APPENDIX A2: Terrestrial Ecological Survey Report: Goodenough System

LUBWSS_WSS Amendment
Terrestrial Ecological Survey Report

for

May 2020

Report prepared by

Executive summary

Khuselimvelo has been appointed to update the existing Terrestrial Ecological Survey that was undertake by GJ Mc Donald and L Mboyi in 2018 for the Lower Umkomaas Bulk Water Supply Scheme (attached as Appendix 1). The project design as originally Authorized by the competent authority has undergone some changes and an amendment is to be done on the original layout of the following project infrastructure:

Table 1. LUBWSS-WSS proposed amendments

	Project Components	Changes
1.	Goodenough Weir Structure	Position and size change
2.	Rising Main to Hydroclones	Position change
3.	High Lift Pump Station	Position change
4.	Rising Main to Reservoir	Position change
5.	Goodenough Reservoir	Size change
7.	Gravity Main to WTP	Size change
8.	Access Road	Position and length change
9.	*WTP Site	Size change
11.	Rising Main to Quarry reservoir	Position and length change
12.	Quarry Reservoir	No change

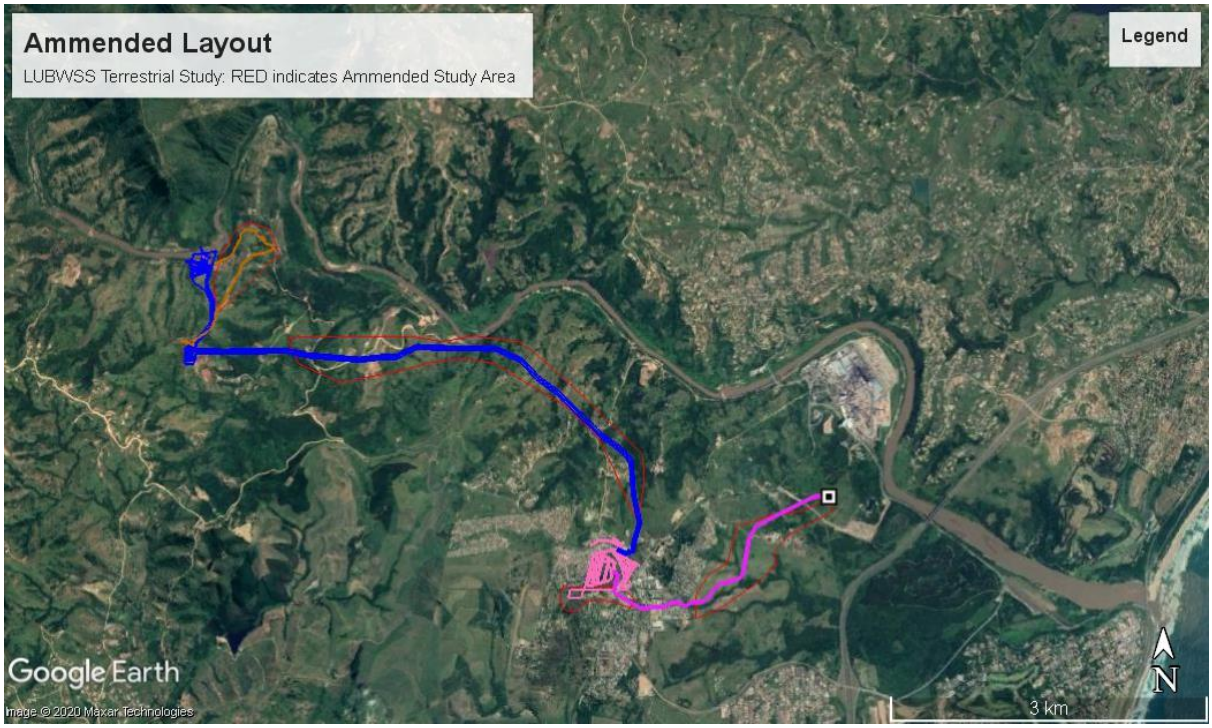


Figure 1. Amended Site Layout with new study focus areas in red

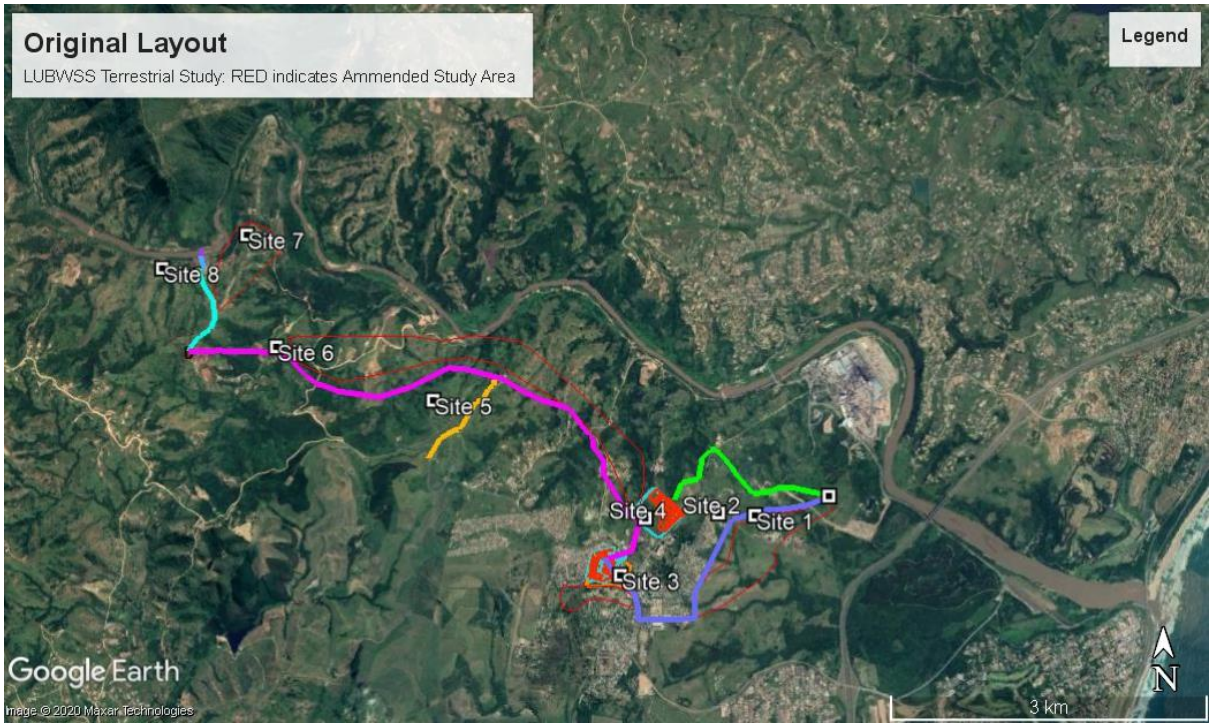


Figure 2. Original Site Layout with new study focus areas in red

Threatened Vegetation

Implications for Amended Layout: The original pipeline routes run within the same ecosystem, with the exception of the Rising Main to Quarry reservoir which in had previously not interacted with the CR Ecosystem. On the other hand, the exclusion of the second option of the WTP location is favourable as this option was located with the CR Ecosystem. The new layout does not result in significant improvement to the conservation of threatened ecosystems and thus has a negative impact for this aspect.

KZN Critical Biodiversity Areas (CBAs)

Implications for Amended Layout: The Original Layout had the same impact on the Macro Ecological planning domain. The exception is the exclusion of the second WTP site option, which fell under this layer. Thus, from a CBA perspective the Amended Layout is less detrimental to the receiving environment.

eKZN Wildlife dispersal corridors

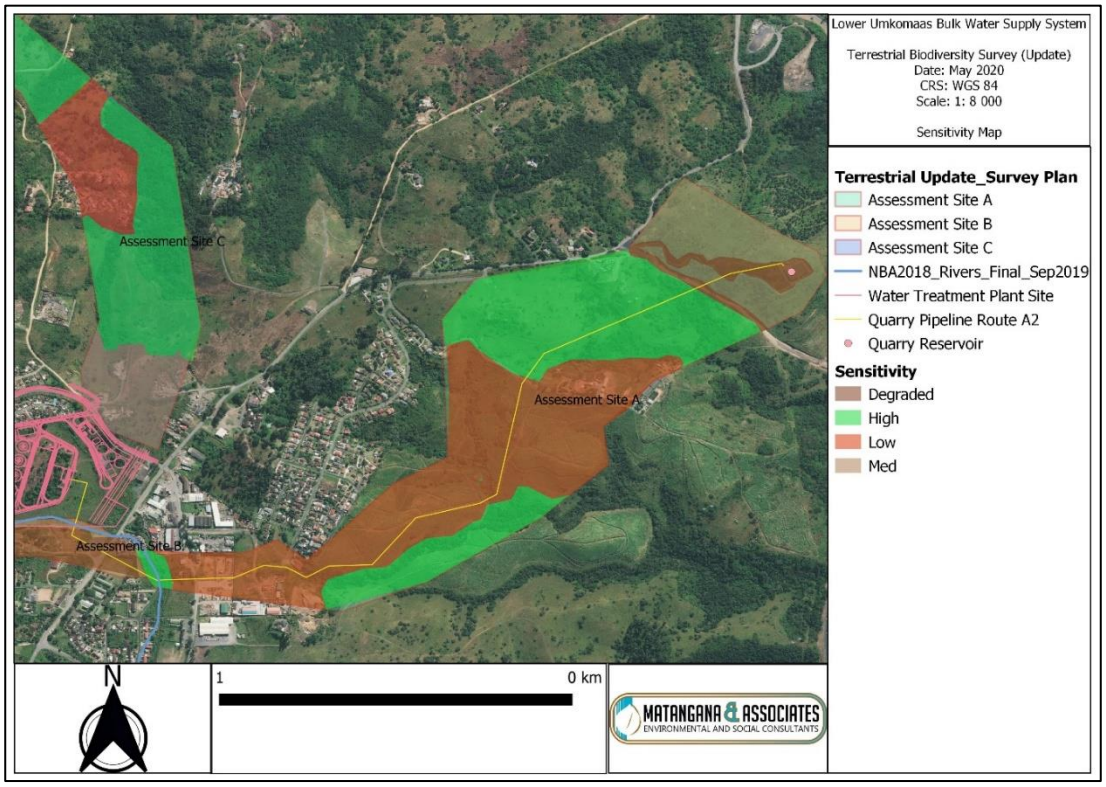
Implications for Amended Layout: The Original Layout had the same impact on the Macro Ecological planning domain. The exception is the exclusion of the second WTP site option,

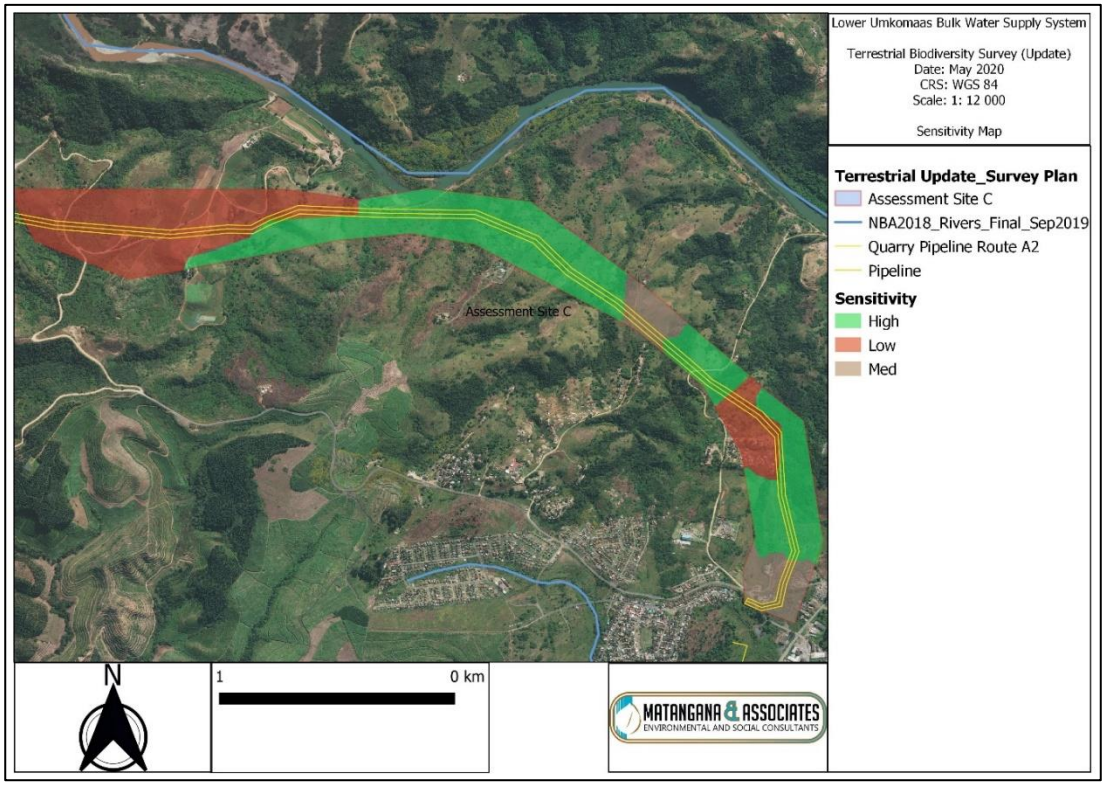
which fell under this layer. Thus, from a Macro Ecological Corridor perspective the Amended Layout is less detrimental to the receiving environment.

D'MOSS

Implications for Amended Layout: The original pipeline and Goodenough weir had the same impact on the DMOSS layer, with exception of the increased size of the disturbance. The orientation and/or position changes have no "new" impact on the D'MOSS, while the increased size only impacts an area situated within the "transformed" category of D'MOSS and outside of the D'MOSS area. On the other hand, the size changes related to the Goodenough Reservoir and the WTP Site have significant impact on the intermediate category of the D'MOSS. The removal of the Option 1 as found in the Original Layout is inconsequential as this site did not fall within the D'MOSS area. Thus the net effect on the D'MOSS is negative and an increase in management measures need to be implemented to ensure rehabilitation and improvement of ecosystems. Further, a strict working servitude needs to instituted that takes into account 1) 32m Watercourse Buffer, 2) a working servitude of not more than 20m in D'MOSS (Good & Intermediate) and 3) a working servitude of less than 30m in D'MOSS (Degraded & Transformed). Infrastructure located in areas under D'MOSS (unknown) should follow the Precautionary Principle to natural resources management and utilize the 20m working buffer.

Sensitivity Mapping




Lower Umkomaas Bulk Water Supply System
Terrestrial Biodiversity Survey (Update)
Date: May 2020
CRS: WGS 84
Scale: 1: 12 000
Sensitivity Map
Terrestrial Update_Survey Plan
Assessment Site C
NBA2018_Rivers_Final_Sep2019
Quarry Pipeline Route A2
Pipeline
Sensitivity
High
Low
Med
Assessment Site C
N
1
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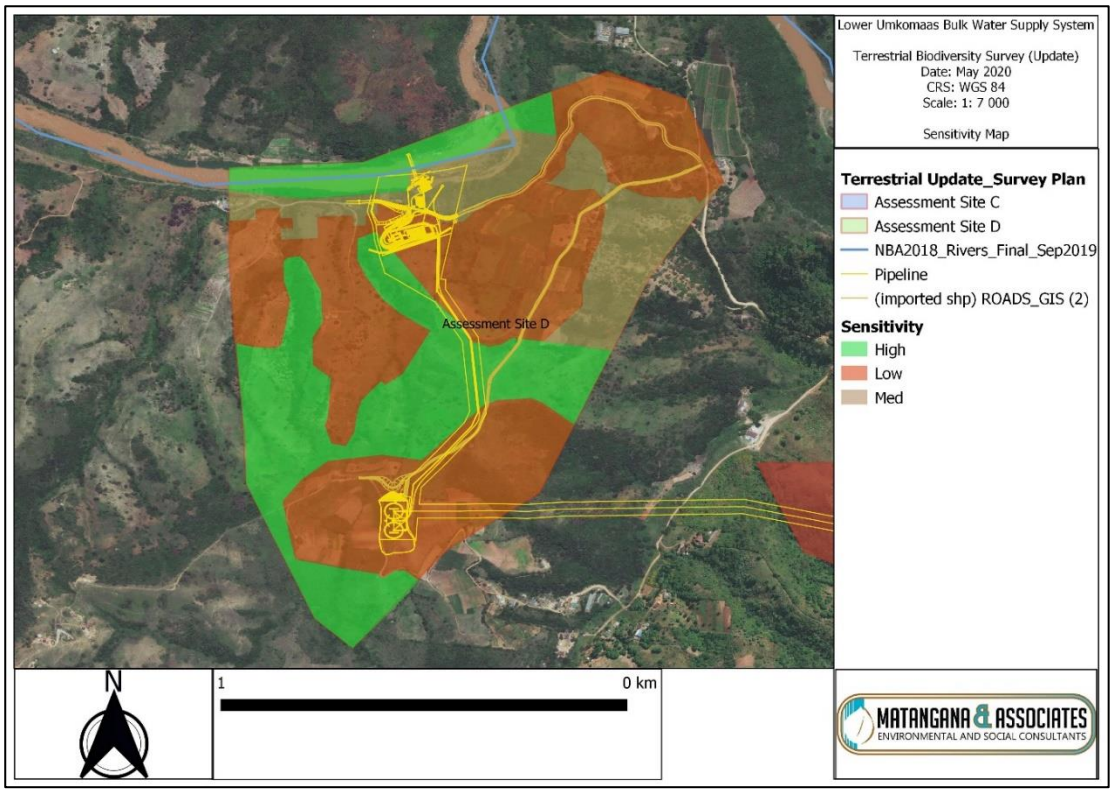
MATANGANA & ASSOCIATES
ENVIRONMENTAL AND SOCIAL CONSULTANTS


Lower Umkomaas Bulk Water Supply System
Terrestrial Biodiversity Survey (Update)
Date: May 2020
CRS: WGS 84
Scale: 1: 7 000
Sensitivity Map
Terrestrial Update_Survey Plan
Assessment Site C
Assessment Site D
NBA2018_Rivers_Final_Sep2019
Pipeline
(imported shp) ROADS_GIS (2)
Sensitivity
High
Low
Med
Assessment Site D
N
1
0 km
MATANGANA & ASSOCIATES
ENVIRONMENTAL AND SOCIAL CONSULTANTS

The findings of this report should be read in conjunction with the original Terrestrial Ecology Report compiled by McDonald and Mboyi in 2018 for the original site layout. The proposed amended layout will have a higher ecological impact significance overall. This is driven by the following aspects of change:

Assessment Area A (Quarry Pipeline Route):

No increase in impacts. The new route is more ecologically desirable as it avoids crossing the high sensitivity area (riparian zone) on the southern border of the assessment area. The route thus results in a reduction of biodiversity risk.

Assessment Area B (Quarry Pipeline & Expansion of WTP Site):

This component of change results in a notable increase in the ecological risk as it presents itself as a single option for assessment. Further the area to be disturbed has increased in size within an ecologically sensitive zone. The area had previously been associated with species of conservation concern and these were encountered in the current survey- thus a search and rescue is recommended following the necessary permitting from the EKZNW.

Assessment Area C (Gravity Main to WTP):

The new pipeline route has not increased the footprint of the vegetation loss and faunal habitat loss. However, the shift of the pipeline route towards more sensitive riparian habitats has implications for more sensitive species such as amphibians, snakes and avifauna breeding site. Thus the net effect of this change will be negative on the ecological risk associated with the project.

Assessment Area D (Reservoir, High Lift Pump Station, Rising Main to Hydroclones, Goodenough Weir Structure, Goodenough Reservoir, Access Road):

A large proportion of the study area consists of transformed agricultural lands and road network. The increased size of the Reservoir will result in impacts remaining within the low sensitivity zones of the study area. Further, the road layout follows the route of existing informal road networks linked to the surrounding farms. The net impact of the changes associated with the study area will be negligible with the exception of the selection of Goodenough Weir changes. The anticipated increase in the footprint of the weir will have negative impacts at a local sensitivity level and implications for landscape level downstream systems. Thus making the changes within the study area increase the ecological risk of the new layout.

It is the opinion of the investigators that there should be no opposition to the proposed amendment provided that the mitigation and monitoring measures highlighted in this report and preceding reports are followed.

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Responsible person	Signed	Date
B Mqokeli (Pr. Sci. Nat) –Ecological Science		27/05/2020
L Mboyi (Cert. Sci. Nat) – Environmental Science		27/05/2020

I, **B Mqokeli**, declare that --

General declaration:

- I act as the independent specialist in this application;
- do not have and will not have any vested interest (either business, financial, personal or other) in the undertaking of the proposed activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2010;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

Name of company (if applicable):

Date: 27 May 2020

1. INTRODUCTION

Khuselimvelo has been appointed to update the existing Terrestrial Ecological Survey that was undertake by GJ Mc Donald and L Mboyi in 2018 for the Lower Umkomaas Bulk Water Supply Scheme (attached as Appendix 1). The project design as originally Authorized by the competent authority has undergone some changes and an amendment is to be done on the original layout of the following project infrastructure:

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The changes related to the abovementioned infrastructure will therefore have a significant impact on the findings related to the level of acceptability of the project from a Terrestrial Ecology perspective. The maps (Figure 1 & 2) below highlight the major changes as per Table 1. It can be seen from the map below that there are several key focus areas for the updated survey that stem from the original layout and survey. It is worth noting that a vast proportion of the "new" layout is included in the original study(Mc Donald and Mboyi 2018). The focus areas for the current survey include:

Assessment Area A- Encompasses the Rising Main to the Quarry reservoir, with the new route straightening and subsequently moving at most 350m South East before crossing the watercourse below Jupiter Road. Between the watercourse crossing and the WTP site the change is at most 120m in a northern direction. The assessment area stretches between the main road from SAPPI Saiccor Plant and towards SAPPI Training Centre. This assessment is aimed at addressing **Change 11**.

Assessment Area B- The area surrounding the WTP site to account for any additional Terrestrial impacts that may be presented by altering the size of the WTP. This area is relatively small and addresses **Change 9**

Assessment Area C- Includes the Gravity Main to WTP, with the new route now moving approximately 400m (+- 100m in some stretches) in a northern direction towards the Umkomaas River. This assessment area addresses **Change 7**

Assessment Area D- This assessment area includes the position changes to the Rising Main to Reservoir, High Lift Pump Station, Rising Main to Hydroclones. Additionally, the position and size/length changes to the Goodenough Weir Structure and Access Road are also looked at. The area also investigates the implications of the size change to the Goodenough Reservoir. This assessment area addresses **Changes 1, 2, 3 4, 5 & 8**.

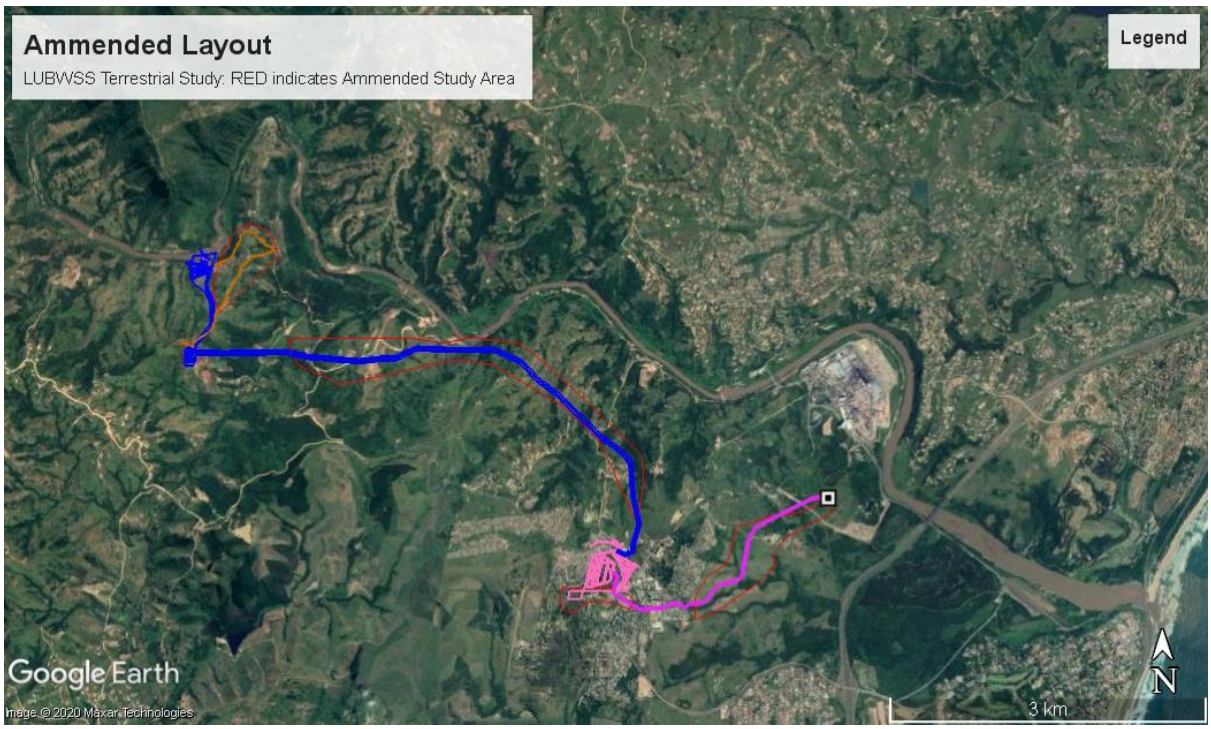

Figure 3. Ammended Site Layout with new study focus areas in red

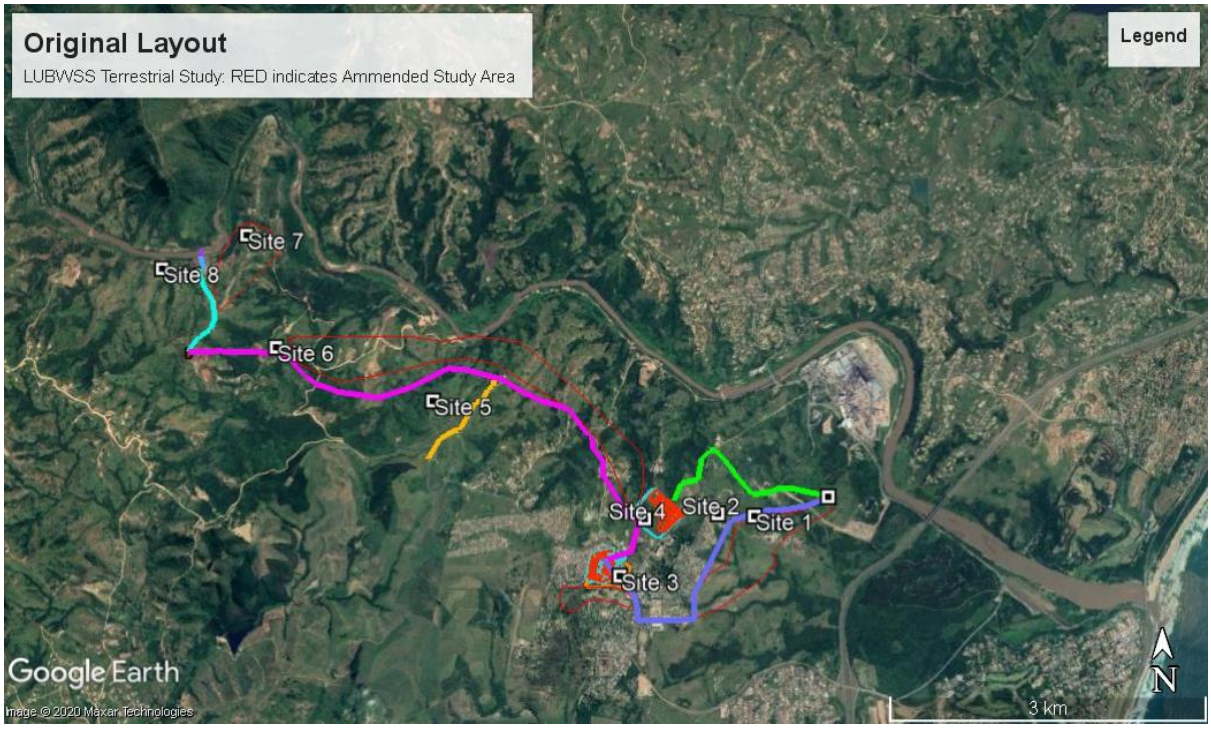

Figure 4. Original Site Layout with new study focus areas in red

2. METHODOLOGY (Adapted from McDonald & Mboyi, 2018)

Geographic Information Systems (GIS) study undertaken to generate overlays for the area taking into account:

- National vegetation type and KwaZulu-Natal vegetation type;
- National Biodiversity Assessment (2018) Remaining and Threatened Vegetation;
- KZN Ecological Support Areas and Macro Ecological Corridors
- Wetlands and watersheds;
- Ezemvelo KwaZulu-Natal Wildlife's Conservation Plan and Durban Metropolitan Open Space System (D'MOSS) impacts; and
- Soils

Desktop study methodology

- An initial remote sensing mapping exercise (using Google earth), identifying important habitats and vegetation types, and contextualising the significance of the natural asset on the study site;
- SANBI Plants of Sothern Africa Online GIS platform was consulted for SCC encountered in the QDGS (3030BA and 3030BB)
- An examination of Ezemvelo KZN Wildlife's Conservation Planning Tool (MINSET) in respect of features of conservation importance and evaluation in terms of Systematic Conservation Planning – this focused on vegetation features and;
- Establish the environmental baseline in terms of the benchmark condition (as per C.R Scott Shaw and Dr. B. Escott, 2011 KwaZulu-Natal Veg Map) for comparative on-site investigations.

Field Assessment Methodology

- Field assessment was undertaken to determine the likely impact of the proposed development on the vegetation and fauna of the study area on the 20th and 22nd May 2020.
- A walkover field survey of the site, verifying the presence or absence of species predicted to occur on the site;
- This included marking the geographic location of any important species and plant communities, and The identification and location of keystone or indicator species that may be impacted;
- Identify important habitats, including grasslands, forests etc.;
- Identify areas of conservation and or ecological importance;
- Consider invasive alien plant status and rehabilitation potential of natural areas; and
- An overall assessment of the condition of the vegetation found on the site, including an assessment of cover, vegetation structure, and vegetation quality.

The generation of recommendations.

- Combining Desktop and Field observations for the Assessment area sensitivity mapping
- Establishment of appropriate no-go areas, buffers in sensitive areas and mitigation measures

2.1 Limitations (Adapted from McDonald & Mboyi, 2018)

The major constraints of such surveys are time and season. Often where more intensive field work is possible, rarer and more cryptic species may be encountered. Furthermore, flowering is season-dependent and makes it easier to locate and identify certain non-woody forb and geophyte species. After the site visits it can be assumed that it is unlikely that returning to the site in other seasons or extending the duration of the survey would yield any different overall findings. The species checklists provided in this report are, nevertheless, reflective of only those species identified at the time of the survey and cannot be regarded as exhaustive.

Any faunal study is largely limited to a literature survey of species known to occupy the general area or vegetation type as a result of the mobility of the species involved. Repeated visits and intensive sampling may still not reveal the true presence or absence of certain species.

The study area falls within two Quarter Degree Grid Squares (QDGS), namely 3030 BA (Dududu) and 3030 BB (Umkomaas). The latter QDGS is largely under-sampled in terms of fauna in the databases consulted and the majority of the proposed development would fall within this QDGS. Very little of the proposed development falls within QDGS 3030BB, which contains a large proportion of coastal habitat, which means many of the species recorded from faunal databases are unlikely to occur at the site (eg. numerous Red Data sea birds).

2.2 Study area

The study area falls within the QDGSs 3030 BA and 3030 BB in the eThekwini Municipality which is 229190.6 hectares in extent. Areas remaining natural constitute some 106016.1 hectares (46.3% of municipality), while areas where no natural habitat remains constitute 122641.2 hectares (53.5% of municipality).

There are six formal land-based protected areas covering 999.8 hectares (0.4% of municipality) and includes Beachwood Mangroves (Provincial) Nature Reserve

(77.6ha - 0.03% of municipality), Bluff (Provincial) Nature Reserve (46ha - 0.02% of municipality), Kenneth Stainbank (Provincial) Nature Reserve (211ha - 0.09% of municipality), Krantzkloof (Provincial) Nature Reserve (588.4ha - 0.26% of municipality), North Park (Provincial) Nature Reserve (42.1ha - 0.02% of municipality) and uMhlanga Lagoon (Provincial) Nature Reserve (34.8ha - 0.02% of municipality).

There are no Ramsar sites in the eThekwini Municipality.

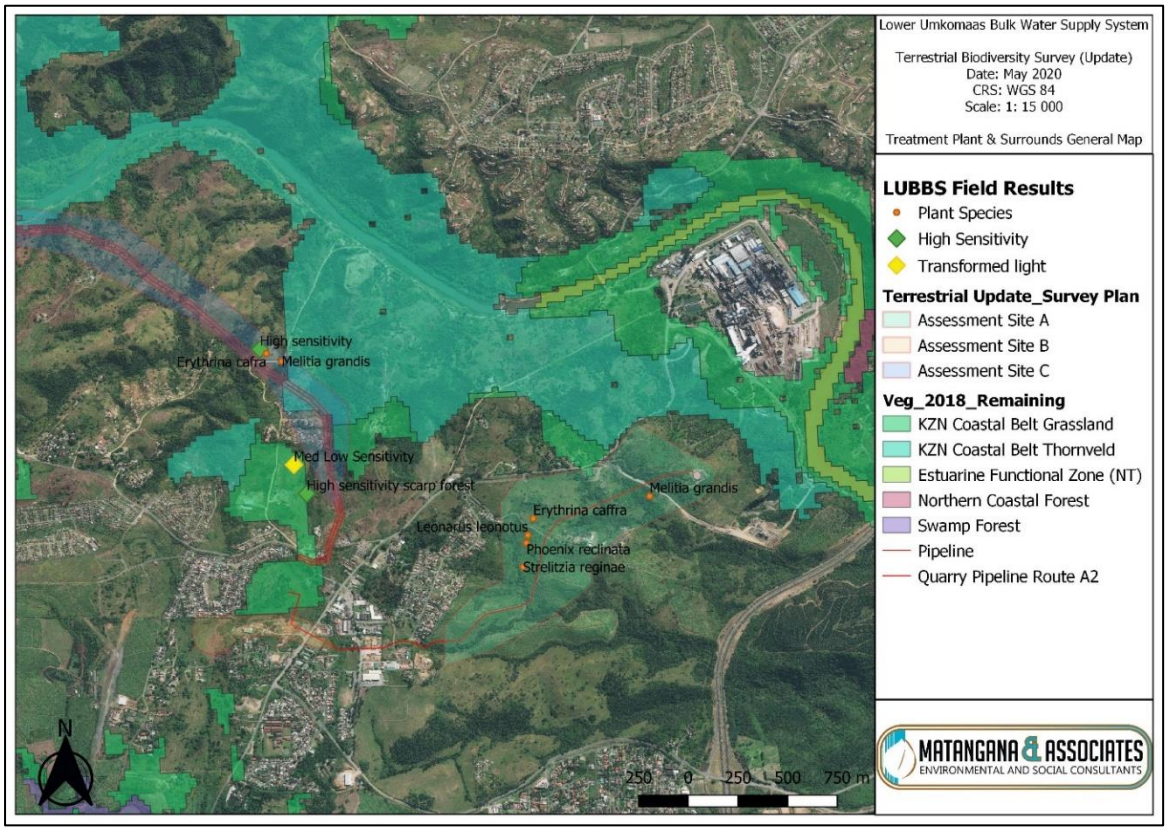

Figure 5. NBA 2018 Remaining Vegetation Map relative to Amended Project Layout for LUBSS-WSS

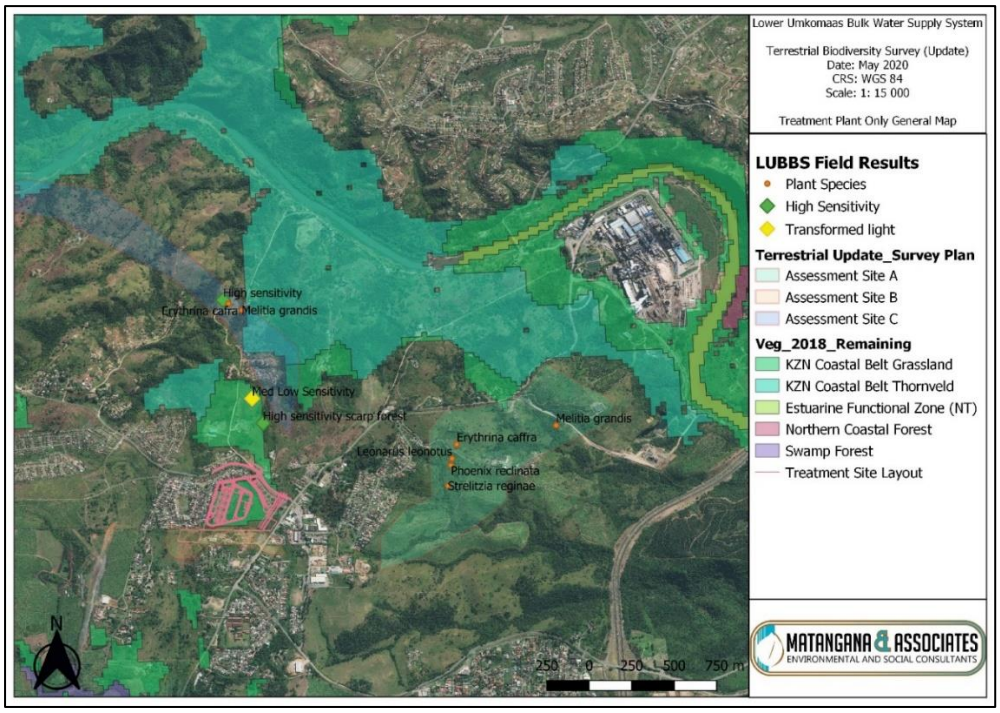

Figure 6. NBA 2018 Remaining Vegetation Map relative to Amended Project Layout for LUBSS-WSS showing WTP Site

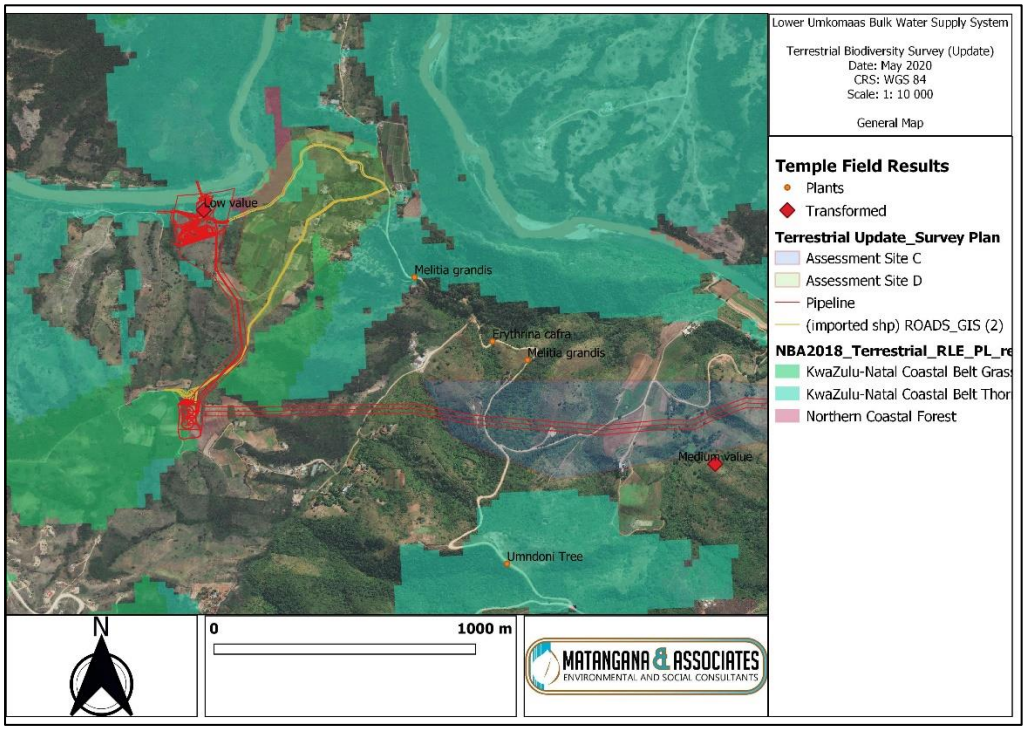

Figure 7. NBA 2018 Remaining Vegetation Map relative to Amended Project Layout for Goodenough Infrastructure

Soils

Soils in the general study area are uniformly distributed and are characterised as soils with minimal development, usually shallow on hard or weathering rock, with or without intermittent diverse soils. Lime is rare or absent in the landscape. These soils are classed as Lithosols.

Vegetation types

The Municipality falls within two Biomes, namely the Indian Ocean Coastal Belt of 152670.7 hectares (66.61% of municipality) and Savanna of 76272.4 hectares (33.28% of municipality) and has 10 vegetation types, namely:

- Eastern Valley Bushveld (22542ha - 9.84% of municipality)
- KwaZulu-Natal Coastal Belt (148366.3ha - 64.73% of municipality)
- KwaZulu-Natal Hinterland Thornveld (6897.8ha - 3.01% of municipality)
- KwaZulu-Natal Sandstone Sourveld (15670.4ha - 6.84% of municipality)
- Mangrove Forest (61.9ha - 0.03% of municipality)
- Ngongoni Veld (31986.7ha - 13.96% of municipality)
- Northern Coastal Forest (937.6ha - 0.41% of municipality)
- Scarp Forest (1017.9ha - 0.44% of municipality)
- Subtropical Coastal Lagoons (1094.6ha - 0.48% of municipality)
- Subtropical Seashore Vegetation (367.7ha - 0.16% of municipality)

Threatened Terrestrial Ecosystems

Critically Endangered (CR)

- Durban Metropole North Coast Grassland - **KZN 2 -** 12763.3ha (5.57% of municipality)
- Interior North Coast Grasslands - **KZN 6** - 10816.4ha (4.72% of municipality)
- Interior South Coast Grasslands - **KZN 7** - 9782.9ha (4.27% of municipality)
- uMlazi Gorge - **KZN 11** - 2805.7ha (1.22% of municipality)
- New Hanover Plateau - **KZN 12** - 3582.3ha (1.56% of municipality)
- Northern Coastal Grasslands - **KZN 16 -** 5127.5ha (2.24% of municipality)
- Southern Coastal Grasslands - **KZN 18** - 2396.9ha (1.05% of municipality)

Endangered (EN)

- KwaZulu-Natal Coastal Forest - **FOz 7_1** - 2.8ha
- KwaZulu-Natal Sandstone Sourveld - **SVs 5** - 5529.3ha (2.41% of municipality)

Vulnerable (VU)

- Eastern Scarp Forest - **FOz 5_1** - 775.8ha (0.34% of municipality)
- KwaZulu-Natal Coastal Belt - **CB 3** - 16557ha (7.22% of municipality)
- Ngongoni Veld - **SVs 4** - 16881ha (7.37% of municipality)

Wetlands

There are 1239 wetlands covering 4025.1 hectares (1.8% of eThekwini Municipality), none of which falls within the study area.

Land use:

Much of the area in which the proposed activity will take place is secondary grassland (fallow cane fields) with some areas still under commercial agriculture. A few natural areas still exist, but these have been substantially impacted by alien plant invasion and by cattle grazing and fire. Through part of its route, the pipeline passes through areas of low density formal housing.

3. DESKTOP FINDINGS

3.1 Vegetation types

According to Mucina and Rutherford (2006) the following applies:

Box 1. FOz 7 Northern Coastal Forest and Swamp Forest

FOz 7 Northern Coastal Forest

Distribution: KwaZulu-Natal and (to a very small extent) Eastern Cape Province: Especially along the seaboards of the Indian Ocean of KwaZulu-Natal Province and particularly well-developed in Maputaland. Few patches of the dune forest also occur on the Wild Coast of Transkei (Eastern Cape Province). Beyond South Africa these forests occur throughout the Mozambican seaboard as far as southern Tanzania. At low altitudes, from about 10 to 150m.

Vegetation & Landscape Features: Species-rich, tall/medium-height subtropical coastal forests occur on coastal (rolling) plains and stabilised coastal dunes. Forests of the coastal plains are dominated by *Drypetes natalensis*, *Englerophytum natalense*, *Albizia adianthifolia*, *Diospyros inhacaensis*. The low-tree and shrubby under-storeys are species-rich and comprise many taxa of (sub)tropical provenence. On dunes, these forests have well-developed tree, shrub and herb layers. *Mimusops caffra*, *Sideroxylon inerme*, *Dovyalis longispina*, *Acacia kosiensis* and *Psydrax obovata* subsp. *obovata* are the most common constituents of the tree layer. *Brachylaena discolor* var. *discolor*, *Chrysanthemoides monilifera* subsp. *rotundata*, *Carissa bispinosa* subsp. *bispinosa*, *Euclea natalensis*, *E. racemosa*, *Eugenia capensis*, *Gymnosporia nemorosa*, *Kraussia floribunda*, *Peddiea africana*, *Strelitzia nicolai* and *Dracaena aletriformis* are frequent in the understorey. The herb layer usually contains *Asystasia gangetica*, *Isoglossa woodii*, *Microsorum scolopendria*, *Zamioculcas zamiifolia* and *Oplismenus hirtellus*. Herbaceous vines and woody climbers (*Acacia kraussiana*, *Artabotrys monteiroae*, *Dalbergia armata*, *Landolphia kirkii*, *Monanthotaxis caffra*, *Rhoicissus tomentosa*, *Rhus nebulosa*, *Scutia myrtina*, *Uvaria caffra* and *Gloriosa superba*) are important structural determinants in these forests.

Geology & Soils: Well-developed sandy-loamy soils on sedimentary rocks of the Karoo Supergroup and Jurassic intrusive dolerites (in places) as well as on Holocene marine sediments. Forming stabilised sandy dune systems, mostly younger than 10 000 years and still in the process of sedimentation.

Important Taxa: Tall Trees: *Albizia adianthifolia*, *Drypetes reticulata, Mimusops caffra, Psydrax obovata* subsp. *obovata, Sideroxylon inerme, Trichilia emetica*, *Vepris lanceolata*. Small Trees: *Brachylaena discolor* subsp. *discolor, Buxus natalensis, Cavacoa aurea, Englerophytum natalense, Erythroxylum emarginatum, Eugenia capensis, Gymnosporia nemorosa, Kraussia floribunda, Peddiea africana*, *Rhus nebulosa, Strychnos henningsii, Acokanthera oblongifolia*, *Callichilia orientalis*,

Deinbollia oblongifolia, *Dovyalis rhamnoides*, *Euclea natalensis*, *E. racemosa*, *Scutia myrtina*, *Strychnos decussata*, *Tapura fischeri*, *Teclea gerrardii*, *Turraea floribunda*, *Xylotheca kraussiana*. Woody Climbers: *Acacia kraussiana, Rhoicissus tomentosa, Dalbergia armata*, *Monanthotaxis caffra*, *Uvaria caffra*. Herbaceous Climber: *Gloriosa superba*. Tall Shrubs: *Carissa bispinosa* subsp. *bispinosa*, *Hyperacanthus amoenus*, *Putterlickia verrucosa*. Low Shrub: *Chrysanthemoides monilifera* subsp. *rotundata*. Soft Shrub: *Isoglossa woodii*. Megaherbs: *Dracaena aletriformis, Strelitzia nicolai.* Herbs: *Achyranthes aspera*, *Asystasia gangetica, Laportea peduncularis*. Geophytic Herb: *Microsorum scolopendria*. Graminoids: *Cyperus albostriatus*, *Oplismenus hirtellus*.
Biogeographically Important Taxa : ([M]Maputaland endemic, [S]Southern distribution limit) Tall Trees: *Celtis gomphophylla*[S] (d), *Chrysophyllum viridifolium*[S] (d), *Diospyros inhacaensis*[S] (d), *Drypetes natalensis*[S] (d), *Cola natalensis*[S], *Inhambanella henriquesii*[S], *Manilkara concolor*[S]. Small Trees: *Coffea racemosa*[S] (d), *Dovyalis longispina*[S] (d), *Artabotrys monteiroae*[S], *Encephalartos ferox*[M], *Erythrococca berberidea*[S], *Pancovia golungensis*[S]. Tall Shrubs: *Haplocoelum foliolosum* subsp. *mombasense*[S], *Landolphia kirkii*[S].

Endemic Taxon: Small Tree: *Acacia kosiensis*.

Conservation Status: LEAST THREATENED in general, but still under threat on coastal dunes of KwaZulu-Natal (due to mining) where it is considered CRITICALLY ENDANGERED. The original extent of these forests has been diminished by agriculture (mainly sugar cane and fruit gardens), timber plantations, urban sprawl and tourism-oriented development on the KwaZulu-Natal coast. The current threats include (besides the ongoing coastal development pressures) illegal clearing of the forest and turning it into lots for small-scale farming. These subtropical forests are sensitive to alien plant invasion, and invaders such as *Chromolaena odorata,* species of *Pereskia* and *Acacia* are posing serious threats.

FOa 2 Swamp Forest
Refer to Mucina and Rutherford (2006) pg 607, Figure 12.19 and 12.20.
Distribution:
KwaZulu-Natal and Eastern Cape Provinces: In pockets and narrow ribbons extending in a narrow belt along the Indian Ocean coast from Maputaland as far south as Port Grosvenor in Pondoland. Swamp Forests reach lower latitudes than Mangrove Forests, which suggests that they are climatically more limited than the mangroves. At low altitude, mainly between 20 and 60 m. This can be further subdivided into Swamp Forests: *Ficus trichopoda*; *Barringtonia*, *Voacanga thouarsii* and *Raphia* Swamp Forest.
Vegetation and Landscape features:
12-15 m tall forests with 2 main strata (canopy and shrub layers). The dominating trees include *Ficus trichopoda, Barringtonia racemosa, Casearia gladiiformis, Cassipourea gummiflua, Syzygium cordatum, Phoenix reclinata* and *Raphia australis.* Understorey is poorly developed. Some ferns such as *Microsorum punctatum* and *Nephrolepsis bisserata* are of importance and orchids (*Eulophia horsfallii)* occur frequently.

Box 2. CB 3 KwaZulu-Natal Coastal Belt Grassland and Thornveld

CB 3 KwaZulu-Natal Coastal Belt Grassland

Distribution KwaZulu-Natal Province: Long and in places broad coastal strip along the KwaZulu-Natal coast, from near Mtunzini in the north, via Durban to Margate and just short of Port Edward in the south. Altitude ranges from about 20 to 450m.

Vegetation & Landscape Features Highly dissected undulating coastal plains which presumably used to be covered to a great extent with various types of subtropical coastal forest (the remnants of one of which are described as Northern Coastal Forest). Some primary grassland dominated by *Themeda triandra* still occurs in hilly, high-rainfall areas where pressure from natural fire and grazing regimes prevailed. At present the KwaZulu-Natal Coastal Belt is affected by an intricate mosaic of very extensive sugarcane fields, timber plantations and coastal holiday resorts, with interspersed secondary *Aristida* grasslands, thickets and patches of coastal thornveld.

Geology & Soils Ordovician Natal Group sandstone, Dwyka tillite, Ecca shale and Mapumulo gneiss (Mokolian) dominate the landscapes of the KwaZulu-Natal Coastal Belt. Weathering of old dunes has produced the red sand, called the Berea Red Sand, in places. The soils supported by the above-mentioned rocks are shallow over hard sandstones and deeper over younger, softer rocks.

Climate Summer rainfall, but with some rainfall also in winter. High air humidity. No incidence of frost. Mean maximum and minimum monthly temperatures for Durban (airport) are 32.6°C and 5.8C and for Port Shepstone 30.6°C and 8.8°C (both for January and July, respectively).

Important Taxa Graminoids: *Aristida junciformis* subsp. *galpinii*, *Digitaria eriantha*, *Panicum maximum*, *Themeda triandra*, *Alloteropsis semialata* subsp. *eckloniana*, *Cymbopogon caesius*, *C. nardus*, *Eragrostis curvula*, *Eulalia villosa*, *Hyparrhenia filipendula*, *Melinis repens*. Herbs: *Berkheya speciosa* subsp. *speciosa*, *Cyanotis speciosa*, *Senecio glaberrimus*, *Alepidea longifolia*, *Centella glabrata*, *Cephalaria oblongifolia*, *Chamaecrista mimosoides*, *Conostomium natalense*, *Crotalaria lanceolata*, *Dissotis canescens*, *Eriosema squarrosum*, *Gerbera ambigua*, *Hebenstretia comosa*, *Helichrysum cymosum* subsp. *cymosum*, *H. pallidum*, *Hibiscus pedunculatus*, *Hybanthus capensis*, *Indigofera hilaris*, *Pentanisia prunelloides* subsp. *latifolia*, *Senecio albanensis*, *S. bupleuroides*, *S. coronatus*, *S. rhyncholaenus*, *Sisyranthus imberbis*, *Stachys aethiopica*, *S. nigricans*, *Vernonia galpinii*, *V. oligocephala*. Geophytic Herbs: *Bulbine asphodeloides*, *Disa polygonoides*, *Hypoxis filiformis*, *Ledebouria floribunda*, *Pachycarpus asperifolius*, *Schizocarphus nervosus*, *Tritonia disticha*. Low Shrubs: *Clutia pulchella*, *Gnidia kraussiana*, *Phyllanthus glaucophyllus*, *Tephrosia polystachya*. Woody Climbers: *Abrus laevigatus*, *Asparagus racemosus*, *Smilax anceps*. Small Trees & Tall Shrubs: *Bridelia micrantha, Phoenix reclinata*, *Syzygium cordatum*, *Acacia natalitia*, *Albizia adianthifolia*, *Antidesma venosum*.

Biogeographically Important Taxa ([C]Coastal belt element, [S]Southern distribution limit) Graminoids: *Cyperus natalensis*[C], *Eragrostis lappula*[S]. Herbs: *Helichrysum longifolium*[C], *Selago tarachodes*[C], *Senecio dregeanus*[C], *Sphenostylis angustifolia*[S]. Geophytic Herbs: *Kniphofia gracilis*[C], *K. littoralis*[C], *K. rooperi*[C], *Pachystigma venosum*[S], *Zeuxine africana*[S]. Low Shrubs: *Helichrysum kraussii*[S] (d), *Agathisanthemum bojeri*[S], *Desmodium dregeanum*[C]. Megaherb: *Strelitzia nicolai*[C] (d). Geoxylic Suffrutices: *Ancylobotrys petersiana*[S], *Eugenia albanensis*[C], *Salacia kraussii*[S]. Small Trees & Tall Shrubs: *Anastrabe integerrima*[C] (d), *Acacia nilotica* subsp. *kraussiana*[S].

Endemic Taxa Herb: *Vernonia africana* (extinct). Geophytic Herb: *Kniphofia pauciflora*. Low Shrub: *Barleria natalensis* (extinct).

Conservation: ENDANGERED in general, but CRITICALLY ENDANGERED in KZN. About 50% transformed for cultivation, by urban sprawl and for road-building. Aliens include *Chromolaena odorata, Lantana camara, Melia azedarach* and *Solanum mauritianum*. Erosion is low and moderate.

CB 6 KwaZulu-Natal Coastal Belt Thornveld

Distribution: KwaZulu-Natal Province: From near Mandini in the north to Oribi Gorge in the south. Altitude 30 to 500m.

Vegetation & Landscape Features: Steep valley sides and hilly landscape mainly associated with drier, larger river valleys in the rain shadow of the rain bearing frontal weather systems from the east coast. Bushed grassland, bushland and bushland thicket, and open woodland.

Climate: Summer rainfall with some rain in winter. Mean Annual Precipitation (MAP) about 740 to 940mm. Summers are hot and humid and winters mild. Frost does not occur.

Conservation Status: VULNERABLE. This vegetation unit grades into the SVs 6 Eastern Valley Bushveld and SVs 3 KwaZulu-Natal Hinterland Thornveld in the larger river valleys.

Threatened Vegetation

Context

The remain natural vegetation has been categorized into their respective threat statuses, the project layout interacts with the KZN Coastal Belt Grassland, KZN Coastal Belt Thornveld and the Northern Coastal Forest vegetation types.

- KZN Coastal Grassland (Critically Endangered in KZN (2011), but Endangered according to the NBA, 2018)
- KZN Coastal Thornveld (Vulnerable in both KZN, 2011 & NBA, 2018)
- Northern Coastal Forest (Least Concern in both KZN, 2011 & NBA, 2018)

Site Analysis

The majority of the project infrastructure is located in the KZN Coastal Grassland (CR), this includes all pipeline infrastructure, access roads and the Goodenough Reservoir. The WTP is not located within a threatened ecosystem, while the Goodenough Weir is located within the KZN Coastal Thornveld (VU).

Implications for Amended Layout: The original pipeline routes run within the same ecosystem, with the exception of the Rising Main to Quarry reservoir which in had previously not interacted with the CR Ecosystem. On the other hand, the exclusion of the second option of the WTP location is favourable as this option was located with the CR Ecosystem. The new layout does not result in significant improvement to the conservation of threatened ecosystems and thus has a negative impact for this aspect.

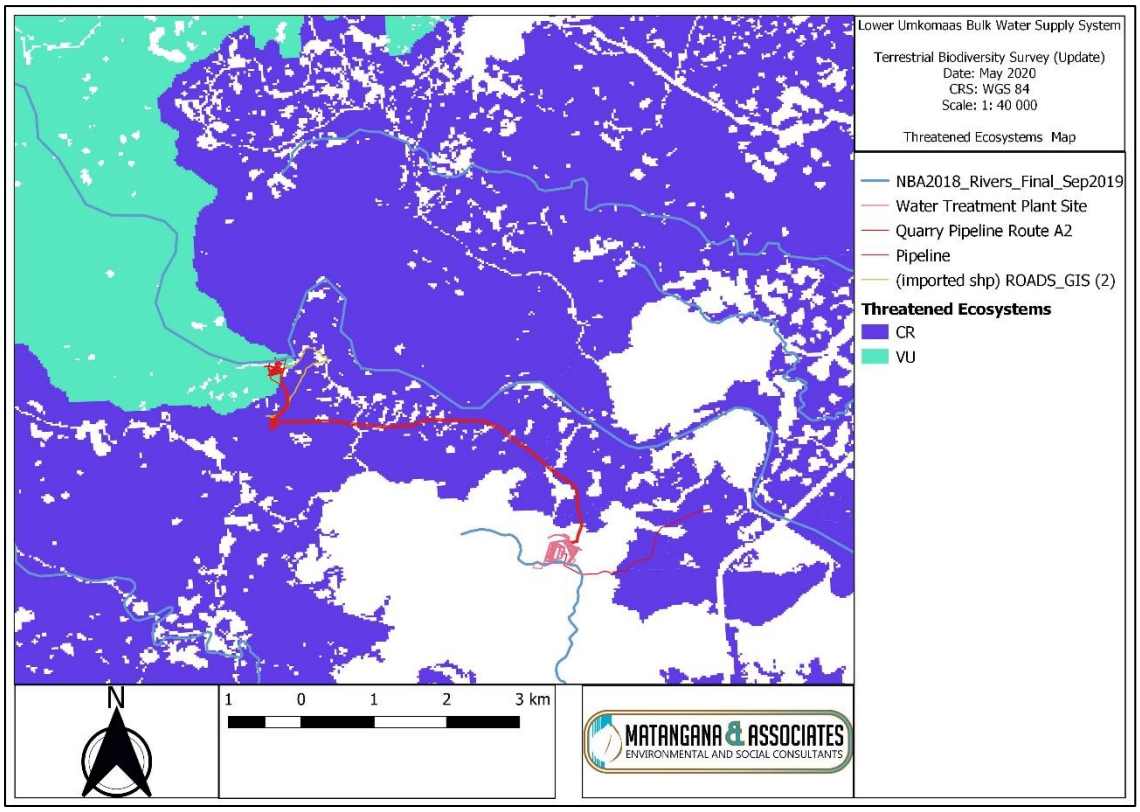

Figure 8. NBA 2018 Threatened Vegetation Map relative to Amended Project Layout for LUBSS-WSS

3.2 KZN Critical Biodiversity Areas (CBAs)

Context

At the core of the systematic conservation planning framework are clearly stated conservation targets or goals for biodiversity features. These features include all the major terrestrial and aquatic ecosystems and processes. In addition, these cover a selected number of species that are either endemic to KwaZulu-Natal (i.e. their worldwide distribution occurs exclusively within the borders of the province) or are nationally or internationally endangered and KwaZulu-Natal can make a significant contribution to their conservation. At the heart of each biodiversity features target is the desire to conserve a representative and viable sample of the feature. Biodiversity targets change as the understanding of the dynamics of the features change.

The first product of the conservation planning analysis in C-Plan is an irreplaceability map of the planning area, in this case the province of KwaZulu-Natal. This map is divided into 2 by 2 km grid cells called 'planning units'. Each cell has associated with it an 'Irreplaceability Value' which is one reflection of the cells importance with respect to the conservation of biodiversity. Irreplaceability reflects the planning units ability to meet set 'targets' for selected biodiversity 'features'. Subsequently, the CBA Irreplaceable map is produced from this.

The proposed development activity will take place within an area designated as a Critical Biodiversity Area (CBA) type 3. This rating is due to the potential presence of a number of invertebrates such as mollusks and millipedes and the presence of South Coast Grassland and South Coast Bushland.

Box 3. Irreplaceability Values and CBA Categories

The CBA: Irreplaceable Areas (SCA) are identified as having an Irreplaceability value of 1, these PUs represent the only localities for which the conservation targets for one or more of the biodiversity features contained within can be achieved, i.e. there are no alternative sites available. This category is identified only through C-Plan optimisation program and is thus only applicable to the Terrestrial and Estuarine Systematic Conservation Assessment (SCA) outputs. In the Terrestrial SCA, this category was previously referred to as a ***Biodiversity Priority 1 Area.***

The CBA: High Irreplaceable Areas represent areas of significantly high biodiversity value. In C-Plan analyses, these areas are identifiable as having an Irreplaceability score of >= 0.8 and < 1.0 whilst the MARXAN equivalent is reflected in Planning Units (PUs) displaying a selection frequency value of between 80 – 100%. In practical terms, this means that there are alternate sites within which the targets can be met for the biodiversity features contained within, but there aren't many. This site was chosen because it represents the most optimal area for choice in the systematic planning process, meeting both the conservation target goals for the features concerned as well as a number of other guiding criteria as defined by the Decision Support Layers or Cost Layer. Whilst the targets could be met elsewhere, the revised reserve design (derived through either the C-Plan MINSET or MARXAN analysis) would more often than not require more area in order to meet its conservation objectives. The scarcity of the biodiversity features contained within is still the primary driver for this PUs selection in the conservation assessment, however. In the Terrestrial SCA, this category was previously referred to as a ***Biodiversity Priority 2 Area.***

The CBA: Optimal Areas are areas which represent the best localities out of a potentially larger selection of available PU's that are optimally located to meet both the conservation target but also the criteria defined by either the Decision Support Layers or the Cost Layer. Using C-Plan, these areas are identified through the MINSET analysis process and reflect the negotiable sites with an Irreplaceability score of less than 0.8. Within the C-Plan MINSET analysis this does not mean they are of a lower biodiversity value however, only that there are more alternate options available within which the features located within can be met. The determination of the spatial locality of these PU's is driven primarily by the Decision Support Layers. In the Terrestrial SCA, this category was previously referred to as a ***Biodiversity Priority 3 Area.***

Site Analysis

The majority of the site falls within the KZN CBA 1 Category or the area that is considered to be highly irreplaceable (Value = 1) within the EKZNW Macro Ecological planning domain. This indicates that the area has high biological diversity. However,

it can be noted that the WTP site does not fall within the CBA layer. This can be attributed to the densely built up area that surrounds the site.

Implications for Amended Layout: The Original Layout had the same impact on the Macro Ecological planning domain. The exception is the exclusion of the second WTP site option, which fell under this layer. Thus, from a CBA perspective the Amended Layout is less detrimental to the receiving environment.

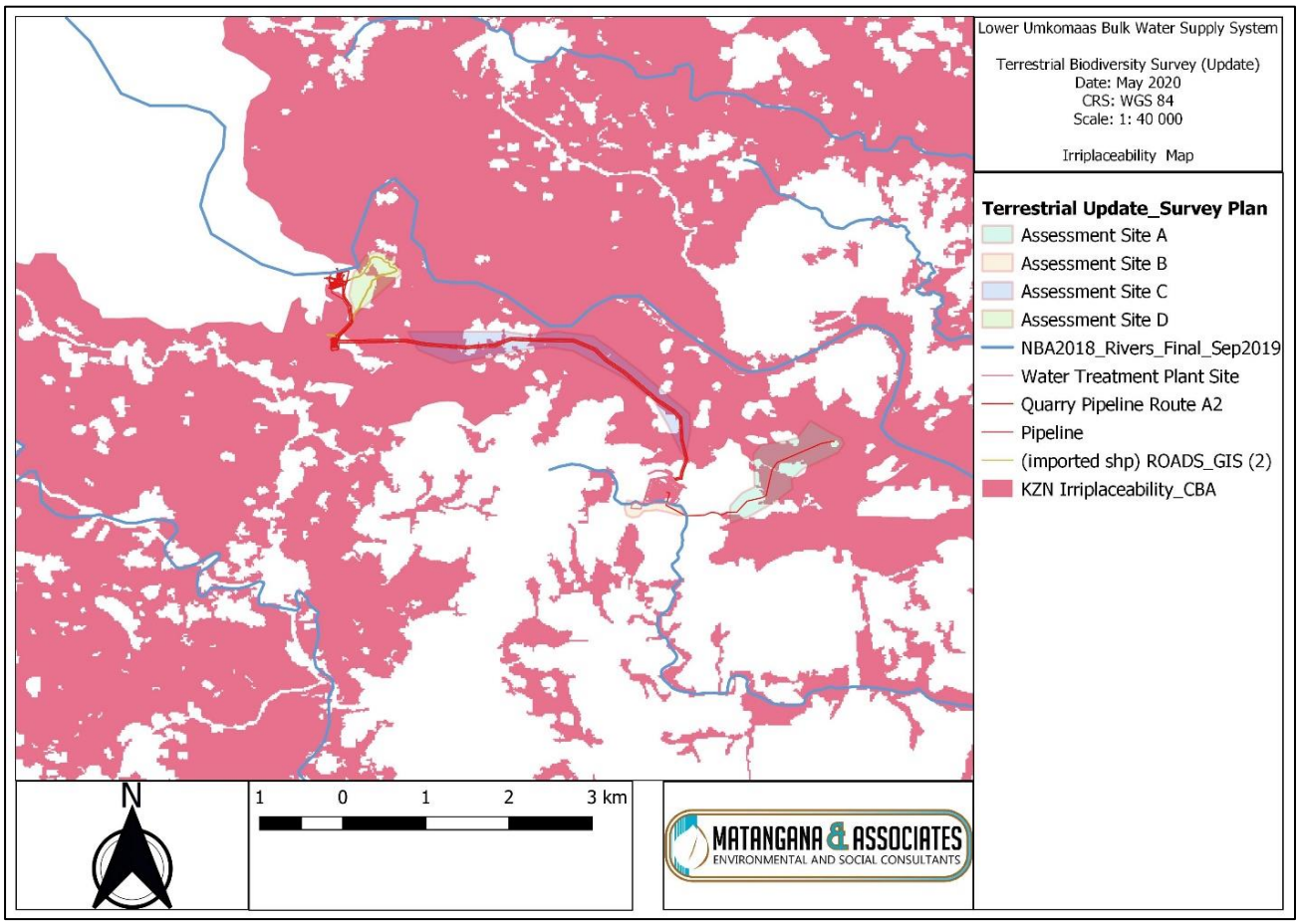

Figure 9. KZN CBA Map relative to Amended Project Layout for LUBSS-WSS

3.3 eKZN Wildlife dispersal corridors

Context

A series of altitudinal and biogeographic corridors were created in KZN to facilitate evolutionary, ecological and climate change processes and to create a linked landscape for the conservation of species in a fragmented landscape.

Site Analysis

The majority of the site falls within the KZN Midlands Macro Ecological Corridor within the EKZNW Macro Ecological planning domain. This indicates that the area has high potential to facilitate landscape connectivity at a regional level. However, it can be noted that the WTP site does not fall within the layer. This can be attributed to a number of factors including the focus of the Corridors on Major River Riparian Zones and the transformed state of the area surrounding the WTP.

Implications for Amended Layout: The Original Layout had the same impact on the Macro Ecological planning domain. The exception is the exclusion of the second WTP site option, which fell under this layer. Thus, from a Macro Ecological Corridor perspective the Amended Layout is less detrimental to the receiving environment.

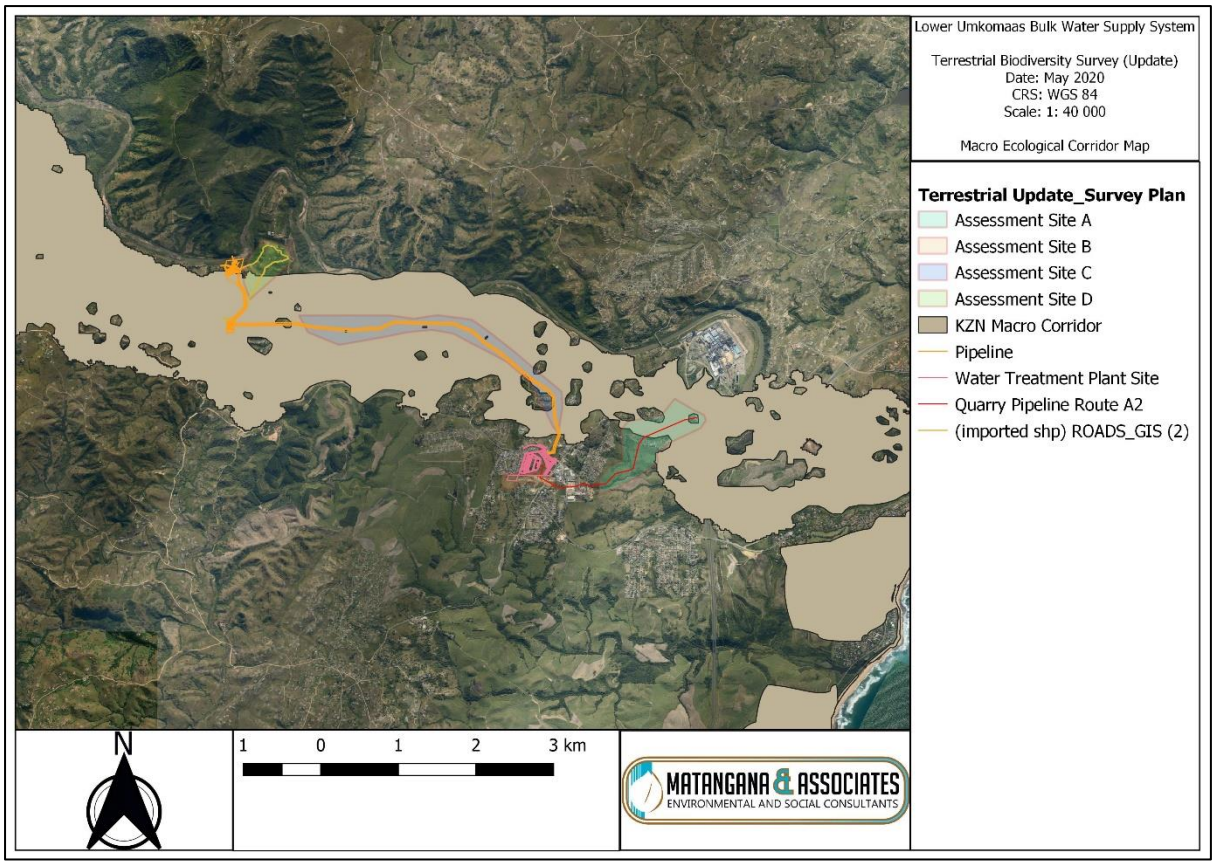

Figure 10. KZN Macro Ecological Corridors Map relative to Amended Project Layout for LUBSS-WSS

3.4 D'MOSS

Context

The Durban Metropolitan Open Space System, currently 94 000 hectares in extent, is a spatial layer of interconnecting open spaces in public, private and traditional authority ownership that seeks to protect the biodiversity and associated ecosystem services of Durban for future generations.

From a natural resource perspective, D'MOSS includes approximately 2 400 ha of estuarine environment, including sand and mudbanks, mangrove and swamp forests; 14 000 ha of forests including dune, coastal and scarp forests; 7 500 ha of wetlands including floodplains, swamp forest and reedbeds; 13 000 ha of grassland including the threatened KZN Sandstone Sourveld Grasslands; and 40 000 ha of dry valley thicket.

Site Analysis

The pipeline traverses largely across the D'MOSS areas in various categories as described in Maps below (Fig. 8-10). The pipeline passes through areas defined as intermediate in the majority of its length, while the towards the Goodenough Reservoir the pipeline traverses areas considered to be degraded. Some sections of the pipeline go through areas that do not fall within D'MOSS.

The WTP section of the project layout is located in a D'MOSS section that is classified as unknown. This may be that the area has not been sufficiently evaluated or attributed to the proximity of the site to heavily transformed landscapes, while containing high sensitivity natural capital such as a major watercourse and associated wetlands.

The Goodenough weir is mostly located within an area classified as Transformed in the D'MOSS layer, while the reservoir and a portion of roads are located in the intermediate classification. It should be noted that the majority of the road is located out of the D'MOSS areas.

Implications for Amended Layout: The original pipeline and Goodenough weir had the same impact on the DMOSS layer, with exception of the increased size of the disturbance. The orientation and/or position changes have no "new" impact on the D'MOSS, while the increased size only impacts an area situated within the "transformed" category of D'MOSS and outside of the D'MOSS area. On the other hand, the size changes related to the Goodenough Reservoir and the WTP Site have significant impact on the intermediate category of the D'MOSS. The removal of the Option 1 as found in the Original Layout is inconsequential as this site did not fall within the D'MOSS area. Thus the net effect on the D'MOSS is negative and an increase in

management measures need to be implemented to ensure rehabilitation and improvement of ecosystems. Further, a strict working servitude needs to instituted that takes into account 1) 32m Watercourse Buffer, 2) a working servitude of not more than 20m in D'MOSS (Good & Intermediate) and 3) a working servitude of less than 30m in D'MOSS (Degraded & Transformed). Infrastructure located in areas under D'MOSS (unknown) should follow the Precautionary Principle to natural resources management and utilize the 20m working buffer.

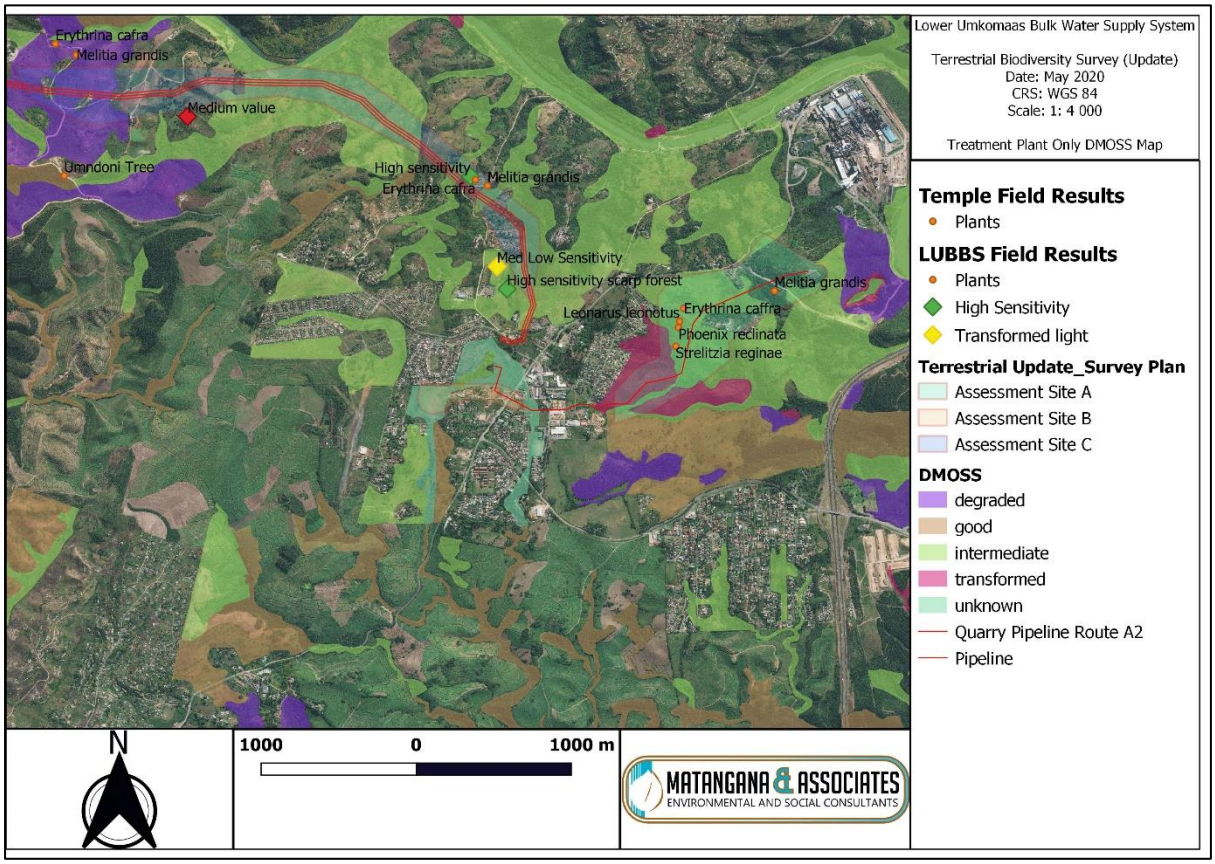

Figure 11. D'MOSS relative to Amended Project Layout for LUBSS-WSS

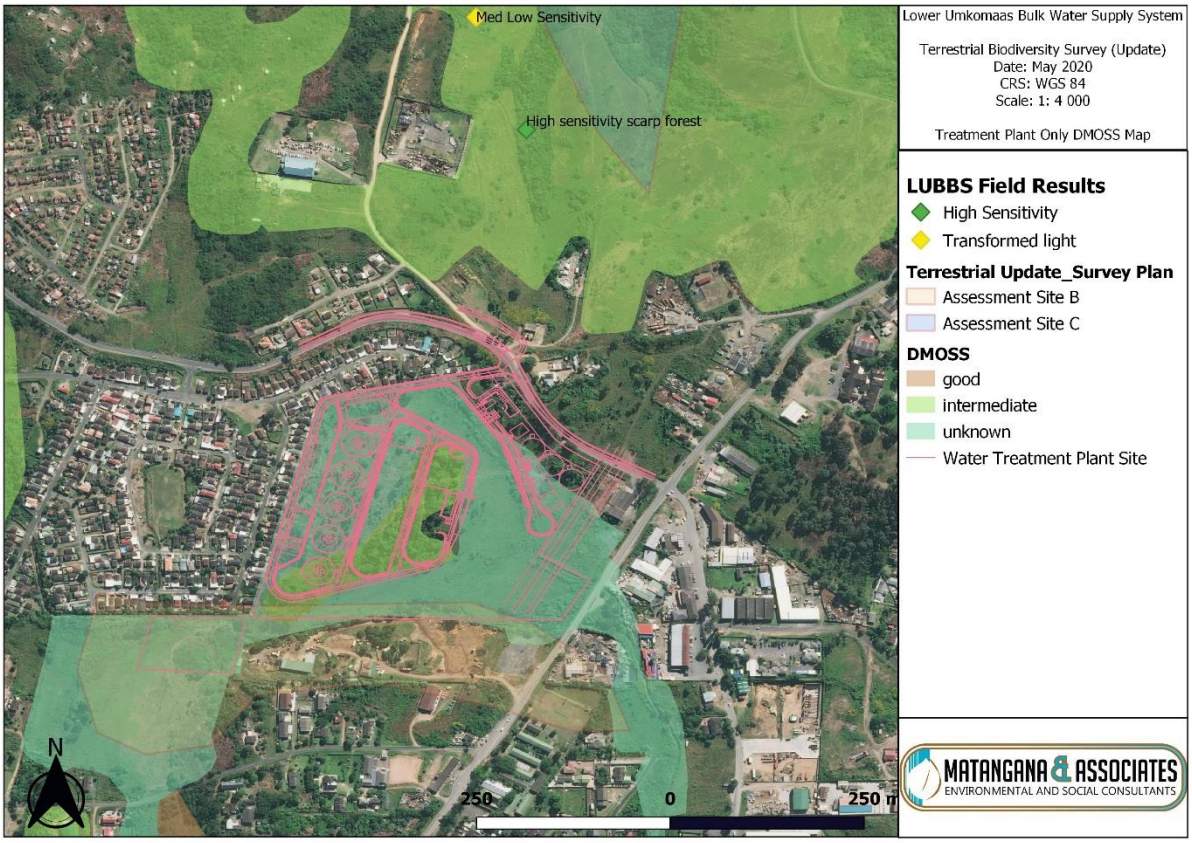

Figure 12. D'MOSS Map relative to Amended Project Layout for LUBSS-WSS showing WTP Site

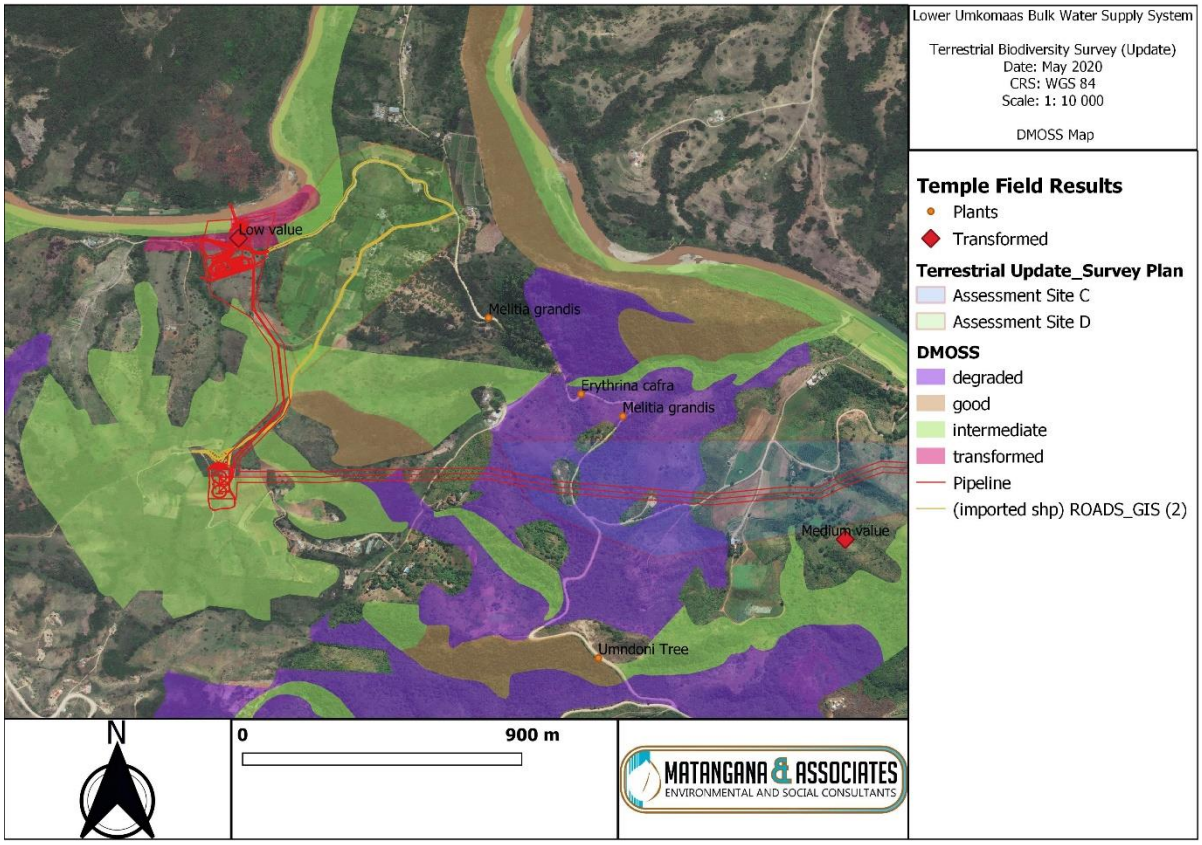

Figure 13. D'MOSS Map relative to Amended Project Layout for LUBSS-WSS showing Goodenough Weir Site

4. STUDY FINDINGS & SENSITIVITY

4.1 Findings for Assessment Area A (Quarry Pipeline Route):

- The area Medium to low sensitivity with a major stream running on the southern border of the assessment area. The area is bordered by gardens with banana and small mango plots associated with a small township.
- The area adjacent to the SAPPI Skills Centre is characterized by patches of healthy grassland vegetation and forest pockets along the drainage lines.
- The area has the potential to provide a breeding and forage site for avifauna species through the riparian corridor.
- The open grasslands with rocky outcrops indicate a suitable site for herpetofauna and wildlife refugia for other faunal species. Grasslands area one of the most at-risk of South Africa's biomes: more than 40% of it has already been irreversibly modified, 60% of remaining grassland is threatened and less than 3% of it is under formal protection (SANBI, 2013). Grassland is also considered to face the greatest risk of significant change due to climate change.
- The site has a number of IAPs that include *Lantana camara, Solanum mauritianum, Tithonia diversifolia, Senna didymobotrya, Psidium guajava, Chromolaena odorata, Melia azedarach, Arundo donax, Ricinus communis, Passiflora subpeltata, Rubus cuneifolius, Passiflora edulis and Ipomoea indica*.

4.2 Findings for Assessment Area B (Quarry Pipeline & Expansion of WTP Site):

- The assessment area is located in the center of a small mixed use industrial area, with a Major River channel traversing the south eastern boundary. The implications of this are that the riparian zone is in a very compromised condition, but may provide an ecological corridor if well maintained. The dominant hydrophilic plants include *Cyperus papyrus* and *Typha capesis.*
- High density of a mix of various alien species with isolated pockets of grassland. The grassland is dominated by species increaser species that indicate disturbance. The dominant IAPs include *Arundo donax, Tithonia diversifolia, Senna didymobotrya, Tecoma stans and Xanthium strumarium*.
- The site is generally of low ecological value, however the presence of a Major River system have increased the ecological significance of the site. The sites

proximity to the river banks will have irreversible negative impacts on the ecological functioning of the riparian system and river channel.

4.3 Findings for Assessment Area C (Gravity Main to WTP):

- The area is mostly open grassland, pockets of forests confined to drainage lines, subsistence and commercial farming and associated farm housing and infrastructure.
- The grassland areas are in healthy condition and are dominated by a good mix of grass species including *Cymbopogon excavatus, Monocymbium ceresiiforme, Aristada junciformis, and Erogrostis sp*. Grasslands area one of the most at-risk of South Africa's biomes: more than 40% of it has already been irreversibly modified, 60% of remaining grassland is threatened and less than 3% of it is under formal protection (SANBI, 2013). Grassland is also considered to face the greatest risk of significant change due to climate change.
- The forest areas are in good condition and need to be protected. According to Scottshaw (2011) , the most conspicuous trees are *Buxus macowanii, B. natalensis, Drypetes gerrardii, Englerophytum natalense, Harpephyllum caffrum, Heywoodia lucens, Memecylon natalense, Millettia grandis, Oricia bachmannii, Philenoptera sutherlandii, Rinorea angustifolia, Rothmannia globosa and Umtiza listeriana.*
- Wildlife refugia are abundant within the Assessment Area as it has vast tracts of undeveloped natural systems that are ideal for small mammals and avifuana with large foraging range. Further trees encountered such as *Harpephyllum caffrum* and *Syzygium cordotum* have fruit that is edible and widely utilized by birds, animals, insects and humans.
- The area is characterized by high biodiversity in some areas.

4.4 Findings for Assessment Area D (Reservoir, High Lift Pump Station, Rising Main to Hydroclones, Goodenough Weir Structure, Goodenough Reservoir):

- The area is dominated by subsistence and commercial farming and associated farm housing and infrastructure. The area contains some areas of ecological significance such as open grasslands and forest patches confined to drainage lines. The northern boundary of the Assessment Area is the Umkomaas River.

- The near natural areas between the commercial farming plots experience severe edge effects that may be exacerbated by increased development within the area.
- The grassland areas are mainly secondary grasslands with high altitude areas contain primary grasslands resembling the original vegetation characteristic. The grasslands are dominated by *Aristada junciformis.*
- The forest areas have been significantly reduced by suspected increased burning and replaced with crops and mango plantations. The remaining forests are limited in extent and species richness.
- The area has the potential to provide a breeding and forage site for avifauna species through the riparian corridor. A Kingfisher and Egyptian geese was spotted during the field investigations.
- The riparian zone associated with the proposed development is heavily transformed with crop farming activities on the river banks. Further, the area proposed for the development of Goodenough weir already has an existing weir structure and associated buildings that are being used by vagrants.

Table 2. Sensitivity Mapping Criteria used in conjunction with field findings

		Upgrading/Sensitivity Factors			Degrading Factors		
	Class	S1	S2	S3	D1	D2	D3
Area A &B	Med	CR, IPA	D'MOSS partial	CBA, ESA	IAPs	Informal Roads	Development
	Degraded				Roads	IAPs Very High	Developed Structures
	Low	CR,IPA			Residential Dvp	Industrial Dvp	Sugarcane Plantation
	Low	CR, IPA	DMOSS, ESA	CBA	Sugarcane Plant	Roads	Industrial Dvp
	High	Riparian, CR, IPA	DMOSS	CBA	Sugarcane Plant	Access Roads	
	High	CR, IPA, SCC,	DMOSS, ESA	CBA	Edge Effects	Residential Minor	

	High	DMOSS	Important Riparian	Major Watercourse	Edge Effects	IAPs	Building encroachment
	Med	Riparian, IPA	DMOSS	Major Watercourse	Edge Effects	Building Encroachment	IAPs
	Degraded				Fully Transformed		
Area C	High	CR, IPA	DMOSS, ESA	CBA	Edge Effects		
	Med	DMOSS		CBA	Roads	Industrial Dvp	Residential
	High	CR, IPA,	DMOSS, ESA	CBA	Access Road		
	High	Riparian, CR, IPA	DMOSS, ESA	PAES, CBA	Access Roads	IAPs	
	Low	CR	DMOSS Degraded, ESA Partial	CBA	IAPs	Roads, Dwellings	Plantations
	Med	Connectivity, CR	ESA	CBA	Subsistence Farming	Access Roads	IAPs
	Low	CR Partial, IPA Partial	ESA Partial	CBA Partial	Transformed	Edge Effects	Subsistence Farming
Area D	Med	CR, IPA Partial	ESA Partial	CBA	Commercial Farming	Edge Effects	Access Roads
	High	Connectivity, CR, IPA	ESA, DMOSS	CBA	Access Road	Edge Effects	

	Low	CR	IPA		Heavily Transformed	Commercial Farming	Access Roads
	Med	Riparian, Intact Veg, Connectivity	CBA		Access Road	Edge Effects	

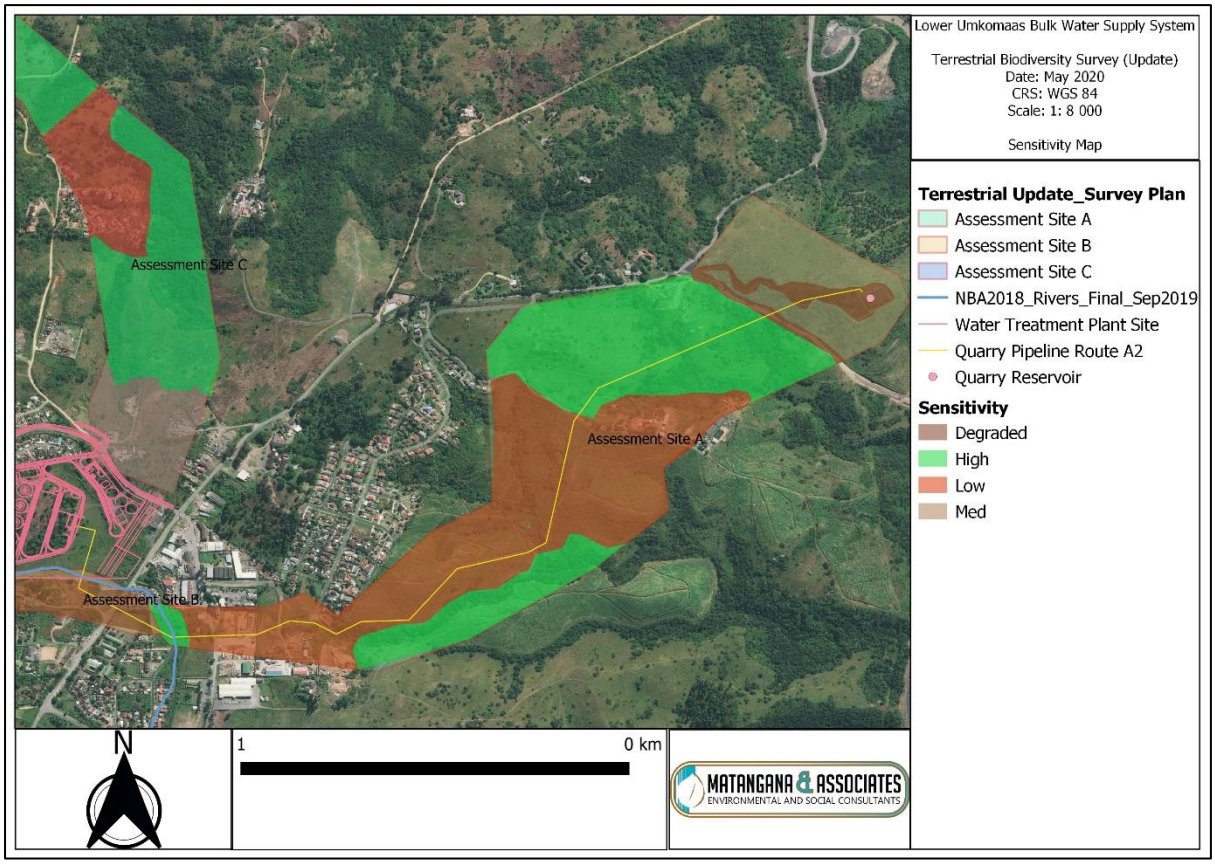

Figure 14. Sensitivity Mapping for Assessment Area A and B

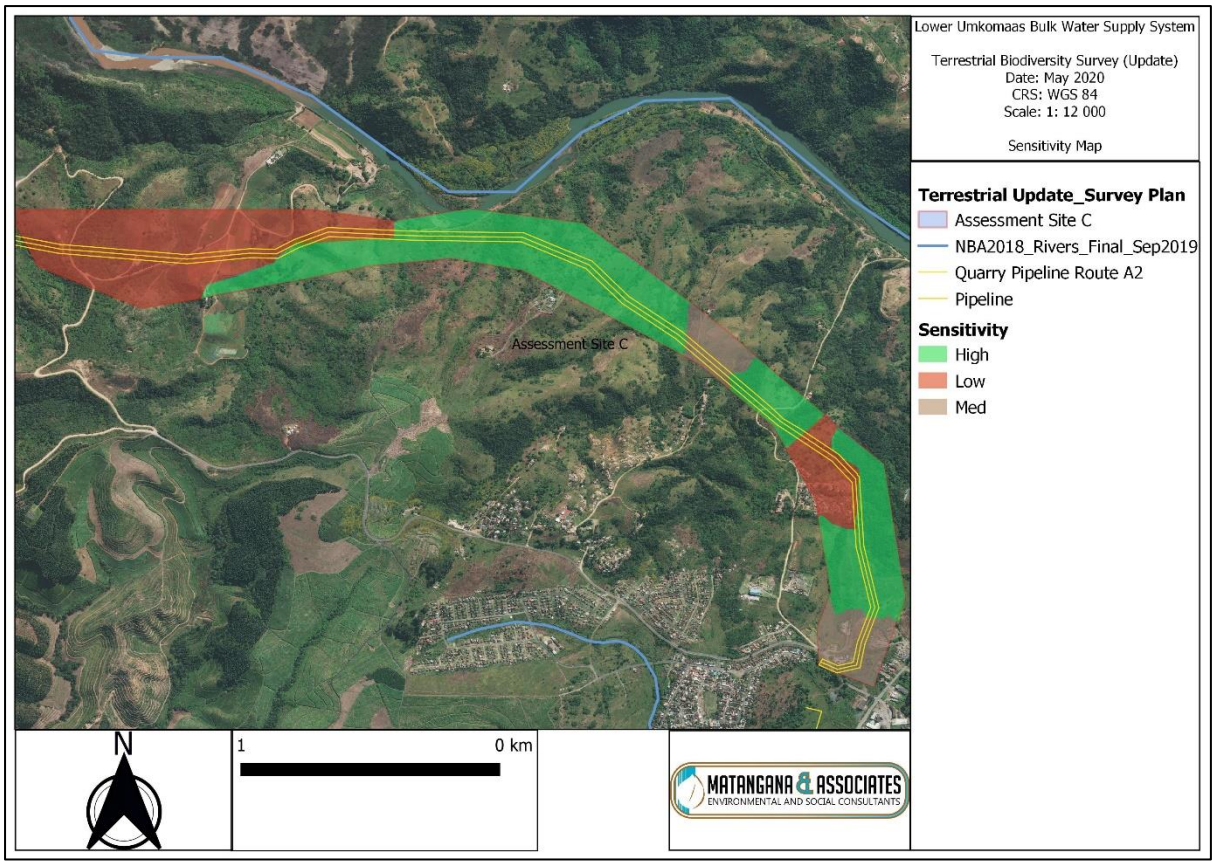

Figure 15. Sensitivity Mapping for Assessment Area C

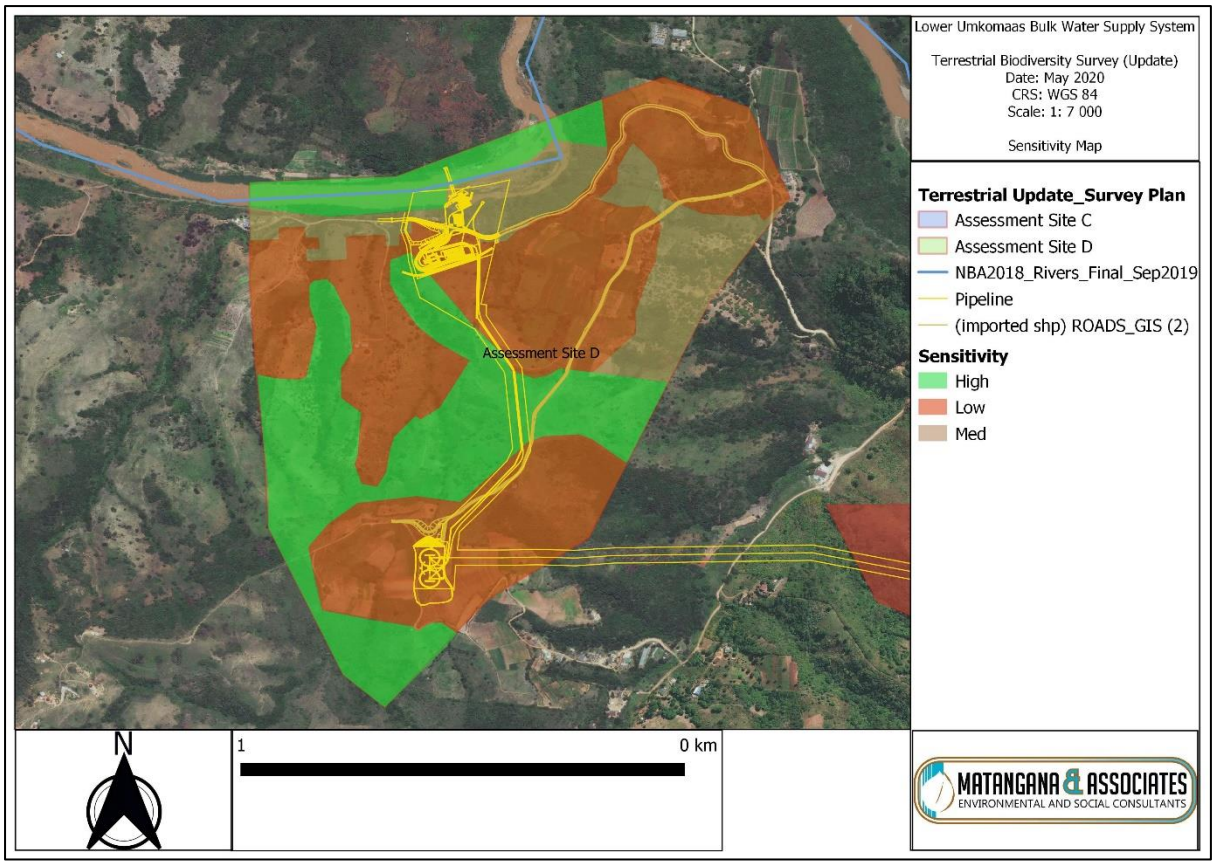

Figure 16. Sensitivity Mapping for Assessment Area D

4.5 Species Encountered During Field Assessment

Table 3. Species encountered during field assessment across all assessment sites

No.	Species	Notes	Xcoordinate	Ycoordinate	Threat Status
1	*Aloe ferox*	Med density	30.59938009999999	-30.1360787	LC
2	*Aloe ferox*	Med density	30.610867	-30.1432532	LC
3	*Aloe ferox*	Low density	30.6124903	-30.1462937	LC
4	*Commiphora harveyi*	Low density	30.5981257	-30.1342992	LC
5	*Commiphora harveyi*	Very low	30.5995056	-30.1361175	LC
6	*Cussonia spicata*	Very low density	30.6068048	-30.1392409	LC
7	*Erythrina caffra*	Very low density	30.76259749999999	-30.1940468	LC
8	*Erythrina cafra*	Med density	30.72050969999999	-30.176339499999999	LC
9	*Erythrina cafra*	Low density	30.7486416	-30.185429	LC
10	*Euphobia ingens*	Low density	30.61451379492113	-30.139726737558139	LC
11	*Kniphofia linearifolia*	High densities	30.6172395	-30.1418468	LC(specially protected under schedule 2 in KZN)
12	*High sensitivity zone*	Suspect DMOSS- Prestine grassland	30.7483143	-30.1852153	N/A
13	*High sensitivity*	Suspect DMOSS- Scarp Forest	30.7507599	-30.192748	N/A
14	*Harpephyllum caffrum*	Low density	30.7623178	-30.1949121	LC
15	*Millettia grandis*	Low density	30.7174133	-30.1737898	LC(specially protected under schedule 2 in KZN)
16	*Millettia grandis*	Low density	30.7219057	-30.1770795	LC(specially protected under schedule 2 in KZN)

17	*Millettia grandis*	Low density	30.7494492	-30.1858352	LC(specially protected under schedule 2 in KZN)
18	*Millettia grandis*	Low density	30.7686774	-30.1928799	LC(specially protected under schedule 2 in KZN)
19	*Phoenix reclinata*	Low density	30.7622407	-30.1953262	LC (protected)
20	*Strelitzia nicolai*	Med density	30.7620634	-30.1965764	LC
21	*Tecomaria capensis*	High density	30.6109965	-30.14360109999999	LC
22	*Tetradenia riparia*	High density	30.5974204	-30.1342455	LC
23	*Tetradenia riparia*	Low density	30.6076072	-30.1400507	LC
24	*Syzygium cordatum*	Low density	30.72109099999999	-30.1851689	LC
25	*Vangueria infausta*	High density	30.6141419	-30.1490582	LC

4.6 Alien and invasive species encountered in the study area

As can be seen below, the site has a rather high preponderance of alien and invasive species. Furthermore, the most commonly encountered species have been characterized below.

Table 4. List of invasive alien plant species occurring in the area

Acacia mearnsii	*Bauhinia variegata*
Achyranthes aspera	*Bidens pilosa*
Agave sp.	*Boerhavia diffusa*
Agave sisalana	*Caesalpinia decapetala*
Ageratum spp.	*Callisia repens*
Amaranthus hybridus	*Canna indica*
Ambrosia artemisiifolia	*Cardiospermum grandiflorum*
Arundo donax	*Cassia* spp.

Centella asiatica
Chromolaena odorata
Citrus limon
Coix lacryma-jobi
Conyza spp.
Costus sp.
Cynodon dactylon
Dactyloctenium australe
Desmodium incanum
Emex spinosa
Eucalyptus spp.
Euphorbia cyathophora
Euphorbia hirta
Galinsoga parviflora
Ipomoea purpurea
Jatropha integerrima
Lagerstroemia indica
Lantana camara
Litsea glutenosa
Malvastrum coromandelianum
Mangifera indica
Melia azedarach
Melilotis albus
Mimosa pudica
Musa hybrid
Nicandra physaloides
Oxalis corniculata
Oxalis rosea
Passiflora edulis
Passiflora subpeltata
Pennisetum purpureum
Persea americana
Plantago lanceolata
Plectranthus comosus
Psidium guajava
Richardia brasiliensis
Ricinus communis
Rumex acetosella
Senna didymobotrya
Sesbania bispinosa
Solanum mauritianum
Solanum nigrum
Sphagneticola trilobata
Stachytarpheta urticifolia

Syzygium cumini
Tagetes minuta
Tecoma stans
Thevetia peruviana
Tithonia diversifolia
Verbena brasiliensis
Xanthium strumarium

4.7 INVASIVE ALIEN PLANT CONTROL METHODS

Best practice measures

1. Cut plants as low to ground as possible.
2. All alien plants must be removed carefully and exposed soil should be covered with cut vegetation or leaf litter that is free of weed seeds to ensure that regrowth will not occur.
3. Press any loosened soil down carefully and firmly and mulch with plant material where possible.
4. All alien seeds, fruit bulbs, tubers and stems must be collected and placed in a sealable container/plastic bag for disposal at a landfill site.
5. The roots system of mature trees including alien invasive play an important role in stabilising soil and therefore the up-rooting of large mature specimen of trees is not advocated. It is better to fell the trees and paint the stump with the relevant herbicides.

4.7.1 Manual Control Methods

Table 5. Manual methods for invasive alien plant control

Method	Description
Hand Pull	• Hand pulling is most effective with small (30cm), immature or shallow rooted plants. • Shake the excess sandy material from the plant, this makes the plant easier to stockpile and lighter to transport. • However, make sure there is no seed on the plant first to eliminate the spread of seed while shaking.
Chopping/cutting/slashing	• This method is most effective for plants in the immature stage, or for plants that have relatively woody stems/ trunks.

	• This is an effective method for non-re-sprouters or in the case of re-sprouts (coppicing) it must be done in conjunction with chemical treatment of the cut stumps. Note • Cut/slash the stem of the plant as near as possible to ground level. • Paint re-sprouting plants (i.e. Black Wattle, Lantana) with an appropriate herbicide immediately after they have been cut. • Stockpile removed material into piles as prescribed.
Felling	• De-branch trees and where possible remove all material. • Where possible large trees that are to be felled such that they fall uphill. • Cut the tree down as low as possible to the ground. • Apply herbicide immediately (no later than 30mins) to the cambium layer. • Ensure all the cuts in the cambium layer are treated.
Ring Barking	• Remove bark in a 30-40cm centimetre band and leave the tree to die • Can be used with or without chemicals but is more successful when herbicide is used

4.7.2 Chemical Control

Table 6. Chemical methods for invasive alien plant control

Method	Description
Cut and Spray	• Slashing the stem to ankle height or lower and applying herbicide on the remaining exposed part of the plant. Note • Cut/slash the stem of the plant as near as possible to ground level. • Stockpile removed material into piles as prescribed.
Foliar Spaying	• Using approved equipment/sprayers this method can be very useful for seedlings and low shrub vegetation. Note • One needs to be very careful when applying this method as there is a high risk of drift and adverse impacts on human and environmental health.
Stem Injection	• This method involves using approved equipment to inject herbicide into the stem of the plant and allow the herbicide to travel within the plant to kill it.

4.7.3 Biological Control

Biological Control involves the release of a biological control agent in the form of a pest that will feed or utilize the target species and thus reducing its spread.

To obtain biocontrol agents, provincial representatives of the Working for Water Programme or the Directorate: Land Use and Soil Management (LUSM), Department of Agriculture, Forestry and Fisheries (DAFF) can be contacted.

5. POTENTIAL IMPACTS OF THE PROPOSED DEVELOPMENT ON BIODIVERSITY (Adapted from McDonald & Mboyi, 2018)

5.1 Direct mortality of faunal species during construction phase

5.1.1 Description of impact

Animal species may be impacted upon directly through mortality of individuals during site preparation and site clearing for the proposed pipeline and related infrastructure.

5.1.2 Assessment of impact

Birds, large snakes and medium-sized mammals would be able to flee at the start of construction. However, small mammals (eg. rodents and insectivores) and much of the herpetofauna may hide in leaf litter, under rocks or underground and might be directly impacted by site clearing and excavations. Although construction activities may lead to direct mortality of individuals that cannot safely flee the construction site, with the exception of the WTP site, no species of Conservation Significance are expected to be impacted by the construction activities and there would thus, not be a permanent impact on any population/species as a whole. It is, therefore, concluded that the impact of direct mortality on faunal species would be of local importance, of short duration and of low intensity. The impact is, therefore, rated to be of overall low significance. The implementation of the proposed mitigation measures would ensure that the potential impact remains of very low significance.

Implications for Amendments: No additional faunal species were encountered or are expected to occur in the study area. The position changes remain within the same faunal habitats, at a landscape level, as previously assessed in McDonald and Mboyi, 2018. However, the increased size of the disturbed areas will have marginal increase in the impact on faunal habitat availability, at an ecosystem and microhabitat level. **Thus negative change in impact score is anticipated**

5.1.3 Mitigation objectives and measures

To avoid and minimise direct mortality of species during the construction phase, every effort should be made to save and relocate any animal encountered during site preparation that cannot flee of its own accord. These animals should be relocated to a suitable area immediately outside the proposed footprint, but under no circumstance to an area further away. No formal searches would be required before site preparation starts as these would in all likelihood prove ineffective. The contractor must ensure that no faunal species are disturbed, trapped, hunted or killed during the construction phase. Conservation-orientated clauses should be built into contracts for construction personnel, complete with penalty clauses for non-compliance. Trenches should only be opened as needed to prevent excessive open trench ahead of the pipe laying process. All trenches must have at least one sloping side to allow animals to escape and must be checked on a daily basis for animals which may have fallen in. Rehabilitation of areas where vegetation was disturbed during the construction phase should be undertaken to ensure that habitats for animals are restored.

5.2 Loss and alteration of habitats (Vegetation Disturbance)

5.2.1 Description of impact

Faunal habitats will be lost through the clearing of vegetation as well as alteration of habitat.

5.2.2 Assessment of impact

As part of the construction phase, vegetation within the footprint would be severely disturbed and habitat options for faunal species would be destroyed within the immediate area of the development. In the area of the pipeline, this habitat can be restored significantly during rehabilitation. However, a portion of the site where the pump station, reservoir and water treatment works are proposed would be permanently altered without the potential for significant rehabilitation. The biodiversity of the faunal component of those habitats would be significantly diminished. The impact of habitat loss would be of significant local extent, long term and of high intensity.

Implications for Amendments: No additional flora species were encountered or are expected to occur in the study area. The position changes remain within the same faunal habitats, at a landscape level, as previously assessed in McDonald and Mboyi, 2018. However, the increased size of the disturbed areas will have marginal increase

in the impact on faunal habitat availability, at an ecosystem and microhabitat level. **Thus negative change in impact score is anticipated**

5.2.3 Mitigation objectives and measures

The objective would be to minimize the loss of habitat as far as possible and to contain construction-related activities. Restricting the construction activities to the smallest practical/functional footprint would be the only possible mitigation in this case.

5.3 Local Microhabitat sensitivities

5.3.1 Description of impact

The area designated for the WTP constitute sensitive areas in the context of the proposed development, especially from riparian and wildlife refugia perspective.

5.3.2 Assessment of impact

WTP area has a number of small water courses associated with it and hygrophilous grassland which may well be inundated in years of high rainfall. The area falls within the D'MOSS.

Implications for Amendments: The increase of the size of the total loss of habitat anticipated with the construction of the new WTP Layout within a sensitive area will significantly increase the ecological risk associated with the project.

5.3.3 Mitigation objectives and measures

It would be prudent to re-route the gravity main so as to avoid impacting on the sensitive habitats such as riparian zones.

Rocky areas provide valuable habitat for herpetofauna and care should be exercised during construction within these areas to minimize disturbance and habitat loss.

the area of the proposed development is hilly and this will result in the potential for soil erosion during and as a result of construction if preventative and corrective measures

are not taken. Care should be taken to keep soils stabilized when removing vegetation during construction and as part of alien plant eradication. Also, care should be taken to prevent the contamination of soil (and ultimately ground water) from accidental fuel and oil spills from earth-moving and construction equipment and vehicles.

Below is an assessment of the significance of impacts associated with the development and the receiving environment. The risk assessment for the activity is done using a significance scoring matrix that considers; extent, aspects, impacts, irreversibility and the severity and probability of the risks related to the activity in accordance with the guideline. The significance scores can be understood by the use of Table 5.3.3-1. While Table 5.3.3-2 to 6.3.3-7 below explain the criteria used to determine Project the various aspects of the impacts.

Table 5.3.3-1. Significance scores related to negative environmental impacts

Score	Significance scoring of negative impact / effect
>35	**Very High- The impact is total / consuming / eliminating** - In the case of adverse impacts, there is no possible mitigation that could offset the impact, or mitigation is difficult, expensive, time-consuming or some combination of these. Mitigation may not be possible / practical. Critically important natural asset lost.
26 - 34	**High- The impact is profound** - In the case of adverse impacts, there are few opportunities for mitigation that could offset the impact, or mitigation has a limited effect on the impact. Social, cultural and economic activities of communities are disrupted to such an extent that their operation is severely impeded. Mitigation may not be possible / practical. Threatened natural asset lost.
21 – 25	**Medium to high- The impact is considerable / substantial** - The impact is of great importance. Failure to mitigate with the objective of reducing the impact to acceptable levels could render the entire project option or entire project proposal unacceptable. Mitigation is therefore essential. At-risk natural asset lost.
8 – 20	**Medium- The impact is material / important to investigate** - The impact is of importance and is therefore considered to have a substantial impact. Mitigation is required to reduce

	the negative impacts and such impacts need to be evaluated carefully.
5 – 7	**Medium to low- The impact is marginal / slight / minor** - The impact is of little importance, but may require limited mitigation; or it may be rendered acceptable in light of proposed mitigation.
0 – 4	**Low- The impact is unimportant / inconsequential / indiscernible**; or it may be rendered acceptable in light of proposed mitigation.

Table 5.3.3-2. Spatial Extent of impact

	Spatial extent
7	International - The impacted area extends beyond national boundaries
6	National - The impacted area extends beyond provincial boundaries
5	Ecosystem - The impact could affect areas essentially linked to the property in terms of significantly impacting ecosystem functioning
4	Regional - The impact could affect a subset of the ecosystem, extending over more than one landscape
3	Landscape - The impact could affect all areas generally visible to the naked eye, as well as those areas essentially linked to the property in terms of ecosystem functioning
2	Site related - The impacted area extends further than the actual physical disturbance footprint; the impact could affect the whole, or a measurable portion of a number of properties, forming part of the development area or within close proximity of the development property
1	Local - The impacted area extends only as far as the activity e.g. a footprint; the loss is considered inconsequential in terms of the spatial context of the relevant environmental aspect

Table 5.3.3-3. Severity, Intensity and Magnitude of impact

	Severity / Intensity / Magnitude
7	Total / consuming / eliminating - Function or process of the affected environment is altered to the extent that it is permanently changed in character / intrinsic value. Certainty of presence of conservation-important flora.
6	Profound / considerable / substantial - Function or process of the affected environment is altered to the extent where it is permanently modified to a sub-optimal state.
5	Material / important - Function or process of the affected environment is altered to the extent where some components of a natural system are permanently modified to a sub-optimal state.
4	Discernible / noticeable - The affected environment is altered, but overall function and process continue, albeit in a modified way. Uncertainty of presence of conservation-important flora.
3	Marginal / slight / minor - The affected environment is altered, but natural function and process continue.
2	Unimportant / inconsequential / indiscernible - The impact alters the affected environment in such a way that the natural processes or functions are negligibly affected.
1	No effect. Certainty that conservation-important flora are not present.

Table 5.3.3-4. Duration of impact

	Duration
7	Long-term – Permanent. Beyond decommissioning and cannot be negated on decommissioning. More than 15 years.
3	Medium term – Lifespan of the project. Reversible over time. 5 to 15 years.
1	Short-term – Quickly reversible. Less than the project lifespan. The impact will either disappear with mitigation or will be mitigated through natural process in a span shorter than any of the phases. 0 to 5 years.

Table 5.3.3-5. Irreplaceability of lost resource as a result of impact

	Irreplaceable loss of resources
7	Long-term – The loss of a non-renewable / threatened resource which cannot be renewed / recovered with or through natural process, in a time span of over 15 years, or by artificial means.
5	Long-term – The loss of a non-renewable / threatened resource which cannot be renewed / recovered with or through natural process, in a time span of over 15 years, but can be mitigated by other means.
4	Loss of an 'at risk' resource - one that is not deemed critical for biodiversity targets, planning goals, community welfare, agricultural production, or other criteria, but cumulative effects may render such loss as significant.
3	Medium term – The resource can be recovered within the lifespan of the project. The resource can be renewed / recovered with mitigation or will be mitigated through natural process in a span between 5 and 15 years.
2	Loss of an 'expendable' resource - one that is not deemed critical for biodiversity targets, planning goals, community welfare, agricultural production, or other criteria.
1	Short-term – Quickly recoverable. Less than the project lifespan. The resource can be renewed / recovered with mitigation or will be mitigated through natural process in a span shorter than any of the phases, or in a time span of 0 to 5 years.

Table 5.3.3-6. Reversibility of impact

	Reversibility / potential for rehabilitation
7	Long-term – The impact / effect will never be returned to its benchmark state.
3	Medium term – The impact / effect will be returned to its benchmark state through mitigation or natural processes in a span shorter than the lifetime of the project, or in a time span between 5 and 15 years.
1	Short-term – The impact / effect will be returned to its benchmark state through mitigation or natural processes in a span shorter than any of the phases of the project, or in a time span of 0 to 5 years.

Table 5.3.3-7. Probability that an impact will occur

	Probability
1	Absolute certainty
0,9	Near certainty / very high probability
0.7 – 0.8	High probability – to be expected
0.4 - 0.6	Likelihood / normal anticipation – to be anticipated
0,3	Seriously anticipated possibility
0,2	Possibility
0.0 - 0.1	Remote possibility

Table 5.3.3-8. Impact Significance Scoring

	Spatial extent		Severity / intensity / magnitude		Duration		Resource loss		Reversibility		Probability		SIGNIFICANCE SCORE	
Mitigation	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
Environmental Risks														
Disturbance of wetland habitat	3	3	3	2	3	3	5	4	7	7	0,8	0,3	16,8	5,7
Change in terrestrial vegetation and habitat	1	1	3	1	1	1	3	2	3	3	0,8	0,5	8,8	4
Loss of species of biodiversity importance (flora)	3	2	4	2	3	1	5	2	3	1	0,8	0,5	14,4	4
Loss of species of biodiversity importance (fauna)	3	2	5	2	3	1	3	1	3	1	0,8	0,3	13,6	2,1
Spread of alien invasives	3	1	4	2	3	1	6	3	3	1	1	0,5	19	4
Inadequate Rehabilitation	5	2	7	4	7	6	6	6	6	6	1	0,5	31	12
													Medium	Medium to low
									Overall Impact/Risk				14,08	3,975

6. Management & Monitoring (Adapted from McDonald & Mboyi, 2018)

Table 9. Management and Monitoring Plan

Mitigation	Indicator	Timeframe	Person Responsible
Sensitive Amphibian Breeding Areas			
Locate and verify breeding site	GPS Coordinates, Confirmation of site from Specialist	Prior to project commencement	Project Manager, Environmental Officer
Demarcate and avoid working within 15m of site boundary	Demarcated area, Education Plan including Amphibian sensitivity	Prior to project commencement	Engineer, Project Manager, Environmental Officer
Assess site integrity	Confirmation of breeding site integrity from Specialist	Prior to project commencement and annually thereafter.	Project Manager, Environmental Officer

Mitigation	Indicator	Timeframe	Person Responsible
General Terrestrial			
Work within a defined servitude (40m or less) or as explicitly stated in sensitive areas	No work or disturbance beyond working servitude	Throughout project life cycle	Engineer, Project Manager, Environmental Officer

Ensure that pollution is avoided	No pollution from the construction and operation of proposed development	Throughout project life cycle	Environmental Officer
Have demarcated areas for workers during breaks, ablution and equipment storage and repair	Clearly demarcated workers areas	Throughout project life cycle	Environmental Officer
Maintain low noise levels	Noise levels at acceptable levels, vehicles fitted with silencing technology	Throughout project life cycle	Environmental Officer

Mitigation	**Indicator**	**Timeframe**	**Person Responsible**
Biodiversity importance (protected flora)			
Locate and verify	GPS Coordinates, Confirmation of site from Specialist	Prior to project commencement and biannually thereafter	Project Manager, Environmental Officer
Demarcate and avoid boundary	Demarcated area, Education Plan including plant sensitivity	Throughout project life cycle	Environmental Officer
Relocate Plants	Permission to demarcate from relevant authority (EKZNW)	Prior to project commencement	Environmental Officer

Mitigation	Indicator	Timeframe	Person Responsible
Biodiversity importance (protected fauna)			
Locate and verify areas of possible occurrence and breeding	GPS Coordinates, Confirmation of site from Specialist	Prior to project commencement and biannually thereafter	Project Manager, Environmental Officer
Demarcate and avoid boundary	Clear demarcations of breeding areas and high potential areas of occurrence	Throughout project life cycle	Environmental Officer

Mitigation	Indicator	Timeframe	Person Responsible
Spread of IAPs			
Document alien species found on site	List of Invasive alien plants	Prior to project commencement and monthly thereafter.	Project Manager, Environmental Officer
Alien plant distribution and densities	Distribution Maps, Density estimates, GPS coordinates	Monthly	Project Manager
Document and record alien control measures implemented	Record of Clearing Activities	Quarterly	Project Manager

Review alien control success rate	Decline in the abundance of alien plant species over time	Annually	Project Manager
Document rehabilitation measures implemented and success achieved in problem areas	Decline in vulnerable bare areas over time	Annually	Project Manager, Environmental Officer
Monitor re-vegetated area and the success of indigenous species re-establishment	Alien plant surveys and distribution map. Records of control measures and their success rate.	Biannually.	Project Manager, Environmental Officer

Mitigation	**Indicator**	**Timeframe**	**Person Responsible**
Rehabilitation			
Avoid exposing the area to soil erosion	Ensure correct rehabilitation takes place during construction phase (phased rehabilitation planning)	Throughout project life cycle	Engineer, Project Manager, Environmental Officer

7. Conclusions

The findings of this report should be read in conjunction with the original Terrestrial Ecology Report compiled by McDonald and Mboyi in 2018 for the original site layout. The proposed amended layout will have a higher ecological impact significance overall. However some areas of conservation and ecological importance have been avoided by the new layout. This is driven by the following aspects of change:

Assessment Area A (Quarry Pipeline Route):

No increase in impacts. The new route is more ecologically desirable as it avoids crossing the high sensitivity area (riparian zone) on the southern border of the assessment area. The route thus results in a reduction of biodiversity risk.

Assessment Area B (Quarry Pipeline & Expansion of WTP Site):

This component of change results in a notable increase in the ecological risk as it presents itself as a single option for assessment. Further the area to be disturbed has increased in size within an ecologically sensitive zone. The area had previously been associated with species of conservation concern and these were encountered in the current survey- thus a search and rescue is recommended following the necessary permitting from the EKZNW.

Assessment Area C (Gravity Main to WTP):

The new pipeline route has not increased the footprint of the vegetation loss and faunal habitat loss. However, the shift of the pipeline route towards more sensitive riparian habitats has implications for more sensitive species such as amphibians, snakes and avifauna breeding site. Thus the net effect of this change will be negative on the ecological risk associated with the project.

Assessment Area D (Reservoir, High Lift Pump Station, Rising Main to Hydroclones, Goodenough Weir Structure, Goodenough Reservoir, Access Road):

A large proportion of the study area consists of transformed agricultural lands and road network. The increased size of the Reservoir will result in impacts remaining within the low sensitivity zones of the study area. Further, the road layout follows the route of existing informal road networks linked to the surrounding farms. The net impact of the changes associated with the study area will be negligible with the exception of the selection of Goodenough Weir changes. The anticipated increase in the footprint of the weir will have negative impacts at a local sensitivity level and implications for landscape level downstream systems. Thus making the changes within the study area increase the ecological risk of the new layout.

It is the opinion of the investigators that there should be no opposition to the proposed amendment provided that the mitigation and monitoring measures highlighted in this report and preceding reports are followed.

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Appendix 1. Additional Mitigation Measures for DMOSS Areas (Unknown)

Implications for Amended Layout: The original pipeline and Goodenough weir had the same impact on the DMOSS layer, with exception of the increased size of the disturbance. The orientation and/or position changes have no "new" impact on the D'MOSS, while the increased size only impacts an area situated within the "transformed" category of D'MOSS and outside of the D'MOSS area. On the other hand, the size changes related to the Goodenough Reservoir and the WTP Site have significant impact on the intermediate category of the D'MOSS. The removal of the Option 1 as found in the Original Layout is inconsequential as this site did not fall within the D'MOSS area. Thus, the net effect on the D'MOSS is negative and an increase in management measures need to be implemented to ensure rehabilitation and improvement of ecosystems. Further, a strict working servitude needs to be instituted that takes into account 1) 32m Watercourse Buffer, 2) a working servitude of not more than 20m in D'MOSS (Good & Intermediate) and 3) a working servitude of less than 30m in D'MOSS (Degraded & Transformed). Infrastructure located in areas under D'MOSS (unknown) should follow the Precautionary Principle to natural resources management and utilize the 20m working buffer.

In addition to the above recommendations with regards to pipeline sections that traverse the D'MOSS conservation areas, the following mitigation measures should be considered within the **32m watercourse buffer zone and/or crossings points**:

1. Maintaining a **20m or less servitude**.
2. Initiate an ecosystem **rehabilitation and erosion control plan**.
3. Due to the high propensity of Invasive Alien Plants observed at most of the sites investigated during field assessments, it is recommended that the **Control Invasive Alien Plant** populations 50m upstream and downstream of crossing points should take place for an appropriate period but **not less than 1 follow up**.
4. Due to the observed domestic and in some cases industrial waste pollution within the riparian zones, it is recommended that **Pollution Control Measures** should be strictly adhered to in order to reduce the impacts on the aquatic species that depend on the rivers and riparian zones.

The additional mitigations, if implemented effectively, are expected maintain and/or contribute to the improvement of the ecosystem services within the riparian zones within the DMOSS areas.