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**SPECIALIST WETLAND ASSESSMENT  
AND DELINEATION AT PROPOSED SITE  
FOR ESKOM MERCURY SUBSTATION**

**28 September 2007**

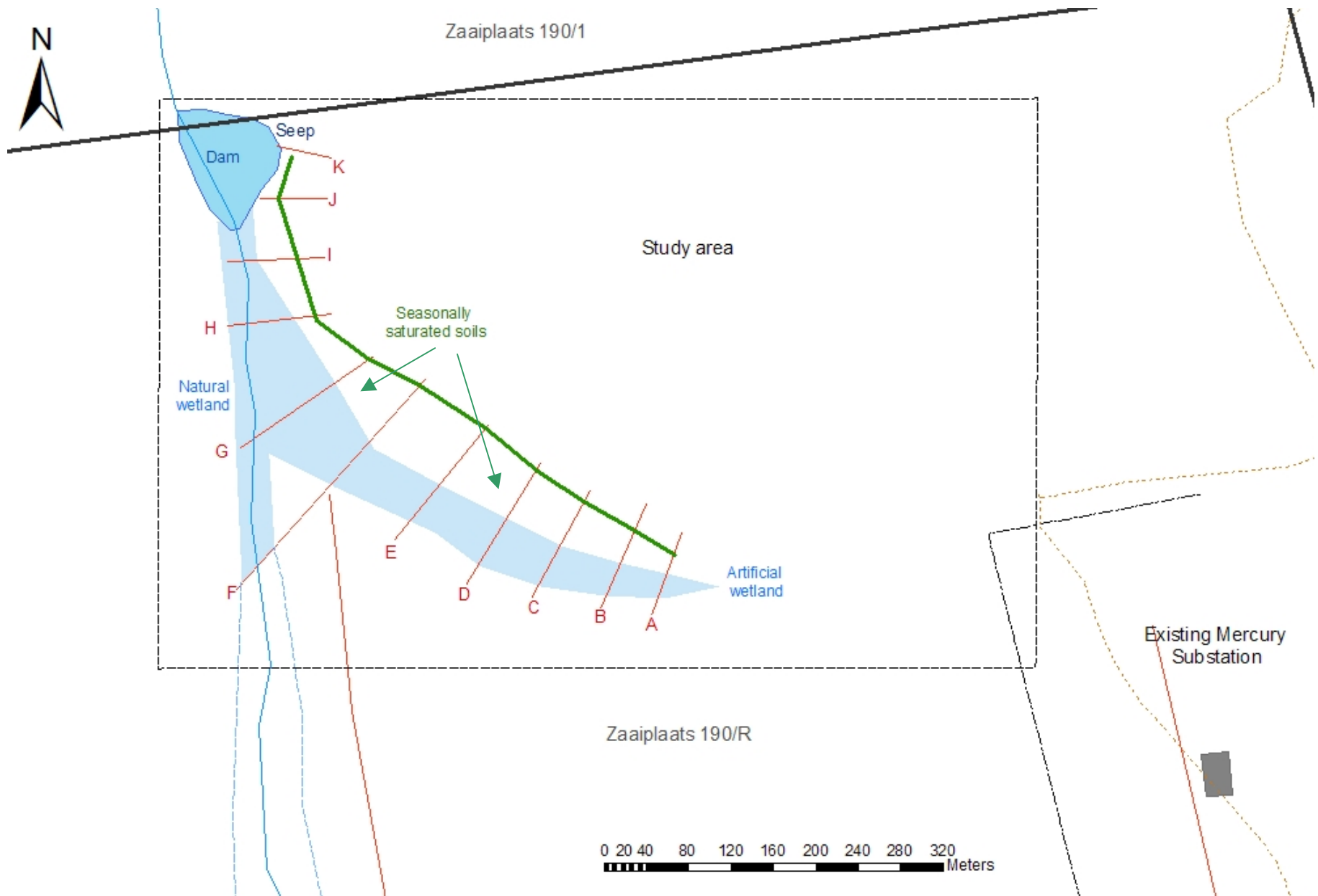


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# SITE PLAN



## INTRODUCTION

### Regulations governing the report

This report has been prepared in terms of Section 33 of Regulation 385– Specialist reports and reports on specialised processes – under the *National Environmental Management Act* No. 107 of 1998 (NEMA). Where applicable, sections of this report are preceded by a text box stating the regulation to which the section applies.

### Appointment of specialist

Regulation 33.

- (1) An applicant or the EAP managing an application may appoint a person who is independent to carry out a specialist study or specialised process.
- (2) A specialist report or a report on a specialised process prepared in terms of these Regulations must contain:
- (3) (a) details of
  - (i) the person who prepared the report, and
  - (ii) the expertise of that person to carry out the specialist study or specialised process;
  - (b) a declaration that the person is independent;

The EAP, Stuart Dunsmore of PBA International, appointed VC Management Services CC to delineate the wetlands on the site.

### Details of specialist

Vincent Carruthers  
VC Management Services CC  
PO Box 368  
Rivonia 2128

Telephone: (011) 463-2390  
Fax: 086-689-3015  
Email: [vcms@mweb.co.za](mailto:vcms@mweb.co.za)

### Expertise of specialist

A CV for Vincent Carruthers is attached as Appendix 1 and is summarised as follows:

- Founded VC Management Services, an independent consultancy, in 1989.
- Conducted over 100 environmental assessment projects including twelve specialist wetland and/or amphibian surveys.
- Published 8 books, 7 papers and numerous popular articles and broadcasts on environmental matters including amphibians.
- Conducted six pioneering amphibian research projects for SA National Parks.
- Received the Stevenson-Hamilton Silver Medal for his contribution to South African zoology (amphibian research).

- Held official positions on a number of parastatal and private sector organisations concerned with environmental, conservation and tourism issues.

#### Independence of specialist

Vincent Carruthers and VC Management Services CC have no financial or other connection with the Applicant, Eskom.

#### **Scope and purpose of report**

Regulation 33. (2)

A specialist report or a report on a specialised process prepared in terms of these Regulations must contain:

(c) an indication of the scope of, and the purpose for which, the report was prepared;

The following terms of reference define the scope and purpose of the report:

1. To identify wetlands or riparian habitats as defined in the Water Act and delineate wetlands and riparian boundaries on the site.
2. To assess wetland functionality on the site including all wetland services.
3. To identify potential impacts of the proposed Eskom substation on the wetland areas and to recommend possible mitigation measures.
4. To prepare a report that is compliant with NEMA Chapter 5 Regulation 385 and provide information to assist the assessment and decisions regarding the proposed development.

#### **Study area**

The Mercury substation (existing and proposed addition) is sited on Portion 3 of the farm Zaaiplaats 190 in the Free State.

The study area includes the grassland to the north-west of the existing Eskom installation extending to a palustrine wetland approximately 750m west of the substation.

## METHOD

Regulation 33. (2)

A specialist report or a report on a specialised process prepared in terms of these Regulations must contain:

(d) a description of the methodology adopted in preparing the report or carrying out the specialised process;

### Pre-field trip procedure

Topographic maps and drawings provided by PBA and Google Earth images were examined to identify potential habitats in the study area and the surrounding neighbourhood. Literature, including the Ecological Assessment by Enviropulse, was consulted (see References).

### Classification and description

The wetland on the site was classified at a basic level to determine whether it fell under the definition of wetland or riparian area in terms of the *National Water Act* No. 36 of 1998 (See DEFINITIONS).

### Functionality

Wetland functional efficiency was established by reviewing a checklist of functions on site. The checklist review appears under the FINDINGS section below. Because of the dry season, some functions could not be verified with certainty and a conservative approach has been adopted.

### Delineation

Eleven transects of various lengths and 50m apart were walked from one side of the wetland areas to the other. The end points are tabulated below and shown on the site plan.

Table 1. Co-ordinates of transect end points

	North-west end		South-east end	
	27° 00' S	26° 48' E	27° 00' S	26° 48' E
A	3.7"	54.9"	1.2"	55.8"
B	3.5"	53.3"	0.3"	54.7"
			26° 59' S	
C	3.2"	51.2"	59.9"	53.0"
D	2.8"	49.2"	59.1"	51.5"
E	1.4"	47.0"	57.9"	49.9"
F	2.9"	42.2"	56.5"	48.0"
	26° 59' S			
G	58.6"	42.3"	55.8"	46.4"
H	54.9"	41.9"	54.5"	45.1"
I	52.9"	41.9"	52.8"	44.9"
J	51.0"	42.9"	51.0"	45.0"
K	49.5"	43.5"	49.8"	45.1"

Wetland indicators were recorded along each transect and boundaries were delineated using methods stipulated in the DWAF publication: *A practical field procedure for identification and delineation of wetlands and riparian areas*. (See DEFINITIONS)

Soil types had been identified on the site by Francois de Wet in the Enviropulse Ecological Assessment, May 2007 and these were used in the delineation process. Soil samples were drawn by auger in soft soil or pits in hard soils to 500mm depths and used to determine the boundaries of soil forms (based on de Wet) and wetness (morphological “signatures” characteristic of anaerobic conditions or alluvial soils).

*Vegetation* - the presence of hydrophytic vegetation, species composition and physical structure, were recorded across the transect lines.

GPS co-ordinates of wetland boundaries were recorded at transect intersections. These are tabulated in the FINDINGS section below and plotted on the site plan.

### Assessment of potential impacts

Table 2. Impacts are assessed on the following basis, assuming no specific mitigation:

Score	Magnitude	Duration	Extent	Probability
5	Ecological functions permanently cease	Permanent impact	International	Definitely will occur
4	Some ecological functions cease	Long term – ceases after life of activity	National	Highly likely to occur
3	Ecological functions altered but continue	Medium term 5-15 years	Regional, e.g. eco-region	Fairly likely to occur
2	Functions unaltered but visual impacts	Short term 0-5 years	Area around site, e.g catchment	May occur
1	Negligible impacts	Immediate	Site only	Improbable
<b>Total score</b> →		15 – 20	8 – 14	1 – 7
<b>Guideline</b> →		Major impact. No go without mitigation	Significant impact. Mitigation recommend	Impact manageable

### Exclusions and assumptions

<p>Regulation 33. (2)</p> <p>A specialist report or a report on a specialised process prepared in terms of these Regulations must contain:</p> <p>(e) a description of any assumptions made and any uncertainties or gaps in knowledge;</p>
---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

1. Wetland assessments in summer rainfall areas are best conducted during the summer months when seepage can be ascertained, botanical indicators are most evident and biodiversity functionality can best be assessed. This survey was required urgently in September. The assessment and conclusions are therefore made on a conservative basis.
2. The wetland survey excludes water quality, water flow, silt burden determination and flood line assessments.

## FINDINGS

Regulation 33. (2)

A specialist report or a report on a specialised process prepared in terms of these Regulations must contain:

(f) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment;

### Description of the wetland habitat in the study area

The study area is open grassland sloping westward to a natural palustrine wetland valley draining from south to north. Sandy Avalon soil forms are underlain by soft plinthic horizons on the mid-slope indicating a perched water table of variable depth. Seepage from these soils accumulates seasonally in Westleigh soils on the foot-slope (Figure 5 in the ILLUSTRATIONS section below) before draining into a permanent hydromorphic wetland with vegetation, soil and topographic indicators (Figures 3 and 4).

A drainage canal from the substation augments hill slope seepage and runoff from the grassland into the wetland. The concrete lined canal terminates to the north-west of the substation (Figure 1) and drains onto a shallow slope creating a secondary artificial tributary wetland (Figure 2) before fusing with the natural wetland area. The artificial wetland appears to be permanently inundated and supports a typical hydrophyte community including *Typha capensis*, *Phragmites* sp. and *Juncus kraussii*.

At the north west corner of the study site the wetland is impounded in a farm dam with permanent seepage and palustrine wetland on the eastern bank (Figure 6).

### Classification

The site includes a palustrine valley bottom wetland recharged from hill slope seepage and runoff. Drainage from the existing Mercury substation contributes to the wetland resources.

### Wetland functionality

Function	Assessment	Rational
Stream flow regulation including: <ul style="list-style-type: none"> <li>▪ Flood attenuation</li> <li>▪ Sediment arrest</li> <li>▪ Phosphate reduction</li> <li>▪ Nitrate reduction</li> <li>▪ Toxicant removal</li> <li>▪ Carbon storage</li> <li>▪ Erosion control</li> </ul>	High	<ul style="list-style-type: none"> <li>▪ Spongy hydromorphic soils in the wetland retain water and attenuate runoff energy.</li> <li>▪ Hill slope seepage in the grassland allows slow release of water and prevents erosion of sandy soils.</li> <li>▪ Toxins and other pollutants are unlikely to be significant in this environment.</li> <li>▪ Grassland is a comparatively low carbon storage medium because of its seasonality and low biomass.</li> </ul>



<p>Maintenance of biodiversity including:</p> <ul style="list-style-type: none"> <li>▪ Retention of accessible surface water for fauna</li> <li>▪ Habitat for aquatic and semi-aquatic fauna</li> <li>▪ Habitat for hydrophytes and other plants with high water dependency</li> </ul>	<p>Moderate</p>	<ul style="list-style-type: none"> <li>▪ A rich bird life and antelope were observed in the wetlands. No red data species were recorded but the habitat and locality is suitable for Giant Bullfrogs and Grass Owls.</li> <li>▪ Hydrophytes such as <i>Typha capensis</i> and <i>Juncus krausii</i> were recorded in the wetlands. The full extent of hydrophyte diversity was not observable at the time of this study.</li> <li>▪ Grasslands are invaded by <i>Stoebe vulgaris</i> towards the foot-slope. This is a reliable indicator of both seasonal seepage and overgrazing.</li> </ul>
<p>Human utilisation including:</p> <ul style="list-style-type: none"> <li>▪ Food resources</li> <li>▪ Cultural significance</li> <li>▪ Education and research</li> <li>▪ Recreation and tourism.</li> <li>▪ Water resource conservation.</li> </ul>	<p>Low</p>	<ul style="list-style-type: none"> <li>▪ The site is used for grazing cattle.</li> <li>▪ It has no current cultural or recreational use.</li> </ul>

## Delineation

Topography. The wetland zone is well indicated by the east and west grassland slopes, especially at the north-west of the study area where the gradient is steeper, confining the wetland to a narrower valley bottom and incidentally allowing the construction of the farm dam across its width. (Figure 6).

Soil indicators. Soils in the valley bottom are kept permanently damp from seepage into the wetland and show distinct hydromorphic characteristics. The soils comprise unconsolidated material with grey colouration associated with wetness. Soil wetness correlated well with topography and vegetation indicators allowing confident delineation of the boundaries of permanent wetland. Longlands and Westleigh soil forms with plinthic sub-soils were indicative of seepage conditions corroborated by vegetation indicators.

Vegetation indicators. Hydrophytic species such as *Phragmites* sp., *Typha capensis* and *Juncus krausii* were distinctly associated with hydromorphic soils. Seasonal wetland zones were delineated by stands of *Ischaemum fasciculatum* which shows distinctly russet colouration at this time of year (Figure 5). The lower extent of hill slope seepage on the mid-slope was clearly marked by *Stoebe vulgaris* and a sharp ecotonal distinction was evident at the interface between the *Stoebe* and *Ischaemum*.

Table 3. Co-ordinates delineating the boundary of the permanently wet soils and hydrophytes of the natural wetland – shaded blue on the site plan.

West border		East border	
<b>27° 00' S</b>	<b>26° 48' E</b>	<b>27° 00' S</b>	<b>26° 48' E</b>
2.8"	42.4"	1.8"	43.4"
<b>26° 59' S</b>		<b>26° 59' S</b>	
58.4"	42.2"	54.8"	43.0"
54.9"	42.1"	53.0"	42.8"

Table 4. Co-ordinates delineating the boundary of the permanently wet soils and hydrophytes of the artificial wetland – shaded blue on the site plan.

South-west border		North-east border	
<b>27° 00' S</b>	<b>26° 48' E</b>	<b>27° 00' S</b>	<b>26° 48' E</b>
2.8"	57.0"	2.8"	57.0"
3.2"	55.3"	2.4"	55.3"
3.1"	53.5"	2.1"	53.9"
2.8"	51.5"	1.6"	52.1"
		<b>26° 59' S</b>	
2.2"	49.6"	0.8"	50.6"
1.2'	48.3"	59.7"	48.4"
<b>26° 59' S</b>			
59.8"	45.2"	58.6"	46.4"
58.4"	42.5"	56.6"	45.2"

Table 5. Co-ordinates delineating the eastern ecotone between seasonally saturated seeps (indicated by *Ischaemum fasciculatum* and grey chroma surface soils) and temporary hill slope seepage zone (indicated by *Stoebe vulgaris* and reddish-grey surface soils without chromo mottling). Marked as a green line on the site plan.

<b>27° 00' S</b>	<b>26° 48' E</b>
1.9"	55.6"
1.1"	54.3"
0.2"	52.8"
<b>26° 59' S</b>	
59.3"	51.4"
58.0"	49.8"
56.7"	47.8"
55.9"	46.2"
54.7"	44.6"
51.0"	43.5"
49.7"	43.9"

## POTENTIAL IMPACTS

### Potential impact 1:

#### Encroachment of structures into permanent wetland zones

Encroachment would be confined to the artificial wetland created by drainage of the existing substation. Drainage from the new substation would replace and enlarge the existing artificial wetland. However, the new substation will increase the volume of flow and bring the drainage points to more steeply sloped contours above the wetland. This will increase the danger of erosion and flooding.

Assessment of impact of encroachment of structures *without* mitigation:

Score	Magnitude	Duration	Extent	Probability
13	3. Ecological functions altered but continue.	4. Long term – for life of activity.	2. Site and close surrounds.	4. Highly likely to occur.
<b>Significant impact. Mitigation recommended</b>				

Recommended mitigation:

- Storm water runoff and subterranean seepage under the substation site should be channelled and allowed to seep away gradually into the wetland as is currently done in the case of the existing substation. Energy dissipaters in the form of attenuation ponds, gabions or other suitable structures will need to be introduced.

Assessment of impact of encroachment of structures *after* mitigation:

Score	Magnitude	Duration	Extent	Probability
6	2. Functions unaltered but with visual impacts	2. Short term 0-5 years	1. Site only	1. Improbable
<b>Impact manageable</b>				

**Potential impact 2:  
Impact on flow regulation**

The new substation will dislocate the hill slope seepage processes on the site. The attenuating functions of absorption and slow release would be disrupted, possibly causing more concentrated water flow and energy, with consequent soil erosion and sporadic flooding.

Assessment of impact on flow regulation *without* mitigation:

Score	Magnitude	Duration	Extent	Probability
13	4. Some ecological functions cease	4. Long term – for life of activity.	2. Area around site, e.g catchment	4. Highly likely to occur.
<b>Significant impact. Mitigation recommended</b>				

Recommended mitigation:

The measures recommended above for encroachment of structures should also address this impact adequately.

Assessment of impact on flow regulation *after* mitigation:

Score	Magnitude	Duration	Extent	Probability
6	2. Functions unaltered but with visual impacts	2. Short term 0-5 years	1. Site only	1. Improbable
<b>Impact manageable</b>				

**Potential impact 3:  
Pollution during construction**

Construction may lead to the release of rubble and pollutants such as oil, etc. into the wet areas and catchment.

Assessment of pollution impacts *without* mitigation:

Score	Magnitude	Duration	Extent	Probability
9	3. Ecological functions altered but continue	2. Short term 0-5 years	2. Area around site, e.g catchment	2. May occur
<b>Impact may be manageable but some mitigation recommended</b>				

Recommended mitigation:

Inclusion of and compliance with the following clauses in the EMP:

- All waste to be assembled at a given point on the site during construction and regularly removed from site at short intervals.
- Effective emergency practices for accidental spillage of hazardous materials.
- The wetland area and a 50m buffer zone should be cordoned off and entry prohibited.

Assessment of impact of pollution impacts *after* mitigation:

Score	Magnitude	Duration	Extent	Probability
6	2. Functions unaltered but with visual impacts	2. Short term 0-5 years	1. Site only	1. Improbable
<b>Impact manageable</b>				

**Potential impact 4:  
Compaction of wetlands and seepage during construction**

Construction may lead to compaction of wetland and seepage soils by vehicles.

Assessment of compaction impacts *without* mitigation:

Score	Magnitude	Duration	Extent	Probability
11	3. Ecological functions altered but continue	3. Medium term 5-15 years	1. Site only	4. Highly likely to occur
<b>Significant impact. Mitigation recommended</b>				

Recommended mitigation:

Inclusion of and compliance with the following clauses in the EMP:

- Vehicles to be confined to prescribed tracks in low-sensitive areas.
- The wetland area should be cordoned off and entry prohibited during construction.
- All areas damaged during construction should be rehabilitated in a manner that restores wetland functions as much as possible.

Assessment of compaction impacts *after* mitigation:

Score	Magnitude	Duration	Extent	Probability
7	2. Functions unaltered but with visual impacts	2. Short term 0-5 years	1. Site only	2. May occur
<b>Impact manageable</b>				

**Potential impact 5:  
Habitat destruction**

The development of the extended substation will destroy faunal and floral habitat on the site.

Assessment of habitat destruction *without* mitigation:

Score	Magnitude	Duration	Extent	Probability
15	4. Some ecological functions cease	4. Long term – for life of activity.	1. Site only	5. Definitely will occur
<b>Significant impact. The loss of habitat will be inevitable and cannot be avoided</b>				

Recommended mitigation:

- The affected area is relatively small and care should be taken to preserving all natural habitats immediately adjacent to the site.
- Consideration should be given to acquiring and guaranteeing the preservation of an alternative offset grassland-wetland area.

Assessment of habitat destruction *after* mitigation including acquisition of alternative site:

Score	Magnitude	Duration	Extent	Probability
11	1. Negligible impacts	4. Long term – for life of activity.	1. Site only	5. Definitely will occur
<b>Impact remains significant but unavoidable.</b>				

## ILLUSTRATIONS



Figure 1. Drainage canal from substation



Figure 2. Artificial wetland starts from culvert



Figure 3. Wetland soils and vegetation.



Figure 4. Hydrophyte, *Juncus kraussii* in wetland



Figure 5. Reddish stands of *Ischaemum fasciculatum* indicative of seasonally saturated seeps.



Figure 6. *Stoebe vulgaris* indicative of temporary hill slope seepage zone. Note abrupt slope down to wetlands around the dam.



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## DEFINITIONS

- Hydromorphic soils – soil that is saturated or flooded long enough to develop anaerobic conditions favouring the growth and regeneration of hydrophytic vegetation. Indicated by grey, bluish or greenish colours in the soil matrix.
- Hydrophytes – plants that grow in water or in a substratum that is at least periodically anaerobic as a result of saturation.
- Plinthic B horizon – sub-soils with a high metal oxide concretions, resulting from periodic saturation from water table fluctuation. May be “soft plinthic” (i.e. semi permeable and can be manually broken) or “hard pan” (i.e. hard plinthite concretions resistant to permeation).
- Riparian areas. The Act recognises riparian areas, which are defined as:

Riparian habitat includes the physical structure and associated vegetation of the areas associated with a watercourse which are:

  - commonly characterised by alluvial soils, and
  - which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas.
- Wetlands. The *National Water Act* No. 36 of 1998 defines a wetland as:

Land which is transitional between terrestrial and aquatic systems where:

  - the water table is usually at or near the surface,
  - or the land is periodically covered with shallow water, and
  - which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.

### Wetland and riparian indicators

DWAF defines the following indicators to identify and demarcate wetlands and riparian areas:

- Hydrological indicators – permanent, seasonal, temporarily or terrestrial water movement including levels of ground saturation.
- Soil form (composition and colour) and soil wetness – morphological “signatures” characteristic of anaerobic conditions developed in the soil profile as a result of prolonged and frequent saturation. Or alluvial soils and deposited material in the case of riparian areas.
- Terrain / topography – the landscape profile where wetlands and watercourses are likely to occur because of slope, depressions, drainage lines, etc.
- Vegetation indicators – the presence of hydrophytic vegetation, species composition and physical structure, i.e. vigour and robustness.

## APPENDIX

### CV: ENVIRONMENTAL ASSESSMENT PROFESSIONAL

#### VINCENT CARRUTHERS

##### Details required in terms of NEMA Chapter 5 Regulation R 385 Section 29 (1) (a) (i)

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Nationality: South African

Family status: Married – Wife: Professor EJ Carruthers

#### Summary

Vincent Carruthers is a company director and consultant with twenty-five years experience of senior level management and tourism consulting (more than 120 projects) and six years experience in environmental consulting (see list of EIA and related projects below).

He has published extensively in the fields of natural science and South African history. He is the author of authoritative publications on southern African amphibians and works with several universities and overseas institutions.

He has held official positions on a number of parastatal and private sector organisations concerned with environmental, conservation and tourism issues.

#### Current professional and official appointments and directorships:

##### **Director: VC Management Services CC**

Director and owner since 1989

The company is a consulting practice specialising in business strategies and organisation with particular emphasis on environmental and related issues.

##### **Vice Chairman: Delta Environmental Centre (Section 21 Co.)**

Vice Chairman. Director since 1987

The Centre is a leader in environmental education programmes. Courses are given to about 20 000 teachers and children per year on a non-profit basis.

##### **Director: Sustainable Tourism Research Institute of Southern Africa CC (STRISA)**

Director since 1998

The Institute provides strategic development services to the eco-tourism industry. It acts as the South African branch of the International Tourism Society.

##### **Director: Papersmith & Son (Pty) Ltd**

Director since 1995.

The company imports and distributes specialist design paper.

#### Past professional and official appointments and directorships:

##### **Board member: North West Province Parks and Tourism Board (Parastatal)**

Director from 1997 to 2004

The Board is responsible for the development and implementation of tourism and protected area policies in the province.

**Chairman of the Conservation Committee.**

The committee is responsible for the strategic direction of fifteen provincial parks – Pilanesberg, Madikwe, Kgaswane etc..

**Deputy Chairperson: Magaliesberg Advisory Council (Parastatal)**

Deputy Chairperson from its inauguration in 2002 until its closure in 2005.

The Council developed strategies for sustainable development in the Magaliesberg area and provided advice on land use and development in the to the relevant MECs of Gauteng and North West Provinces.

**Director: National Productivity Institute (Parastatal)**

Director: Marketing 1985-1989.

The institute develops and implements strategies for the improvement of productivity of all resources in the South African public and private sectors.

**Executive Director: Wildlife Society of Southern Africa (WESSA)**

CEO 1982-1985

The Society represents public interests in environmental and conservation matters.

**Manager: TW Beckett & Co (Pty) Ltd.**

Strategic Planning Manager 1966 –1982

The company imports, manufactures and distributes tea and coffee products.

**Honorary and elected positions**

**Director: South African Association of Tourism Professionals**

Director 1999-2001

The association is a forum for professional tourism consultants and development agencies and academics.

**Chairman: South African Ornithological Society (Birdlife SA)**

Chairman 1986 to 1987

The society is a federation of all bird clubs and promotes the interests of birds and birders in southern Africa

**Vice Chairman: Sandton Nature Conservation Society.**

Vice Chairman 1974 to 1979

**Secretary: Herpetological Association of Africa.**

Secretary 1980 to 1989

**Research projects**

1973-1975 Kruger National Park. Amphibians survey – first scientific survey of amphibians in the KNP – for National Parks Board.

Output (see publications):

Published handbook;

Paper in accredited journal, *Koedoe*;

Two articles in *Custos*,

One article in *Panorama*;

Report lodged with SA National Parks.

1976 Tsitsikama, Bontebok, Addo and Mountain Zebra National Parks. Amphibians and wetland habitat survey for National Parks Board.

Output (see publications):

Paper in accredited journal, *Koedoe*;

Report lodged with SA National Parks.

- 1977 Golden Gate National Park: Amphibians and wetland habitat survey for National Parks Board.  
Output: Report lodged with SA National Parks.
- 1977-1978 Suikerbosrand Nature Reserve. A study of wetland habitats and amphibians for the Transvaal Nature Conservation Division.  
Output (see publications):  
Published visitors' field guide;  
Audio-visual programme for use in visitors centre;  
Report lodged with TPA Nature Conservation;  
Published article in Fauna and Flora.
- 1980 Percy Fyfe Nature Reserve. Survey of amphibians for the Transvaal Nature Conservation Division.  
Output: Report lodged with TPA Nature Conservation.
- 1996 Conducted a social and hydrological investigation of Sabi River from source to the Kruger National Park boundary funded by Casinos Austria.  
Output: Report lodged with Mpumalanga Dep. Nature Conservation.

**Award:**

**Stevenson Hamilton Silver Medal** (ZSSA) for contribution to South African zoological (amphibian) research 1989.

**Regular lectures given:**

Overseas Tropical Studies Programme (visiting students from Duke University USA and South African Universities). Annual lecture series – Amphibians

ETG programme (environmental and field guide course) annual lectures:  
“Sustainable Utilisation and the Future of Formally Protected Areas In South Africa.”  
“Amphibians”

Magaliesberg field courses (Mount Grace Hotel)

Ad hoc lectures and public addresses to various audiences: Magaliesberg, Amphibians, Wildlife conservation.

**Publications - books:**

*Field Guide to Frogs of Southern Africa.* Co-author Prof. L. du Preez. Struik. In press

The Anglo-Boer War in the Cradle of Humankind. In *A Search for Origins - History of the Cradle of Humankind*. Ed. Prof Phil Bonner. Wits University Press. In press

*Frogs & Frogging in Southern Africa.* Struik. 2001

*Terrarien Atlas* Vol. 1 and Vol. 2. Contributing author. Ed. Dr Hans-Joachim Herman. Mergus. 2001.

*SASOL First Field Guide to Frogs of Southern Africa.* Struik 2001.  
Afrikaans *SASOL Eerste Veldgids to Paddas van Suider-Africa* 2001.

*The Magaliesberg.*  
First edition. Southern Book Publishers. 1990  
Revised edition. Protea Book House. 2000.

*The Wildlife of Southern Africa. A field guide to the animals and plants of the region.*  
English. Struik 1996.  
Afrikaans *Natuurlewe van Siuder-Afrika* 1997.  
German *Fauna und Flora im Sudlichen Afrika* 2002.

Kruger National Park; Mpumalanga; Limpopo. In *South Africa*. Ed Johannes Haape.  
London. Insight Guides. 1992 & 1997.

*South African Frogs. A Complete Guide* Co-author Prof. N I Passmore.  
First edition. Wits University Press. 1979  
Revised edition. Southern Book Publishers. 1995.

*The Sandton Field Book*. Ed. Sandton: SNCS. 1982

*A Guide to the Frogs of the Suikerbosrand Nature Reserve*. Co-author Dr Jane Carruthers. TPA. 1979

*The Frogs of the Kruger National Park*. Co-authors Dr U de V Pienaar. Dr N I Passmore NPB 1976

*A Guide to the Identification of the Frogs of the Witwatersrand*: Cons. Press. 1976.

### **Publications - articles and papers**

Carruthers, V. C. 'Conservation of the Magaliesberg'. *African Wildlife*. Vol 44 No 5.

Passmore, N.I. and Carruthers, V.C., 'A new species of *Tomopterna* (Anura: Ranidae) from the Kruger National Park, with notes on related species', *Koedoe*, No 18, 1975.

Carruthers, V.C. and Robinson, G.A., 'Notes on Amphibia in the Tsitsikama National Parks', *Koedoe*, No. 20, 1977, pp.115-123.

Carruthers, V.C. and Passmore, N.I., 'A note on *Breviceps macrops* Boulenger', *Journal of the Herpetological Association of Africa*, No. 18, June 1978, pp.13-15.

Passmore, N.I. and Carruthers, V.C., 'Further comment on English common names for South African frogs', *Journal of the Herpetological Association of Africa*, No. 19 November 1978.

Carruthers, V.C., 'Frog survey – Suikerbosrand Nature Reserve' *Journal of the Herpetological Association of Africa*, No. 19, November 1978, p.14.

Carruthers, V. and J., 'A new locality record for *Tomopterna delalandei* (Tschudi) with some discussion on possible distribution patterns', *Journal of the Herpetological Association of Africa*, No. 20, March 1979, pp.3-4.

Carruthers, V.C., 'On photographing frogs', *Journal of the Herpetological Association of Africa*, No. 22, February 1980, pp.

### **Publications – other:**

*Frogs of Southern Africa*. Poster. Korck Publishing. 2006

*Wildlife of Southern Africa*. Electronic PDA field guide. 2004

*Frogs of Gauteng and North West Province*. (Co-author Mervyn Mason). DVD 1998.

*Calls of South African Frogs*. (Co-author Neville Passmore). CD. 1996

50/50 Veldfocus judge and advisor

Popular articles, radio and television and broadcasts.

**Examples of recent impact assessments and associated projects conducted:**

<b>Application</b>	<b>Project Type</b>	<b>Year</b>	<b>Authority</b>
Ekurhuleni storm water system upgrade	Nine basic assessments	2007	Gauteng
Midwater Estates township	Specialist amphibian study	2007	Gauteng
Mount Savannah Game Reserve	EMP	2007	Gauteng
Kommandonek township development	Scoping & EIA	2007	North West
Metro Boulevard road alignment	Specialist wetland study	2007	Gauteng
Midrand Estates road alignment	Specialist wetland study	2007	Gauteng
Zonkizizwe Phase 1 – township	Specialist amphibian study	2007	Gauteng
Zonkizizwe Phase 2 – township	Specialist amphibian study	2007	Gauteng
Kirkney township development	Specialist wetland study	2007	Gauteng
Cornwall Hill township development	Specialist wetland study	2007	Gauteng
Mount Grace Hotel	Appeal against ROD	2007	Gauteng
Bushveldview	Application for exemption	2007	North west
Soweto Highway	Specialist wetland study	2006	Gauteng
Mayfords Seeds expansion project	Scoping & EIA	2007	Gauteng
K54 Road alignment – Irene	Specialist wetland study	2007	Gauteng
N4 / M37 Intersection - Midrand	Specialist amphibian study	2007	Gauteng
Soweto Highway- FNB alignment	Specialist wetland study	2007	Gauteng
Fort West township development	Specialist wetland study	2006	Gauteng
Mount Savannah	Appeal against ROD	2006	Gauteng
Norton Park	Specialist amphibian study	2006	Gauteng
Tourist Lodge: Boshoff	Scoping / EMP	2006	North West
West Lake	Exemption application	2006	North West
Zwartkoppies residential development	Specialist wetland study	2006	Gauteng
Shangri-La resort upgrade Phase I	Exemption application	2005	North West
Shangri-La resort upgrade Phase 2	Scoping / EMP	2005	North West
Bushveld view housing estate	Scoping / EMP	2005	North West
Hartebeesfontein region	Cumulative impact study	2005	North West
Lilianton Municipal Outfall Sewer	Exemption application	2005	Gauteng
Maroeladal	Specialist amphibian study	2005	Gauteng
Mnandi	Specialist amphibian study	2005	Gauteng
Mount Grace Hotel / Nature Reserve	Scoping / EMP	2005	Gauteng
Ormonde Road	Advice to I&Aps	2005	Gauteng
Rhenosterspruit	Environ. Management Plan	2005	Gauteng
Seasons Golf Course Estate	Scoping / EMP	2005	North West
Staff Housing	Scoping / EMP	2005	North West
University of the Witwatersrand	Inst. of Human Evolution	2005	Wits
Blair Atholl	Advice to I&APs	2004	Gauteng
Budmarsh 2	Exemption application	2004	Gauteng
Monaghan Estate	Scoping / EMP	2004	Gauteng
Mount Grace Hotel / Nature Reserve	Scoping / EMP	2004	Gauteng
Eskom Powerline	Visual impact assessment	2003	National
GLR Manyane Pilansber Game Reserve	Scoping / EMP	2003	North West
Krokodildrift Bridge Madikwe	Scoping / EMP	2003	National
Madikwe Investments	Scoping / EMP	2003	Limpopo
Cradle of Humankind WHS	Management plans	2003	Gauteng
Platinum Highway (N4)	Specialist amphibian study	2003	Gauteng
Budmarsh 1	Scoping / EMP	2002	Gauteng
Eagle Canyon	Specialist amphibian study	2002	Gauteng
Helderfontein	Specialist amphibian study	2002	Gauteng

John Nash Reserve	Scoping / EMP	2002	Gauteng
Laaste Poort	Provincial Prosecution	2002	Limpopo
Noordwyk	Scoping / EMP	2002	Gauteng
Cradle: Restaurant	Scoping / EMP	2001	Gauteng
Montagu Homes	Specialist amphibian study	2001	Gauteng
Pecanwood II Golf Course Estate	Appeal	2000	North West
Austria International Casino near KNP	EIA (pre regulations)	1996	National

#### Examples of sustainable tourism projects conducted

Client	Year	Locality	Project
Madibeng Municipality	2007	Madibeng	Tourism Master plan
Limpopo DEDET	2006	Nylsvlei	Nylsvlei tourism development plan
Lesotho DTI	2005	Mohale	Mohale Dam tourism strategy
Amakhosi Game Lodge	2005	KZN	Specialist tourism
Namibia Tourism Board	2005	Windhoek	Tourism resources audit
Mopane Municipality	2005	Tzaneen	Tourism plan regional
Makhado Municipality	2004	Limpopo	Local tourism plan
Lephalale Municipality	2004	Limpopo	Local tourism plan
Mnweni Cableway	2003	Drakensberg	Peer review of plans
World Parks Congress	2003	Durban	NW Parks presentation
Taung WHS	2003	North West	WHS nomination - Tourism
Mount Grace	2003	Magaliesburg	Specialist tourism
Capricorn Reg Municipality	2003	Limpopo	Tourism framework
Hibiscus Coast	2003	KZN	Tourism monitoring
Gazan Trust	2003	Limpopo	Community Tourism
Cradle of Humankind WHS	2002	Gauteng	Site Management Contracts
Tzaneen Municipality	2002	Tzaneen	Tourism Plan
Dinokeng	2001	Gauteng	Tourism Plan
Kwa-Zulu Natal Tourism	2001	Durban	Tourism branding
Hugh Lendrum	2001	Magaliesburg	Tourism workshop
SANP: SAN Parks	2000	Pretoria	Concession facilitation
Cradle: World Heritage	2000	Gauteng	Management Plan
Daannel KNP	2000	Mpumalanga	Community dispute resolution
Bushmans River Game Lod	2000	KZN	Tourism Plan
Ruanda	1996	Ruanda	Tourism Plan
CHRONOS	1996	Hartebeespoort	Theme park evaluation
KNP	1995	Skukuza	Tourism conservation integration
Makapan Municipality	1995	Limpopo	Tourism Plan
Namibrand	1991	Kuiseb	Community Tourism

#### Examples of strategy and management projects conducted

Client	Year	Locality	Project
MTN	2007	Johannesburg	Performance assessment system
Macmillan	2006	Mozambique	Publishing strategy
Wits University	2005	Johannesburg	Institute of Human Evolution Bus Plan
MTN System provider	2005	Sandton	Strategic plan roll-out
Delta Environment Centre	2004	Johannesburg	Strategic Plan
St Mary's - Workshops	2004	Johannesburg	Strategic Plan
MTN System provider	2004	Sandton	Top Management planning
SAN Parks	2003	Cape Town	



Jane Goodhall Institute SA	2003	Johannesburg	SA Institute development
NWP&T Board	2003	Mafikeng	CEO appraisal
H&P Steel	2003	Boksburg	Strategic plan
Birdlife SA	2002	Johannesburg	Strategic plan
SAN Parks Addo Nat Park	2002	Port Elizabeth	World Bank funding app
GCIS	2002	Pretoria	Staff Appraisal
Papersmith	2001	Johannesburg	Staff Structures
GCIS	2001	Pretoria	Market Research
SANParks Addo Nat Park	2001	Port Elizabeth	Expansion Plan
Monash University	2001	Johannesburg	Student Recruitment Plan
Kreepy Krauly	2001	Johannesburg	Strategic Plan
Macsteel (NTC)	2001	Germiston	Strategic Plan
Coach House	2001	Limpopo	Strategic Plan
SANParks - Social Ecology	2000	Pretoria	Strategic Plan
Publishing Forum	2000	Johannesburg	Strategic Plan
Hall & Pickels	2000	Boksburg	Strategic Plan
Scottish Trade International	1999	Sandton	Research
Berry Bush BBDO	1999	Sandton	Research
Rembrandt Park School	1999	Johannesburg	Research
H & P - Management	1999	Boksburg	Management re-structure
H & P Labelling	1999	Boksburg	Management re-structure
Pure Media	1998	Kempton Park	Marketing Plan
ACSA	1998	Kempton Park	Management structure
SANParks	1998	Pretoria	Management appraisal
Stock Roads	1998	Kempton Park	Strategic Plan
H & P	1998	Boksburg	Staff appraisals
Birdlife SA	1997	Johannesburg	Management structure
SANParks	1997	Johannesburg	Management structure
XPS	1997	Kempton Park	Marketing audit
Samrand	1996	Midrand	Research
H & P - Heat Treatment WS	1996	Boksburg	Strategic Plan
SANParks Strategy	1995	Pretoria	Management structure
Baldwins	1995	Boksburg	Marketing audit
Hall & Pickels	1995	Boksburg	Strategic Plan
Showerlux	1994	Kempton Park	Marketing strategy
Edenvale Brake Tech	1994	Edenvale	Marketing strategy
Maskew Miller Longman	1994	Cape Town	Marketing Plan
ASS Book Sellers	1994	Durban	Planning process
MacMillan Boleswa Swazi	1994	Swaziland	Staff development
AFI	1993	Springs	Strategic Plan
Jakkalsfontein	1993	Cape Town	Development Plan
Kromdraai Conservancy	1993	Broederstroom	Business Plan
JA Carsons & Partners	1993	Johannesburg	Staff Structure
Financial Workshop	1993	Sandton	Re-structure
Winchers & Winders	1993	Germiston	Research
Universal Shipping Survey	1993	Johannesburg	Research
Haddons	1993	Johannesburg	Strategic Plan
Surveys: Renfreight/Safcor	1993	Kempton Park	Research
Hall Longmore	1993	Benoni	Strategic Plan

CHEMPRO	1992	Kempton Park	Management Structure
Dulux	1992	Alberton	Management Structure
Intervent	1992	Johannesburg	Strategic review
Ermetek	1992	Kempton Park	Research
Telkor	1992	Sandton	Marketing Plan
Eskom	1991	Sandton	Staff Training
Suprachem	1991	Kempton Park	Management Structure
Syndachem	1991	Kempton Park	Management Structure
Harvey Roofs	1991	Springs	Marketing audit
SANCC	1991	Johannesburg	Strategic Plan
Raeburn	1991	Germiston	Strategic Development
Southern Books	1991	Midrand	Strategic Plan
Paralyser Electronics	1991	Kempton Park	Marketing Plan
Telkor	1991	Sandton	Marketing Plan
CSIR - Watertech	1990	Pretoria	Development Plan
SSS Engineering	1990	Alberton	Marketing audit
Thermo Power	1990	Kempton Park	Marketing audit
Valmetex	1990	Springs	Strategic Plan
ERD Engineering	1990	Alberton	Strategic Plan
SAPNA	1989	Kempton Park	Staff Training
Mercedes Benz	1989	Pretoria	Marketing Development
Barlows	1989	Pretoria	Marketing audit
Barlan Forms	1989	Krugersdorp	Marketing audit

**Examples of training courses given:**

<b>Client</b>	<b>Year</b>	<b>Locality</b>	<b>Course</b>
Codes of Conduct	2004	Johannesburg	Tourism
UNISA/FGASA	2001	Pretoria	Tourism
STRISA Winter School	2000	Haenertzburg	Tourism
MPA Capacity Building	2000	Magaliesburg	Legislation
ETG Training	2000	Johannesburg	Training