A BASIC ASSESMENT OF THE PLANT COMMUNITIES INTERESECTED BY PHASE 4 OF THE NORTHERN AQUEDUCT AUGMENTATION (NAA PH4) AND A BRIEF ACCOUNT OF THEIR POSSIBLE ROLES IN DETERMINING BIODIVERSITY

1. Introduction & Background

Knight Piésold Consulting are undertaking the environmental investigations associated with the proposed Northern Aqueduct Augmentation Phase 4 (NAA Ph4) for the additional provision of potable water to the Phoenix, Cornubia, Umhlanga, Wateroo and iNyaninga areas. Phase 4 involves a link, approximately 6km long, between Duffs Road, Phoenix 6 Reservoir and Phoenix 2 Reservoir just north of Phoenix Highway (Figure 1).

The rate at which existing areas north of Durban, such as Umhlanga Rocks are growing, and the sizes of new developments such as Cornubia necessitate that more water be delivered to these areas in the near future.
eThekwini's existing Northern Aqueduct pipeline (NAX) that supplies the northern areas does not have sufficient capacity to supply the growth in demand in the north. One solution to this problem would be to increase the pressure within the NAX thereby causing the water to move through this system at a higher rate. However, when this possibility was investigated, it was found that, because portions of the NAX comprise aged pipes of comparatively small diameter which also lack modern internal linings, increasing the pressure would result in high frictional resistance and subsequent lining damage, thereby exacerbating the problem.

The so-called Western Aqueduct (WA) commences at Umlaas Road Reservoir which located ca.10km south-east of Pietermaritzburg almost adjacent to the N3. This reservoir is supplied with water from Midmar Dam near Howick. One of the primary objectives of the Western Aqueduct (WA) – which terminates at Ntuzuma 5 Reservoir and is located ca.10km north of the Umgeni River - is to take over part of the water demand presently allocated to eThekwini Municipality's existing Northern Aqueduct (NAX) system. An integral part of this option is a further link to the Western Aqueduct at Emachobeni near Ntuzuma. This link, known as the Northern Aqueduct Augmentation (NAA) would link new development in the north with the Western Aqueduct, thereby increasing both the volume of water delivered to the region as well as the extent of supply. It was therefore decided that a new system – the Northern Aqueduct Augmentation (NAA) – had to be constructed which would link into the NAX system to augment both the volume and extent of supply.

While Phase 1 of the WA (Umlaas Road Reservoir to Inchanga Station) was completed at the end of 2010 a variety of factors have delayed construction of Phase 2 (Inchanga Station to Ntuzuma 5 and two branch limbs) such that it is currently anticipated that construction of this phase will only commence early in 2013. Also, it will take several years to complete. Although the WA is seen as the ultimate long-term solution to meet the growth in demand in the north of Durban, until it is completed, an alternative short term solution is required.

A major bottleneck in the NAX exists in the two comparatively small-diameter pipelines (525cm & 450cm) which run between Duff's Road and Phoenix 2 Reservoir. Removal of this restriction would allow a much higher flow rate through this part of the supply system; thereby increasing water available to new developments in the north. Therefore, to solve this problem it is proposed to lay a new pipeline, 1200cm in diameter, parallel to these two existing ones between Duff's Road and Phoenix 2 Reservoir. Consequently, this proposed new pipeline will be laid in an existing registered servitude. From an environmental perspective, the proposed route has therefore been disturbed at least twice since the 450 cm diameter pipe was laid in 1972 and has continued to be disturbed not only when the second existing pipe was laid in 1984 but also as a result of maintenance which includes periodic mowing.

This proposed new 1200cm diameter pipeline is referred to in this report as Phase 4 of the NAA and by the design engineers as Phase 3. The difference in names comes about partly as a result of the sequence in which it is intended to construct the NAA and how the tenders for the work will be grouped but also because when the EIA was submitted for the NAA in 2011 the project comprised only three phases. It is intended that construction of Phase 4 of the NAA takes place during the same period during which Phase 1 is being constructed so that both

phases can be commissioned at more or less the same time and in this way extend the NAX system to meet the anticipated demands of Cornubia, Waterloo, Nyaninga and Umhlanga.

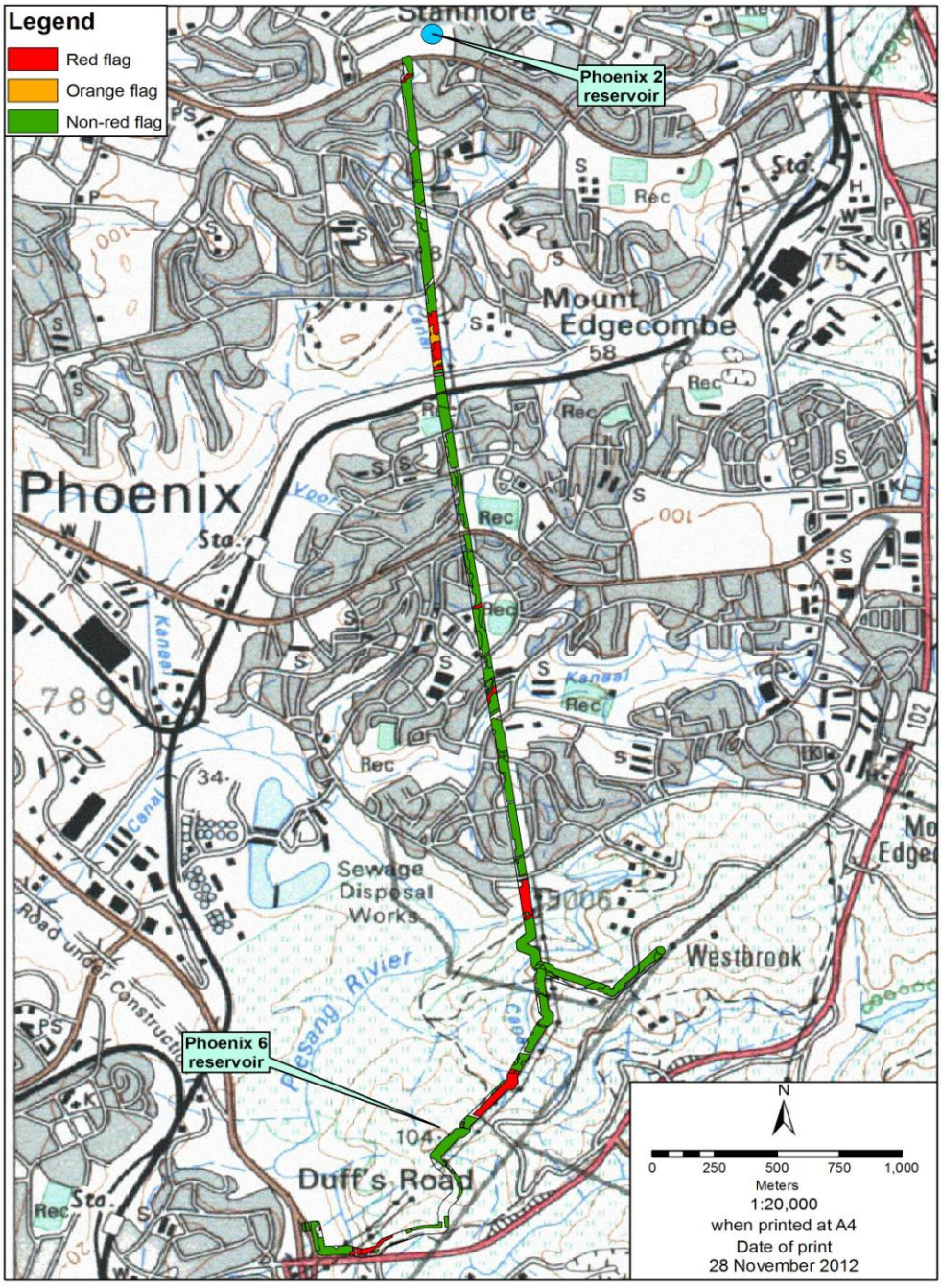

Figure 1. The 40m-wide corridor assessed for Phase 4 of the NAA superimposed on an enlarged portion of the 1:50 000 topcadastral map of Durban.

2. Terms of Reference

The information which the client seeks to obtain from a biodiversity specialist report includes:

- A description of the terrestrial and aquatic biodiversity that characterizes the existing ecosystems crossed by the proposed route and the probable effects of the proposed project..
- Discuss the contribution of the project to any anticipated changes in regional biodiversity and the potential impact to local and regional ecosystems
- Describe any monitoring programs proposed to measure changes to biodiversity caused by the project and the effectiveness of mitigation plans.

It is also required that segments of the proposed pipeline be 'flagged' according to the potential impact the pipeline may have on the status and/or significance of that environment (with respect to the specialist field in question).

The flag system proposed includes three colour- coded situations:

- **Green Flag:** Given the status of the receiving environment within a segment and/or the nature or proximity of the proposed activity, the potential impacts on the specialist-specific environment are negligible.
- **Orange Flag:** Given the status of the receiving environment within a segment and/or the nature or proximity of the proposed activity, the potential impacts on the specialist-specific environment are possible, and with the implementation of known mitigation measures/alternatives it is unlikely to have any significant impact.
- **Red Flag:** Given the status of the receiving environment within a segment and/or the nature or proximity of the proposed activity, the potential impacts on the specialist-specific environment are possible and probable, and *highly significant – possibly even a no-go area*. Further detailed specialist investigation will be required to determine the exact nature of these impacts, possible alternatives and options for mitigation.

3. Methodology

Colour aerial photography, flown during 2011 and covering the eThekwini municipal area, was used as a base for mapping the vegetation which occurs within a 40m-wide corridor. The centre-line of the route also served as the centre-line of this corridor. The various plant communities were mapped using the system described by Edwards (1983) as modified by Granger (1984). Some further minor modifications of this system were incorporated into this system to make it appropriate for this assessment.

This classification system can be described as a physiognomic-structural system in which different categories of vegetation are distinguished on the basis of the plant life-forms which dominate the canopy (and any other defined stratum or strata) and the height and density of these life-forms. Physiognomic-structural categories can be further sub-divided using a variety of subordinate physiognomic criteria such as leaf-size, leaf-texture and/or the names of two or three of the physiognomically dominant species. When the names of species are used to distinguish between different categories it is preferable that their selection is based on species-composition data which is recorded within sampling units often referred to as quadrats. However, because the collection of such species-composition data is usually time consuming – especially if quantitative data (e.g. numbers of individuals of each species) is required – species that are deemed to distinguish one physiognomic unit from another, are selected subjectively while carrying out the mapping.

In the case of this assessment only some physiognomic communities were differentiated using the names of characteristic species because:

- Many of the units which are crossed by the 40m-wide corridor have been severely disturbed and are therefore characterised by alien problem-plant species. Furthermore, many of these species are annual species which can only be confidently identified – except by a vegetation specialist - during the season in which they flower (generally spring and summer).

- Staying longer in some sections of the route than was required to determine more than the physiognomic-structural category to which the unit belonged, posed risks to personal security.

Prior to commencing the mapping the aerial photography was first examined at various scales using the ArcView Vers.2 (Esri 1996) software package. This was followed by a half-day field trip in order to become familiar with the proposed route on the ground and the major physiognomic-structural units. A considerable number of terrestrial digital photographs were taken during this excursion. The information gained was used to digitize – using the heads-up facility in ArcView – the boundaries of the different vegetation units (polygons) on a 32" computer monitor.

Aerial photo-mosaics, at a scale of 1:4000, on which the mapped and numbered polygons appeared, were taken into the field and used as the base on which to differentiate the various physiognomic-structural units and to make any corrections and additions which were considered necessary. The field-annotated photo-mosaics were used to revise the map which had been compiled in ArcView. Field-notes and terrestrial photographs were then used to finalise the names of the various polygons which have been mapped with this information being incorporated into the corresponding attribute table of ArcView. The primary aims of this mapping exercise were therefore to create a map:

- of the different physiognomic-structural categories of the vegetation which occur within the 40m-wide corridor which can be related to conservation data and can be recognised at a scale of 1:4000,
- which identifies the locations of the various vegetation categories in terms of the Red, Orange and Green-flag criteria described in the terms of reference,
- of different categories of vegetation which are readily distinguishable throughout the year by a person who might not be a vegetation specialist, and
- which could serve as a base for compiling a vegetation rehabilitation plan for the contractor who will construct the pipeline and rehabilitate its corridor.

This report therefore comprises this text and an atlas of nine sheets at a scale of 1:200 which show the polygons which were mapped for this study. The boundaries and categorisation of the various vegetation categories which were mapped for this report have been simplified to form the basis of the Plant Rescue & Rehabilitation Plan which is being compiled for Phase 4 of the NAA. This plan is not a component of this report.

The conservation data referred to above which has been consulted for this report is primarily that which is contained in the databases of D'MOSS (2011) and KZN Wildlife's Spatial Resources Plans (2012). A variety of other published sources of information were also consulted.

4. Physiognomic-Structural Vegetation Communities, Distinguishing Characteristics & Selected Features

A total of 94 polygons were mapped representing 26 different communities (**Tables 1 and 2**). The occurrence of what may be considered a large number of communities over a comparatively short distance (ca.6.6km**)** is primarily a reflection of the variation in landuse that occurs along the route. Complexity is amplified by the variety and distinctiveness of the landforms that it crosses.

No instances were encountered where it was deemed justified to recognise a different colour-flag status within a particular vegetation type. Therefore, the colours of the titles in Table 1 reflect the flag-status of the various vegetation types.

Table1. Physiognomic-structural plant communities recognised within the 40m-wide corridor assessed for the proposed route for Phase 4 of the Northern Aqueduct Alignment and their distinguishing characteristics. The colours of the names of the map symbols and community names reflect flag status categories described in the Terms of Reference.

Map Symbol	Plant communities characterised by indigenous species	Distinguishing characteristics
a	Short Moderately Disturbed Coastal Forest (Red)	Total tree cover > 0.1%; shrub cover < 10% if > 1m high, trees 5 - 10m high. Moderately invaded throughout by alien problem plant species but margins conspicuously invaded by alien problem-plant species.
b	Short Dense Thicket (Red)	Total tree cover of canopy 1-20%; shrub cover > 10% & > 1m high, trees 5-10m, shrubs 2-5m high, C 20-50%. Margins conspicuously invaded by alien problem-plant species.
c	Short Dense Disturbed Thicket (Green)	Total tree cover of canopy 1-20%; shrub cover > 10% & > 1m high, trees 5-10m, shrubs 2-5m high, C 20-50%. Moderately to extensively invaded throughout by alien problem plant species and margins conspicuously invaded by alien problem-plant species.
d	Low Dense Disturbed Thicket (Green)	Total tree cover of canopy 1-20%; shrub cover > 10% & > 1m high, Trees 2-5m, shrubs 1-5m high, C 20-50% Moderately to extensively invaded throughout by alien problem plant species and margins conspicuously invaded by alien problem-plant species.
e	Short Closed Disturbed *Acacia schweinfurthii* Shrubland (Green)	Total tree cover,< 0.1%; shrub cover > 0.1% or tree cover up to 1% & shrub cover > 10% & 1m high. Shrubs 0.5 - 1m, C100 - 10%, Ø 0 – 2. Moderately to extensively invaded throughout by alien problem plant species and margins conspicuously invaded by alien problem-plant species. Canopy dominated almost exclusively by *Acacia schweinfurthii.*
f	Short Dense Grassland (Orange)	Total tree cover < 0.1%; shrub cover < 0.1%; grass cover dominant and > 0.1%. Grasses 0.5 - 1m high, C100 - 10%, Ø 0 – 2.
g	Short Dense Disturbed Grassland (Green)	Total tree cover < 0.1%; shrub cover < 0.1%; grass cover dominant and > 0.1%. Grasses 0.5 - 1m high, C100 - 10%, Ø 0 – 2.Conspicuous signs of current or recent cultivation and alien problem-plant species conspicuous.
h	Short Dense Disturbed Grassland & Subsistence cultivation Mosaic (Green)	Total tree cover < 0.1%; shrub cover < 0.1%; grass cover dominant and > 0.1%. Grasses 0.5 - 1m high, C100 - 10%, Ø 0 – 2.Conspicuous signs of current or recent cultivation which forms a mosaic with land which has either not been cultivated in the recent past or has never been cultivated. Alien problem-plant species conspicuous.
Wetlands		
i	Short Dense Riparian Thicket (Red)	Total tree cover of canopy 1-20%; shrub cover > 10% & > 1m high, trees 5-10m, shrubs 2-5m high, C 20-50%. Occurs as fringing vegetation on flanks of perennial streams or rivers. Moderately invaded throughout by alien problem plant species but margins generally conspicuously invaded by alien problem-plant species.
j	Tall Closed Disturbed Riparian Shrubland (Red)	Total tree cover,< 0.1%; shrub cover > 0.1% or tree cover up to 1% & shrub cover > 10% & 1m high. Shrubs 1.0 – 2.0m, C100 - 10%, Ø 0 – 2. Moderately to extensively invaded throughout by alien problem plant species and margins generally invaded by alien problem-plant species. Occurs as fringing vegetation on flanks of perennial streams or rivers.
k	High Closed Disturbed Wetland Shrubland (Red)	Total tree cover,< 0.1%; shrub cover > 0.1% or tree cover up to 1% & shrub cover > 10% & 1m high. Shrubs 2.0m – 5.0m, C100 - 10%, Ø 0 – 2. Moderately to extensively invaded throughout by alien problem plant species and margins generally invaded by alien problem-plant species. Occurs as fringing vegetation on flanks of perennial streams or rivers.

Map Symbol	Plant communities characterised by indigenous species	Distinguishing characteristics
l	High Dense *Phragmites australis* Reedbed-Cultivation Mosaic (Red)	Total tree cover < 0.1%; shrub cover < 0.1%; reed cover dominant and > 0.1% C100 - 10%, Ø 0 – 2, reeds >2.0m, Clumps of reeds form a mosaic with areas of subsistence cultivation.
m	High Dense Riparian *Phragmites australis* Reeds (Red)	Total tree cover < 0.1%; shrub cover < 0.1%; reed cover dominant and > 0.1% C100 - 10%, Ø 0 – 2, reeds >2.0m and occur as the most conspicuous growth-form along the margins of perennial rivers or streams
n	Wetland: *Typha capensis* & *Phragmites australis* (Red)	Total tree cover < 0.1%; shrub cover < 0.1%; intermingled cover comprising mainly reeds and bulrush (*Typha*) dominant, reeds & bulrush > 0.1% C100 - 10%, Ø 0 – 2, reeds >2.0m, bulrush 1.0m – 2.0m.
o	Stream & streambanks (Red)	Open, perennial streams and rivers and immediate fringes which may support a variety of wetland communities characterised by reeds and/or bulrush but also other water-loving plants such as sedges and rushes.
Plant communities characterised by alien species		
p	Alien tree clumps (Green)	Trees, sometimes alien problem spp. e.g. Syringa (*Melia azedarach*).
q	Short Dense Alien Tree & Shrub spp.-dominated Thicket (Green)	Total tree cover of canopy 1-20%; shrub cover > 10% & > 1m high, Trees 2-5m, shrubs 1-5m high, C 20-50% with alien problem-plant species strongly or totally dominant
r	High Closed Disturbed Valley Shrubland & subsistence cultivation (Green)	Total tree cover,< 0.1%; shrub cover > 0.1% or tree cover up to 1% & shrub cover > 10% & 1m high. Shrubs 2.0m – 5.0m, C100 - 10%, Ø 0 – 2. Occurs throughout the shallow valley in which it was recognised & is extensively transformed by subsistence cultivation both current and recent..
s	Tall Open Alien spp. Shrubland & Short Dense Grassland (Green)	Total alien spp. tree cover <0.1%; alien spp. shrub cover > 0.1% or alien spp. tree cover up to 1% & shrub cover > 10% & 1m high, C10 -1%, Ø 2 - 8.5 occurring throughout Short Dense Grassland in which grasses 0.5 - 1m high, C100 - 10%, Ø 0 – 2.
t	Short Closed alien spp. Shrubland & Subsistence cultivation (Green)	Total alien tree spp. cover <0.1%; alien shrub spp. cover > 0.1% or alien tree spp. cover up to Shrubs 0.5 - 1m 1% & shrub cover > 10%, C100 - 10%, Ø
u	Low mown Dense Grassland (existing servitude) (Green)	Grasses 0.2 - 0.5m high and dense i.e. canopy cover >0.1%, C100 - 10%,
v	Dwarf Dense Roadside Grassland (Green)	Grasses <0.2m high and dense i.e. canopy cover >0.1%, C100 - 10%,
x	Sports field turf (Green)	As for v above but single creeping grass spp. generally dominant
y	Subsistence cultivation (Green)	Various crops including maize, legumes and madumbi (*Colocasia esculenta*)
Wetlands		
z	Riparian Subsistence cultivation & severely disturbed High Closed Shrubland (Red)	Current & recent subsistence cultivation is the dominant form of landuse within High Closed Shrubland which is strongly or totally dominated by alien problem-plant spp.
zz	Wetland: shallow drainage line (Red)	A single short shallow drainage line covered in Low mown Dense Grass species and conveys water during episodes of high rainfall.

Symbols used to denote selected vegetation characteristics

C = canopy cover

Ø = canopy diameters (refers to distance between canopies i.e. density of plants, especially trees & shrubs, can be described on the basis of how far apart individuals are where the distance between canopies is expressed as the number of mean canopy width which separates them.)

↔ = clump diameters apart. This symbol applies to clumps of woody vegetation rather than individual canopies, but, in the same way as density of individual trees & shrubs can be described as 'number of canopy-distances apart' so too can the density of clumps of a specified size (determined on the basis of the mean diameter of the interlocked canopies of the trees & shrubs which form the clumps) be described e.g. 5 canopy diameters (↔)/ha.

Table 2. Selected features which describe the sizes and degree of fragmentation of the mapped physiognomic-structural vegetation units recognised within the 40m-wide corridor assessed for Phase 4 of the Northern Aqueduct Augmentation.

Map Symbol	Plant communities characterised by indigenous species	No. of polygons	Total area (m^2)	Mean area (m^2)
a	Short Moderately Disturbed Coastal Forest (Red)	**1**	**2257**	n/a
b	Short Dense Thicket (Red)	**1**	**3252**	n/a
c	Short Dense Disturbed Thicket (Green)	**2**	**4128**	2064
d	Low Dense Disturbed Thicket (Green)	**4**	**7370**	1843
e	Short Closed Disturbed *Acacia schweinfurthii* Shrubland (Green)	**2**	**2871**	1436
f	Short Dense Grassland (Orange)	**3**	**2832**	944
g	Short Dense Disturbed Grassland (Green)	**3**	**9396**	3132
h	Short Dense Disturbed Grassland & Subsistence cultivation Mosaic (Green)	**2**	**10156**	5078
Wetlands				
i	Short Dense Riparian Thicket (Red)	**2**	**6627**	3314
j	Tall Closed Disturbed Riparian Shrubland (Red)	**3**	**1251**	417
k	High Closed Disturbed Wetland Shrubland (Red)	**1**	**774**	n/a
l	High Dense *Phragmites australis* Reedbed-Cultivation Mosaic (Red)	**1**	**134**	n/a
m	High Dense Riparian *Phragmites australis* Reeds (Red)	**2**	**932**	466
n	Wetland: *Typha capensis* & *Phragmites australis* (Red)	**2**	**2900**	1450
o	Stream & streambanks (Red)	**1**	**656**	n/a
Plant communities characterised by alien species				
p	Alien tree clumps (Green)	**8**	**4413**	552
q	Short Dense Alien Tree & Shrub spp.-dominated Thicket (Green)	**3**	**7045**	235
r	High Closed Disturbed Valley Shrubland & subsistence cultivation (Green)	**8**	**16612**	208
s	Tall Open Alien spp. Shrubland & Short Dense Grassland (Green)	**3**	**6145**	205
t	Short Closed alien spp. Shrubland & Subsistence cultivation (Green)	**3**	**1.5149**	505
u	Low mown Dense Grassland (existing servitude) (Green)	**18**	**82127**	456
v	Dwarf Dense Roadside Grassland (Green)	**17**	**1.0082**	59
x	Sports field turf (Green)	**1**	**0.0705**	n/a
y	Subsistence cultivation (Green)	**1**	**0.0296**	n/a
Wetlands				
z	Riparian Subsistence cultivation & severely disturbed High Closed Shrubland (Red)	**1**	**0.8028**	n/a
zz	Wetland: shallow drainage line (Red)	**1**	**0.0530**	n/a
TOTALS		**94**	**206668**	-

The following important characteristics of the vegetation emerge from the data presented in Table 2.

a. 18.60ha or **90% of the total area of the corridor is occupied by non-wetland vegetation** which is **disturbed to some degree.**
b. 151,132m^2 or **73%** of the total area of the corridor is occupied by vegetation which was mapped as **Plant communities characterised by alien species** (includes two categories of wetland).
c. Of the total area of the corridor (206,668m^2) only 13274m^2 or **6.4% comprises wetland** communities which are **slightly to moderately disturbed**.
d. Wetland areas which were mapped as being severely or almost entirely transformed comprise 8,558m^2 or 4.1% of the total area of the corridor.
e. Wetland areas which are considered to be in good condition:
   i. 11,115m^2 or **5.4%** of all areas mapped as **wetland can be considered to be in good condition**.
   ii. **3,556m^2** of this 11,115m^2 is contributed by the area of wetland and stream which occurs on the northern side of Eastbury Drive and occurs **within the 40m-wide corridor**.
f. As regards areas of non-wetland vegetation the polygons mapped as Short Moderately Disturbed Coastal Forest (2,257m^2), Short Dense Thicket (3,252m^2) which occurs on the slope just above (i.e. north of

Eastbury Drive) and Short Dense Riparian Thicket (polygon 36,5604.6m^2) Together these three areas comprise ca.5509m^2 or ca.5.4% of the total area of the corridor.

g. The grassland component of the areas mapped as Short Dense Disturbed Grassland & Subsistence cultivation Mosaic, 17,247.6m^2 in extent and comprising ca.**8.4% of the total area of the corridor**, can be considered to be in a **moderately good condition** from a conservation perspective. However, this status is **threatened by the extent to which it has become invaded by alien problem-plant species** and by several comparatively small dispersed areas which, at the time of carrying out the field mapping, appeared not to have been cultivated for several seasons. The conservation status of this grassland would be improved by burning the grassland every second year during winter or very early spring

5. Vegetation Communities, Importance for Conservation and Threats

The corridor of the proposed route for Phase 4 of the NAA occurs within the vegetation type which was mapped (scale 1: 250 000) and described by Mucina & Rutherford (2006) as: CB3: KwaZulu-Natal Coastal Belt. These authors state that: "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 forest".

Only a few small portions of vegetation which occur within the corridor namely Short Moderately Disturbed Coastal Forest, Short Dense Thicket and Short Dense Riparian Thicket (polygon 36) correspond to any of the indigenous communities cited by Mucina & Rutherford. The areas mapped as Short Dense Disturbed Grassland & Subsistence cultivation Mosaic could possibly be considered to be a degraded stage of secondary *Aristida* grassland but this can only be substantiated by undertaking an assessment of the species composition of these areas in late spring/early summer after they have been burnt during the preceding winter but such an investigation was beyond the scope of the fieldwork undertaken for this report. The primary relevance of the work of Mucina & Rutherford (2006) for this report lies in the fact that these authors categorised the conservation status of KwaZulu-Natal Coastal Belt as Endangered.

Superimposing the corridor on the 2011 D'MOSS maps revealed that most of the corridor crosses land which does not form part of D'MOSS. However, comparatively small portions of six different D'MOSS categories do occur within the corridor. These six categories and their equivalents which were mapped for this report are presented and commented on briefly in **Table 3** below and are also shown in **Figure 2**.

Table 3. D'MOSS categories intercepted by the corridor of Phase 4 of the NAA and the equivalent categories and the polygons in which they occurred which were mapped for this report.

D'MOSS category	Map units as recognised for this report	Comments
Freshwater Wetland: Umhlangane River	High Dense *Phragmites australis* Reedbed-Cultivation Mosaic & High Dense Riparian *Phragmites australis* Reeds (Polys.6, 7 & 8)	Two very distinct components of the floodplain and banks of the Umhlangane River which probably provide habitat for at least a number of different spp. of fauna and which require different approaches to rehabilitation included in single D'MOSS category
Forest transitional : Umhlangane River	Short Moderately Disturbed Coastal Forest (Poly.9).	D'MOSS and vegetation category typifications agree but boundaries of polygons within the corridor differ.
Coastal Forest Mt Moriah	Short Dense Riparian Thicket (Poly. 36)	Certainly not forest within the corridor. Therefore, may support some spp. of flora and fauna which are not forest spp.
Freshwater wetland: drainage line	Short Dense Disturbed Riparian Thicket (Polys. 47 & 48)	D'MOSS categorisation fails to indicate dominance of woody spp. Such information highly relevant for determining rehabilitation treatment.
Terrestrial Recreational Parkland: Ghandi Luthuli Park	Short Dense Grassland, Wetland: *Typha capensis* & *Phragmites australis,* Stream & Streambanks & Short Dense Thicket (Polys. 70, 73, 74, 75, 76 & 77)	D'MOSS polygon and description fails to reveal existence of different habitats at least two of which i.e. *Typha capensis* & *Phragmites australis,* Stream & Streambanks may provide habitat for a Red Data frog sp.

D'MOSS category	Map units as recognised for this report	Comments
Terrestrial Secondary Grassland: Ghandi Luthuli Park	Short Dense Grassland, Short Dense Thicket & Low mown Dense Grassland (existing servitude) Polys. 75, 76 and 78)	D'MOSS fails to recognise three very different vegetation types/habitats which are likely to support a number of different spp. of flora & fauna. Also, two of the three vegetation types recognised for this report require different rehabilitation treatments.

Based on the brief comments provided in **Table 3** above it is concluded that while the D'MOSS map supports the information presented in a – I above the D'MOSS categories which are intersected by the corridor are not, in most instances provide a informative as the titles given to the various communities which have been mapped for this report. A further shortcoming is that the boundaries of some of the D'MOSS units appear to not be as accurate as the boundaries of corresponding polygons mapped for this report.

While the more general titles of the D'MOSS categories and also the discrepancies between polygon boundaries can be ascribed to the difference in the scales at which the D'MOSS map and the one presented in this report were mapped the discrepancies between boundaries makes the use of the areas covered by the D'MOSS units which are given in the underlying database unreliable for the purpose of determining what proportion of these categories occur within the corridor.

The 'failure' of the D'MOSS mapping to reveal the existence of the wetland and stream which occurs just north of Eastbury Drive is of concern because it is considered possible that one or both of these habitats may be found to support Pickergill's Reed Frog which is a Red Data species.

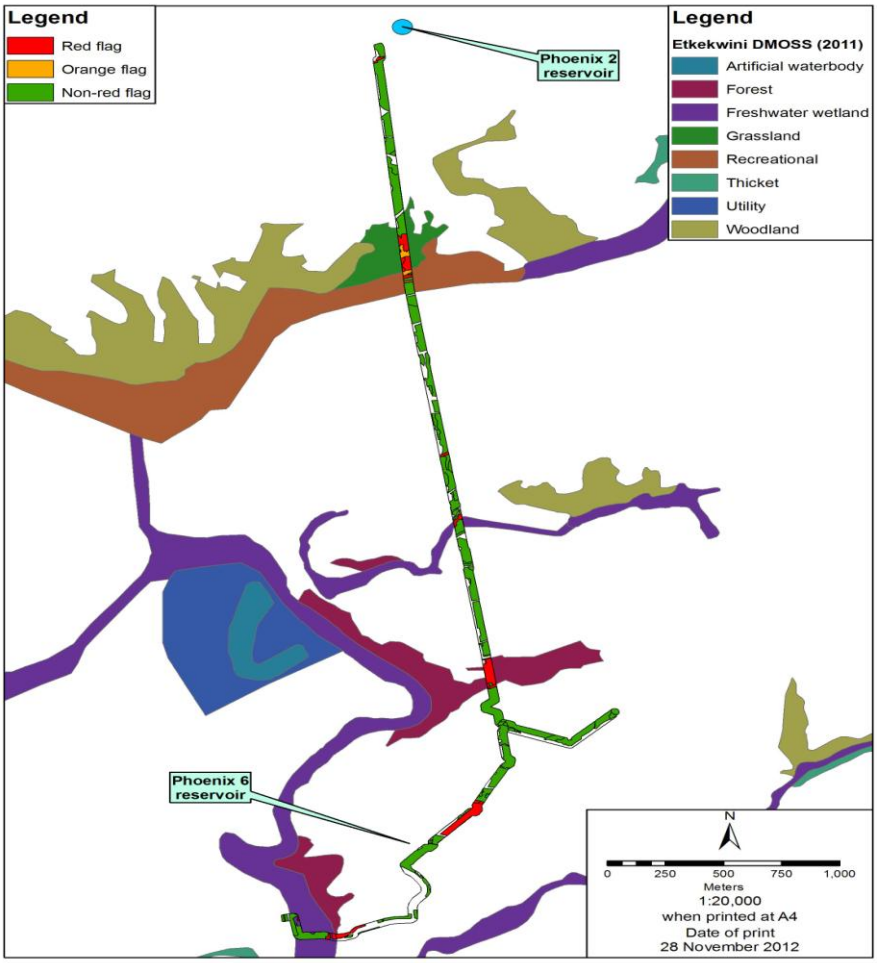

Figure 2. The 40m-wide corridor assessed for Phase 4 of the NAA superimposed on the D'MOSS categories it crosses.

At a more detailed scale, vegetation maps compiled by KZN Wildlife (KZNW) reveal that most of the route crosses land which is classified as Transformed. However, at its south-eastern-most end the route crosses just outside an area of Subtropical Alluvial Vegetation which from a conservation perspective is classified as Endangered. A probable reason that this particular area of Subtropical Alluvial Vegetation does not extend further upstream in the floodplain of the Umhlangane River where it would be crossed by the corridor is because in this area the natural vegetation has been highly transformed and only small remnants of the original natural vegetation remain.

Where polygon 36 occurs in the corridor it represents a portion of KwaZulu-Natal Coastal Forests: a vegetation type which is classified as being Critically Endangered. However, due probably to the fact that much of this polygon includes the servitude of the existing pipelines and is therefore cut and mown periodically, when seen during the field assessment, the vegetation in this polygon was identified as Short Dense Disturbed Thicket rather than any form of forest. Notwithstanding this difference in classification the fact that this polygon does comprise dense woody vegetation which is flanked on both sides by forest does not preclude it from providing habitat for none or more species of flora and or fauna which are of conservation concern.

A further aspect which must be considered is that because the vegetation in this polygon has been recognised as thicket, it is reasonable to assume that this portion of the corridor is not cut and mown frequently. An important implication of this is that so long as even thicket persists in this portion of the corridor it will serve as a corridor to link the areas of forest which occur on both sides of it. Therefore, when the corridor is cleared and grubbed to order to construct Phase 4 of the NAA the effectiveness of this area of thicket as a link will be conspicuously disrupted. This may impact negatively on some species of fauna if they occur in this area.

While it is appreciated that this impact is unavoidable when the new pipeline is constructed in the existing servitude it does identify the need for the corridor to be rehabilitated appropriately as soon as possible after the trench has been backfilled.

The route for Phase 4 of the NAA was also superimposed on KZNW's Minset map.
The Minset database comprises a selection of 255 red data and endemic plant and animal species which occur in KwaZulu Natal. Drawing on data for the known occurrences of these species, and a number of criteria which characterise the preferred habitats of these species, the Minset map is made up of polygons which define areas within which nine of the 255 species occur or can be expected to occur. The identities of the Minset polygons, especially their spatial extent is highly correlated with the boundaries of the habitat type. In the case of terrestrial flora and fauna these are the vegetation types which make up KZNW's vegetation map while in the case of freshwater aquatic species a map of the freshwater habitats in the province provides the basis for identifying the type of habitat. The different habitats are also classified on the basis of their importance for conservation.

Drawing largely on the Minset database KZNW has identified three categories of areas in KwaZulu-Natal which reflect the organisation's conservation priorities. Priority 1 Biodiversity areas are those in which KZNW places the highest priority on the preservation of the existing habitat while Priority 3 Biodiversity areas are those which are of least concern to EKZNW with regard to nature conservation. Lest it be assumed that Priority 3 areas all coincide with land which has been highly transformed and therefore no longer comprises habitat which is likely to support any of the 255 red data or endemic species referred to above, this is not necessarily the case. An area classified as Priority 3 may be so classified because all or most of it comprises land that is a proclaimed conservation area i.e. it is an area in which a number of red data and endemic species as well as important habitats occur but these are all protected by legislation. Consequently there is less 'pressure' on KZNW to either acquire them or to ensure that being outside of a proclaimed reserve, they are properly managed for nature conservation. Therefore, Priority 1 areas are, in many instances, areas which do not form part of a proclaimed nature conservation area but in which one or more habitat types and or species of conservation concern do or may occur.

The basis on which the conservation priority areas of KwaZulu-Natal have been identified is not infallible. Two criticisms which can be levelled at it are: (i) many Priority 1 areas are identified on the basis of the predicted occurrence of one or more of the 255 species of particular conservation concern and not on their actual occurrence and (ii) the scale at which most of the habitats have been mapped is too large/general to reflect the

variation in the quality of the habitat. This second criticism tends to be justified in the case of polygon 36 which delineates a portion of KwaZulu-Natal Coastal Forest where the habitat has been degraded.

Such criticisms do not diminish the value of products such as Minset or the Conservation Priority map. Some reason why this is so are: (a) the boundaries shown in all of the maps referred to above are not 'cast in stone' but are constantly revised as new data comes available and there are sufficient specialists to process it and (b) the more detailed maps become i.e. the smaller the scale the more unwieldy they are likely to be especially if they cover a wide area of heterogeneous landscape.

In the case of investigations which have been undertaken for this report one of the most valuable attributes of KZNW's Conservation Priority map is that it identifies areas within a landscape which have been strongly and extensively transformed but where plant and/or animal species of conservation importance may still be present and therefore should be looked for. The existing servitude and route for Phase 4 of the NAA crosses 13 areas of Biodiversity Priority 1 and no areas of either Priority 2 or 3. The distribution of these areas is shown in **Figure 3** and additional details provided in **Table 4**. The total area of KZNW Priority 1 areas within the corridor is ca.4,7984m^2 or 23.2% of the total area of the corridor.

Table 4. Locations (chainage start and end distances) and sizes of KZNW Priority 1 areas which occur within the 40m-wide corridor assessed for Phase 4 of the NAA and the corresponding vegetation polygons which were recognised and mapped for this report. The numeral indicates the polygon number and the lower-case letter which accompanies it, indicates the vegetation category (see end of table). Polygons which comprise highly transformed vegetation are highlighted in yellow.

Priority Area 1 polygon number	Chainages (m): start - finish	Area (m^2)	Corresponding vegetation polygon(s) and unit(s): this report	Area (m^2)	Comments
1	3480 - 3360	3109	4e, 6q, 7m,8m,9a,10v	2539,6139,428,504,2257,150	71% transformed
2	3275 - 3350	2030	11v	229	100% transformed
3	2465 - 2560	3159	17t	40	100% transformed
4	2475 - 2900	12017	20z	8028	100% transformed
5	2860 - 2915	1134	28h, 30c	125,84	40% transformed
6	1525 - 1620	2451	35h,89n, 35(b)h, 36i	7948,560,220,5605	57% transformed
7	1510 - 1535	138	48i	1023	0% transformed
8	1030 - 1035	3	53u,56s	1934, 594	100% transformed
9	65 - 445	13387	66u,67s	1208,2096	100% transformed
10	35 - 385	10204	68s,69v,70o,71f,73k,74n,75f,76b,77f	2614,560,656,110,774,2340, 854,3252,1869	30% transformed
11	450 - 460	10	80d	2147	100% transformed
12	1265 - 1295	296	81d	3063	100% transformed
13	1200 - 1235	10	84i	675	0% transformed
Total		47948			

Key to symbols used in Table 4

a: Short Disturbed Coastal Forest, b: Short Dense Thicket, c: Short Dense Disturbed Thicket, d: Low Dense Disturbed Thicket, e: Short Closed Disturbed *Acacia schweinfurthii* Shrubland, f: Short Dense Grassland, h: Short Dense disturbed Grassland & Subsistence cultivation Mosaic, i: Short Dense Riparian Thicket, k: High Closed Disturbed Wetland Shrubland, m: High Riparian *Phragmites australis* Reeds, n: Wetland: *Typha capensis* & *Phragmites australis,* o: Stream & Streambanks, q: Short Dense Alien Tree & Shrub spp.-dominated Thicket, s: Tall Open Alien spp. Shrubland & Short Dense, Grassland, t: Short alien spp. Shrubland & Subsistence cultivation, u: Low mown Grassland (existing servitude), v: Short Dense Alien Tree & Shrub spp.-dominated Thicket, z: Riparian Subsistence cultivation & severely disturbed High Closed Shrubland, High Closed Disturbed Wetland Shrubland

Summarising the data presented in **Table 4** it emerges that of the 47,948m^2 of KZNW Priority 1 areas which are shown in **Figure 3** to occur within the corridor 40,085m^2 or **84% of these areas were mapped for this report as some category of disturbed vegetation.**

While this may seem to cast some doubt on either the extent or categorisation of the KZNW areas shown in **Figure 3** or on the categorisation of the vegetation in the corridor when it was mapped for this report it should be noted that in the case of KZNW polygon 10 which comprises 13,029m^2 of Priority 1 land, only 30% of this area

was identified as comprising one or more categories of transformed vegetation when the corridor was mapped for this report. In other words, where areas of vegetation within the corridor were considered during the field assessments as being in good condition from a conservation perspective the mapped polygons which define these areas coincide to a large degree with the area identified by KZNW as being Priority 1. This is not surprising when it is appreciated that much of KZNW's Priority 1 polygon 10 comprises the Ghandi Luthuli Park.

A further aspect to be considered is, that because the scale at which the KZNW maps have been compiled are much smaller, and therefore more generalised, than the scale at which the vegetation was mapped for this report, it is not possible for the KZNW maps to reflect the variations in the condition/quality which occur in every area of North Coast Grassland, Subtropical Alluvial Vegetation and KwaZulu-Natal Coastal Forests. Therefore, it may be argued that the categorisation of the polygons which were mapped for this report, does, to some extent, contribute additional information as to the quality of the portions of these three vegetation types which are crossed by the proposed route.

Notwithstanding that some or all the portions of the above three KZNW vegetation/habitat categories may not be in prime condition from a structural and also plant species composition perspective, this does not mean that these portions do not serve as habitat for one or more of the species of indigenous fauna listed in **Table 4**.

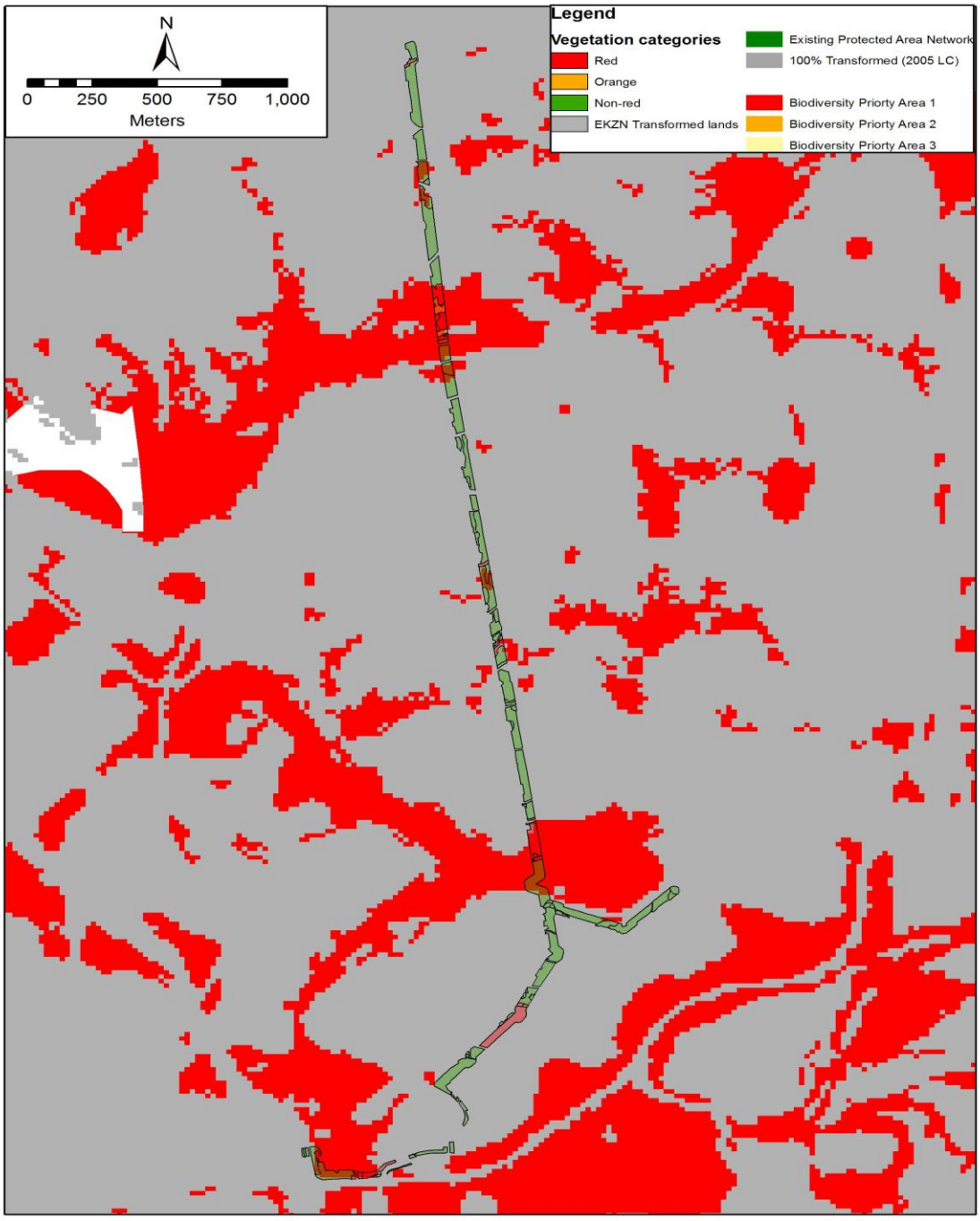

Figure 3. The 40m-wide corridor assessed for Phase 4 of the NAA superimposed on the relevant portion of the Ezemvelo KZN Wildlife map of Biodiversity Priority Areas in KwaZulu-Natal. The coloured portions of the corridor reflect the flag categories described in the Terms of Reference for this report and referred to in the legend of this figure as Vegetation Categories.

Table 5 below summarises the species or categories of flora and fauna that may occur within the corridor, or in the immediately adjacent areas of the communities that were mapped for this report and what the anticipated impacts of construction may be.

Consideration is also given to measures that could be taken to prevent or reduce the severity of these possible impacts.

Table 5. Vegetation types and plant and animal species of conservation concern listed in KZN Wildlife's Minset database which do or may occur within the 40m-wide corridor assessed for Phase 4 of the NAA.

Category or Taxon	KZNW conservation status	Map units this report in which category or taxon does or may occur	Specific/micro-habitats	Predicted impacts due to construction	Proposed mitigation measures
Flora					
Kwazulu-Natal Coastal Belt Grassland	Critically Endangered	-	-	Complete removal when clearing & grubbing takes place	If possible, burn off in winter (July-August) and have plant specialist search during spring (late October-November) to locate and rescue species of conservation concern. Local people may want some surplus plants for traditional purposes. Rehabilitate with appropriate methods as soon as possible after trench has been backfilled and topsoil spread.
Subtropical Alluvial Vegetation (natural)	Endangered	All polygons mapped as wetland	-	-	Negotiate narrowing of construction corridor with project engineer. Rescue wetland plant species for later use in rehabilitation. Rehabilitate in accordance with wetland rehabilitation specifications as described in Plant Rescue & Rehabilitation Plan.
Southern Mesic Coastal Lowlands Forest	Critically Endangered	-	-	-	Rescue & rehabilitate as prescribed in Plant Rescue & Rehabilitation Plan
Barleria natalensis	Extinct	Grassland	Grassland	Scott-Shaw (1999) states that although extinct in the Verulam & Stanger areas where it occurred, it should still be searched for.	If possible, burn off grassland areas in winter (July-August) and have plant specialist search during spring (late October-November) search for species of conservation concern with close attention being given to all species of *Barleria* which may be encountered. Specialist to inspect or at least obtain photographs of specimens which may be lodged in herbaria.
Vernonia africana	Extinct	Grassland	Grassland	Scott-Shaw (1999) states that although extinct in the Verulam & Mt. Edgecombe areas where it occurred, it should still be searched for.	If possible, burn off grassland areas in winter (July-August) and have plant specialist search during spring (late October-November) search for species of conservation concern with close attention being given to all species of *Vernonia* which may be encountered. Specialist to inspect or at least obtain photographs of specimens which may be lodged in herbaria.
Fauna					
Edouardia conulus (Conical Bark Snail)	Scarce	Forest, thicket & wooded grassland	Lives under stones	Very little suitable habitat which has not already been	Likelihood of encountering this snail is considered remote.

Category or Taxon	KZNW conservation status	Map units this report in which category or taxon does or may occur	Specific/micro-habitats	Predicted impacts due to construction	Proposed mitigation measures
				transformed occurs along the route.	
Euonyma lymneaeformis (Lymnaeid Awl Snail)	Locally common	Forest to grassland	Logs, stones & leaf-litter	Removal of logs, leaf-litter and stones in wooded vegetation types.	Stockpile logs, leaf-litter and stones separately from top and sub-soil and re-distribute these items across those portions of the corridor in which they were encountered immediately prior to implementing rehabilitation treatments.
Cochlitoma semidecussata (formerly *Arachatina semidecussata*) (Durban Agate Snail)	Rare, limited distribution in KZ-N	Coastal lowland and scarp forest	Lives in leaf litter	Destruction of leaf litter. However, given the extent to which potential habitat has already been transformed, likelihood of encountering this snail is remote (D. Herbert, pers. com.)	Likelihood of encountering this snail is considered remote.
Gnomeskelus spectabilis (millipede)	IUCN Not evaluated. KZN endemic	Forest	Inhabits leaf litter	Clearing & grubbing resulting in destruction and removal of leaf litter	When clearing & grubbing are undertaken leaf litter and topsoil to be stacked in a single row along outer margin of corridor & left undisturbed until rehabilitation commences.
Doratogonus cristulatus Cristulate Black Millipede	IUCN: Least concern. KZN endemic	In Coastal & Mistbelt Forest & forest ecotones	Inhabits leaf litter	Clearing & grubbing resulting in destruction and removal of leaf litter.	When clearing & grubbing are undertaken leaf litter and topsoil to be stacked in a single row along outer margin of corridor & left undisturbed until rehabilitation commences.
Doratogonus falcatus (millipede)	IUCN: Least concern. KZN endemic .	Savanna & Valley Bushveld	Inhabits leaf litter	Clearing & grubbing resulting in destruction and removal of leaf litter.	When clearing & grubbing are undertaken leaf litter and topsoil to be stacked in a single row along outer margin of corridor & left undisturbed until rehabilitation commences.
Doratogonus peregrinus (Wandering Black Millipede)	IUCN Not evaluated. KZN endemic	Forest &	Inhabits leaf litter	Clearing & grubbing resulting in destruction and removal of leaf litter.	When clearing & grubbing are undertaken leaf litter and topsoil to be stacked in a single row along outer margin of corridor & left undisturbed until rehabilitation commences.
Bittacus zulu (Zulu Hanging Fly)	Status uncertain due possibly to, as yet, insufficient collecting but thus far appears to be highly localised.	Short dense grassland esp. in Ghandi-Luthuli Park	In grassland beneath large *Acacia* spp. trees i.e. shaded habitat.	If this species does occur, it is likely to move to avoid disturbance.	Given the extent to which most of the vegetation along the route has been transformed and the extent and intensity of development it is considered unlikely that this insect will be present along the route.
Durbania amakosa (Amakosa Rocksitter Butterfly)	Vulnerable	Rocky outcrops in grassland. Almost no such habitat present in corridor.	Usually inhabits rocky ledges and grassy hillsides.	If this species does occur, it is likely to move to avoid disturbance.	ECO to be competent to identify. Construction activities in vegetation type where encountered to cease immediately and guidance of appropriate specialist to be sought.

Category or Taxon	KZNW conservation status	Map units this report in which category or taxon does or may occur	Specific/micro-habitats	Predicted impacts due to construction	Proposed mitigation measures
Atyoida serrata (Large Freshwater Shrimp)	Rare. Very restricted distribution in Durban area.	Streams	In crevices & beneath rocks in fast-flowing streams	Unlikely to be present in the river and streams which are crossed by the route.	None
Hyperolius pickersgilli (Pickersgill's Reed Frog)	Endangered	Wetlands	Breeds in thick emergent vegetation	Removal of vegetation essential for breeding.	Prior to construction commencing across wetlands – especially wetland immediately north of Eastbury Drive – must be searched by amphibian specialist and any animals found: captured & relocated.
Bradypodion melanocephalum [KwaZulu (Black-headed) Dwarf Chameleon]	Restricted RSA endemic- Vulnerable to Threatened	Drainage lines, forest edge and wetland edge	Drainage lines, forest edge and wetland edge	Destruction of habitat, disruption of breeding.	Check with appropriately qualified specialist as to whether species is known to or might occur along the route. Specialist to advise whether search and rescue measures are required.
Anthropodes paradisea (Blue Crane)	Vulnerable, populations declining but where present may be common resident. Endemic	Wetlands	Vleis & grassland	The likelihood of encountering this species or disrupting feeding or breeding habitat along the route is considered highly remote given the extent to which potential habitat has been transformed and the high density of human settlement.	ECO be able to identify this species and if it is encountered all construction activities in the vegetation type in which the bird has been seen / found must stop immediately and the advice of a suitably qualified specialist sought.
Balearica regulorum (Southern Crowned Crane)	Endangered but where present may be a common localised resident.	Wetlands	Marshes, dams & adjoining grassland	As above.	As above.
Eupodotis caerulescens (Blue Korhaan)	Near threatened but where present may be locally common, endemic	Short grassland	Short open grassland	As above	As above.
Neotis denhami (Stanley's Bustard)	Near threatened, uncommon	Short grassland	Open grassland	As above	As above.

6. Flag Categorisation

Red-flag areas: All polygons which were mapped as any type of wetland are recognised as Red-flag polygons because, being wetland habitats, it is considered inevitable that in creating a corridor approximately 30m-wide, which is necessary in order to be able to lay pipes which are 1.2m in diameter, the potential impacts which will be caused to these habitats – even temporarily – will be severe. Furthermore, in the case of some of these wetland areas it is considered possible that they may support at least one Red-data species namely Pickersgill's Reed Frog.

Although, areas which were mapped as forest or thicket or shrubland or indigenous grassland may provide habitat for one or more species of conservation concern most of these areas have not been classified as Red-flag

polygons because of the extent to which they have been disturbed and are invaded with alien problem-plant species.

Orange-flag areas: Three polygons which were mapped as Short Dense Grassland have been designated as Orange-flag polygons. This flag-status was allocated because: (a) these polygons have been disturbed and are invaded to varying degrees by alien problem-plan species but, (b) they may provide habitat for at least one species of conservation concern namely KwaZulu-Natal Dwarf Chameleon. However, sufficient knowledge and expertise has been gained by a number of biodiversity specialists that if this species is found to be present, individuals can either be captured and relocated or captured and returned to the area in which they were found once the corridor has been rehabilitated. A third reason for allocating an Orange-flag status to these polygons is that relatively similar habitat occurs adjacent to them, in which case it is possible that any chameleons which may be present will simply relocate themselves when they perceive disturbance commencing in the vicinity of their habitat within the corridor.

Green-flag areas: Polygons which were designated as Green-flag areas support habitat which has been markedly or entirely transformed. These areas comprise most of the corridor.

7. Summary & Recommendations

Most of the vegetation which occurs in the 40m-wide corridor which was assessed for this report has been highly to moderately transformed.

The most severe transformation has been caused through human settlement that includes subsistence cultivation. Human settlement and its associated subsistence cultivation has not simply replaced areas of natural vegetation but the currently utilized areas of subsistence cultivation, together with others which have been abandoned, support a wide variety of alien problem-plant species which have invaded other areas which have not been developed or cultivated.

Periodic mowing and cutting has also contributed to a decline in the conservation quality of areas of natural vegetation that occur in the corridor. In some instances, especially in woody communities which are crossed by the existing servitude and in which the vegetation appears to be controlled less frequently than the areas dominated by grasses, invasion by alien problem-plant species is more pronounced.

Approximately 23% of the corridor comprises areas which form part of usually much larger areas which have been designated by KZN Wildlife as Priority 1 areas. However, the fieldwork and mapping which was undertaken for this report indicates that approximately 84% of the Priority 1 areas which occur within the corridor comprise vegetation which has been transformed to some degree.

Notwithstanding the extent and severity of this transformation it should not be assumed that all areas of natural vegetation in the corridor which show evidence of disturbance and transformation do not still provide habitat for one or more plant – but more probably – animal species of conservation concern.

The opinion expressed in the above paragraph pertains to the polygons which have been mapped as Short Disturbed Coastal Forest, Short Dense Thicket and *Typha capensis-Phragmites australis* Wetland.

The areas of natural vegetation which occur in the corridor where it crosses the Ghandi Luthuli Park are considered to have the highest possibility of supporting animal species of high conservation concern.

It is recommended that all areas of wetland which have been mapped for this report as communities which are characterised by reeds (*Phragmites australis*) and bulrush (*Typha capensis*) be searched at the optimum time of year by an appropriately qualified specialist to determine whether these areas support Pickersgill's Reed Frog in

particular, but also any others of conservation concern, and, if they do, advise how best to minimise the impacts of construction on these frogs can be minimised.

It is also recommended that an appropriately qualified specialist be briefed to review this report and to carry out a rapid field reconnaissance of the vegetation in the corridor to determine the likelihood of KwaZulu-Natal (Black-headed) Dwarf Chameleon being present. If this is considered to be a possibility then the relevant areas should be searched when these animals are most likely to be found so that they can be rescued.

As regards the remaining animal species of conservation concern which may occur in the corridor it is recommended that a simple illustrated identification guide be compiled and that the contractor and site engineer are obliged to familiarise themselves with its contents. The ECO, in particular, must also be required to be familiar with the contents of same guide and should be the first person to be contacted should any other person involved in the construction of Phase 4 of the NAA encounter any of these species.

The ECO must also be familiar with any practical measures which can be taken to minimise the impact of construction on any of these species should representatives be encountered.

Finally, it is recommended that all areas which have been mapped as comprising indigenous woody vegetation – irrespective of the extent to which it may be disturbed – be rehabilitated as soon as possible after the trench has been backfilled using methods which are aimed at re-establishing the same or better category of natural vegetation.

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9. Acknowledgements

Dr. J. Londt and Dr. R. Kinvig provided freely the information on the locations and typical habitat of *Batticus zulu* while Dr. M. Graham and Mr. M. Coke provided similar information, in the same sprit of cooperation, with regard to *Atyoida serrata.* The assistance given by Mr. N. Berjak of S3 Technologies in resolving some of the difficulties which arose concerning the chainage data is also acknowledged with gratitude.

PHOTOGRAPHS

Photo. 1. View looking west across the disturbed floodplain of the Umhlangane River. Most of the area which appears in this photograph was mapped as High Dense *Phragmites australis* Reedbed-Cultivation Mosaic.
The area mapped as Short Closed Disturbed *Acacia schweinfurthii* Shrubland (arrowed) can be seen on the slope below Curnick Ndlovu Highway in the distance (Sheet 1) (26/10/12).

Photo. 2. View looking north along the Umhlangane River. The woody vegetation on the right (eastern) bank of the river was mapped as Short Moderately Disturbed Coastal Forest. A portion of one of the areas mapped as High Dense Riparian *Phragmites australis* Reeds can be seen in the right foreground. (26/10/12).

Photo. 3. The extent to which the southern margin of the polygon mapped as Short Moderately Disturbed Coastal Forest comprises alien problem-plant species can be judged from this photograph. The pink flowers are those of *Lantana camara*. (10/11/12).

Photo. 4. The south-east facing slope below Phoenix 6 Reservoir. Most of the trees and shrubs are alien species. Areas of current and former subsistence cultivation can be seen on the hillside. (10/11/12).

Photo. 5. View looking south-west from Street 122309 towards Phoenix 6 Reservoir (arrowed). The valley in the middle distance was mapped as High Closed Disturbed Valley Shrubland & subsistence cultivation. The dotted line shows the approximate proposed centreline of Phase 4 of the NAA (Sheet 2). (26/10/12).

Photo. 6.View from Street 121359 looking north-east down the valley mapped as High Closed Disturbed Valley Shrubland & subsistence cultivation. The approximate centre-line of Phase 4 of the NAA is indicated by the dotted line (Sheet 2). (10/11/12).

Photo.7. View looking south within the existing servitude near the crest of the hill above Street 122323. The vegetation in the foreground was mapped as Short Dense Disturbed Grassland & Subsistence cultivation Mosaic. A further portion of the existing servitude can be seen beyond the power pylon. The proposed route for Phase 4 of the NAA does not cross the closed woody vegetation in the right middle-distance but takes a 'dog-leg' around and to the left (east) of the transformer station (Sheet 3). (26/10/12)

Photo.8. View looking north along the existing servitude between Eastwood Road and Parkmead Avenue illustrating one of the areas which was mapped as Low mown Dense Grassland (existing servitude) (Sheet 4). (26/10/12).

Photo.9. View looking north-east from the verge of Eastbury Drive across the areas which mapped as: Stream & Streambanks (o), *Typha capensis* & *Phragmites australis* Wetland (n) and Short Dense Thicket (b). The stream in the foreground coincides with the southern boundary of Ghandi Luthuli Park (Sheet 6). (10/11/12).

Photo.10. View looking south from Longbury Drive across the Short Dense Thicket (foreground) and *Typha capensis* & *Phragmites australis* Wetland illustrated in Photo.9. A portion of Low mown Dense Grassland (existing servitude) can be seen extending away from Eastbury Drive (arrowed) (Sheets 6 and 7). (10/11/12).