1.1 Impact on habitat for floral species

The roads to be upgraded are existing roads that will serve as access roads to the dams. The road upgrades are mostly in the Ntabelanga Dam study area. In terms of vegetation habitat, the edge effects of the existing roads, overgrazed veld and surrounding community villages has transformed the vegetation to the extent that only grass species such as *Eragrostis curvula, E. chloromelas, Hyparrhenia hirta, Sporobulus africanus* and *Cynodon dactylon*, which are associated with more disturbed areas, occur alongside the current access roads. In areas that are associated with disturbance and vegetation clearance, the impact on further transformation of floral habitat of the road upgrade will be very low, should all possible mitigation measure be implemented.

Other areas of the road upgrade are located within the higher altitude areas. Indigenous species such as *Aloe marlothii, Aloe ferox* and *Aloe aborescence* occurred alongside the current road. These areas are more sensitive that the transformed vegetation areas. Therefore mitigation measure must be implemented to ensure that the footprint area is kept as small as possible.

Wetland crossings occur alongside the proposed road upgrades. Erosion control measure such as berms and gabion structures should be implemented to ensure that soil erosion and sedimentation due to the rod construction does not further decrease the wetland habitat and function.

New access roads will be constructed in the Lalini Dam area. The majority of the newly proposed access roads traverse transformed vegetation types. These areas will not be highly impacted upon since vegetation transformation has already occurred. Access roads close to the Lalini Dam will have a very high impact on the overall loss of floral habitat, since these mountain areas provide suitable habitat for numerous indigenous and possible protected floral species.

Although most of the vegetation where the road upgrades or new roads will be constructed within the Lalini Dam has been transformed, it is possible that *Podocarpus* species, *Encephalartos* species and other protected and RDL floral species could occur along the proposed road upgrade and new roads located within the Lalini Dam area, especially in the Mountain / afromontane forest sections close to the dam wall. Thus the impact of the road

construction will be very high and is not recommended. Alternative routes should be considered.

New access roads are proposed within the Lalini Dam area. The habitat area (Mountain / Rocky Outcrops) where the proposed access roads will be situated is considered sensitive due to the higher floral species diversity and possible suitable habitat for protected species. It is suggested that a walk down be done for the Lalini HEP and access roads prior to the construction phase to identify any important Red Data Listed (RDL), medicinal or protected species. Should any RDL or protected species be located during the walk down, the necessary authorisation should be obtained to remove, relocate or cut and destroy these floral species.

It is also proposed that a road will be constructed to access the long hydropower tunnel and alternative power line 1. This road will be constructed within a highly sensitive habitat area, containing a high diversity of floral species. Most of the floral species are indigenous to the area and also provide suitable habitat for protected tree species and other important and RDL floral species such as *Encephalartos* species. This increases the diversity and overall sensitivity of the area. Should the construction of this road continue a large portion of floral habitat and diversity will be lost. Thus the impact on the immediate and surrounding area will be very high. This route is thus not recommended due to the high impacts and loss of floral habitat and diversity.

Recommended mitigation (Also refer to general management and good housekeeping practices):

- Edge effects of all construction activities, such as erosion and alien plant species proliferation, which may affect floral habitat, need to be strictly managed.
- Areas falling outside of the footprint area of the road upgrade should be rehabilitated with indigenous grass species. Eroded areas, especially in around the wetland crossings should also be addressed, as per the wetland assessment mitigation measures.
- It is suggested that a walk down be done for the Lalini HEP and access roads prior to the construction phase to identify any important Red Data Listed (RDL), medicinal or protected species. Should any RDL or protected species be located during the walk down, the necessary authorisation should be obtained to remove, relocate or cut and destroy these floral species.
- Permits for the removal or destruction of protected tree species (should it occur within the construction footprint area) need to be obtained at the relevant authorities before any construction activities occur.

Impact on habitat for floral species	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Road upgrades associated with the Ntabelanga Dam							
Without Mitigation	1 (Site)	2 (Medium) term	2 (Low)	3 (Medium)	3 (Medium)	High	Low
With Mitigation	1 (Site)	1 (Short term)	1 (Negligible)	1 (Low)	2 (Low)	High	Very low
Road upgrades associated with the Lalini Dam							
Without Mitigation	2 (Local)	2 (Medium) term	3 (Medium)	3 (Medium)	5 (Definite)	High	Medium-high
With Mitigation	1 (Site)	2 (Medium) term	3 (Medium)	3 (Medium)	4 (High)	High	Medium-low
Road construction associated with the power generated long tunnel							
Without Mitigation	3 (Regional)	5 (Permanent – no mitigation)	5 (Very high)	5 (High)	5 (Definite)	High	Very high
With Mitigation	2 (Local)	3 (Long) term	5 (Very high)	3 (Medium)	5 (Definite)	High	High
Residual Impact: • Poor rehabilitation measures after construction activities could lead to further floral habitat loss and soil erosion							

9.1.2 Impact on floral diversity

The roads to be upgraded are existing roads that will serve as access roads to the dams. In terms of vegetation diversity, the edge effects of the existing roads, overgrazing and trampling of veld by livestock and the surrounding community villages has transformed the majority of the road upgrade area. Therefor the impacts in terms of floral diversity will be low to very low with mitigation measures. New access roads will be constructed in the Lalini Dam area. The majority of the newly proposed access roads traverse transformed vegetation types. These areas will not be highly impacted upon since vegetation transformation has already occurred. Access roads close to the Lalini Dam will have a very high impact on the overall loss of floral habitat, since these mountain areas provide suitable habitat for numerous indigenous and possible protected floral species.

Areas such as the rocky outcrops and mountain areas, where sections of afromontane forest occur, have a greater floral diversity. Protected tree species were located along this habitat unit. Several medicinal species are also located within this habitat unit. It will be very important to implement mitigation measure such as effective rehabilitation and preventing collection of indigenous vegetation used for medicinal purposes within these areas to ensure that the diversity of floral species within the rocky and mountain areas are maintained.

Alien proliferation alongside the roads will also be one of the main concerns. Disturbances of the ground through excavations often lead to the dominance of alien pioneer species that rapidly dominate the area. Invader alien plants can significantly alter the composition, structure and functionality of ecosystems. As a result, they degrade the productive potential of the land; intensify the damage caused by veld fires and flooding, increase soil erosion,

and impact on the health of rivers and estuaries. Indigenous species may be reduced in numbers/coverage, or may be lost as a result of alien plant infestation.

It is also proposed that a road will be constructed to access the long hydropower tunnel and alternative power line 1. This road will be constructed within a highly sensitive habitat area, containing a high diversity of floral species. Most of the floral species are indigenous to the area and also provide suitable habitat for protected tree species and other important and RDL floral species such as *Encephalartos* species. This increases the diversity and overall sensitivity of the area. Should the construction of this road continue a large portion of floral habitat and diversity will be lost. Thus the impact on the immediate and surrounding area will be very high. This route is thus not recommended due to the high impacts and loss of floral habitat and diversity.

Recommended mitigation (Also refer to general management and good housekeeping practices):

- Proliferation of alien and invasive species is expected within any disturbed areas. These species should be eradicated and controlled to prevent their spread beyond the road upgrade footprint.
- Alien plant seed dispersal within the top layers of the soil within footprint areas, that will have an impact on future rehabilitation, has to be controlled.
- All areas affected by construction should be rehabilitated upon decommissioning of the construction phase. Areas should be reseeded with indigenous grasses as required. All rehabilitated areas should be rehabilitated to a point where natural processes will allow the pre-development ecological functioning and biodiversity of the area to be re-instated.
- Permits for the removal or destruction of protected tree species (should it occur within the construction footprint area) need to be obtained at the relevant authorities before any construction activities occur.

Impact on habitat for floral species	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Road upgrades associated with the Ntabelanga Dam							
Without Mitigation	1 (Site)	2 (Medium) term	3 (Medium)	3 (Medium)	3 (Medium)	High	Low
With Mitigation	1 (Site)	1 (Short term)	2 (Low)	1 (Low)	2 (Low)	High	Very low
Road upgrades associated with the Lalini Dam							
Without Mitigation	2 (Local)	2 (Medium) term	3 (Medium)	3 (Medium)	5 (Definite)	High	Medium-high
With Mitigation	1 (Site)	2 (Medium) term	3 (Medium)	3 (Medium)	4 (High)	High	Medium-low
Road construction associated with the power generated long tunnel							
Without Mitigation	3 (Regional)	5 (Permanent – no	5 (Very high)	5 (High)	5 (Definite)	High	Very high

		mitigation)					
With Mitigation	2 (Local)	3 (Long) term	5 (Very high)	3 (Medium)	5 (Definite)	High	High
Residual Impact: • Loss of floral habitat may lead to altered floral diversity. • Ineffective rehabilitation may lead to permanent transformation of floral habitat and species composition.							

9.1.3 Impact on important and protected floral species

Podocarpus falcatus and *P. latifolius* were located alongside the road upgrade areas within the Ntabelanga Dam, on the northern section of the dam. More *Podocarpus* species were located on the secondary pipeline route south of the town Tsolo. These species is considered protected according to the notice of the list of protected tree species under the National Forests Act, 1998 (Act No. 84 of 1998). Permits for the removal of these protected tree species (should it occur within the construction footprint area) need to be obtained at the relevant authorities before any construction activities occur within this area. Although most of the vegetation where the road upgrades or new roads will be constructed within the Lalini Dam has been transformed, it is possible that *Podocarpus* species, *Encephalartos* species and other protected and RDL floral species could occur along the proposed road upgrade and new roads located within the Lalini Dam area, especially in the Mountain / afromontane forest sections close to the dam wall.

It is suggested that a walk down be done for the Lalini HEP and access roads prior to the construction phase to identify any important Red Data Listed (RDL), medicinal or protected species. Should any RDL or protected species be located during the walk down, the necessary authorisation should be obtained to remove, relocate or cut and destroy these floral species.

It is also proposed that a road will be constructed to access the long hydropower tunnel and alternative power line 1. This road will be constructed within a highly sensitive habitat area, containing a high diversity of floral species. Most of the floral species are indigenous to the area and also provide suitable habitat for protected tree species and other important and RDL floral species such as *Encephalartos* species. This increases the diversity and overall sensitivity of the area. Should the construction of this road continue a large portion of floral habitat and diversity will be lost. Thus the impact on the immediate and surrounding area will be very high. This route is thus not recommended due to the high impacts and loss of floral habitat and diversity

Other medicinal species such as *Aloe* species were located along the road upgrade route. These species and other species should be relocated, if possible, should they occur within the footprint area of the road upgrade. During construction, collection of these important species should be prevented to ensure that the diversity of the species within the area is still maintained. Vehicles used during the construction should also be prevented to drive through areas outside of the footprint area. This will decrease floral habitat, therefore suitable habitat for important species to occur. The impact associated with the loss of the species is considered to be of medium-low significance prior to the implementation of mitigation measures.

Recommended mitigation (Also refer to general management and good housekeeping practices):

- Protected tree species *Podocarpus fulcatus* and *P. latifolius* were located along the sections scheduled for road upgrades. The following must be ensured:
  - Where protected trees will be disturbed, ensure effective relocation of individuals (if possible) to suitable similar habitat.
  - Permit applications must be obtained from relevant authorities.
  - Possible re-alignment of the roads where protected tree species were found, in order to avoid cutting and destroying the trees (**Figure 69**)
- It is suggested that a walk down be done for the Lalini HEP and access roads prior to the construction phase to identify any important Red Data Listed (RDL), medicinal or protected species. Should any RDL or protected species be located during the walk down, the necessary authorisation should be obtained to remove, relocate or cut and destroy these floral species.
- Prohibit the collection of plant material for firewood or for medicinal purposes during the construction phase.

Impact on habitat for floral species	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Road upgrades associated with the Ntabelanga Dam							
Without Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	3 (Medium)	4 (High)	High	Medium-low
With Mitigation	1 (Site)	1 (Short term)	2 (Low)	1 (Low)	3 (Medium)	High	Low
Road upgrades associated with the Lalini Dam							
Without Mitigation	2 (Local)	2 (Medium) term	3 (Medium)	3 (Medium)	5 (Definite)	High	Medium-high
With Mitigation	1 (Site)	2 (Medium) term	3 (Medium)	3 (Medium)	4 (High)	High	Medium-low
Road construction associated with the power generated long tunnel							
Without Mitigation	3 (Regional)	5 (Permanent – no mitigation)	5 (Very high)	5 (High)	5 (Definite)	High	Very high
With Mitigation	2 (Local)	3 (Long) term	5 (Very high)	3 (Medium)	5 (Definite)	High	High
Residual Impact: • A decrease in potential medicinal / protected floral species diversity may lead to a loss of species richness over time within the region.							

Figure 69: Possible areas identified along the proposed road upgrade areas and new roads that require search and rescue before construction activities commence.

9.2 OPERATION PHASE

9.2.1 Impact on habitat for floral species

During the operational phase no major impacts for the roads at the Ntabelanga and Lalini Dam area expected, should rehabilitation of the affected areas from construction have been implemented. It must be ensured that alien proliferation is controlled during the operation phase to ensure that indigenous floral habitat is not lost. During the maintenance of the access road, all vehicles should travel on the designated road to limit the ecological footprint and reduce further degradation or loss of floral habitat. Impacts on the tunnel road will still be high since edge effects from the road will still take place.

Recommended mitigation (Also refer to general management and good housekeeping practices):

- Ensure that operational related activities are kept strictly within the development footprint. Ensure that indigenous floral species are not removed and edge effects from the road are controlled.
- Ensure that further degradation of the surrounding area does not take place by ensuring that vehicles travel on designated roads.
- Alien and invasive vegetation control should take place throughout the operational phase of the development.

Impact on habitat for floral species	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Road upgrades associated with the Ntabelanga Dam							
Without Mitigation	1 (Site)	1 (Short)	2 (Low)	1 (Low)	2 (Low)	High	Very low
With Mitigation	1 (Site)	1 (Short)	1 (Negligible)	1 (Low)	1 (Improbable)	High	Very low
Road upgrades associated with the Lalini Dam							
Without Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	3 (Medium)	4 (High)	High	Medium-low
With Mitigation	1 (Site)	1 (Short term)	2 (Low)	1 (Low)	3 (Medium)	High	Low
Road construction associated with the power generated long tunnel							
Without Mitigation	2 (Local)	5 (Permanent – no mitigation)	3 (Medium)	3 (Medium)	4 (High)	High	Medium-high
With Mitigation	2 (Local)	3 (Long) term	2 (Low)	3 (Medium)	3 (Medium)	High	Medium-low
Residual Impact: • Poor rehabilitation measures after construction activities could lead to further floral habitat loss and soil erosion							

9.2.2 Impact on floral diversity

Floral diversity within all habitat units has been decreased as a result of historic and on-going disturbances. The species diversity is however higher within the rocky ridge and mountain areas than that associated with the transformed habitat unit. The impact significance associated with the loss of species diversity is considered to be very low prior to the implementation of mitigation measures. It must be ensured that alien proliferation is controlled during the operation phase to ensure that indigenous floral habitat and diversity is not lost. During the maintenance of the access road, all vehicles should travel on the designated road to limit the ecological footprint, reducing the loss of floral habitat and in turn the diversity of species in the area.

The diversity of floral species within higher sensitivity areas such as the tunnel access roads and new access roads close to the Lalini Dam wall will still be affected during the operational phase due to edge effects from the road and mitigation measure that was not fully implemented during the construction and operation phase.

Recommended mitigation (Also refer to general management and good housekeeping practices):

- Ensure that operational related activities are kept strictly within the development footprint.
- Alien and invasive vegetation control should take place throughout the operational phase of the development.

Impact on habitat for floral species	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Road upgrades associated with the Ntabelanga Dam							
Without Mitigation	1 (Site)	1 (Short)	2 (Low)	1 (Low)	2 (Low)	High	Very low
With Mitigation	1 (Site)	1 (Short)	1 (Negligible)	1 (Low)	1 (Improbable)	High	Very low)
Road upgrades associated with the Lalini Dam							
Without Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	3 (Medium)	4 (High)	High	Medium-low
With Mitigation	1 (Site)	1 (Short term)	2 (Low)	1 (Low)	3 (Medium)	High	Low
Road construction associated with the power generated long tunnel							
Without Mitigation	2 (Local)	5 (Permanent – no mitigation)	3 (Medium)	3 (Medium)	4 (High)	High	Medium-high
With Mitigation	2 (Local)	3 (Long) term	2 (Low)	3 (Medium)	3 (Medium)	High	Medium-low
Residual Impact: • Ineffective rehabilitation may lead to permanent transformation of floral habitat and species composition.							

9.2.3 Impact on important and protected floral species

Alien proliferation alongside the road will also be one of the main concerns. Disturbances of the ground through excavations often lead to the dominance of alien pioneer species that rapidly dominate the area. Invader Alien Plants can significantly alter the composition, structure and functionality of ecosystems. As a result, they degrade the productive potential of the land; intensify the damage caused by veld fires and flooding, increase soil erosion, and impact on the health of rivers and estuaries. Indigenous species may be reduced in numbers/coverage, or may be lost as a result of alien floral infestations.

Recommended mitigation:

- Proliferation of alien and invasive species is expected within any disturbed areas. These species should be eradicated and controlled to prevent their spread beyond the footprint areas.

Impact on habitat for floral species	Extent	Duration	Intensity	Potential for irreplaceable loss of resources	Probability	Confidence	Significance
Road upgrades associated with the Ntabelanga Dam							
Without Mitigation	1 (Site)	2 (Medium term)	2 (Low)	1 (Low)	2 (Low)	High	Very low
With Mitigation	1 (Site)	2 (Medium term)	1 (Negligible)	1 (Low)	1 (Improbable)	High	Very low
Road upgrades associated with the Lalini Dam							
Without Mitigation	2 (Local)	2 (Medium term)	3 (Medium)	3 (Medium)	4 (High)	High	Medium-low
With Mitigation	1 (Site)	1 (Short term)	2 (Low)	1 (Low)	3 (Medium)	High	Low
Road construction associated with the power generated long tunnel							
Without Mitigation	2 (Local)	5 (Permanent – no mitigation)	3 (Medium)	3 (Medium)	4 (High)	High	Medium-high
With Mitigation	2 (Local)	3 (Long) term	2 (Low)	3 (Medium)	3 (Medium)	High	Medium-low
Residual Impact: • A decrease in potential RDL/ protected floral species diversity may lead to a loss of species richness over time within the region.							

10 IMPACT ASSESSMENT FOR THE NO PROJECT ALTERNATIVE

This Chapter presents the findings of the environmental impact assessment for the no-project alternative. The no-project alternative includes no construction of the dams or related infrastructure. This would mean that

- No sensitive and indigenous floral species will be lost;
- No permit application would be required for the removal of protected tree species located along the road upgrade section in Ntabelanga Dam or along the secondary pipeline routes, south of Tsolo;
- No floral habitat (riparian, wetland or indigenous woody species habitat) will be lost;
- The diversity of floral species will not decrease;
- The current impacts such as overgrazed veld and alien proliferation along the riparian features will continue. Thus the ecological state of these areas will not improve if the no project alternative is implemented.

11 MITIGATION HIERARCHY AND OFFSET DISCUSSION

'Mitigation' is a broad term that covers all components of the 'mitigation hierarchy' defined hereunder. It involves selecting and implementing measures – amongst others – to conserve biodiversity and to protect, the users of biodiversity and other affected stakeholders from potentially adverse impacts as a result of development. The aim is to prevent adverse impacts from occurring or, where this is unavoidable, to limit their significance to an acceptable level. Offsetting of impacts is considered to be the last option in the mitigation hierarchy for any project.

The mitigation hierarchy in general consists of the following in order of which impacts should be mitigated (DEA *at al.* 2013):

1. **Avoid/prevent impact:** can be done through utilising alternative sites, technology and scale of projects to prevent impacts. In some cases if impacts are expected to be too high the "no project" option should also be considered, especially where it is expected that the lower levels of mitigation will not be adequate to limit environmental damage and eco-service provision to suitable levels;
2. **Minimise impact:** can be done through utilisation of alternatives that will ensure that impacts on biodiversity and ecoservices provision are reduced. Impact minimisation is considered an essential part of any development project;
3. **Rehabilitate impact** is applicable to areas where impact avoidance and minimisation are unavoidable where an attempt to re-instate impacted areas and return them to conditions which are ecologically similar to the pre-project condition or an agreed post project land use, for example arable land. Rehabilitation often only restores ecological function to some degree to avoid ongoing negative impacts and to minimise aesthetic damage to the setting of a project.
4. **Offset impact:** refers to compensating for latent or unavoidable negative impacts on biodiversity. Offsetting should take place to address any impacts deemed to be unacceptable which cannot be mitigated through the other mechanisms in the mitigation hierarchy. The objective of biodiversity offsets should be to ensure no net loss of biodiversity. Biodiversity offsets can be considered to be a last resort to compensate for residual negative impacts on biodiversity.

Following the assessment of the resources within the study area, impacts associated with the project, with specific mention of the construction of the Ntabelanga and Lalini Dams and their associated infrastructure, are deemed high, largely due to the impact assessment method. Nevertheless, the impacts are considered acceptable when taking into account the socio-economic value of the dams compared to the residual impacts on floral biodiversity. Whilst sections of floral habitat within the study area are considered to be ecologically important and sensitive on a localised and provincial scale, these habitats have already undergone varying degrees of transformation due to ongoing anthropogenic activities within the area, thus the integrity and overall value of these areas has been compromised to some extent. Residual impacts such as the locality of protected trees and cremnophyte habitats are deemed unlikely to be mitigated by offsetting these habitats thus limiting the significance

of an offset programme. The mitigation hierarchy as defined above should nonetheless be implemented accordingly in order to minimise the significance of the impact of the proposed development to ensure that regional conservation targets and objectives are met while still ensuring sustainable development. Although our opinion that a formal offset is not required, “green” initiatives could possibly contribute to the overall success and value to the project.

12 CONSULTATION PROCESS

12.1 CONSULTATION PROCESS FOLLOWED

PUBLIC PARTICIPATION

Engagement with Interested and Affected Parties (I&APs) forms an integral component of the EIA process. I&APs have an opportunity at various stages throughout the EIA process to gain more knowledge about the proposed project, to provide input into the process and to verify that their issues and concerns have been addressed.

The proposed project was announced in April 2014 to elicit comment from and register I&APs from as broad a spectrum of public as possible. The announcement was done by the following means:

- The distribution of Background Information Documents (BIDs) in English and IsiXhosa;
- Placement of site notices in the project area and Municipal offices (Tsolo and Qumbu);
- Placement of advertisements in one regional (The Herald) and two local (Daily Dispatch and the Mthatha Fever) newspapers; and
- Publication of all available information on the DWS web site (www.dwa.gov.za/mzimvubu).

The Draft Scoping Report (DSR) was made available for a 30 day public comment period in May 2014. All documents were uploaded to the web, notification letters were sent out, the summary of the DSR was translated into isiXhosa, distributed to all registered stakeholders and hardcopies of the full report and translated summary report were available at public places. Additionally, three public meetings were held in the affected areas, Siqhungqwini, Tsolo and Lalini respectively. An Authorities Forum Meeting with all relevant authorities was held in the Eastern Cape on the 28 May 2014. This was to assist the authorities with commenting on the relevant documentation.

Comments received from stakeholders were captured in the Issues and Response Report (IRR) which formed part of the Final Scoping Report (FSR). The FSR was made available to the public for a 21 day comment period on 13 June 2014 and was submitted to the Department of Environmental Affairs (DEA). Comments received during the Final Scoping public comment period were compiled and an updated IRR was submitted to DEA on 8 July 204 and uploaded to the website. The FSR was accepted by DEA with certain conditions on 15 July 2014. Following this, a newsletter was compiled and translated to isiXhosa, explaining everything that has happened to date as well as what is to come. Both the English and isiXhosa versions were electronically distributed to all registered stakeholders and hardcopies were distributed by the local facilitators in the affected areas.

The Draft Environmental Impact Assessment Report (DEIR), its summary (translated into isiXhosa), the various specialist studies, the Environmental Management Programmes (one for the construction and operation of the project, and one for the borrow areas and quarries) as well as the Water Use Licence Application will be made available for a period of thirty (30 days) for stakeholders to comment. Hardcopies will be made available at the same venues as the DSR and all documents will be uploaded to the website. The availability of these documents as well as the announcement of the upcoming public meetings in Siqhungqwini, Tsolo and Lalini will be advertised on the Eastern Cape SABC radio station, Umhlobo Wenene FM, which has a

listenership of over 4 million people. Another Authorities Forum Meeting is scheduled for September 2014.

Stakeholder comments will be taken into consideration with the preparation of the final documents. The availability of the final documents will be announced prior to submission to the decision-making authority. Once a decision has been made by the DEA, all stakeholders will again be notified.

The following issues were sourced from the Issue and Response Report (Final Version 1) as submitted to the Department of Environmental Affairs with the Final Scoping Report.

12.2 SUMMARY OF COMMENTS RECEIVED

Issue/Comment/Question	Date received	Origin	Response
In previous cases, alien vegetation growth that was flooded caused a lot of unhappiness with communities, as the plants were being used by people and because people derived an income from removing the vegetation through, for example, *Working for Water*. He asked how this aspect was being dealt with in the EIA.	28.05.2014 AFM	Andrew Lucas (Department of Water Affairs)	If such plants qualified as a resource that is currently being used, and they are lost, this will be captured in the RAP.
Impacts on terrestrial plants to consider search and rescue of protected plants including where they will be relocated to (Rescue Plan for Plants).	01.07.2014 via email	Sizekele Gabula (Department of Environmental Affairs)	Search and rescue of protected tree species must take place within all sensitive habitat areas as identified in the sensitivity maps. Permits for the relocation or cut and destroy of all protected floral species should be obtained from the relevant authorities. Any indigenous floral species that can rescued should be relocated to similar habitat areas outside of the project footprint.
With regards to additional authorization, please consider National Environmental Biodiversity Act (NEMBA) Threatened or Protected Species (TOPS) Regulations in respect of protected plants other than tress covered by National Forest Act.			All species listed under NEMBA TOPS and the National Forest Act was considered. Species deemed likely to inhabit the specific habitat areas of the dams and infrastructure were considered in the POC calculations.
There are two endangered and protected plant species in the project area: a Yellow Arum Lily and a small shrub that has medicinal properties believed to make you strong	May 2014	Isa Thompson (DWS)	During the site assessment, no Arum lilies were noted. It is however possible that this specie can occur within wetland areas closer to the Mountain / Rocky habitat unit outcrops. In terms of the medicinal species referring to in the response, specific reference to this species should be made in order to determine the type of habitat and possible siting.

13 OTHER INFORMATION REQUESTED BY THE AUTHORITY

DEA requested that a map of vegetation types in the study area be provided. This is included in **Figures 13** to **15**.

14 IMPACT STATEMENT

The following table summarises the impacts perceived before and after mitigation measures have been implemented. Impacts will be very high in areas that are associated with more sensitive habitat such as the mountain / afromontane forest and rocky areas due to more suitable habitat available for indigenous floral vegetation and protected and important tree species.

Impact	Construction and first filling		Operational phase	
Mitigation status	**Unmitigated**	**Mitigated**	**Unmitigated**	**Mitigated**
Roads and Infrastructure impact on habitat	High	High	Medium-high	Low
Roads and Infrastructure impact on floral diversity	High	High	Medium-high	Medium-low
Roads and Infrastructure impact on floral SCC	High	High	Medium-high	Medium-low
Electricity Generation and distribution impact on habitat	High	Medium-high	Medium-low	Low
Electricity Generation and distribution impact on species diversity	High	Medium-high	Medium-low	Low
Electricity Generation and distribution impact on SCC	High	Medium-high	Medium-low	Low
Dam impact on habitat	High	Medium-high	Medium-high	Medium-high
Dam impact on species diversity	High	Medium-high	Medium-high	Medium-high
Dam impact on SCC	High	Medium-high	High	Medium-high

14.1 NTABELANGA DAM

The proposed Ntabelanga Dam entails construction of the dam wall and associated infrastructures, such as the camp sites, quarries and burrow pits and accommodation for operational staff. The first filling will form part of the last stages once construction has occurred. Construction of the dam wall would entail the clearance of vegetation, movement of construction vehicles and storage of construction material, leading to the decrease in floral habitat.

Vegetation surrounding the Ntabelanga Dam wall consists of rocky ridge vegetation, mostly indigenous to the area. Little transformation has occurred within this area. The first filling will take approximately 0-3 years, meaning that vegetation located within the footprint area of the full supply level will be submerged under water. Habitat for indigenous floral vegetation along the riparian / wetland areas and the mountain / rocky outcrop areas will be lost.

The impact significance associated with the loss of species habitat is considered to be medium-high prior to implementation of mitigation measures.

Key mitigation measures for the Ntabelanga Dam and associated infrastructure would include the possible re-alignment of the roads where protected tree species were found, in order to avoid cutting and destroying the trees.

14.2 LALINI DAM

The Lalini Dam footprint consists mainly of transformed vegetation due to the surrounding rural communities clearing vegetation for small scale agricultural activities. Thus large sections of the Lalini Dam basin have undergone vegetation transformation, also caused by overgrazing and trampling of veld by livestock.

More sensitive habitat (*Euphorbia* forest) located closer to the dam wall will be affected by the construction of the dam wall and the first filling phase. Vegetation habitat for numerous and sensitive indigenous vegetation will be lost. No protected or RDL floral or tree species were located during the time of the site assessment, but there is a high probability that such species could be present within this habitat unit. The impacts of the loss of protected species will be medium-high to high due to the suitable habitat available for protected woody species to occur.

The impact significance associated with the loss of species habitat is considered to be high prior to implementation of mitigation measures. Rescue and relocation measures can be implemented in more sensitive areas such as the mountain/rocky ridge habitat before construction commences. Floral species need to be relocated to similar habitat types, outside of infrastructure footprint areas.

For the Lalini Dam construction, three alternatives were given. The alternatives covering the least amount of floral and especially sensitive floral vegetation and habitat should be considered. Therefore Alternative 2 would be the more preferred alternative.

Another aspect that should be considered is the type of vegetation and the growth of specific floral species such as cremnophytes. The cremnophytes are floral species, mostly succulents that are associated with cliffs but have distributions that extent to non-cliff habitats. Some species include *Crassula cultrate, C. perforate, C. rupestris, Haemanthus albiflos* and *Portulacaria afra.* Water-holding capacity is important as it directly relates to cliff vegetation. Mostly obligate succulent cremnophytes have a relatively shallow root system and are found on cliffs that dry out rapidly (van Jaarsveld, 2011). Thus, the aspect of a lower overall flow rate at the Tsitsa waterfall, thus decreasing the amount of mist spray and water availability to the surrounding vegetation on the cliffs or within the gorge, needs to be taken into account. It is proposed that a detailed baseline study be conducted to determine the sensitivity of this area before any construction activities commence. Should any medicinal important or RDL species be located within this area during the site assessment, it is recommended that these species identified be rescues and relocated to similar habitat e.g. the upstream waterfall area. Where applicable, permit applications should be obtained from the relevant authority to rescue and relocate these species.

14.3 PRIMARY AND SECONDARY PIPELINES AND IRRIGATION PIPELINES

The primary and secondary pipeline will be constructed close to main or existing roads. Protected tree species located along the secondary pipeline route will be lost should re-alignment of these road not be considered. In terms of vegetation habitat, the edge effects of the existing roads, overgrazed veld and surrounding community villages have transformed

the vegetation to the extent that only grass species, which are associated with more disturbed areas, occur alongside the current access roads. In areas that are associated with disturbance and vegetation clearance, the impact on further transformation of floral habitat of the pipelines will be low, should all possible mitigation measure be implemented.

The irrigation pipelines are mostly situated south of the township of Tsolo. The majority of the sections for the proposed pipelines will be along existing dirt roads. Other vegetation habitat units that the pipelines traverse which have been transformed due to historic and on-going small scale agricultural activities include wetland habitat and rocky areas. The northern section of the irrigation pipeline traverses a woody vegetation habitat area that seems to be more diverse in floral tree species than the rest of the pipeline route. It is possible that protected tree species, favouring afromontane habitat, could occur along the pipeline route or in the surrounding area.

14.4 ROAD UPGRADES

The roads to be upgraded are existing roads that will serve as access roads to the dams. In terms of vegetation diversity, the edge effects of the existing roads, overgrazing and trampling of veld by livestock and the surrounding community villages, have transformed the majority of the road upgrade areas. Alien proliferation alongside the road will also be one of the main concerns. Protected tree species located along the road upgrade area within the Ntabelanga Dam, will be lost.

New access roads will be constructed in the Lalini Dam area. The majority of the newly proposed access roads traverse transformed vegetation types. These areas will not be highly impacted upon since vegetation transformation has already occurred. Access roads close to the Lalini Dam wall will have a very high impact on the overall loss of floral habitat, since these mountain areas provide suitable habitat for numerous indigenous and possible protected floral species.

It is also proposed that a road will be constructed to access the long hydropower tunnel and corresponding alternative power line. This road will be constructed within a highly sensitive habitat area, containing a high diversity of floral species. Most of the floral species are indigenous to the area and also provide suitable habitat for protected tree species and other important and RDL floral species such as *Encephalartos* species. This increases the diversity and overall sensitivity of the area. Should the construction of this road continue a large portion of floral habitat and diversity will be lost. Thus the impact on the immediate and surrounding area will be very high. This route is thus not recommended due to the high impacts and loss of floral habitat and diversity.

Key mitigation measures would include planning of routes within low sensitivity areas, edge effects from the construction activity must be kept to a minimum and permit applications for protected tree species *Podocarpus fulcatus* and *P. latifolius* located along the sections scheduled for road upgrades.

14.5 POWER GENERATION WITH HYDROPOWER TUNNELS AND POWER LINE ALTERNATIVES

The majority of the power lines will traverse transformed (grassland) habitat units, where grasslands and mostly *Acacia karroo* and *Acacia caffra* occur. The transformed habitat unit has been significantly disturbed as a result of historic and on-going agricultural activities and overgrazing of veld. The floral habitat within this habitat unit is therefore largely transformed and placement of infrastructure within this habitat unit will most likely have low impact significance.

Sections of the power line closer to the Tsitsa River will traverse more sensitive habitat associated with mountain / afromontane forests and rocky outcrop habitat. These areas are more sensitive in terms of less vegetation disturbance, great floral diversity and suitable habitat for important and protected species such as *Podocarpus* and *Encephalartos* species. Vegetation clearance within this sensitive habitat will take place, resulting in the removal of protected and important species.

All three sections of the power line alternatives, closer to the Tsitsa River will traverse more sensitive habitat associated with Mountain Rocky Outcrop habitat. Due to the sensitive habitat and diversity of species occurring within these sections, placement of support towers will need to be considered, as indigenous and possible important / protected floral vegetation will be affected. According to the impact assessment results, the power line alternative 1 and 3 will have a much higher impact, even if mitigated due to the power lines crossing larger sections of indigenous and possible protected trees and other floral species. The more preferred power line alternative would be alternative 2 due to a lower impact on the receiving environment. Key mitigation measures include rescue and relocation of protected tree species in high sensitive areas as per the sensitivity map (**Figure 64**). Permits for the removal of these protected tree species (should it occur within the construction footprint area) need to be obtained at the relevant authorities before any construction activities occur within this area.

14.6 KEY MITIGATION MEASURES

- Proliferation of alien and invasive species is expected within any disturbed areas. These species should be eradicated and controlled to prevent their spread beyond the footprint areas.
- Protected tree species *Podocarpus fulcatus* and *P. latifolius* were located along the sections scheduled for road upgrades. The following must be ensured:
  - Where protected trees will be disturbed, ensure effective relocation of individuals (if possible) to suitable similar habitat.
  - Permit applications must be obtained from relevant authorities.
  - Possible re-alignment of the roads where protected tree species were found, in order to avoid cutting and destroying the trees.
- It is suggested that a walk down be done (according to the flowering seasons for identification of species) for the Lalini HEP and access roads prior to the construction

phase to identify any important Red Data Listed (RDL), medicinal or protected species. Should any RDL or protected species be located during the walk down, the necessary authorisation should be obtained to remove, relocate or cut and destroy these floral species.

- Prohibit the collection of plant material, outside of the proposed dam basins, for firewood or for medicinal purposes during the construction phase by construction staff.
- Restrict vehicles as far as possible to travel on designated roadways to limit the ecological footprint.

15 CONCLUSION AND RECOMMENDATIONS

The ecology in the vicinity of the three focal points of the study, namely the Ntabelanga Dam, Lalini Dam and the associated infrastructure (road upgrades / roads to be re-surfaced or new roads and primary and secondary pipelines and sections of the power lines and tunnels) has undergone vegetation transformation due to historic agricultural activities, overgrazing and trampled veld from livestock from the local communities, alien proliferation along the riparian features and bush encroachment due to poor management measures. Other areas where less vegetation transformation has occurred and more natural and indigenous vegetation is still present includes section of the power lines, Lalini Dam wall and associated new roads and portions within the Ntabelanga Dam basin and associated road upgrades.

The following conclusions were made based on the assessment of the various habitat units:

- The ecological function and habitat of the Mountain / Rocky Outcrops habitat unit is considered to be moderate to high due to the few disturbances from agricultural activities, overgrazing and alien floral encroachment. In terms of conservation value, the moderate to high ecological functionality, good habitat integrity, the low incidence of bush or alien floral encroachment, combine to increase the ecological sensitivity of this habitat unit. No protected or RDL floral or tree species were located during the time of the site assessment but there is a high probability that such species could be present within this habitat unit;
- A decrease in floral diversity has occurred as a result of the edge effects from ploughing and crop cultivation, overgrazing, trampling by livestock and vegetation clearance causing severe soil erosion. The Grassland / *Acacia* Thornveld habitat unit is considered to have a low ecological sensitivity and low conservation value due to the change in floral species composition and vegetation structure as a result of the above mentioned impacts. This habitat unit is furthermore well represented within the region, and loss thereof as a result of the dam construction and drowning of the valley will not significantly affect the floral conservation in the region;
- The Riparian / Wetland habitat unit is considered to be of high ecological sensitivity due to the contribution of the various wetland and riparian systems to wetland ecoservices provision and the habitat provided for floral species. Although large sections along the riparian system are dominated by alien invader floral species, pockets of indigenous tree species exist along the Tsitsa River. Wetlands (and riparian areas) contribute to the maintenance of biodiversity through the provision of habitat and maintenance of natural processes. The integrity of a wetland or riparian feature contributes strongly to the capacity of such a feature to provide this benefit, in addition to specific attributes such as the presence of threatened faunal or floral species; and
- The Transformed (Grassland) habitat unit includes areas where vegetation has been completely transformed by historic and on-going small scale agricultural activities and overgrazing of livestock causing erosion and a decrease in vegetation diversity in these areas with reduced numbers of sensitive species present. Where vegetation

has recovered from historic transformation, very little floral diversity occurs. This habitat unit is not under threat within the region, and loss thereof as a result of the proposed dam construction and associated flooding of the vegetation type will not significantly affect the floral conservation in the region.

- The roads to be upgraded consist of either new access roads or re-alignment of roads that will be inundated, thus providing access to the dams during both the construction and operation of the dam and its facilities. In addition to this, some existing roads will be upgraded by resurfacing and improving river crossings etc. The road upgrades are mostly in the vicinity of the Ntabelanga and Lalini Dam. In terms of vegetation diversity, the edge effects of the existing roads have transformed the vegetation to the extent that only grass species such as *Eragrostis curvula, E. chloromelas, Hyparrhenia hirta, Sporobulus africanus* and *Cynodon dactylon*, which are associated with more disturbed areas, occur alongside the current roads. Other areas of the road upgrade (roads to be resurfaced) are located within the higher altitude areas. Indigenous species such as *Aloe marlothii, Aloe ferox* and *Aloe aborescence* occur alongside the current road. These and other indigenous species could be relocated should they occur within the road upgrade (roads to be resurfaced) footprint area. New access roads are proposed within the Lalini Dam area. The habitat area (Mountain / Rocky Outcrops) where the proposed access roads will be situated is considered sensitive due to the higher floral species diversity and possible suitable habitat for protected species. It is suggested that a walk down be done for the Lalini HEP and access roads prior to the construction phase to identify any important Red Data Listed (RDL), medicinal or protected species. Should any RDL or protected species be located during the walk down, the necessary authorisation should be obtained to remove, relocate or cut and destroy these floral species.
- The proposed pipeline routes will be located along several riparian and wetland features, containing mostly alien invader floral species such as *Acacia mearnsii, A. dealbata, Eucalyptus grandis, E. camaldulensis, Melia azedarach* and *Solanum mauritianum*. The gramanoid assemblage is of increased diversity within the wetland and riparian areas when compared to the surrounding terrestrial areas which have been more affected by historical agricultural activities. Due to the severe vegetation transformation within most of the areas along the primary and secondary pipeline route, the low ecological function and state and the low diversity in floral species, the areas set out for the construction of the primary and secondary pipeline route are not considered sensitive. Since the impact of the construction will be of a shorter duration and rehabilitation will be undertaken, the severity of the impact on the floral ecology of the area can be significantly reduced.
- The irrigation pipelines are mostly situated south of the village of Tsolo. The majority of the sections for the proposed pipelines will be along existing dirt roads. Other vegetation habitat units that the pipelines traverse, which have been transformed due to historic and on-going small scale agricultural activities, include wetland habitat and rocky areas. The northern section of the irrigation pipeline traverses a woody vegetation habitat area that most likely has been dominated by *Acacia* species Thus;

it is possible that some extent that bush encroachment has occurred. Some small scale plantation areas also occur within the woody habitat. It is possible that protected tree species, favouring afromontane habitat, could occur along the irrigation pipeline route or in the surrounding area.

- The irrigation fields were briefly assessed and selected areas were investigated as examples of the condition of these areas. The proposed agricultural fields are located within old farming lands. Field assessments indicated that these fields have been uniformly heavily disturbed due to prior farming activities, and as such provide very limited habitat to floral species within the area and region. The decommissioning of these areas as irrigated croplands is considered an insignificant impact to the regional floral ecology.
- The majority of the power lines will traverse transformed (grassland) habitat units, where grasslands and mostly *Acacia karroo* and *Acacia caffra* occur. The transformed habitat unit has been significantly disturbed as a result of historic and on-going agricultural activities and overgrazing of veld. The floral habitat within this habitat unit is therefore largely transformed and placement of infrastructure within this habitat unit will most likely have low impact significance. Sections of the power line closer to the Tsitsa River will traverse more sensitive habitat associated with mountain and rocky outcrop habitat. These areas are more sensitive in terms of less vegetation disturbance, increased floral diversity and suitable habitat for important and protected species such as *Podocarpus* and *Encephalartos* species. Vegetation clearance within this sensitive habitat will take place, most likely resulting in the removal of protected and important species.
- *Podocarpus falcatus* and *P. latifolius* were identified in low abundance alongside the road upgrade (roads to be resurfaced) areas within the Ntabelanga Dam basin, on the northern section of the dam. More *Podocarpus* species were located on the secondary pipeline route south of the town Tsolo. These species are protected according to the notice of the list of protected tree species under the National Forests Act, 1998 (Act No. 84 of 1998) Possible mitigation measure would be to re-align the roads to avoid the trees from being removed or permits for the removal of these protected tree species (should it occur within the construction footprint area) need to be obtained at the relevant authorities before any construction activities occur within this area.
- Although most of the vegetation where the road upgrades or new roads will be constructed within the Lalini Dam has been transformed, it is possible that *Podocarpus* species, *Encephalartos* species and other protected and RDL floral species could occur along the proposed new Lalini Dam roads and the power line 1, in the vicinity of the Tsitsa Falls. Another aspect that should be considered is the type of vegetation and the growth of specific floral species such as cremnophytes. The cremnophytes are floral species, mostly succulents that are associated with cliffs but have distributions that extend to non-cliff habitats. Some species include *Crassula cultrate, C. perforate, C. rupestris, Haemanthus albiflos* and *Portulacaria afra.* Water-holding capacity is important as it directly relates to cliff vegetation. Mostly obligate succulent cremnophytes have a relatively shallow root system and are found on cliffs

that dry out rapidly (van Jaarsveld, 2011). Thus, the aspect of a lower overall flow rate at the Tsitsa waterfall, thus decreasing the amount of mist spray and water availability to the surrounding vegetation on the cliffs or within the gorge, needs to be taken into account. It is proposed that a detailed baseline study be conducted to determine the sensitivity of this area before any construction activities commence. Should any medicinal important or RDL species be located within this area during the site assessment, it is recommended that these species identified be rescues and relocated to similar habitat e.g. the upstream waterfall area. Where applicable, permit applications should be obtained from the relevant authority to rescue and relocate these species.

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APPENDIX A

PROJECT TEAM CURRICULA VITAE

APPENDIX B

VEGETATION INDEX SCORE (VIS)

Habitat unit 1 – Mountain / Rocky Outcrop habitat unit

1. EVC=[(EVC1+EVC2)/2]

EVC 1 - Percentage natural vegetation cover						
Vegetation cover %	**0%**	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Site score					x	
EVC 1 score	0	1	2	3	4	5

EVC 2 – Total site disturbance						
Disturbance score	**0**	**Very low**	**Low**	**Moderate**	**High**	**Very high**
Site score		x				
EVC 2 score	5	4	3	2	1	0

2. SI=(SI1+SI2+SI3+SI4)/4)

	Trees (S1)		Shrubs (S2)		Forbs (S3)		Grasses (S4)	
Score	*Present state	**Perceived reference state	Present state	Perceived reference state	Present state	Perceived reference state	Present state	Perceived reference state
Continuous	x	x						
Clumped								
Scattered			x	x	x	x		
Sparse							x	x

*Present State (P/S) = currently applicable for each habitat unit

**Perceived Reference State (PRS) = if in pristine condition

Each SI score is determined with reference to the following scoring table of vegetation distribution for present state versus perceived reference state.

	Present state (P/S)			
Perceived reference state (PRS)	**Continuous**	**Clumped**	**Scattered**	**Sparse**
Continuous	3	2	1	0
Clumped	2	3	2	1
Scattered	1	2	3	2
Sparse	0	1	2	3

3. *PVC=[(EVC)-(exotic x 0.7) + (bare ground x 0.3)]*

Percentage vegetation cover (exotic)						
	0%	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Vegetation cover %		x				
PVC score	0	1	2	3	4	5
Percentage vegetation cover (bare ground)						
	0%	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Vegetation cover %		x				
PVC score	0	1	2	3	4	5

4. RIS

Extent of indigenous species recruitment	0	Very low	Low	Moderate	High	Very high
RIS						x
RIS Score	0	1	2	3	4	5

VIS = [(EVC) + (SI x PVC) + (RIS)] = 18

The final VIS scores for each habitat unit are then categorised as follows:

Vegetation Index Score	Assessment Class	Description
22 to 25	**A**	Unmodified, natural
18 to 22	**B**	Largely natural with few modifications
14 to 18	**C**	Moderately modified
10 to 14	**D**	Largely modified
5 to 10	**E**	The loss of natural habitat extensive
<5	**F**	Modified completely

Habitat unit 2 – Riparian / Wetland habitat unit

1. EVC=[(EVC1+EVC2)/2]

EVC 1 - Percentage natural vegetation cover						
Vegetation cover %	**0%**	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Site score					x	
EVC 1 score	0	1	2	3	4	5

EVC 2 – Total site disturbance						
Disturbance score	**0**	**Very low**	**Low**	**Moderate**	**High**	**Very high**
Site score			x			
EVC 2 score	5	4	3	2	1	0

2. SI=(SI1+SI2+SI3+SI4)/4)

	Trees (S1)		Shrubs (S2)		Forbs (S3)		Grasses (S4)	
Score	*Present state	**Perceived reference state	Present state	Perceived reference state	Present state	Perceived reference state	Present state	Perceived reference state
Continuous	x	x						
Clumped								
Scattered			x	x			x	
Sparse					x	x		x

*Present State (P/S) = currently applicable for each habitat unit

**Perceived Reference State (PRS) = if in pristine condition

Each SI score is determined with reference to the following scoring table of vegetation distribution for present state versus perceived reference state.

	Present state (P/S)			
Perceived reference state (PRS)	**Continuous**	**Clumped**	**Scattered**	**Sparse**
Continuous	3	2	1	0
Clumped	2	3	2	1
Scattered	1	2	3	2
Sparse	0	1	2	3

3. *PVC=[(EVC)-(exotic x 0.7) + (bare ground x 0.3)]*

Percentage vegetation cover (exotic)						
	0%	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Vegetation cover %			x			
PVC score	0	1	2	3	4	5
Percentage vegetation cover (bare ground)						
	0%	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Vegetation cover %		x				
PVC score	0	1	2	3	4	5

4. RIS

Extent of indigenous species recruitment	0	Very low	Low	Moderate	High	Very high
RIS						x
RIS Score	0	1	2	3	4	5

VIS = [(EVC) + (SI x PVC) + (RIS)] = 14

The final VIS scores for each habitat unit are then categorised as follows:

Vegetation Index Score	Assessment Class	Description
22 to 25	**A**	Unmodified, natural
18 to 22	**B**	Largely natural with few modifications
14 to 18	**C**	Moderately modified
10 to 14	**D**	Largely modified
5 to 10	**E**	The loss of natural habitat extensive
<5	**F**	Modified completely

Habitat unit 3 – Transformed (grassland) habitat unit

1. EVC=[(EVC1+EVC2)/2]

EVC 1 - Percentage natural vegetation cover						
Vegetation cover %	**0%**	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Site score					x	
EVC 1 score	0	1	2	3	4	5

EVC 2 – Total site disturbance						
Disturbance score	**0**	**Very low**	**Low**	**Moderate**	**High**	**Very high**
Site score				x		
EVC 2 score	5	4	3	2	1	0

2. SI=(SI1+SI2+SI3+SI4)/4)

	Trees (S1)		**Shrubs (S2)**		**Forbs (S3)**		**Grasses (S4)**	
Score	*Present state	**Perceived reference state	Present state	Perceived reference state	Present state	Perceived reference state	Present state	Perceived reference state
Continuous						x	x	x
Clumped					x			
Scattered		x	x	x				
Sparse	x							

*Present State (P/S) = currently applicable for each habitat unit

**Perceived Reference State (PRS) = if in pristine condition

Each SI score is determined with reference to the following scoring table of vegetation distribution for present state versus perceived reference state.

	Present state (P/S)			
Perceived reference state (PRS)	**Continuous**	**Clumped**	**Scattered**	**Sparse**
Continuous	3	2	1	0
Clumped	2	3	2	1
Scattered	1	2	3	2
Sparse	0	1	2	3

3. *PVC=[(EVC)-(exotic x 0.7) + (bare ground x 0.3)]*

Percentage vegetation cover (exotic)						
	0%	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Vegetation cover %			x			
PVC score	0	1	2	3	4	5
Percentage vegetation cover (bare ground)						
	0%	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Vegetation cover %		x				
PVC score	0	1	2	3	4	5

4. RIS

Extent of indigenous species recruitment	0	Very low	Low	Moderate	High	Very high
RIS					x	
RIS Score	0	1	2	3	4	5

VIS = [(EVC) + (SI x PVC) + (RIS)] = 10

The final VIS scores for each habitat unit are then categorised as follows:

Vegetation Index Score	Assessment Class	Description
22 to 25	**A**	Unmodified, natural
18 to 22	**B**	Largely natural with few modifications
14 to 18	**C**	Moderately modified
10 to 14	**D**	Largely modified
5 to 10	**E**	The loss of natural habitat extensive
<5	**F**	Modified completely

Habitat unit 4 – Transformed habitat unit

1. EVC=[(EVC1+EVC2)/2]

EVC 1 - Percentage natural vegetation cover						
Vegetation cover %	**0%**	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Site score			x			
EVC 1 score	0	1	2	3	4	5

EVC 2 – Total site disturbance						
Disturbance score	**0**	**Very low**	**Low**	**Moderate**	**High**	**Very high**
Site score				x		
EVC 2 score	5	4	3	2	1	0

2. SI=(SI1+SI2+SI3+SI4)/4)

	Trees (S1)		**Shrubs (S2)**		**Forbs (S3)**		**Grasses (S4)**	
Score	*Present state	**Perceived reference state	Present state	Perceived reference state	Present state	Perceived reference state	Present state	Perceived reference state
Continuous						x	x	
Clumped					x			x
Scattered			x	x				
Sparse	x	x						

*Present State (P/S) = currently applicable for each habitat unit

**Perceived Reference State (PRS) = if in pristine condition

Each SI score is determined with reference to the following scoring table of vegetation distribution for present state versus perceived reference state.

	Present state (P/S)			
Perceived reference state (PRS)	**Continuous**	**Clumped**	**Scattered**	**Sparse**
Continuous	3	2	1	0
Clumped	2	3	2	1
Scattered	1	2	3	2
Sparse	0	1	2	3

3. *PVC=[(EVC)-(exotic x 0.7) + (bare ground x 0.3)]*

Percentage vegetation cover (exotic)						
	0%	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Vegetation cover %				x		
PVC score	0	1	2	3	4	5
Percentage vegetation cover (bare ground)						
	0%	**1-5%**	**6-25%**	**26-50%**	**51-75%**	**76-100%**
Vegetation cover %			x			
PVC score	0	1	2	3	4	5

4. RIS

Extent of indigenous species recruitment	0	Very low	Low	Moderate	High	Very high
RIS					x	
RIS Score	0	1	2	3	4	5

VIS = [(EVC) + (SI x PVC) + (RIS)] = 5

The final VIS scores for each habitat unit are then categorised as follows:

Vegetation Index Score	Assessment Class	Description
22 to 25	**A**	Unmodified, natural
18 to 22	**B**	Largely natural with few modifications
14 to 18	**C**	Moderately modified
10 to 14	**D**	Largely modified
5 to 10	**E**	The loss of natural habitat extensive
<5	**F**	Modified completely