The proposed Kaalspruit Open Space Project, Thembisa, Gauteng

Kaalspruit River Rehabilitation

Biodiversity Scan:
Vegetation and vertebrate report

Date: December 2015

For:

NuLeaf Planning and Environmental
Tel: +27 12 753 5792
Fax: +27 86 571 6292
Mandy@nuleafsa.co.za
www.nuleafsa.co.za

Project by:

dimela eco consulting
+27 83 642 6295
antoinette@dimela-eco.co.za
www.dimela-eco.co.za

DRAFT

Copyright
Copyright in all text and other matter is the exclusive property of the author. It is a criminal offence to reproduce and/or use, without written consent, any matter, technical procedure and/or technique contained in this document. Criminal and civil proceedings will be taken as a matter of strict routine against any person and/or institution infringing the copyright of the author and/or proprietors. This document may not be modified other tan by the author and when incorporated into overarching studies, it should be included in its entirety as an appendix to the main report.

AN ASSESSMENT OF THE FLORA, HABITATS AND VERTEBRATE FAUNA EXPECTED ALONG THE PROPOSED KAALSPRUIT WATERCOURSE REHABILITATION IN TEMBISA, JOHANNESBURG

by

A.C. Kemp PhD Pr.Sci.Nat.
G.J. Bredenkamp DSc Pr.Sci.Nat.
I.L. Rautenbach PhD Pr.Sci.Nat.
J.C.P. Van Wyk MSc Pr.Sci.Nat.

DRAFT

TABLE OF CONTENTS:

DRAFT

DRAFT

LIST OF FIGURES:

DRAFT

DRAFT

DRAFT

DRAFT

LIST OF TABLES:

DRAFT

DISCLAIMER

Even though every care is taken to ensure the accuracy of this report, faunal and environmental assessment studies are limited in scope, time and budget. Discussions and proposed mitigations are made, to some extent, on reasonable and informed assumptions built on *bona fide* information sources, as well as deductive reasoning. A more factual report, based on field collecting and observations, can only be derived over several years and seasons of research, to account for fluctuating environmental conditions and animal migrations. Since environmental impact studies deal with dynamic natural systems, additional information may come to light at a later stage. The vertebrate team can therefore not accept responsibility for conclusions and mitigation measures, made in good faith, based on own databases, and on the information provided at the time of the directive. Although the authors exercised due care and diligence in rendering services and preparing documents, they accept no liability and the client, by accepting this document, indemnifies the authors against all actions, claims, demands, losses, liabilities, costs, damages and expenses that arise from or in connection with services rendered, directly or indirectly, by the authors and use of this document. This report should therefore be viewed and acted upon with these limitations in mind.

DRAFT

1. BACKGROUND INFORMATION

The proposed Kaalspruit Open Space Project entails the recreation of an open space system that is integrated into the daily lives and hearts of the community. It aims to create a safe, accessible and well managed space in which people will feel at home. The open space will not only contribute to the everyday needs and the general quality of life, but also adds value to the greater environment through its integrated response to ecology and social needs.

As part of the open space project, the rehabilitation of the Kaalspruit River, flowing through Tembisa, is proposed. As part of the environmental authorisation process, ecological studies of the Kaalspruit and associated open spaces will be required. However, the area is largely degraded, including alien invasive and pioneer plant species and opportunistic faunal species. Nevertheless, due to the whole area consisting of wetland and/or riparian habitat, the vegetation should already be regarded as sensitive due to its role in stabilising soils and the health and functioning of the watercourses. Therefore, this report (a biodiversity scan comprising of a fauna habitat and vegetation scan of the area) was undertaken to ascertain if any habitat for threatened plant or faunal species may be present and what the impact of the proposed rehabilitation will be on their persistence, if any. If any potential sensitivities are noted, this should be further investigated in the Environmental Impact Assessment Phase.

The designated study area is a northeast projection of and demarcated by the boundary of the City of Johannesburg Metropolitan Municipality, surrounded to the north, east and west by habitats under jurisdiction of the City of Ekurhuleni Metropolitan Municipality (Figs. 1 & 2). The whole area lies within the urban edge, as the northwest part of the long-established, sprawling residential township of Tembisa, and more specifically its suburbs of Ivory Park, Ebony Park and Kaalfontein. The Ekurhuleni part of Tembisa township continues well to the south, where it merges into the residential and industrial areas of Kempton Park, while the commercial and industrial areas of Midrand and Olifantsfontein lie to the west and northeast respectively. The area is accessible from the R21 Pretoria-Kempton Park and N1 Pretoria-Johannesburg Motorways to the east and west respectively, which are interconnected by the main R562 road that passes just north of the area.

The study area comprises the mainstem watercourse of the Kaalspruit, flowing from south to north down its east side (Fig. 3). A small tributary (K1) enters the Kaalspruit from the southwest, about a kilometre downstream of where its drainage line enters the study area from the south, and another tributary (K2) enters the Kaalspruit from the west but further downstream, about 400 m from the northern end of the site. The K2 Tributary has two other

DRAFT

smaller sub-tributaries (K2a & K2b), which also rise just west of the study area and outside the Tembisa suburb of Kaalfontein, in the adjacent President Park and Glen Austin Agricultural Holdings. Further downstream, the K2 Tributary is joined by a third small watercourse (K2c), which rises to the northwest from an indigenous grassland slope just southeast of the brow from the Glen Austin Pan Bird Sanctuary and its adjacent pan (Fig. 1).

The original habitat on and around the study area was grassland and this formed the habitat for its primary local catchment via runoff from the adjacent ridges. This habitat has been almost entirely transformed into and replaced by the high-density residential areas of Tembisa, whose seepage and runoff now drain into the watercourses of the study area. In contrast, the area immediately surrounding the study area, which provides the local extralimital catchment for the largest K2 Tributary, is comprised of relatively low-density residences within agricultural holdings to the west, plus the spacious estates of Eskom's Academy of Learning and the Glen Austin Pan Bird Sanctuary to the north. The study site lies within Quaternary Catchment A21B, with the much more extensive primary catchment upstream from the mainstem section of the Kaalspruit within the study area rising about 7.37 km in a straight line to the southwest in Kempton Park (it source, from Google Earth, near the junction of Zuurfontein Street and Bergrivier Drive at 26o 04' 32.94" S, 28o 11' 22.70" E).

Immediately downstream, the study site exits into a broad wedge of largely undeveloped land with habitat most similar to its original grassland condition.

DRAFT

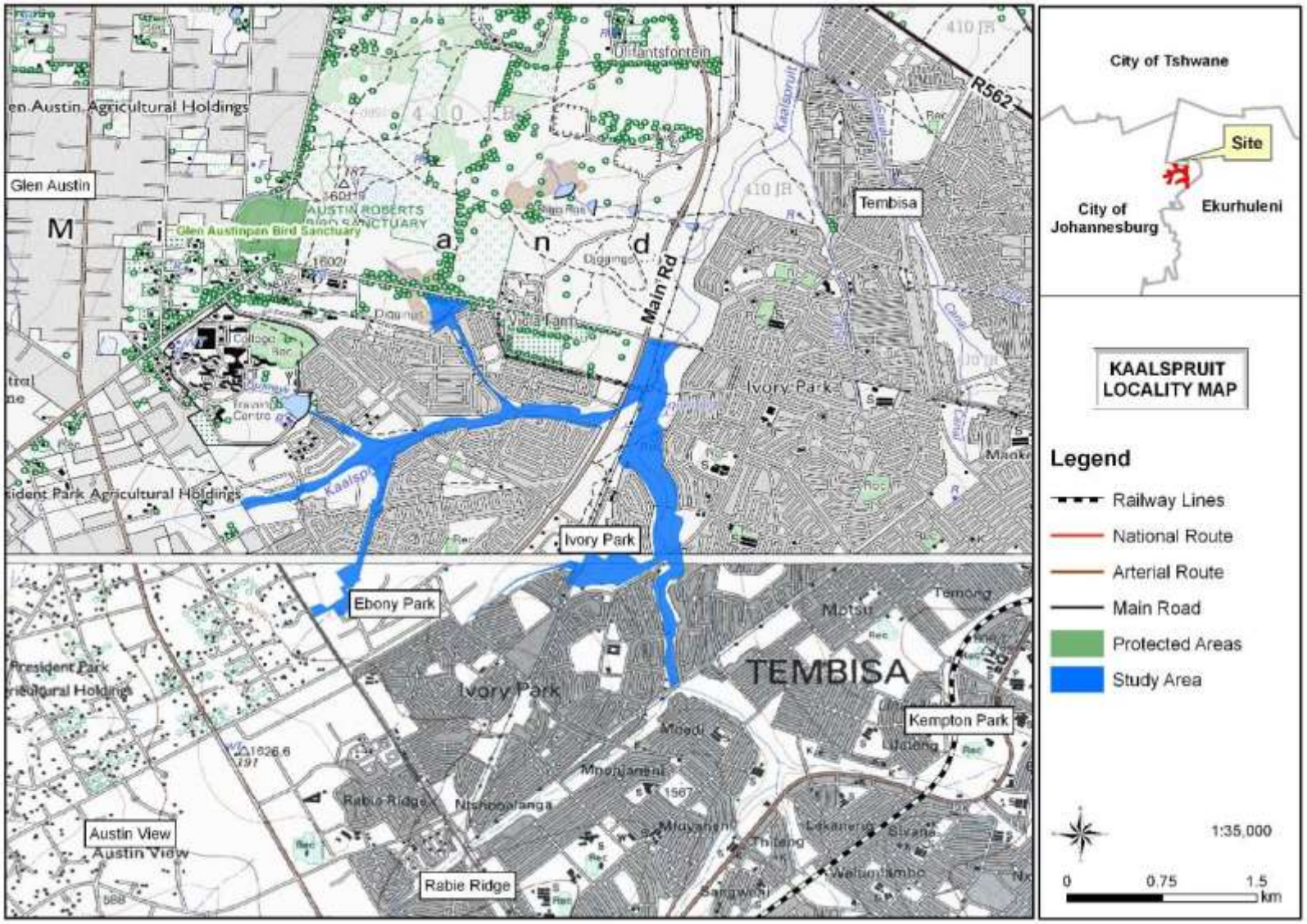

Figure 1: Map of the Kaalspruit study area (blue polygon) in relation to the main topographical features in and around Tembisa, Gauteng.

Figure 2: Aerial image of the main social, ecological and physical features immediately surrounding the Kaalspruit study area. The thin green line marks the boundary between the City of Johannesburg (west) and City of Ekurhuleni (east) Metropolitan Municipalities.

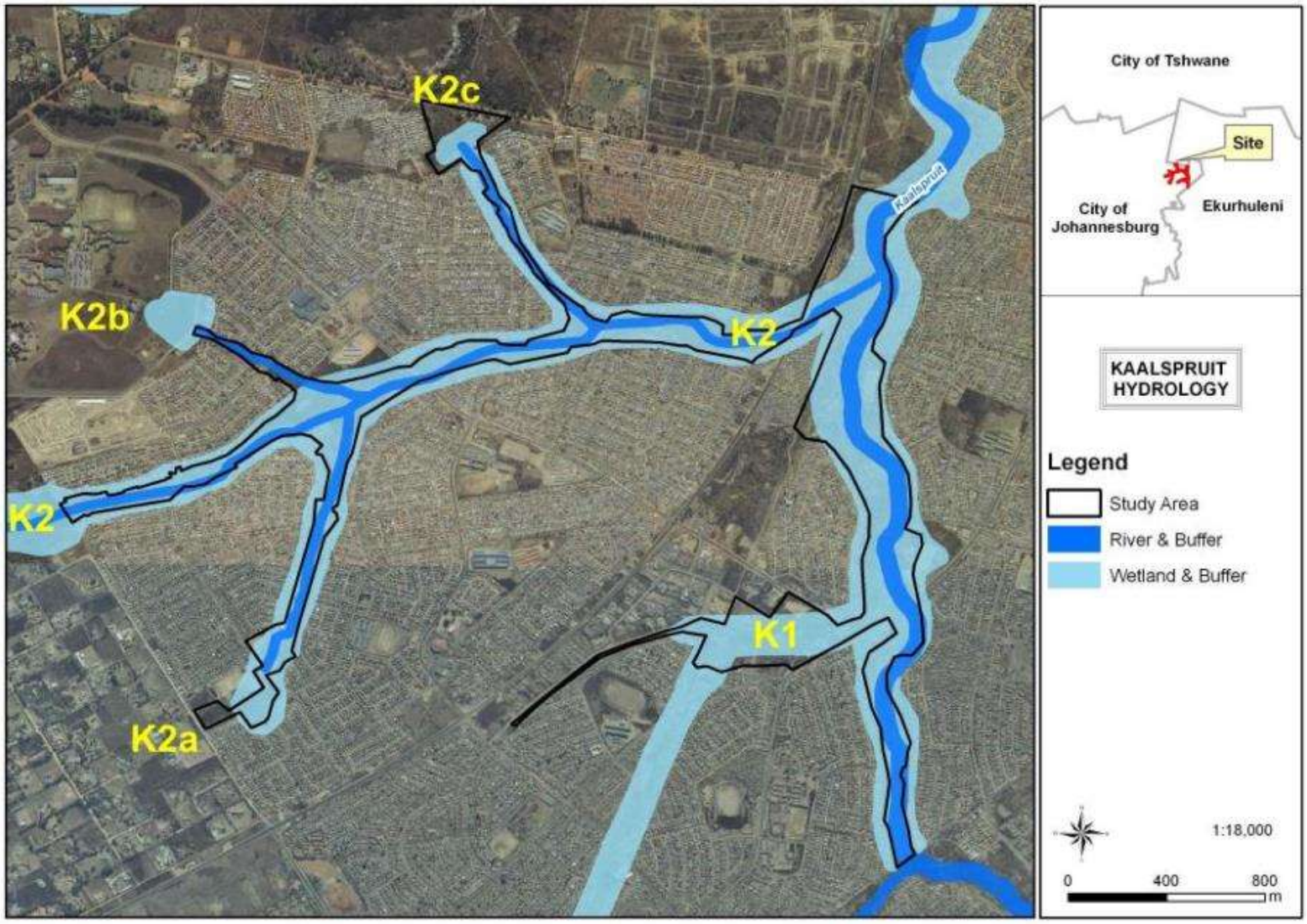

Figure 3: Major hydrological features and delimitations of the Kaalspruit study area and its immediate surroundings, showing the identities given to each of the main tributaries (yellow text).

1.1. PHYSICAL ENVIRONMENT

1.1.1. Geology and soil

Archaean granite and gneiss of the Halfway House Granite cover the area, and on the study area the underlying granite intrudes at points to form less erodible sills across the drainage lines. Soils derived from these sources are light brown, shallow and freely drained on the upland areas, with somewhat darker clayey soils in the bottomlands along the watercourses. The soils along the site are predominately AvB, LoA, dBo41 and sGs15 (Fig. 4).

1.1.2. Regional Climate

Austral summer rainfall with dry winters and a mean annual precipitation of about 680 mm. Mean annual temperature 16.0ºC, with high extremes between the summer maximum and winter minimum temperatures, and frost frequent during winter.

1.1.3. Topography and drainage

The site is located on a flat to slightly undulating plain, at an altitude of over 1520-1590 m a.s.l. The upper catchment areas of the Kaalspruit above the study area rise within Tembisa and Kempton Park, while the Kaalspruit continues into the Olifantsspruit, then the Sesmylspruit and eventually the Hennops River as part of the greater Crocodile and then Limpopo River drainage systems.

1.1.4. Land-use

Land-use in the study area is dense residential. The whole study area has low agricultural potential, except for a small high-potential area on the alluvial plain to the west, around the confluence of three tributaries (K2, K2a & K2b; Fig. 5).

1.1.5. Vegetation Types

The site is situated within Bankenveld (veld type 61) as described by Acocks (1988). Low & Rebelo (1996) described the vegetation of the area as Rocky Highveld Grassland (vegetation type 34). In the new vegetation map of South Africa (Mucina & Rutherford 2006), the area falls within the Egoli Granite Grassland (vegetation unit Gm10). Except for the large patches of *Phragmites australis* or *Typha capensis*, the vegetation within the watercourses is very scanty, but the vegetation on their banks and adjacent terrestrial open spaces is severely disturbed, even rather transformed.

DRAFT

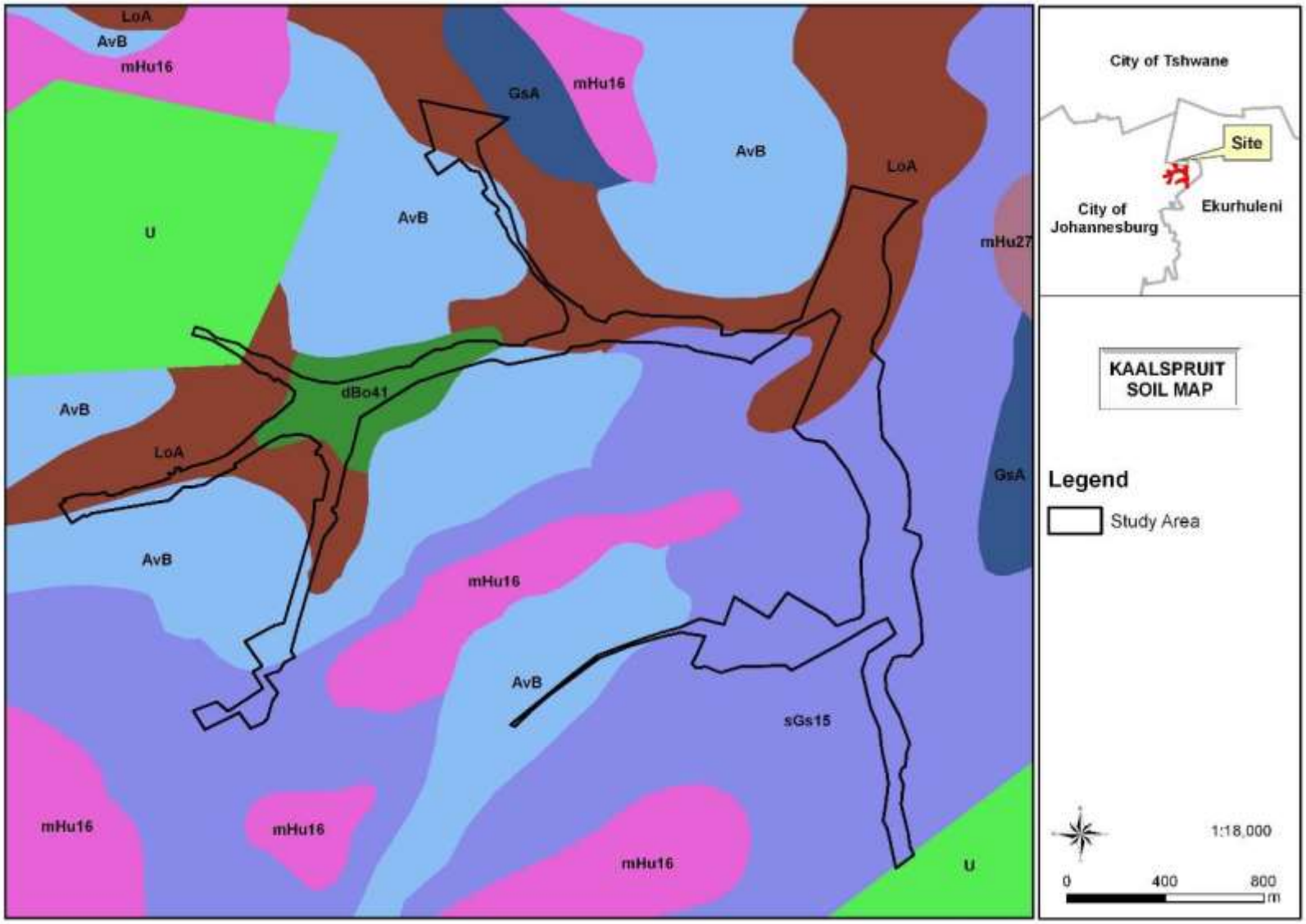

Figure 4: Major soil types on and around the Kaalspruit study area.

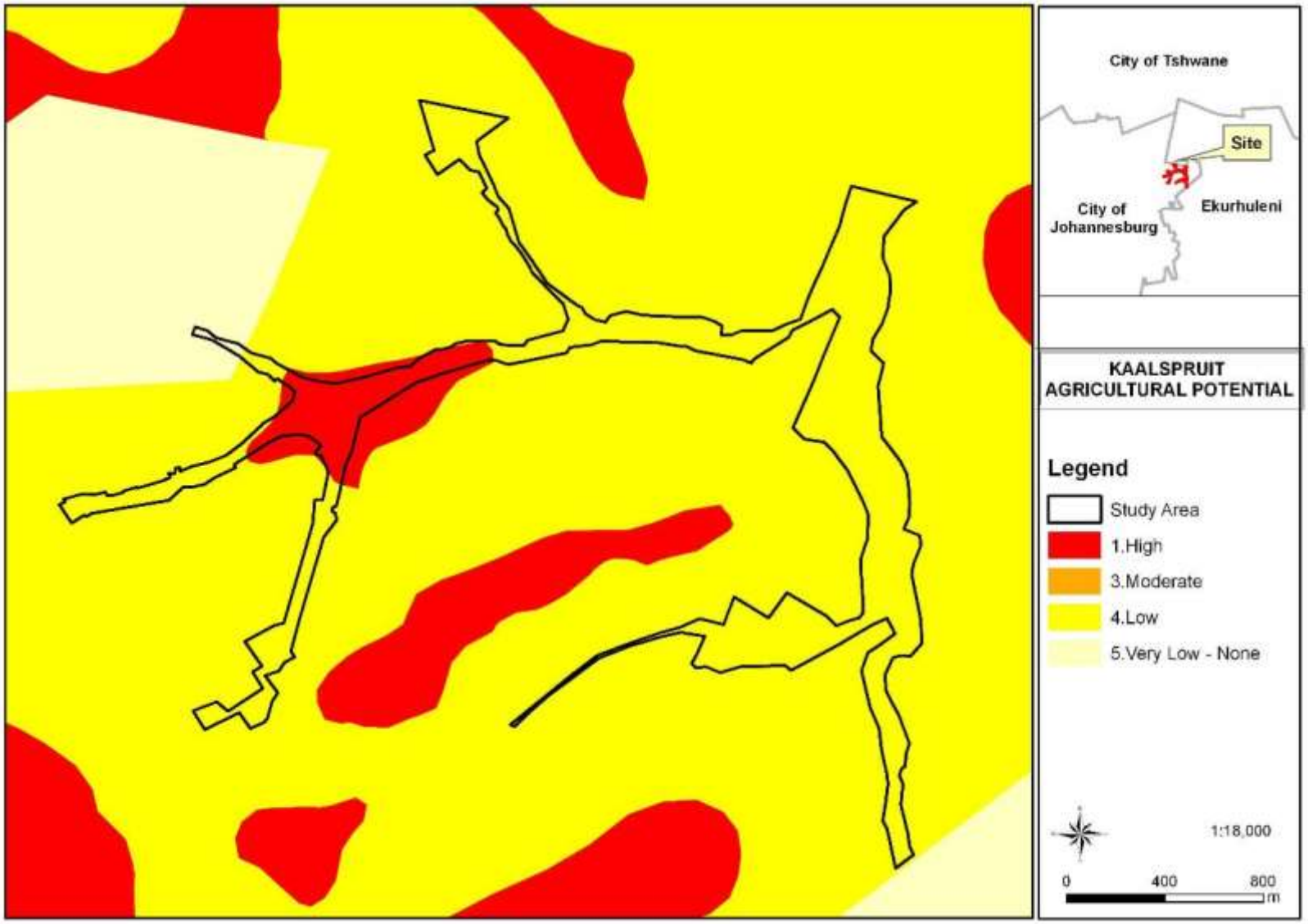

Figure 5: Estimates of agricultural potential for land on and around the Kaalspruit study area.

1.2. ECOLOGICAL PERSPECTIVE

The study area is an ecological system whose services and management are constrained by three main factors:

1. **All watercourse habitats have their primary catchments originating outside the study area to the south, west and north**. This means that the study area comprises only a small lower section of the mainstem Kaalspruit that, together with most of its smaller tributaries, forms only a partial system of linear watercourse habitats and their immediate margins, whose inflows depend to a greater or lesser extent on what arrives from upstream.
2. **Any indigenous floral and faunal habitats and connectivity that remains are confined largely to within the drainage systems of the study area.** The original indigenous grassland habitats on either side of this linear system have been replaced almost entirely by densely populated housing and amenity developments, so that most of the local inputs of seepage, runoff and nutrients into the system come from these unnatural sources. Historically, the adjoining grassland habitats would have been important in their ecological support of much of the watercourse and wetland flora, fauna and ecosystem functions, so only a subset of those elements can be expected to remain.
3. **The limits of the study area are demarcated by municipal rather than ecological boundaries.** This means that any proposals for rehabilitation of the study area depend to a large extent on separate and successful management of extralimital upstream impacts from the catchment areas. In the same way, the success or failure of the proposed rehabilitation will affect the future quality of the Kaalspruit further downstream.

At a local level, within the study area, it is important to prioritise on ecological grounds the main impacts that are expected to affect the study area and how these might be mitigated. A possible order for four main approaches that need attention is proposed below, although they can all be initiated concurrently if funding permits:

A. **Attend to those impacts that are degrading and undermining the very physical basis, structure and function of the ecosystem**, such as bank erosion and stream sedimentation from runoff or cultivation, and incursions into and blockages across the fundamental flow patterns of the system caused by dumping of soil/rubble, which alter the watercourses, their banks or their riparian and alluvial borders.

DRAFT

B. **Improve the quality and flow of the water in the system**, by ecological, hydrological, chemical and microbiological control of all sources of inflow from outside and seepage/runoff from inside the study area. Without management, monitoring, control and improvement of the water quality and quantity, all other efforts at wetland and adjacent rehabilitation will be futile.
C. **Assess and then allocate roles to what remains of the wetland, riparian, alluvial and grassland margins outside the drainage lines**, so that ecologically sound management decisions and designs can be made about their contribution to ecosystem functioning (e.g. runoff and flooding attenuation, sediment control and biofiltration), their support from and for the flora and fauna (e.g. pollination, seed dispersal, habitat connectivity, green-space creation), and where and how to use of their soils and surfaces for residents (e.g. for agricultural plots, landfills/dumps and recreational areas).
D. **Manage the other less ecologically important impacts on the system**, which can only be initiated successfully once the first three impacts have been assessed and their management commenced. These lesser impacts are judged to be less ecologically and more socially and cosmetically valuable, such as control and removal of litter, provision of optimal routes alongside and across the watercourses, and integration of aesthetic, social and recreational requirements for surrounding residents.

As background to the decisions about these approaches, the study area itself is recognised as having ecological and conservation potential as an Important Area by Gauteng's Directorate of Nature Conservation (Fig. 6). The Johannesburg City Parks and Zoo (JCPZ) appointed consultants to undertake the master planning of the proposed open space (JCPZ, 2015). As part of the master planning, many issues raised by Interested and Affected Parties were identified will be addressed as indicated in Fig. 7. This information was also introduced into our considerations.

DRAFT

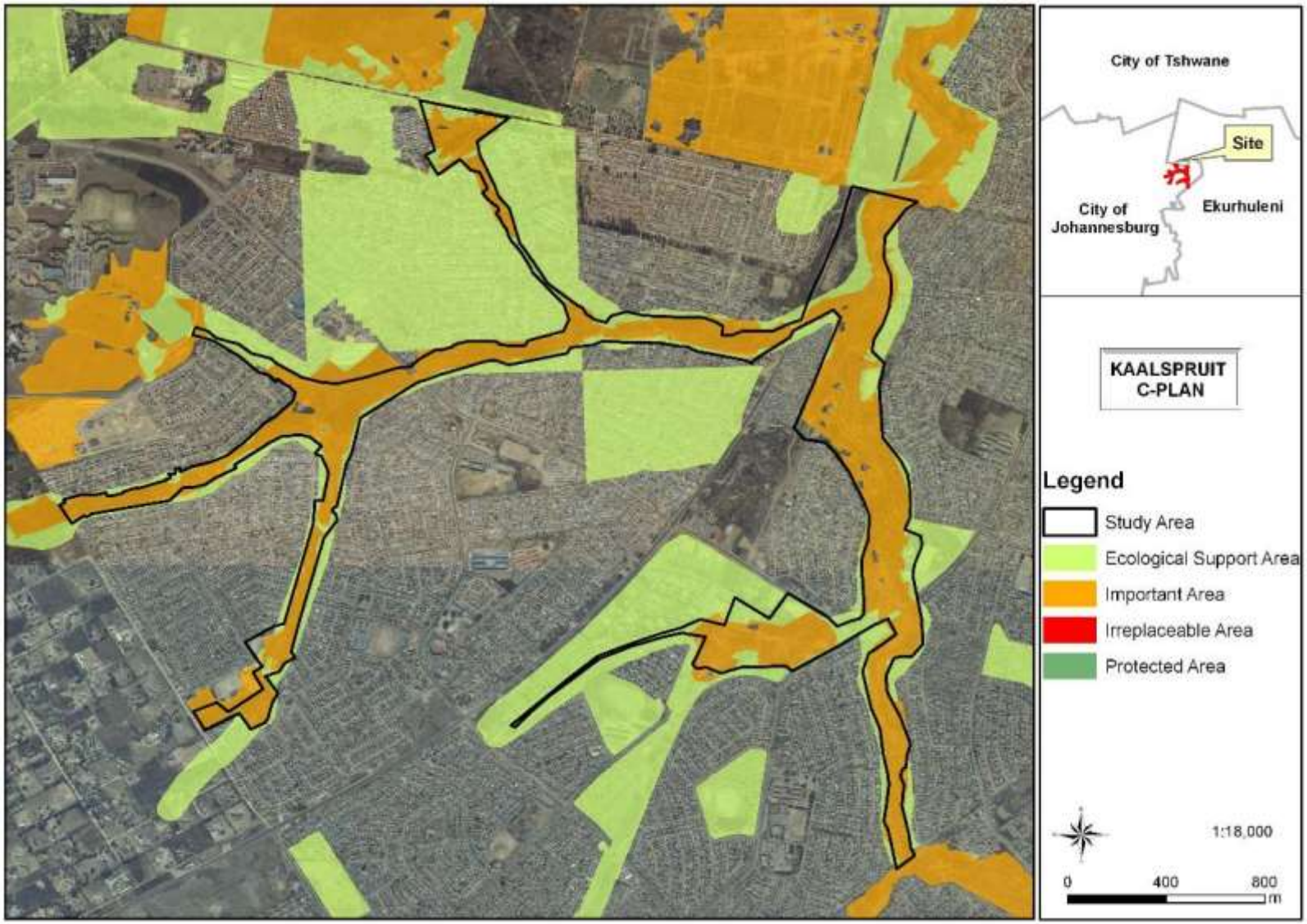

Figure 6: Ecological significance of habitats on and around the site from Gauteng's Directorate of Nature Conservation's C-Plan Version 3.3 (2014a).

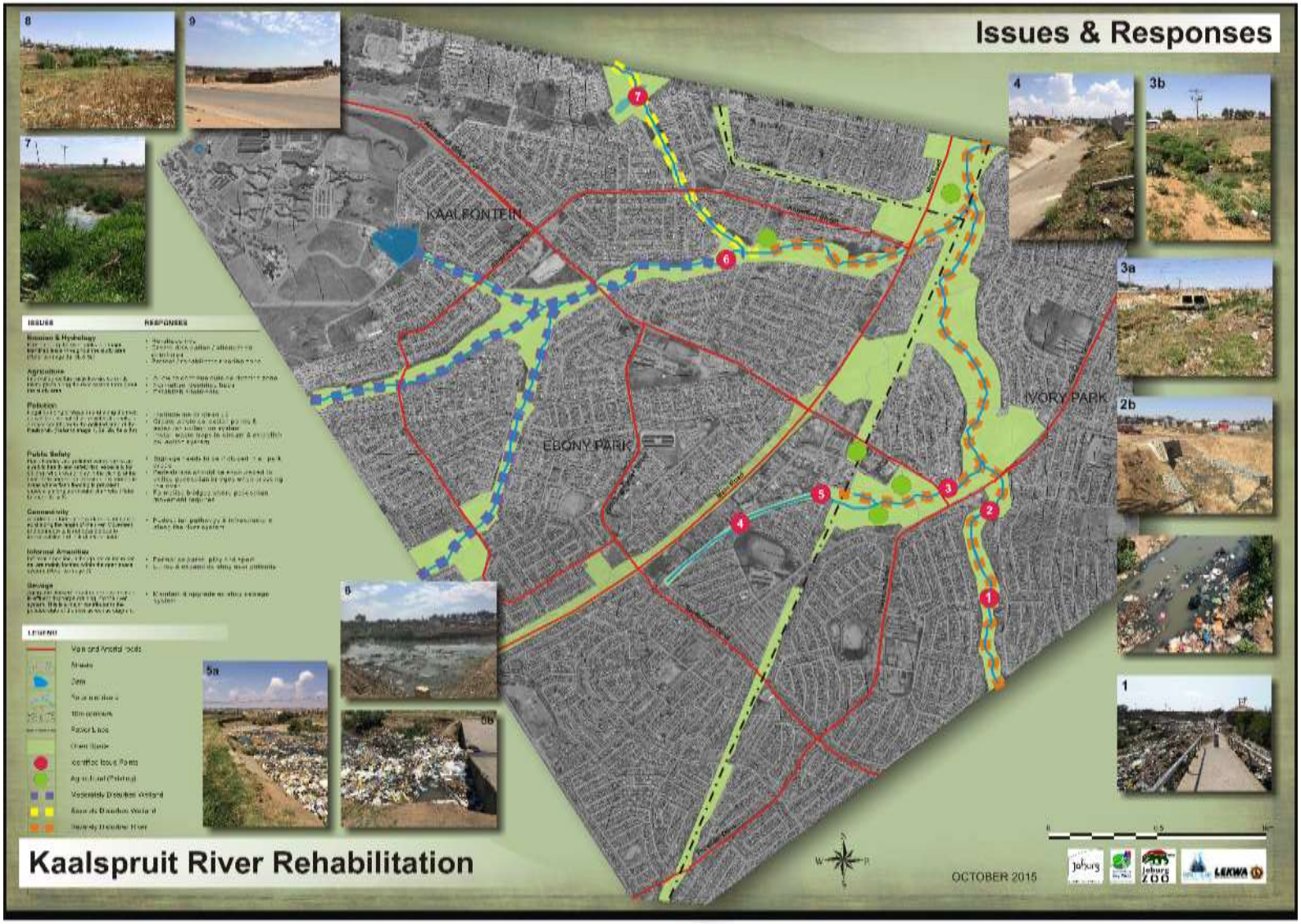

Figure 7: Poster analysis following Issues raised and Responses to the Kaalspruit River Rehabilitation project (October 2015).

2. CURRENT HABITAT CONDITIONS

The assessment of the Kaalspruit area was undertaken on 11 November 2015, on a hot, partly cloudy day with a steady north wind. The field survey was done by Prof GJ Bredenkamp, accompanied by Dr IL Rautenbach and Dr AC Kemp. This early summer visit was before any significant summer rains had fallen in the region, making it difficult to assess any flow, seepage and/or runoff conditions that might arise latter in the summer under conditions of strong flows or flooding.

The following images and their captions form the basis for our habitat assessment, taken at various points along the watercourses to illustrate the main habitats and impacts that we detected. When examining these images and captions, it will be useful to keep in mind the differences in drop or gradient along each part of the system, as a surrogate for the flow velocities that can be expected in each section, especially during summer floods (cf. Fig. 8; Table1). Water entering the system from outside the study area arrives from the extensive Kaalspruit catchment after a relatively steep overall gradient (20.1 m/km). Within the study area, the Kaalspruit mainstem has the least overall gradient (7.6 m/km), while the smaller tributaries have much higher overall gradients (28.7-33.1 m/km). Variation of lesser gradients within each section of the drainage lines within the study area can be calculated from the data on Fig. 8 (e.g. Kaalspruit 1.8, 6.2 & 29.7 m/km from entry to exit, highest as it enters the study area and highest over the rapids in Fig.14 just before it exits).

The names and codes of the separate watercourses follow those described in the Background Information (Fig.3), with images of each watercourse presented in order from the watercourse's entry into the study area to its mouth or departure from the study area.

Table 1: Indication of the gradient for the main upstream catchment and for each of the sections of water course within the study area, as a surrogate for what flow velocities can be expected along within the drainage lines. Data from Fig. 8 below.

Mainstem	Start	End	Drop, m	Distance, km	Gradient, m/km
Kaalspruit: catchment	source	site S edge	148	7.37	20.1
site	site S edge	site N edge	21	2.78	7.6
Tributaries: K1	channel start	mouth	44	1.33	33.1
K2	site W edge	mouth	45	3.12	14.4
K2a	site W edge	mouth	39	1.36	28.7
K2b	Eskom dam wall	mouth	17	0.55	30.9
K2c	site N edge	mouth	35	1.08	32.4

DRAFT

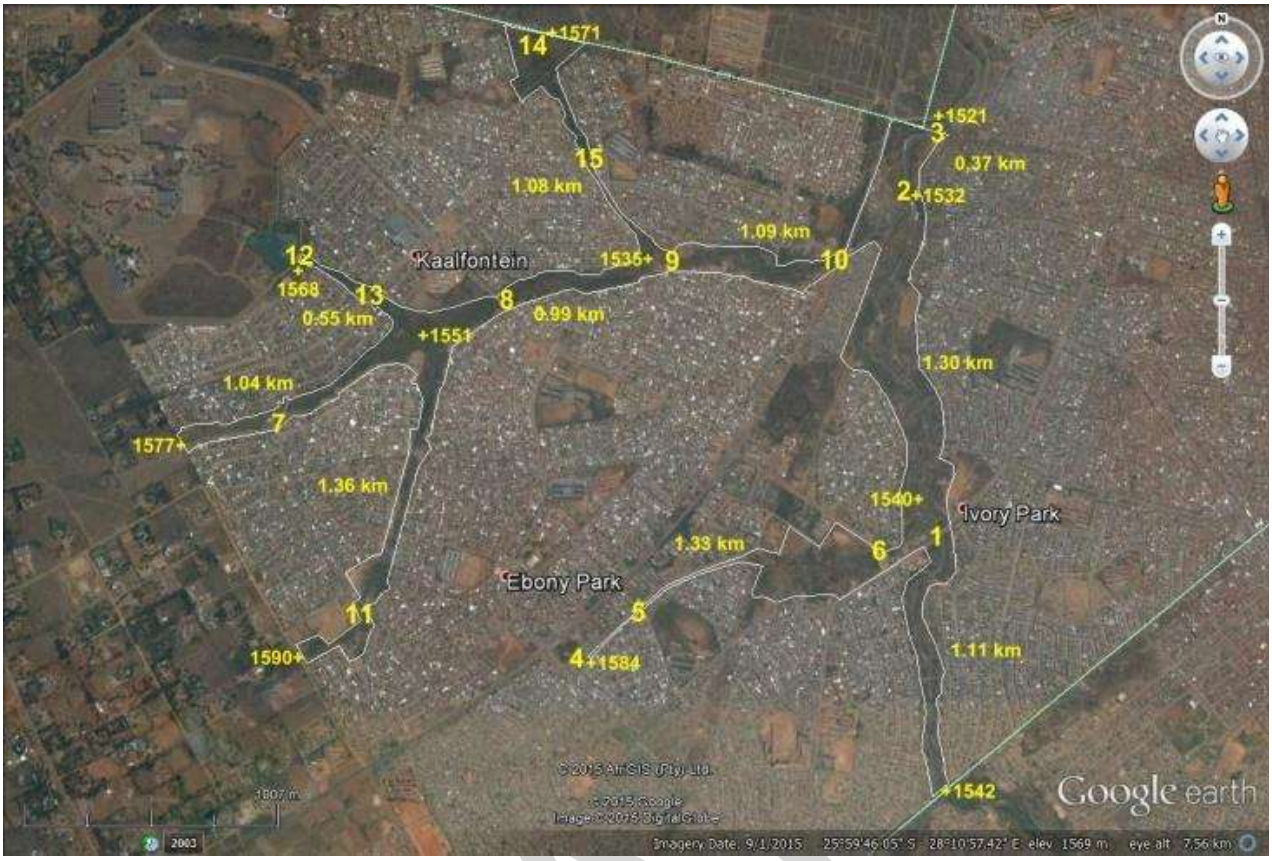

Figure 8: Sequence of positions for images taken to show the main features of each of the drainage systems involved along the mainstem Kaalspruit and its tributaries, starting each one upstream and ending downstream. Altitudes at points along the system are indicated as m a.s.l. (taken from Google Earth), and the straight-line distance between these points (+) as kilometres, to allow estimation of gradient. The estimated source of the Kaalspruit is at 1690 m a.s.l. and 7.37 km straight-line upstream of the study area.

2.1. KAALSPRUIT RIVER (LOW OVERALL GRADIENT, 7.6 M/KM)

Figure 9, position: 1: View south (upstream) from an earth landfill into the west bank of the Kaalspruit River, west of its crossing of Freedom Drive, showing the reedy watercourse, grassy banks and low gradient upstream, with a pedestrian bridge and in the distance the southwestern Johannesburg-Ekurhuleni boundary. Note the constrictions on either side from the pedestrian walkway embankments.

Figure 10, position 1: View south (upstream) from the crossing of the Kaalspruit River over Freedom Drive, showing the reed-filled watercourse, with a pipeline crossing in the foreground and the pedestrian crossing in the distance. Note the stream restricted to only one of several channels due to late rains. Note the damming effect of the road embankment (cf. Fig. 11).

Figure 11, position 1: View north (downstream) from the crossing of the Kaalspruit River over Freedom Drive, showing the single bed, with the watercourse cleared of most wetland vegetation by flooding and the banks by used as croplands watered from the river. The K1 tributary enters from the west (left) at the far end of the open water. Note the low weir further down the river.

Figure 12: position 1: View north (downstream) from the western end of the Freedom Drive bridge, showing the line of the K1 tributary drainage entering the Kaalspruit from the west (left) in the distance, the green river-watered maize along the Kaalspruit bank and, in the foreground, the channel where runoff from the road drains into the watercourse. Note the design for and erosion from runoff from the road surface above (behind).

Figure 13, position 2: View south (upstream) of the lower section of the Kaalspruit on the study area, taken from a granite outcrop used as a dumping site for rubbish and rubble, and showing the relatively wide banks with secondary grassland near the river and small croplands closer to the eastern (left) houses. The K2 tributary from entering from the west (right; green strip) is channeled by the resistant outcrop into the Kaalspruit at this point, with the incised Kaalspruit bed visible just beyond. Note the various powerlines used as perches, and that the outcrop still supports a few *Xerophyta retinervis* lilies.

Figure 14, position 2: View south (upstream) of the steeper drop at the small rapids where the Kaalspruit has eroded through the resistant granite intrusion of Fig. 13.

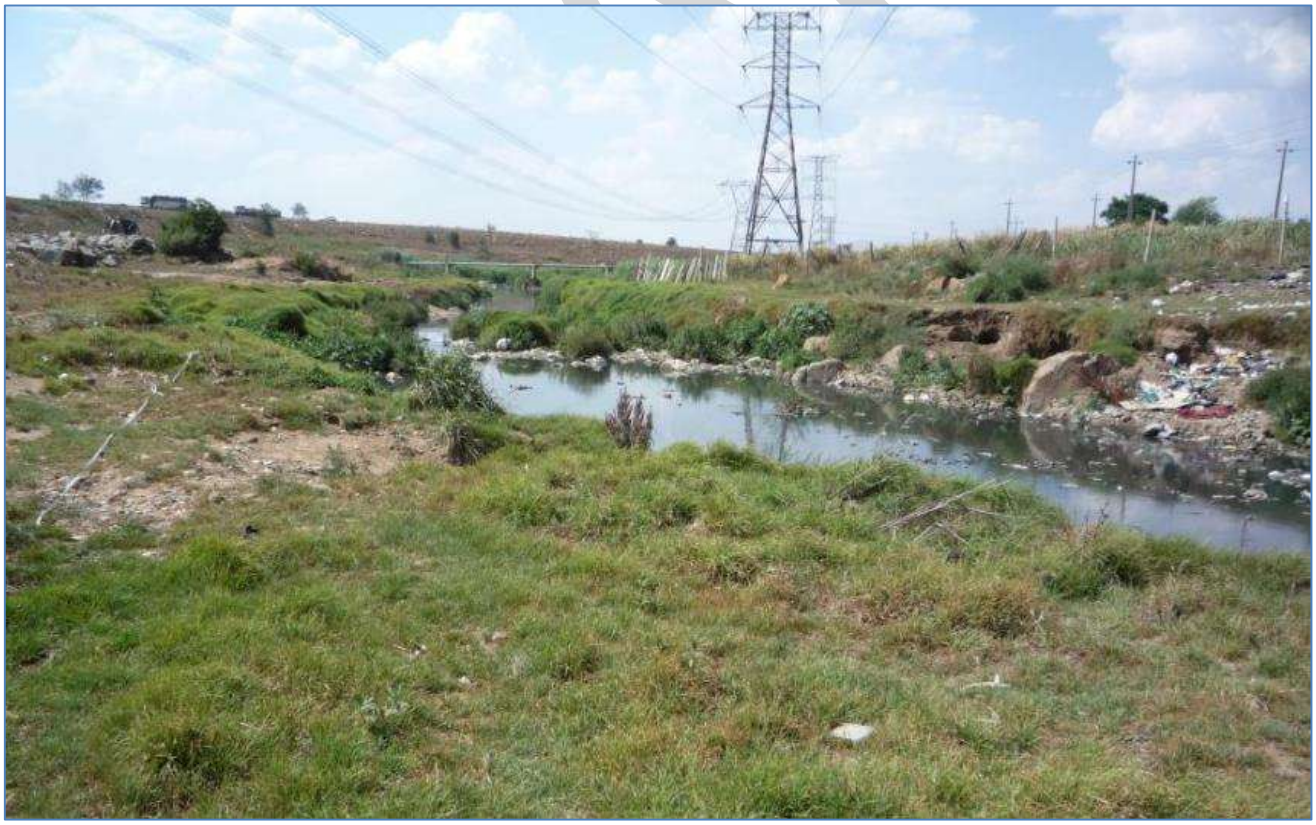

Figure 15, position 2: View north (downstream) of the slow-flowing reach of the Kaalspruit below the rapids, with the embankment of Riverside Road forming the distant horizon. Note the eroded bank, degraded secondary grassland on either side invaded near the watercourse by alien *Pennisetum clandestinum* (kikuyu grass), and the pipeline used as a water bird perch above the river.

Figure 16, position 3: View south (upstream) from the northern edge of the study area, taken from the bridge crossing Riverside Road. Note the reed-fringed banks of the strong-flowing Kaalspruit over its rocky bed, and the mix of secondary grassland and croplands on the banks with disturbance mostly close to the housing. Note the minimal damming effect of the road embankment due to the deep hard river bed (cf. Fig. 17).

Figure 17, position 3: View north (downstream) of the less developed and more natural habitats along the Kaalspruit below its crossing of Riverside Road. Some newer housing does extend north along the eastern (right) edge of the drainage line, and there is some informal settlement and cropland along the banks, including clearing patches of reeds and excavating the river bed to acquire fertile sedimentary soils.

2.2. K1 TRIBUTARY (HIGH OVERALL GRADIENT, 33.1 M/KM)

Figure 18, position 4: View south (upstream) along the concrete-lined canal to where the start of the open tributary emerges from a storm-water drain passing under 29th September Street, but not as a distinct watercourse. Note the proximity of informal housing to the east (left) edge and tarred road to the east (right).

Figure 19, position 5: View south (upstream) from further down the concrete-lined canal than Fig. 18, showing the incursion of temporary shelters, sales areas and litter along the edges. Note the impermeable road surface running alongside the canal and lack of any flow-reduction structures within the relatively steep canal.

Figure 20, position 5: View north (downstream) from the same position as Fig. 19, showing weeds growing where runoff/seepage down a side street leaks into the canal, a pedestrian bridge across the canal, informal housing encroaching on the east (right) bank and portable toilets on the west (left) bank. Note the lack of any flow-reduction structures within the canal and its relatively steep gradient.

Figure 21, position 6: View west (upstream) towards where the K1 Tributary emerges from housing into an extensive open area, most of which is under cultivation with little natural vegetation and many weeds in between and along the banks. A weir above the open water breaks the flow, but further upstream deep erosion of the drainage line is evident, apparently where water emerges at high velocity from the upper concrete-lined canal.

Figure 22, position 6: View northeast (downstream) towards where the K1 Tributary passes under Karee Street *en route* to the Kaalspruit mainstem in the valley below. Note the drainage line invaded by alien ornamental cannas to the west (left), constricted by levelling for a concrete-block-making enterprise and corvered with froth. Little natural vegetation remains and most trees are introduced alien species. See Fig. 12 for where the K1 Tributary actually enters the Kaalspruit.

2.3. K2 TRIBUTARY (MEDIUM OVERALL GRADIENT, 14.4 M/KM)

Figure 23, position 7: View west (uphill) from where Finger Fish Street crosses the upper reaches of the K2 Tributary, at the time a strip of dry degraded grassland between the housing, encroached along the edge by dumping of rubble, with the only wetland entering from the south (left) where seepage/runoff from the housing support a drainage line with *Typha* bulrushes and some sedges. Residents report that during heavy rains runoff from the grassland floods across the road.

Figure 24, position 7: View east (downstream) from the same position as Fig. 23, showing the dry watercourse of the upper K2 Tributary (apart from seepage under Finger Fish Street from township seepage on the other side), with alien *Salix* willow trees in the foreground and extensive bulrush beds in the background that indicate the flatter more fertile conditions downstream.

Figure 25, position 8 (&13): View south from Angelfish Street, looking down the drainage line of K2b Tributary to its junction within a large crow's foot of bulrush beds and towards the confluence of the K2, K2a and K2b Tributaries (cf. Fig. 3). The bare area created within the bulrush beds is part of a specially created and equipped recreation site, with the central K2 Tributary passing just to the near (north) side of the recreation site. Note the structures built into the riparian zone.

Figure 26, position 8: View west (upstream) from K2 Tributary's crossing under Archer Fish Street, looking along the 'hind-toe' of the crow's foot and K2 Tributary's wide bed of bulrushes. Housing and dumping intrude on the west (left) bank but on the east (right) bank a long high fence around commercial developments reduces disturbance to only a few small cultivated plots along its outer edge and leaves some secondary grassland.

Figure 27, position 8: View east (downstream) along the K2 Tributary taken below its crossing under Archer Fish Street, showing where the drainage of runoff from the impermeable road surface has eroded and opened the outside of the bend, reducing the bulrush beds as their soils are washed away, with the streambed quality declining and giving way to reeds further downstream in the distance.

Figure 28, position 9: View west (upstream) from where Glassnose Street crosses and dams up the K2 Tributary. Note the intrusions of landfills and cultivation on the edges of the watercourse, but the presence of Glossy Ibis and other smaller wetland birds feeding amongst the litter in the sludge and sediment.

Figure 29, position 9: View east (downstream) where the K2 Tributary flows out from under the Glassnose Street crossing and constriction. Note the eroded bed and banks, and the degraded and transformed edges of the watercourse between the housing, with minimal marginal vegetation to protect and retain them.

Figure 30, position 10: View west (upstream) where the lower reaches of the K2 Tributary pass under Republic (Main) Road. Note the encroachment of landfills and informal housing along the banks, the presence of some reed beds to stem water flow, and the obvious litter load.

Figure 31, position 10: View east (downstream) towards where the K2 Tributary joins the northern section of the Kaalspruit mainstem in the valley floor below. Note the eroded river bed, total incursion of informal settlements and their waste on the south (right) bank, but the semi-natural though degraded vegetation on the north (left) bank.

Figure 32, position 2(& 10): View southwest (upstream) from where a concrete causeway crosses and dams up the K2 Tributary, almost at its confluence with the Kaalspruit mainstem. Note the narrow deep bed at this point, with its rim of mainly alien plants and weeds, and the ever-present litter.

Figure 33, position 2 (& 10). View northeast (downstream) at the K2 Tributary's confluence with the nearby Kaalspruit mainstem down below in its deep bed. Note the disturbed and eroded stream bed below the causeway obstruction, and the croplands extending right to the confluence.

2.3.1. K2a Tributary (high overall gradient, 28.7 m/km)

Figure 34, position 11: View southwest (uphill), looking towards the distant trees within the President Park Agricultural Holding catchment for the K2a Tributary, with a soccer field and fenced playground built up on landfills obstructing the north (right) side of the drainage line. At the time, the drainage line between the housing on either side was dry, degraded indigenous grassland, but with signs of erosion by seasonal flows.

Figure 35, position 11: View along the west side of Camellia Street, showing where the drainage line of the K2a Tributary passes round the end of a landfill for a fenced recreation area and then re-enters its bed under the street. The narrow strip of green bulrushes that remains in the bed is fed by drainage of seepage/runoff from housing to the east (far side) of the tributary.

Figure 36, position 11: View northeast along the K2a Tributary below where it crosses Camellia Street, showing the narrowed and channeled drainage line with earth berms on either side, sited some distance from the nearest housing and presumably to protect it from flooding. Note the highly degraded secondary vegetation that has appeared, much of it alien species.

2.3.2. K2b Tributary (high overall gradient, 30.9 m/km)

Figure 37, position 12: View north along the wall of the large dam within the heavily fenced Eskom property that forms the border of the site at this point and controls the catchment flow into the K2b Tributary. At the time, this large body of water, fringed by large trees, supported a large heronry and attracted some fish-eating cormorants and gulls.

Figure 38, position 12: View southeast along the bulrush-filled drainage line of the K2b Tributary, almost completely encroached by the housing on either side, but still with cultivation on what remains of the natural grassland on the west (right) bank. The concrete spillway below the dam in Fig. 37 supports a few willow trees, probably from cuttings/branches washed into its base.

Figure 39, position 13: View northwest (upstream) from where the K2b Tributary crosses Angelfish Street. Upstream, another dirt road with a culvert forms a wall across the tributary, resulting in a bulrush-filled dam above and an eroded bank but grassy stream bed below, presumably maintained by seepage from the dam and attracting Sacred Ibis to feed. Willow trees have established on the embankment wall and clumps of pampas grass within the spillway below

Figure 40, position 13: View southeast (downstream) along the drainage line of the K2b Tributary, with signs of flood damage in the rocky bed, only clumps of resistant pampas grass and bulrushes remaining, and encroachment by housing on either side before the bed emerges into the wide bulrush-filled crow's foot of the K2, K2a and K2b Tributary's confluence (cf. Fig. 25).

2.3.3 K2c Tributary (high overall gradient, 32.4 m/km)

Figure 41, position 14: View north (uphill) across the large vacant area at the head of the K2c Tributary. A narrow seepage line enters at this point but its origins outside the study area were not traced. The cultivated area and the remaining large alien eucalypts mark the edge of the study area. The ridge beyond supports extensive natural grassland, which, over its brow, leads to the Glen Austin Pan Bird Sanctuary and an adjacent pan (cf. Fig. 1).

Figure 42, position 14: View south from the northwest edge of the study area, looking over the open cultivated area at the head of the K2c Tributary to where a wide dam holds the seepage that runs in along the northeast (left) side and the runoff from other small drainage lines crossing the croplands.

Figure 43, position 14: View south from below the dam wall in Fig. 42, looking over more cultivated land at the head of the K2c Tributary to where it enters the drainage line between the housing on either side.

Figure 44, position 15: View north (upstream) from where Trout Street comes to the eastern edge of the steep, narrow drainage line of K2c Tributary, showing how roads and houses have constricted the watercourse from the east (right) and deliberate landfill from the west (left), yet bulrushes and some indigenous grasses and sedges survive within the stream bed.

Figure 45, position 15: View south (downstream) from where Trout Street reaches the east (left) side of the drainage line of the K2c Tributary, constricted by landfill to the east and expanded housing to the west (right). Water still flows in the narrow bed and under an informal roadway, and bulrushes and other alien vegetation survive along its margins.

Figure 46, position 15 (& 9): View west (upstream) from where Glassnose Street crosses and dams up the K2 Tributary, showing its confluence with where the K2c Tributary flows in from the north (right) between weed-infested banks; (cf. Fig. 28).

DRA

3. VEGETATION AND FLORA

3.1. METHODS

3.1.1. Initial preparations:

For background information, the relevant maps, aerial photographs and other information on the natural environment of the concerned area were obtained.

3.1.2. Site visit

The vegetation/habitats in and along the spruit system were stratified into relatively homogeneous units on recent Google images of the area. This stratification focused on relatively homogeneous river reaches. Within each reach a mosaic of habitats occurred, including stream bed, stream banks and the floodplain or terrestrial grassland areas adjacent to the stream bank. Each of these was variously disturbed or transformed. At several sites within each relatively homogeneous unit, transects were walked and sampled. A description of the dominant and characteristic species found in transects was made. The position of the sample plots/transects are shown in Figure 8. These descriptions were based on total floristic composition, following established vegetation survey techniques (Mueller-Dombois & Ellenberg 1974; Westhoff & Van der Maarel 1978). Data recorded were a list of the plant species present, including trees, shrubs, grasses and forbs. Comprehensive species lists were therefore derived for each plant community/ecosystem present on the site. These vegetation survey methods have been used as the basis of a national vegetation survey of South Africa (Mucina *et al*. 2000) and are considered to be an efficient method of describing vegetation and capturing species information. Additional notes were made of any other features that might have an ecological influence.

The identified systems are not only described in terms of their plant species composition, but also evaluated in terms of the potential habitat for Red Data plant species.

Critically Endangered, Endangered, Vulnerable and Protected Species (NEMBA species, TOPS species) are evaluated against the list published in Department of Environmental Affairs and Tourism Notice No. 2007 (National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004)).

Protected trees are identified in accordance with the list of nationally protected trees published in Government Notice No. 29062 3 (2006) (National Forests Act, 1998 (Act No. 84 0f 1998), as Amended (Department of Water Affairs Notice No 897, 2006).

DRAFT

Lists of Red Data plant species for the area were obtained from the SANBI data bases, with updated threatened status, (Raimondo *et al* 2009) as well as GDARD for the map grid 2627AA and 2528CC. These lists were then evaluated in terms of habitat available on the site, and also in terms of the present development and presence of Man in the area.

Alien invasive species, according to the Conservation of Agricultural Resources Act (Act No.43 of 1983) as listed in Henderson (2001) and other weeds Bromilow (2010) are indicated.

Medicinal plants are indicated according to Van Wyk, Van Oudthoorn & Gericke (1997).

3.3.3. Plant Species Status

Plant species recorded in each plant community with an indication of the status of the species by using the following symbols:
A = Alien woody species; D = Dominant; d = subdominant; G = Garden or Garden Escape; M = Medicinal plant species; P = Protected trees species; p = provincially protected species; RD = Red data listed plant; W = weed.

3.2. RESULTS

3.2.1. Classification of the river-reach units

Four different relatively homogeneous river-reach units were recognized (Fig 47). These include:

1. The mainstem river with a definite stream of flowing water,
2. Moist wetland system with wet or moist soils, covered with reeds,
3. Dry wetland systems with little or no surface water, dominated by grass, and
4. Transformed canal system.

DRAFT

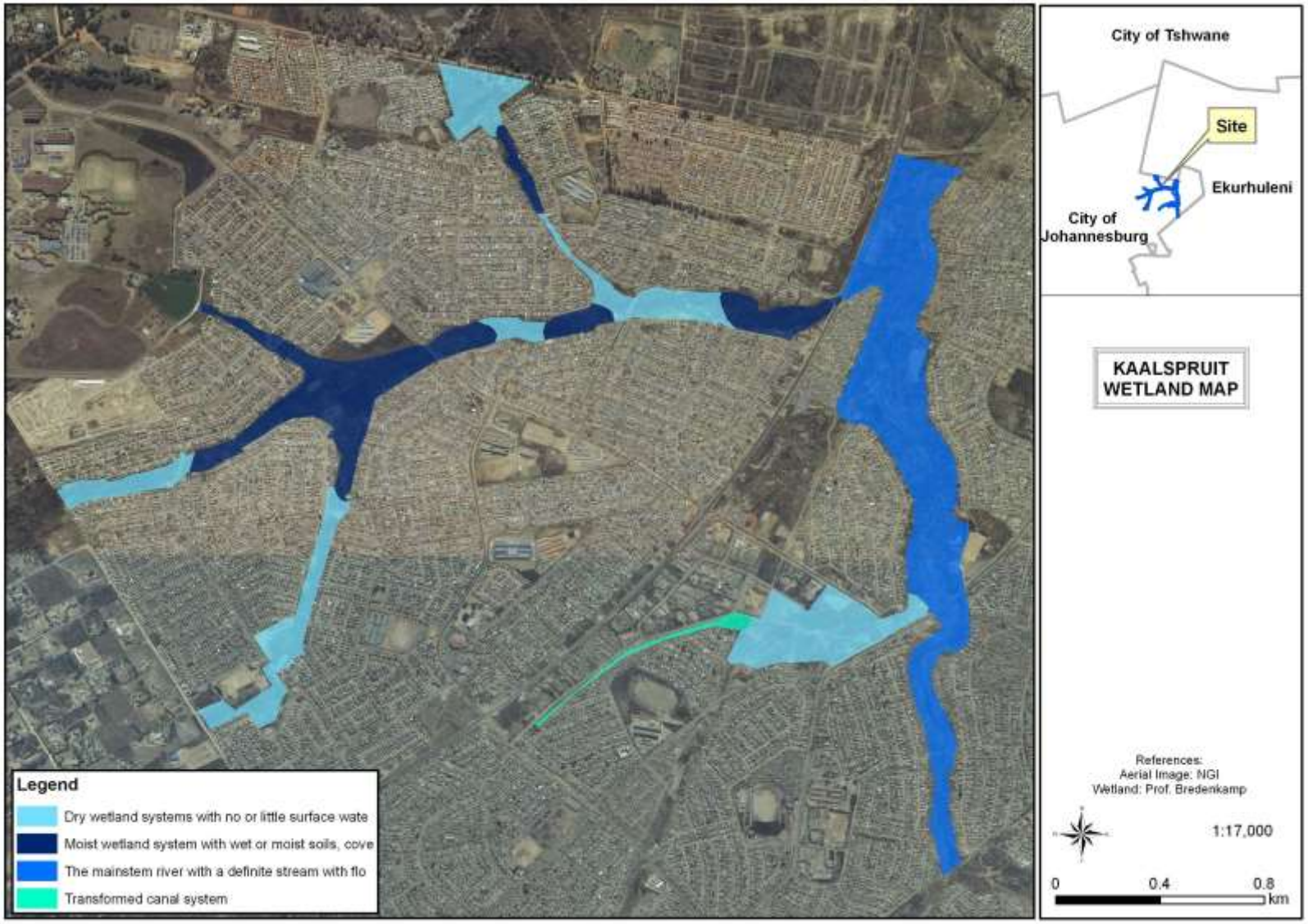

Figure 47: Kaalspruit wetland systems based on vegetation.

3.2.2. Floristic description of the river reach systems

3.2.2.1. The mainstem river

The mainstem river is illustrated by Figs. 9, 10, 11, 14, 15, 16, 17, 31, 32, 33, 38 These figures clearly illustrate the streambed with flowing water.

Streambed

Extensive reed (*Phragmites australis*) or bulrush *(Typha capensis*) beds occur in the streambed (Fig. 10) or along the fringes of the stream (Fig. 16 & 17) and onto the stream banks, or reed patches may be only locally present (Figs. 11, 14 & 15). Other plant species that occur scattered in the streambed include several sedge species of the genera *Cyperus, Schoenoplectus, Pycrius* and rarely others. Exotic species such as *Persicaria lapathifolia, Persicaria serrulata* and *Ludwugia octovalvis* are also encountered, especially closer to the stream edge. The fast flowing water inhibits the presence of many plants, as they are strongly influence by flooding. The few plant species that cover the stream bed are mostly indigenous.

Lower stream banks

Apart from *Phragmites australis,* several other plant species do occur on the stream banks. Although some indigenous species may occur, the vegetation of the banks is mostly composed of exotic, weedy species. These plants are subjected to regular flooding, being replaced regularly and therefore this vegetation is quite dynamic, often changing from year to year. This results in the often high cover and frequency of weedy species. However, woody tree or shrub species, mostly exotic, became locally established, though woody plants occur only scattered along the spruit. These include the Spanish reed (*Arundo donax*) and woody species for example *Salix babylonica, Eucalyptus* sp., *Melia azedarach, Cestrum laevigatum, Morus alba, Morus nigra, Celtis australis, Ligustrum lucidum Populus xcanescens, Robinia pseudo-acacia, Prunus persica, Solanum mauritianum, Melilotis alba, Acacia mearnsii.* A few individuals of the indigenous *Vachellia karroo* were locally noticed.

Herbaceous (exotic and invasive) plant species that often dominate the stream banks include *Ricinus communis, Datura stramonium, Amaranthus hybridus, Tagetes minuta, Bidens pilosa, Bidens bipinnata, Xanthium strumarium, Mirabilis jalapa, Canna indica, Rumex crispus, Verbena bonariensis, Plantago lanceolata, Argemone mexicana.* Some grass species may be present, e.g. *Pennisetum clandestinum, Paspalum dilatatum, Paspalum urvillei, Cortaderia selloana.*

It is estimated that exotic vegetation covers 80% of this habitat.

DRAFT

Upper stream banks

The vegetation of the upper banks is mainly highly disturbed grassland, which in historical times would have merged into terrestrial grassland of the Egoli Granite Grassland vegetation type. This type of grassland is not restricted to the mainstem of the Kaalspruit but is also prominent on the banks of the wet and drier wetland systems (mapping units 2 and 3, described below). Within the demarcated study site this is a narrow zone, where the original vegetation was grassland, mostly part of the Kaalspruit floodplain system. Currently this area is a mosaic of various disturbances. Some areas are disturbed and trampled grassland (Figs. 11 & 17), though many small agricultural fields (Figs 11 & 13) or patches of weedy vegetation (Fig. 14) occur scattered in this zone, while in the more transformed areas kikuyu grass (Fig. 15), earthworks, soil and rubble dumps (Figs. 9 & 13, 30), or even residential houses (Fig. 38), shacks (Fig. 31) and construction works interrupt the scene.

In general the vegetation of the spruit bed with reeds and bulrushes is basically indigenous; the lower spruit banks are 70-80% exotic weeds while the upper stream bank grassland is 50-60% indigenous, though locally more severely degraded areas with 0-30% indigenous occur.

At sample plot 12, a red-listed plant species, *Hypoxis hemerocallidea* (Declining*)* was found (see paragraph on plant species of conservation concern).

3.2.2.2. Moist wetland system with wet or moist soils, covered with reeds

Permanent zone

The moist wetland system covers large parts of K2 including K2b, but excludes the upper parts of K2a and K2c (Figure 3). This system is predominantly covered with indigenous bulrushes (*Typha capensis*). This wetland system is illustrated by Figs. 25, 26, 27, 28, 30 and 46. By far the largest part of this wetland system is covered by the totally dominant *Typha capensis,* but reeds (*Phragmites australis*) may also be locally prominent, while very few other species are present (Fig. 26). At somewhat more open spaces, such species occur as *Cortaderia selloana* (Figs. 39 & 40) *Persicaria lapathifolia, Persicaria serrulata*, *Mirabilis jalapa, Canna indica, Rumex crispus, Verbena bonariensis, Conyza bonariensis, Plantago lanceolata, Pennisetum clandestinum, Salix babylonica* (Figs. 38 & 39) and *Morus alba*.

DRAFT

Seasonal zones

The seasonal zones at the outer fringe of the *Typha capensis* wetland zone are almost always highly disturbed and dominated by weedy vegetation (Figs. 25 & 27), with soil dumps and landfill (Figs. 28 & 30), or housing (Fig. 38).

Although the moist wetland system is relatively poor in plant species, it forms important habitat for fauna and is regarded as ecologically very important.

In general the largest area, about 70%, is covered by indigenous reed vegetation, while exotic weeds contribute about 30%.

3.2.2.3. Dry wetland systems with no or little surface water, dominated by grass

The upper reaches of the tributaries K1 as well as K2a and K2c (Fig. 3) represent drier wetland systems where little or no surface water is present during the dry season (Figs 12, 23, 24, 35, 36, 41, 42, and 43). Grasses and/or sedges are dominant (Fig. 24, but in general these areas are also highly disturbed (Fig. 35, 36), often with bare soil patches (Fig. 23). Agriculture for maize and vegetable production (Fig. 23, 41) occurs in this area.

Grass species and sedge species are mostly characteristic of this wetland type. Grass species include the indigenous *Cynodon dactylon, Eragrostis plana, Eragrostis curvula* and *Hyparrhenia hirta* on drier spots and *Paspalum dilatatum, Paspalum urvillei, Imperata cylindrica* at the moister spots. Sedge species are from the genera *Cyperus, Fuirena* and *Kyllinga.*

The usual weed species such as *Verbena bonariensis, Conyza bonariensis, Plantago lanceolata, Ricinus communis, Datura stramonium, Amaranthus hybridus, Tagetes minuta, Bidens pilosa, Bidens bipinnata, Xanthium strumarium* and the exotic grass *Pennisetum clandestinum* are often found within this system.

Alien woody species such as *Eucalyptus* sp (Fig. 41) and *Salix babylonica* (Fig. 24) are found at some localities, while the indigenous *Vachellia karroo* may be locally present.

Indigenous vegetation covers about 40-60%, depending on the degree of disturbance.

DRAFT

3.2.2.4. Transformed canal system.

A concrete canal was constructed in the upper reaches of K1 (Fig. 3). The canal is illustrated in Figs. 18, 19 & 20. A few grass species, *Cynodon dactylon, Eragrostis curvula, Eragrostis plana, Hyparrhenia hirta* and *Eulysine coriacea* were noted, while the weeds *Ricinus communis, Mirabilis jalapa, Conyza bonariensis* are present.

During rains, the water from the canal runs down into the K1 tributary causing deep channel erosion (Fig. 21), from where the water drains down to the mainstem river.

The vegetation of this system is 80% exotic.

3.2.3. Species of Conservation Concern, Red Data & NEMBA Species, Protected Trees

A Threatened species and Species of Conservation Concern list for the Grid 2528CC and 2628AA were obtained from the POSA database on the SANBI website and include data from GDARD. Threatened species are those that are facing high risk of extinction, indicated by the categories Critically Endangered, Endangered and Vulnerable. Species of Conservation Concern include the Threatened Species, but additionally have the categories Near Threatened, Data Deficient, Critically Rare, Rare and Declining. This is in accordance with the new Red List for South African Plants (Raimondo *et al*. 2009).

Table 2 Red-listed plant species from the area (in alphabetical order)

Family	Species	Threat status	Available habitat
Euphorbiaceae	*Acalypha caperonioides* Baill. var. *caperonioides*	DDT	Limited not found
Poaceae	*Agrostis eriantha* Hack. var. *planifolia* Gooss. & Papendorf	DDT	Limited to wet areas, not found
Amaryllidaceae	*Boophone disticha* (L.f.) Herb.	Declining	Yes, not found
Hyacinthaceae	*Bowiea volubilis* Harv. ex Hook.f. subsp. *volubilis*	VU	Yes, not found
Orchidaceae	*Brachycorythis conica* (Summerh.) Summerh. subsp. *transvaalensis* Summerh.	EN	No
Asteraceae	*Callilepis leptophylla* Harv.	Declining	No
Capparaceae	*Cleome conrathii* Burtt Davy	NT	No
Acanthaceae	*Dicliptera magaliesbergensis* K.Balkwill	VU	No
Hyacinthaceae	*Drimia elata* Jacq.	DDT	No
Hyacinthaceae	*Drimia sanguinea* (Schinz) Jessop	NT	No
Zamiaceae	*Encephalartos laevifolius* Stapf & Burtt Davy	CR	No

DRAFT

Family	Species	Threat status	Available habitat
Zamiaceae	*Encephalartos longifolius* (Jacq.) Lehm.	NT	No
Scrophulariaceae	*Freylinia tropica* S.Moore	Rare	No
Gunneraceae	*Gunnera perpensa* L.	Declining	Very limited, to wet areas not found
Orchidaceae	*Habenaria barbertoni* Kraenzl. & Schltr.	NT	No
Orchidaceae	*Habenaria kraenzliniana* Schltr.	NT	No
Orchidaceae	*Habenaria mossii* (G.Will.) J.C.Manning	EN	No
Orchidaceae	*Holothrix randii* Rendle	NT	No
Hypoxidaceae	*Hypoxis hemerocallidea* Fisch., C.A.Mey. & Avé-Lall.	Declining	Yes, present
Aquifoliaceae	*Ilex mitis* (L.) Radlk. var. mitis	Declining	No
Proteaceae	*Leucadendron daphnoides* (Thunb.) Meisn.	EN	No
Mesembryanthemaceae	*Lithops lesliei* (N.E.Br.) N.E.Br. subsp. *lesliei*	NT	No
Fabaceae	*Melolobium subspicatum* Conrath	VU	No
Apocynaceae	*Miraglossum laeve* Kupicha	Threatened	?
Fabaceae	*Pearsonia bracteata* (Benth.) Polhill	NT	No
Alliaceae	*Tulbaghia pretoriensis* Vosa & Condy	DDT	Limited? Not found

Other red-listed species that could be present in the area include *Gnaphalium nelsonii,* which was not present, and *Trachyandra erythrorrhiza.* There is suitable habitat for *Trachyandra erythrorrhiza* but this species was not found.

For most of the red-listed plant species that have been collected from the Grid 2528CC, there is not suitable habitat on the site. Only a few individuals of one Red-Data-listed species (*Hypoxis hemerocallidea*) were found within the buffer zone of the spruit, at the top end of K2, close to the dam and are therefore protected against the proposed development. The reason for this is probably the extremely disturbed and degraded condition of the site in general, but also of the wetland area.

NEMBA species are evaluated against the list published in Department of Environmental Affairs and Tourism Notice No. 2007 (National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004)). No NEMBA species were found on the site.

Protected trees are identified in accordance with the list of nationally protected trees published in Government Notice No. 29062 3 (2006) (National Forests Act, 1998 (Act No. 84 0f 1998), as Amended (Department of Water Affairs Notice No 897, 2006). No Protected trees occur on the site.

DRAFT

3.2.4. Medicinal Plants

The medicinal plants include the weeds *Bidens bipinnata* and *Datura stramonium*, but in general medicinal plants are rare on the site.

3.2.5. Alien Plants

Some alien plant species are listed as declared invasive plants (Henderson 2001) and they should be removed and controlled (Conservation of Agricultural Resources Act (Act 43 of 1983).

The Invader Categories as per CARA are basically described as follows:

- Category 1: Declared weeds that are prohibited on any land or water surface in South Africa. These species must be controlled, or eradicated where possible.
- Category 2: Declared invader species that are only allowed in demarcated areas under controlled conditions and prohibited within 30 m of the 1:50 year flood line of any watercourse or wetland.
- Category 3: Declared invader species that may remain, but must be prevented from spreading. No further planting of these species are allowed.

The National Environmental Management: Biodiversity Act (NEMBA) is the most recent legislation pertaining to alien invasive plant species. In August 2014 the list of Alien Invasive Species was published in terms of the National Environmental Management: Biodiversity Act (Act 10 of 2004) (Government Gazette No 78 of 2014). The Alien and Invasive Species Regulations were published in the Government Gazette No. 37886, 1 August 2014. The legislation calls for the removal and / or control of alien invasive plant species (Category 1 species). In addition, unless authorised thereto in terms of the National Water Act, 1998 (Act No. 36 of 1998), no land user shall allow Category 2 plants to occur within 30 meters of the 1:50 year flood line of a river, stream, spring, natural channel in which water flows regularly or intermittently, lake, dam or wetland. Category 3 plants are also prohibited from occurring within close proximity to a watercourse. Categories listed in Government Gazette 37886 published 1 August 2014 are the following:

Category Ia Listed Invasive Species

1) Category 1a Listed Invasive Species are those species listed as such by notice in terms of section 70(1)(a) of the Act as species which must be combatted or eradicated.
2) A person in control of a Category 1a Listed Invasive Species must:

DRAFT

i) comply with the provisions of section 73(2) of the Act,

ii) immediately take steps to combat or eradicate listed invasive species in compliance with sections 75(1), (2) and (3) of the Act;

iii) allow an authorised official from the Department to enter onto land to monitor, assist with or implement the combatting or eradication of the listed invasive species.

3) If an Invasive Species Management Programme has been developed in terms of section 75(4) of the Act, a person must combat or eradicate the listed invasive species in accordance with such programme.

Category 1b Listed Invasive Species

1) Category 1b Listed Invasive Species are those species listed as such by notice in terms of section 70(1)(a) of the Act as species, which must be controlled.
2) A person in control of a Category 1b Listed Invasive Species must control the listed invasive species in compliance with sections 75(1), (2) and (3) of the Act.
3) If an Invasive Species Management Programme has been developed in terms of section 75(4) of the Act, a person must control the listed invasive species in accordance with such programme.
4) A person contemplated in sub-regulation (2) must allow an authorised official from the Department to enter onto the land to monitor, assist with or implement the control of the listed invasive species, or compliance with the Invasive Species Management Programme contemplated in section 75(4) of the Act.

Category 2 Listed Invasive Species

1) Category 2 Listed Invasive Species are those species listed by notice in terms of section 70(1)(a) of the Act as species which require a permit to carry out a restricted activity within an area specified in the Notice or an area specified in the permit, as the case may be.
2) Unless otherwise indicated in the Notice, no person may carry out a restricted activity in respect of a Category 2 Listed Invasive Species without a permit.
3) A landowner on whose land a Category 2 Listed Invasive Species occurs or person in possession of a permit must ensure that the specimens of the species do not spread outside of the land or the area specified in the Notice or permit.
4) If an Invasive Species Management Programme has been developed in terms of section 75(4) of the Act, a person must control the listed invasive species in accordance with such programme.
5) Unless otherwise specified in the Notice, any species listed as a Category 2 Listed Invasive Species that occurs outside the specified area contemplated in sub-regulation (1), must, for purposes of these regulations, be considered to be a Category 1b Listed Invasive Species and must be managed according to Regulation 3.
6) Notwithstanding the specific exemptions relating to existing plantations in respect of Listed Invasive Plant Species published in *Government Gazette* No. 37886, Notice 599 of 1 August 2014 (as amended), any person

DRAFT

or organ of state must ensure that the specimens of such Listed Invasive Plant Species do not spread outside of the land over which they have control.

Category 3 Listed Invasive Species

1) Category 3 Listed Invasive Species are species that are listed by notice in terms of section 70(1)(a) of the Act, as species which are subject to exemptions in terms of section 71(3) and prohibitions in terms of section 71A of Act, as specified in the Notice.
2) Any plant species identified as a Category 3 Listed Invasive Species that occurs in riparian areas, must, for the purposes of these regulations, be considered to be a Category 1b Listed Invasive Species and must be managed according to regulation 3.
3) If an Invasive Species Management Programme has been developed in terms of section 75(4) of the Act, a person must control the listed invasive species in accordance with such programme.

In terms of the amendments to the regulations under the Conservation of Agriculture Resources Act, 1983 (Act No. 43 of 1983) and Regulation 598, Government Gazette 37885, August 2014 (Alien and Invasive Species Regulations), landowners are legally responsible for the control of alien species on their properties.

Some declared invasive plants (Henderson 2001) that should be removed and controlled (Conservation of Agricultural Resources Act (Act 43 of 1983) include:

DRAFT

Acacia mearnsii	Category 2	*Ligustrum lucidum*	Category 3
Arundo donax	Category 1	*Morus* spp	Category 3
Canna indica	Category 1	*Mirabilis jalapa*	Category 3
Celtis australis	Category 3	*Populus* spp	Category 2
Cirsium vulgare	Category 1	*Robinia pseudoacacia*	Category 2
Cortaderia jubata	Category 1	*Ricinus communis*	Category 2
Datura stramonium	Category 1	*Salix babylonica*	Category 2
Eucalyptus sp	Category 2	*Solanum mauritianum*	Category 1
Ipomoea purpurea	Category 3	*Xanthium strumarium*	Category 1

Other weeds not placed under Categories 1,2 or 3 include:

Amaranthus hybridus	W	*Melilotus alba*	W
Bidens bipinnata	W	*Schkuhria pinnata*	W
Bidens pilosa	W	*Solanum panduriforme*	W
Chamaesyce hirta	W	*Sonchus* sp	W
Chenopodium album	W	*Tagetes minuta*	W
Conyza bonariensis	W	*Verbena aristigera*	W
Conyza canadensis	W	*Verbena bonariensis*	W
Medicago sativa	A	*Verbena braziliensis*	W

These weedy herbaceous species occur on the site, but they are not listed in terms of the above-mentioned legislation.

3.3. GENERAL ECOLOGICAL SENSITIVITY

According to the National Water Act, all wetland systems in South Africa must be regarded as being ecologically sensitive. **Therefore the Kaalspruit system as a whole is regarded as ecologically sensitive** (Fig. 48). The vegetation in general reflects typical wetland habitat, as *Phragmites australis* and *Typha capensis* are dominant or at least present, over large areas of the system. It is however clear that the system is largely disturbed and degraded. This is also reflected by the vegetation through the presence, often dominance of, many weed species in the area. It should, however, be recognized that river and spruit systems are by nature highly dynamic, and influenced by periods of low and high water and by regular flooding, which cause changes in the habitat and the resulting vegetation. The stream systems represent “highways” for the transport of not only pollution (chemical and physical) but also seeds and other plant parts that can become established along the river or spruit. These plants are mostly weedy species, both woody and herbaceous.

DRAFT

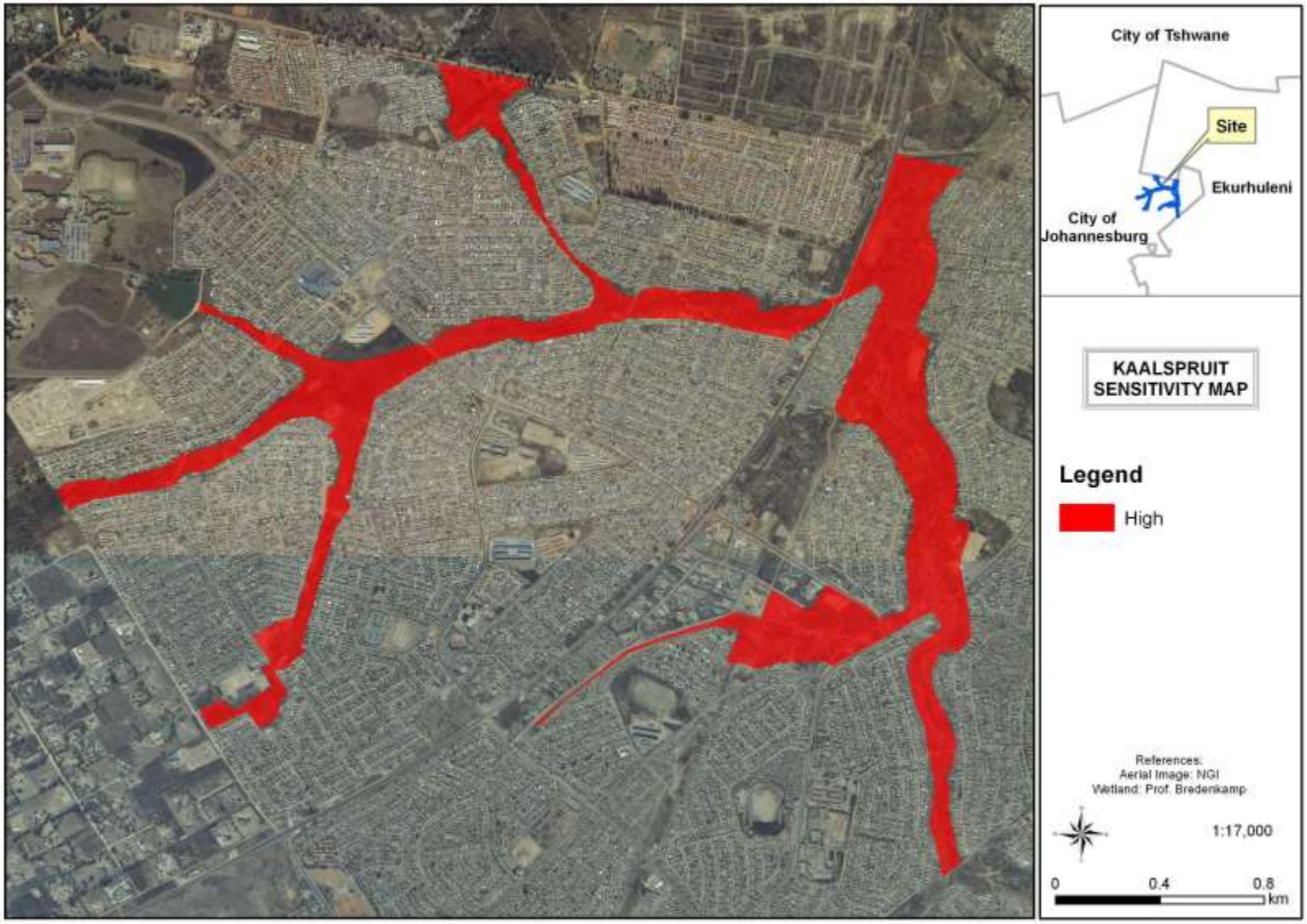

Figure 48: Sensitivity map of the Kaalspruit wetland systems.

3.4. ESTIMATES OF PERCENTAGE INDIGENOUS

The percentage indigenous are not seen as the percentage indigenous species versus exotic species, but rather as the percentage (aerial) cover by indigenous vegetation versus exotic vegetation. In this regard the different vegetation units described above differs considerably.

1. The mainstem river with a definite stream with flowing water.

Habitat	% indigenous	% exotic
Stream bed	95	5
Lower stream banks	30	70
Upper stream banks /grassland	40-50	60-50

2. Moist wetland system with wet or moist soils, covered with reeds.

Habitat	% indigenous	% exotic
Permanent	80	20
Seasonal	70	30

3. Dry wetland systems with no or little surface water, dominated by grass.

Habitat	% indigenous	% exotic
Drier wetland system	40-60	60-40

4. Transformed canal system.

Habitat	% indigenous	% exotic
Canal area	20	80

It is concluded that, although highly disturbed, even transformed in many localities, indigenous vegetation is still generally prominent in the Kaalspruit system.

3.5. IMPACTS OF THE PROPOSED REHABILITATION

From a vegetation and plant species point of view, transforming the area has the greatest impact. Currently transformed areas include the extensive and enormous degree of waste dumping and pollution, also (illegal) construction within the spruit zone, agriculture and general trampling of the remaining drier (grassland) vegetation on the upper banks.

Doing nothing (= pre-rehabilitation) will surely result in worsening of the situation and further deterioration of the spruit system.

DRAFT

The Draft Kaalspruit Framework ref 2 suggests an excellent and comprehensive rehabilitation plan. The following, extracted from the Draft Framework ref 2, is relevant for vegetation and plant species:

- Remove and dispose of dumping and waste.
- Rehabilitate moderately disturbed wetlands as follows:
    - Remove dumping and clean-up,
    - Stabilise and shape banks,
    - Repair and stabilise storm water inlets (bio-engineering),
    - Re-vegetate banks.
- Reconstruct severely disturbed wetlands as follows:
    - Remove dumping, makeshift infrastructure clean-up,
    - Re-shape wetland and banks,
    - Repair and stabilise storm water inlets (bio-engineering),
    - Re-vegetate wetland and banks.
- Reconstruct severely disturbed river channels as follows:
    - Remove dumping and clean-up,
    - Re-shape stream channel and banks,
    - Repair and stabilise storm water inlets (bio-engineering),
    - Re-vegetate stream channel and banks
- Improve hydrological and ecological systems through the creation of off stream constructed wetlands, attenuation areas and flow dissipation areas.
- T**he impact of the implementation of this rehabilitation plan can only improve the spruit system, benefit the ecology, thereby the total biodiversity and also benefit the people living in the area.**
- Ensure clean-up and proper waste control, to avoid further dumping in the spruit, and keeping the spruit clean, thereby ensuring sustainable ecosystem functioning of the system, providing the habitats for the specific vegetation and plant species.
- Take utmost care in reshaping channels and banks: these actions can easily enhance rather than control erosion.
- Take care when exotics, invaders are removed from the banks, to avoid erosion and ensure successful establishment of indigenous woody species on banks.
- Ensure correct placement of agricultural practices, to avoid further transformation of natural vegetation, and avoid damage during floods.
- Ensure correct placement of parks, recreational facilities, paving, paths, *and etcetera*, to avoid further transformation of natural vegetation and avoid damage during floods.

DRAFT

- Ensure using indigenous plant species in the rehabilitation, plant in the correct relevant habitats, e.g. grass on higher banks, woody species at banks.
- If the Declining *Hypoxis hemerocallidea* (African potato) may be damaged by rehabilitation activities, this species must be temporarily removed during the activities and replanted as part of re-vegetation of the area. Note that this can only be done with the approval of the GDARD.

4. VERTEBRATE FAUNA

These faunal analyses will compare the historical and present diversity of vertebrates, in an attempt to document species loss during Recent times. Only species that are reliant on a combination of aquatic, wetland, riparian or alluvial zones are highlighted, excluding species that would have had to rely for part of their existence on the extensive less-mesic grassland areas outside of these zones, which now have dense housing and amenity developments on them and cannot be rehabilitated. We suggest that, in order to rehabilitate an area or ecosystem, it is of fundamental importance to understand the characteristics of the unadulterated floral and faunal systems during historical times. This knowledge will serve to direct and guide actions, and to define a best-practice stepwise-series of rehabilitation endeavours. The extent of the rehabilitation effort required and its success will obviously be the difference found between the pristine condition and the *status quo*.

The data used to extract this information come from a variety of specialized resources and are based on integration using our specialist knowledge and experience, assessment of whatever habitats remains, and impressions received during the site visit on 11 November 2015.

4.1. MAMMALS

Acocks (1988), Mucina and Rutherford (2006), Low & Rebelo (1996), Knobel and Bredenkamp (2006), SANBI & DEAT (2009) discuss the distinguishing plant associations of the study area in broad terms. It should be acknowledged that botanical geographers have made immense strides in defining plant associations (particularly assemblages denoted as vegetation units or veld types), whereas this cannot be said of zoologists. The reason is that vertebrate distributions are not very dependent on the minutiae of plant associations. Rautenbach (1978 & 1982) found that mammal assemblages can at best be correlated with botanically defined biomes, such as those by Low and Rebelo (1996 & 1998), and latterly by Mucina and Rutherford (2006) as well Knobel and Bredenkamp (2006). Hence, although the former's work has been superseded by the work of the latter two, the definitions of biomes are similar and

DRAFT

both remain valid for mammals and are therefore recognized as a reasonable determinant of mammal distribution.

The local occurrences of mammals are, on the other hand, closely dependent on broadly defined habitat types, in particular terrestrial, arboreal (tree-living), rupicolous (rock-dwelling) and wetland-associated vegetation cover. It is thus possible to deduce the presence or absence of mammal species by evaluating the habitat types within the context of global distribution ranges.

4.1.1 Mammal Habitat Assessment

It is clear from images 1 – 46 and the descriptions of the legends that the ecology of the site is extensively transformed. Highveld grasslands that historically constituted the major habitat type, has been transformed. Only degraded riparian zones, wetlands overgrown with reeds and bulrushes, and the running water of the stream could be evaluated as habitat for mammals. The dense stands of reeds and bulrushes presumably offer refuge to robust species with wide habitat tolerances.

4.1.2 Observed and Expected Mammal Species Richness

Historically 45 mammals occurred in and along the unadulterated stream, its banks and riparian zones (Table 3). Of these, only 14 are likely to have survived (√) whereas 31 were extirpated (†). The 14 species deemed to be still present, are all reticent in habits, and furthermore find excellent refuge in the dense reed and bulrush beds. It is contended that the streams are now so polluted that it can no longer support prey for otter and marsh mongooses. Should the water pollution negatively impact on insect abundance, it will also deprive hawking insectivorous bats of feeding patches when insect swarms no longer rise over water during summer sunsets.

The difference of 31 species between extant and extinct species is a reflection of environmental impact of unchecked development and ecological neglect.

Table 3: Mammal diversity. The species observed or deduced to occupy the site. (Systematics and taxonomy as proposed by Bronner et.al [2003] and Skinner and Chimimba [2005]).

	Scientific Name	English Name
√	*Lepus saxatilis*	Scrub hare
√	*Cryptomys hottentotus*	African mole rat
†	*Hystrix africaeaustralis*	Cape porcupine

DRAFT

	Scientific Name	English Name
√	*Thryonomys swinderianus*	Greater cane rat
†	*Pedetes capensis*	Springhare
DD†	*Lemniscomys rosalia*	Single-striped grass mouse
†	*Rhabdomys pumilio*	Four-striped grass mouse
NT	*Dasymys incomtus*	African marsh rat
†	*Mus indutus*	Desert pygmy mouse
†	*Mus minutoides*	Pygmy mouse
†	*Mastomys natalensis*	Natal multimammate mouse
†	*Mastomys coucha*	Southern multimammate mouse
†	*Aethomys ineptus*	Tete veld rat
√	*Otomys angoniensis*	Angoni vlei rat
√	*Otomys irroratus*	Vlei rat
†	*Gerbilliscus brantsii*	Highveld gerbil
En†	*Mystromys albicaudatus*	White-tailed mouse
†	*Dendromus melanotis*	Grey pygmy climbing mouse
†	*Dendromus mesomelas*	Brants' climbing mouse
†	*Dendromus mystacalis*	Chestnut climbing mouse
DD√	*Myosorex varius*	Forest shrew
DD†	*Suncus lixus*	Greater dwarf shrew
DD†	*Suncus infinitesimus*	Least dwarf shrew
DD√	*Crocidura cyanea*	Reddish-grey musk shrew
DD√	*Crocidura hirta*	Lesser red musk shrew
NT†	*Atelerix frontalis*	Southern African hedgehog
√	*Tadarida aegyptiaca*	Egyptian free-tailed bat
√	*Neoromicia capensis*	Cape serotine bat
√	*Scotophilus dinganii*	African yellow house bat
√	*Scotophilus viridis*	Greenish yellow house bat
NT†	*Parahyaena brunnea*	Brown hyena
†	*Felis silvestris*	African wild cat
†	*Civettictis civetta*	African civet
†	*Genetta genetta*	Small-spotted genet
†	*Genetta tigrina*	SA large-spotted genet
√	*Cynictis penicillata*	Yellow mongoose
√	*Galerella sanguinea*	Slender mongoose
†	*Atilax paludinosus*	Marsh mongoose
†	*Aonyx capensis*	African clawless otter
NT†	*Lutra maculicollis*	Spotted-necked otter
NT†	*Mellivora capensis*	Honey badger
DD†	*Poecilogale albinucha*	African weasel
†	*Ictonyx striatus*	Striped polecat
†	*Potamochoerus larvatus*	Bushpig
†	*Sylvicapra grimmia*	Common duiker
†	*Raphicerus campestris*	Steenbok

DRAFT

√ Definitely there or have a *high* probability to occur;

***** *Medium* probability to occur based on ecological and distributional parameters;

? *Low* probability to occur based on ecological and distributional parameters.

Red Data species rankings as defined in Friedmann and Daly's S.A. Red Data Book / IUCN (World Conservation Union) (2004) are indicated in the first column: CR= Critically Endangered, En = Endangered, Vu = Vulnerable, LR/cd = Lower risk conservation dependent, LR/nt = Lower Risk near threatened, DD = Data Deficient. All other species are deemed of Least Concern.

4.1.3 Red-listed Mammal Species Identified:

By the Scientific Community

The three extant shrew species cited as 'DD' in Table 3 are not necessarily endangered. These small mammals have not been adequately studied to provide quantitative field data to accurately assign a conservation ranking. As a precaution they are thus considered as 'Data Deficient'. Shrews exist at the apex of the food pyramid, which means that their population numbers are inevitably significantly lower than that of similar-sized herbivorous mammals and especially of their smaller prey species. Because of the diet of these ferocious little insectivores/carnivores, they are furthermore not readily trapped with conventional bait or traps which may mean that their numbers are under-estimated. Good capture results obtained with drift fences and pitfalls support the latter statement.

No other Red Data or sensitive species are deemed present on the site, either since the site is too disturbed, falls outside the distributional ranges of some species, or does not offer suitable habitat(s).

By the Biodiversity Act No 10 of 2004

Protected Species: Nil

-By the Gauteng Guidelines for Biodiversity Assessments, 2014

Protected Species: Nil

4.2. BIRDS

4.2.1 Avifaunal Habitat Assessment

The three main avian habitats in the study area could be separated as 1) Open water and aquatic vegetation, 2) Vegetation on the water margin, banks and alluvia and 3) Dry grass- and croplands. Given the limited extent and close juxtaposition of these habitats, only 12

DRAFT

species are assessed to require two rather than just one habitat type as their primary attraction, so for the 178 habitat requirements of the 166 bird species expected in the study area, 67 (37%) of all species would rely on the watercourse itself, 51 (29%) on the edges of the watercourse and 64 (36%) on the immediately adjacent drier habitats. Most birds associated with aquatic habitats and their margins are notoriously widespread and mobile, due to the extreme seasonal and inter-annual changes that such systems experience, so it is not realistic to try and categorise them as resident or as frequent or infrequent visitors, although the list does exclude species considered vagrants because of their rarity or minimal use of such habitats. Only threatened Red Data species are included as expected, based on the Precautionary Principle that even if they just use the habitat in passing it may still contribute to their survival.

Conservation areas around the study area that might be the source of water or wetland birds visiting the study area include the Rietvlei, Diepsloot, Bronkhorstspruit Dam and Marievale Nature Reserves, as well as such smaller reserves as the nearby Glen Austin Pan Bird Sanctuary, and others around pans, dams and rivers in Midrand, Sandton and Benoni.

4.2.2. Observed and Expected Avian Species Richness

The aerial mobility of most bird species makes their presence in an area vary from permanent residency to infrequent vagrancy, depending on the biology of the species and/or the quantity and quality of its preferred habitats available. The best recent data sets available stem from the first Southern African Bird Atlas Project (SABAP1), with a quarter-degree grid cell (QDGC) resolution and data collection that ended in 1992 (Harrison et al. 1994), while the second phase SABAP2, with a pentad resolution commenced in 2007 and ongoing (www.sabap2.adu.org) allows comparison over this 25-year interval to detect trends in population distribution and relative abundance. The study area falls within the 2528CC (Verwoedburg) and 2628AA (Johannesburg) QDGCs, with 313 and 338 bird species reported respectively for SABAP1, and in the 2555_2805, 2555_2810, 2600_2805 and 2600_2810 pentads (with an elevated 364-329 species for the same QDGCs, partly due to better coverage and observer skills).

However, given that the study area has really only riverine, riparian and alluvial habitat, and their associated wet and drier grasslands, and is sandwiched between densely occupied housing areas, only 166 species (just under half (49%) of those historically possible) could ever be reasonably expected to reside on or visit the study area, of which only 33 (20%) were recorded during the site visit to the study area (Table 4). The probability of their occurrence is estimated subjectively as high, medium or low based on three criteria, their known distribution

DRAFT

ranges, habitat preferences and the quality and quantity of suitable habitats in the study area. In this instance, the extensive transformation and degradation of the habitats and their surroundings was the most significant negative factor for lowering the probability or discounting the presence of each species. Sixty species (36%) were expected with a high probability, a similar 58 (35%) a medium and a high 48 (29%) a low probability, which indicates the rather low quality, accessibility and avian safety of the habitats available in the study area.

Table 4: Bird species diversity observed and expected on the Kaalspruit Rehabilitation Project, Tembisa, City of Johannesburg Metropolitan Municipality, Gauteng Province (2528CC & 2628AA). Based on the national list and annotations of Birdlife South Africa (2014), sorted in the order of 'Roberts VII' (Hockey *et al*. 2005), with probability of occurrence and habitat preferences assessed after a site visit on 11 November 2015 and comparison with lists from SABAP 1 & 2 (Harrison *et al*., 1997; www.sabap2.org). Species in bold font were detected on the site visit.

Common English Name	Scientific Name	Status Codes (see below)			Probability of occurrence			Habitat		
		RD	S	E	High	Medium	Low	1	2	3
Orange River francolin	*Scleroptila levaillantoides*						L			X
Swainson's Spurfowl	*Pternistis swainsonii*				H					X
Common Quail	*Coturnix coturnix*		NBM				L			X
Helmeted Guineafowl	*Numida meleagris*				H				X	X
Fulvous Duck	*Dendrocygna bicolor*						L	X		
White-faced Duck	*Dendrocygna viduata*				H			X		
Egyptian Goose	*Alopochen aegyptiaca*				H			X	X	
Spur-winged Goose	*Plectropterus gambensis*					M		X	X	
Cape Teal	*Anas capensis*						L	X		
African Black Duck	*Anas sparsa*				H			X	X	
Yellow-billed Duck	*Anas undulata*				H			X	X	
Cape Shoveler	*Anas smithii*					M		X		
Red-billed Teal	*Anas erythrorhyncha*				H			X		
Kurrichane Buttonquail	*Turnix sylvaticus*					M				X
Red-throated Wryneck	*Jynx ruficollis*						L			X
African Hoopoe	*Upupa africana*				H					X
Half-collared Kingfisher	*Alcedo semitorquata*	NT,LC					L	X		
Malachite Kingfisher	*Alcedo cristata*						L	X		
Giant Kingfisher	*Megaceryle maxima*						L	X		
Pied Kingfisher	*Ceryle rudis*						L	X		
White-fronted Bee-eater	*Merops bullockoides*				H				X	X
Little Bee-eater	*Merops pusillus*					M			X	
European Bee-eater	*Merops apiaster*		B/NBM		H			X	X	
Burchell's Coucal	*Centropus burchellii*					M			X	

Common English Name	Scientific Name	Status Codes (see below)			Probability of occurrence			Habitat		
		RD	S	E	High	Medium	Low	1	2	3
African Palm-Swift	***Cypsiurus parvus***				**H**			**X**		
Alpine Swift	*Tachymarptis melba*		**BM**			M		X		
African Black Swift	*Apus barbatus*					M		X		
Little Swift	*Apus affinis*				H			X		
Horus Swift	*Apus horus*					M		X		
White-rumped Swift	*Apus caffer*		**BM**		H			X		
Barn Owl	*Tyto alba*					M				X
African Grass-Owl	*Tyto capensis*	**VU,LC**					L		X	
Spotted Eagle-Owl	*Bubo africanus*					M				X
Marsh Owl	*Asio capensis*				H				X	X
Fiery-necked Nightjar	*Caprimulgus pectoralis*					M				X
Rufous-cheeked Nightjar	*Caprimulgus rufigena*		**BM**			M				X
Rock Dove	***Columba livia***				**H**					**X**
Speckled Pigeon	*Columba guinea*					M				X
Laughing Dove	***Streptopelia senegalensis***				**H**					**X**
Cape Turtle-Dove	***Streptopelia capicola***				**H**					**X**
Red-eyed Dove	***Streptopelia semitorquata***				**H**				**X**	**X**
Namaqua Dove	*Oena capensis*						L			X
Red-chested Flufftail	*Sarothrura rufa*				H				X	
African Rail	*Rallus caerulescens*				H				X	
African Crake	*Crecopsis egregia*		**BM**		H				X	
Corn Crake	*Crex crex*		**NBM**			M			X	
Black Crake	***Amaurornis flavirostra***				**H**				**X**	
Baillon's Crake	*Porzana pusilla*					M			X	
African Purple Swamphen	*Porphyrio madagascariensis*					M			X	
Common Moorhen	*Gallinula chloropus*				H				X	
Red-knobbed coot	*Fulica cristata*					M		X		
African Snipe	*Gallinago nigripennis*				H			X		
Marsh Sandpiper	*Tringa stagnatilis*		**NBM**			M		X		
Common Greenshank	*Tringa nebularia*		**NBM**			M		X		
Wood Sandpiper	*Tringa glareola*		**NBM**			M		X		
Common Sandpiper	*Actitis hypoleucos*		**NBM**			M		X		
Little Stint	*Calidris minuta*		**NB**			M		X		
Ruff	*Philomachus pugnax*		**NBM**			M		X		
Greater Painted-snipe	*Rostratula benghalensis*	**VU,NT**					L	X		
Spotted Thick-knee	*Burhinus capensis*					M				X
Black-winged Stilt	*Himantopus himantopus*					M		X		

Common English Name	Scientific Name	Status Codes (see below)			Probability of occurrence			Habitat		
		RD	S	E	High	Medium	Low	1	2	3
Pied Avocet	*Recurvirostra avosetta*						L	X		
Common Ringed Plover	*Charadrius hiaticula*		NBM				L	X		
Kittlitz's Plover	*Charadrius pecuarius*						L	X		
Three-banded Plover	*Charadrius tricollaris*				H			X		
Blacksmith Lapwing	***Vanellus armatus***				**H**			**X**	**X**	
African Wattled Lapwing	*Vanellus senegallus*					M		X		
Crowned Lapwing	*Vanellus coronatus*				H				X	
Black-winged Pratincole	*Glareola nordmanni*	NT,NT	NBM			M		X		
Grey-headed Gull	***Chroicocephalus cirrocephalus***				**H**			**X**		
White-winged Tern	*Chlidonias leucopterus*		NBM			M		X		
Black-shouldered Kite	***Elanus caeruleus***				**H**					**X**
Black Kite	*Milvus migrans*		NBM				L			X
African Marsh-Harrier	*Circus ranivorus*	EN,LC					L		X	
Steppe Buzzard	*Buteo buteo*		NBM		H					X
Lesser Kestrel	*Falco naumanni*		NBM				L			X
Amur Falcon	*Falco amurensis*		NBM			M				X
Lanner Falcon	*Falco biarmicus*	VU,LC					L			X
Little Grebe	*Tachybaptus ruficollis*					M		X		
Reed Cormorant	***Phalacrocorax africanus***					**M**		**X**		
White-breasted Cormorant	***Phalacrocorax lucidus***						**L**	**X**		
Black Heron	*Egretta ardesiaca*						L	X		
Little Egret	*Egretta garzetta*					M		X		
Yellow-billed Egret	*Egretta intermedia*						L	X		
Grey Heron	*Ardea cinerea*						L	X		
Black-headed Heron	***Ardea melanocephala***				**H**					**X**
Purple Heron	*Ardea purpurea*					M			X	
Cattle Egret	***Bubulcus ibis***				**H**				**X**	**X**
Squacco Heron	*Ardeola ralloides*					M		X		
Green-backed Heron	*Butorides striata*						L	X	X	
Black-crowned Night-Heron	*Nycticorax nycticorax*						L		X	
Little Bittern	*Ixobrychus minutus*					M			X	
Hamerkop	*Scopus umbretta*						L	X		
Glossy Ibis	***Plegadis falcinellus***				**H**			**X**		
Hadeda Ibis	***Bostrychia hagedash***				**H**			**X**		
African Sacred Ibis	***Threskiornis aethiopicus***				**H**			**X**		
African Spoonbill	*Platalea alba*					M		X		

Common English Name	Scientific Name	Status Codes (see below)			Probability of occurrence			Habitat		
		RD	S	E	High	Medium	Low	1	2	3
Yellow-billed Stork	*Mycteria ibis*	EN,LC					L		x	
Abdim's Stork	*Ciconia abdimii*	NT,LC	NBM				L			X
White Stork	*Ciconia ciconia*		NBM			M				X
Southern Boubou	*Laniarius ferrugineus*						L		X	
Bokmakierie	*Telophorus zeylonus*					M				X
Pied crow	***Corvus albus***				**H**					**X**
Red-backed Shrike	*Lanius collurio*		NBM			M				X
Lesser Grey Shrike	*Lanius minor*		NBM				L			X
Common Fiscal	*Lanius collaris*				H					X
Sand Martin	*Riparia riparia*		NBM				L	X		
Brown-throated Martin	*Riparia paludicola*					M		X		
Banded Martin	*Riparia cincta*						L	X		
Barn Swallow	***Hirundo rustica***		NBM		**H**			**X**		
White-throated Swallow	***Hirundo albigularis***		BM		**H**			**X**		
Pearl-breasted Swallow	*Hirundo dimidiata*					M		X		
Greater Striped Swallow	***Cecropis cucullata***		BM		**H**			**X**		
Lesser Striped Swallow	*Cecropis abyssinica*		BM			M		X		
Red-breasted Swallow	*Cecropis semirufa*						L	X		
South African cliff-Swallow	*Petrochelidon spilodera*			B(*)	H			X		
Rock Martin	*Hirundo fuligula*						L	X		
Common House-Martin	*Delichon urbicum*		NBM			M		X		
Little Rush-Warbler	*Bradypterus baboecala*				H				X	
Sedge Warbler	*Acrocephalus schoenobaenus*		NBM			M			X	
African Reed-Warbler	*Acrocephalus baeticatus*		BM		H				X	
Marsh Warbler	*Acrocephalus palustris*		NBM			M			X	
Great Reed-Warbler	*Acrocephalus arundinaceus*		NBM			M			X	
Lesser Swamp-Warbler	***Acrocephalus gracilirostris***				**H**				**X**	
Levaillant's Cisticola	***Cisticola tinniens***				**H**				**X**	
Zitting Cisticola	*Cisticola juncidis*				H				X	
Desert Cisticola	*Cisticola aridulus*					M				X
Cloud Cisticola	*Cisticola textrix*			(*)			L			X
Wing-snapping Cisticola	*Cisticola ayresii*						L			X
Tawny-flanked Prinia	***Prinia subflava***				**H**				**X**	

Common English Name	Scientific Name	Status Codes (see below)			Probability of occurrence			Habitat		
		RD	S	E	High	Medium	Low	1	2	3
Black-chested Prinia	*Prinia flavicans*					M				X
Melodious Lark	*Mirafra cheniana*	LC,NT		(*)			L			X
Rufous-naped Lark	*Mirafra africana*					M				X
Eastern clapper Lark	*Mirafra fasciolata*						L			X
Spike-heeled Lark	*Chersomanes albofasciata*						L			X
Chestnut-backed Sparrowlark	*Eremopterix leucotis*					M				X
Red-capped Lark	*Calandrella cinerea*				H					X
African StoneChat	***Saxicola torquatus***				**H**				**X**	
Capped Wheatear	*Oenanthe pileata*					M				X
Familiar Chat	*Cercomela familiaris*						L			X
Pied Starling	*Lamprotornis bicolor*			(*)		M				X
Wattled Starling	*Creatophora cinerea*					M				X
Common Myna	***Acridotheres tristis***		I		**H**					**X**
Amethyst Sunbird	*Chalcomitra amethystina*						L			X
White-bellied Sunbird	*Cinnyris talatala*						L			X
Cape Weaver	*Ploceus capensis*			(*)			L		X	
Southern Masked-Weaver	***Ploceus velatus***				**H**				**X**	**X**
Red-billed Quelea	*Quelea quelea*				H					X
Yellow-crowned Bishop	*Euplectes afer*					M			X	
Southern Red Bishop	***Euplectes orix***				**H**				**X**	
White-winged Widowbird	*Euplectes albonotatus*					M				X
Red-collared Widowbird	*Euplectes ardens*					M			X	
Long-tailed Widowbird	*Euplectes progne*						L			X
Thick-billed Weaver	***Amblyospiza albifrons***					**M**			**X**	
Orange-breasted Waxbill	*Amandava subflava*						L		X	
African Quailfinch	*Ortygospiza fuscocrissa*						L			X
Red-headed Finch	*Amadina erythrocephala*						L			X
Common Waxbill	*Estrilda astrild*				H				X	
Bronze Mannikin	*Spermestes cucullata*						L			X
Pin-tailed Whydah	*Vidua macroura*				H				X	
House Sparrow	***Passer domesticus***		I		**H**					**X**
Cape Sparrow	***Passer melanurus***				**H**					**X**
Cape Wagtail	***Motacilla capensis***				**H**			**X**	**X**	
Cape Longclaw	*Macronyx capensis*					M			X	X
African Pipit	***Anthus cinnamomeus***				**H**					**X**

Common English Name	Scientific Name	Status Codes (see below)			Probability of occurrence			Habitat		
		RD	S	E	High	Medium	Low	1	2	3
Black-throated Canary	***Crithagra atrogularis***				H				X	X
Cinnamon-breasted Bunting	*Emberiza tahapisi*						L			X

Red Status	Status in south Africa (S)	Endemism in South Africa (E)
NA = Not Assessed	BM = breeding migrant	Endemism in South Africa (E) (not southern Africa as in field guides)
LC = Least Concern	NBM = non-breeding migrant	
NT = Near-Threatened	V = vagrant	* = endemic
VU = Vulnerable	I = introduced	
EN = Endangered	R = rare	(*) = near endemic (i.e. ~70% or more of population in RSA)
CR = Critically Endangered	PRB = probable rare breeder	B* = breeding endemic
EX = Extinct Regionally	RB = rare breeder	B(*) = breeding near endemic
NR = Not Recognised	RV = rare visitor	W* = winter endemic
Red Status is from *The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland,* Taylor (2015).		

4.2.3. Red-listed Bird Species Identified

By the Scientific Community

Based on the most recent assessment of the threatened status of South Africa's avifauna (Taylor 2015), a total of eight Red Data avifaunal species are expected possibly to use the site and its surroundings given the habitats available (Table 4). All eight species (*Near Threatened*: Half-collared Kingfisher, Black-winged Pratincole, Abdim's Stork; *Vulnerable*: African Grass-Owl, Greater Painted-Snipe, Lanner Falcon; *Endangered*: African Marsh Harrier, Yellow-billed Stork) were recorded up to 1992 for the two QDGCs (2528CC & 2628AA) in which the site falls for SABAP1 (Harrison *et al.* 1998) although, during the period of the ongoing Southern African bird atlas project started in 2007 (SABAP2; www.adu.org.za), three species were no longer reported for the same QDGCs (Black-winged Pratincole, Greater Painted-Snipe, African Marsh Harrier), the same ones also not yet reported for the four SABAP2 pentads that cover the site and its immediate surroundings (2555_2805, 2555_0810, 2600_2805, 2600_2810). Even so, all five of the eight threatened species recently reported for the QDGCs and pentads are only expected in the study area with a low probability, and so the site does not at present offer significant support to their conservation.

DRAFT

-By the Biodiversity Act No 10 of 2004

The following species expected on and around the site are listed under Government Notice 2007 of the NEMBA 2004 Act:

Vulnerable: African-Grass-Owl.

Protected: African Marsh Harrier.

These species were presumably selected from the 2000 Red Data book for South African birds (Barnes 2000), but have been superseded by the latest 2015 revision (Taylor 2015). No species selected for special conservation as Threatened or Protected Species (ToPS, 2015) are expected.

-By the Gauteng Guidelines for Biodiversity Assessments, 2014

Red List priority species anticipated on the site: African Grass-Owl, African Marsh Harrier.

These species were presumably selected from the 2000 Red Data book for South African birds (Barnes 2000) but have been superseded by the latest 2015 revision (Taylor 2015).

4.2.4. Overall Avifaunal Impressions of the Site

The current habitats and avifauna at the site created both positive and negative impressions. On the negative side, the drainage lines are compromised by various residential, commercial and recreational incursions, which reduce their effective area and restrict or divert their stream flow, by complete transformations through building, cultivation and harvesting of wetland plants, and/or by unrestricted pedestrian disturbance. Water quality appears to be poor or low, with no evidence of such aquatic fauna as crabs, frogs, fish or dragonflies, or of their avian predators. On the positive side, reeds and/or bulrushes thrive in even the narrowest sections, helping to control flow velocity, capture particle loads and detoxify runoff, and in places there are dense wide beds with sufficient invertebrates to attract bird species that probe into the muddy substrate, such as ibises and lapwings. Marginal vegetation, indigenous or alien, grows well wherever it is undisturbed, seems unaffected by the poor water quality and has sufficient invertebrates to attract birds that feed among the vegetation and form a significant suite of small arthropod-eating species. Notably, the high density of pedestrian traffic seems to habituate a variety of bird species, from ibises to warblers, which are then able to coexist with and use most of the suitable habitats. This suggests that any disturbance of sensitive species is more accidental than deliberate, and bodes well for what rehabilitation might accomplish.

DRAFT

4.3. HERPETOFAUNA

The local occurrences of reptiles and amphibians are closely dependent on broadly defined habitat types, in particular terrestrial, arboreal (tree-living), rupicolous (rock-dwelling) and wetland-associated vegetation cover. It is thus possible to deduce the presence or absence of reptile and amphibian species by evaluating the habitat types within the context of global distribution ranges.

4.3.1. Herpetofauna Habitat Assessment

From a herpetological habitat perspective, it was established that three of the four major habitats are naturally present on the study site, namely mainly wetlands, but also terrestrial and rupicolous.

The Kaalspruit and its tributaries are prominent and significant wetland features, even between the dense housing. The wetland habitat of the study area is by far the most extensive, but also the most degraded and/or transformed by agriculture (small croplands and heavy grazing by communal livestock) and housing (both formal and informal). The different drainage lines are severely polluted by littering, raw sewage and dumping of waste and rubble. Earth-filling near drainage lines, pipe lines, bridges, power lines, exotic plants and concrete-lined canals also degraded the wetland habitat.

Some areas of the drainage have been choked by tall dense reed-beds, which provide safe shelter for species that do not require open water. Although some wetlands are artificial and severely polluted, they are still functional with wetland plant species, and also wetland fauna. As a consequence, habitat is available for common water- and moisture-reliant herpetofauna. All rivers, streams and wetlands are protected in Gauteng and are regarded as being sensitive.

Very few semi-natural grasslands areas occur at some places along the drainage lines. Most of the terrestrial areas are severely disturbed by above mention factors. No active or moribund termite mounds were observed. Moribund termite mounds are good indicators of the occurrence of small herpetofauna. Accordingly, it is estimated that the reptile and amphibian population density for the study site is lower. At the time of the site visit, the basal cover was poor in many places and would not provide adequate cover for small terrestrial herpetofauna, but it was good in other places. The grasslands of the study site have been severely transformed and prey is probably sparsely distributed, so foraging grounds would need to be fairly extensive to support the different population of herpetofauna.

DRAFT

Noticeable absentees from the study site are indigenous trees. Arboreal habitat is therefore absent in a functional sense. Due to the absence of natural arboreal habitat, some species such as tree agamas and flap-neck chameleons were omitted from the species list in Table 5. Most of the scattered trees present on the study site are exotics such as weeping willows. Due to the low number of trees on the study site and the collection of firewood, there are almost no dead logs which could have provided shelter and food for some herpetofauna.

There is very little natural rupicolous habitat along the drainage lines (Figures 13 & 17). However, there are plenty of artificial surrogates for rupicolous habitat, such as bridges, buildings and dumps of rubble. Only common reptiles like the speckled rock skink will benefit from these structures. Due to the absence of natural rupicolous habitat, some species like yellow-throated plated lizard, common girdled lizard and rock agama were omitted from the species list in Table 5.

4.3.2. Observed and Expected Herpetofauna Species Richness

Of the 37 reptile species that may occur on the study site (Table 5), none was confirmed during the site visit and of the possible 13 amphibian species which may occur on the study site (Table 5), none was confirmed during the site visit.

The 50 herpetofauna species are recorded as potential occupants of the study site. Most of these herpetofauna species are robust generalists with the ability to capitalise on disturbed environments. It should be noted that potential occurrence is interpreted as being possible over a period of time, as a result of expansions and contractions of population densities and ranges which stimulate migration.

The American red-eared terrapin (*Trachemys scripta elegans*) and the Brahminy blind snake (*Ramphotyphlops braminus*) are the only two feral reptile or amphibian species known to occur in South Africa (De Moor and Bruton, 1988; Picker and Griffiths, 2011), but with only a few populations, they are not expected to occur on this particular site.

The species assemblage is typical of what can be expected in extensive natural areas with sufficient habitat to sustain populations. Most of the species of the resident diversity (Table 5) are fairly common and widespread (viz. brown house snake, mole snake, common egg eater, rinkhals, speckled rock skink, common platanna, common river frog, Boettger's caco, bubbling kassina, guttural toad and red toad).

DRAFT

Table 5: Reptile and Amphibian diversity. The species observed or deduced to occupy the site. Systematic arrangement and nomenclature according to Branch (1998), Minter, *et.al* (2004), Alexander & Marais (2007), Du Preez & Carruthers (2009) and Bates *et.al* (2014)

	Scientific name	English name
	CLASS: REPTILIA	REPTILES
	Order: TESTUDINES	TORTOISES & TERRAPINS
	Family: Pelomedusidae	Side-necked Terrapins
√	*Pelomedusa subrufa*	Marsh Terrapin
	Order: SQUAMATA	SCALE-BEARING REPTILES
	Suborder:LACERTILIA	LIZARDS
	Family: Gekkonidae	Geckos
√	*Lygodactylus capensis capensis*	Common Dwarf Gecko
*	*Pachydactylus affinis*	Transvaal Gecko
√	*Pachydactylus capensis*	Cape Gecko
	Family: Lacertidae	Old World Lizards or Lacertids
?	*Nucras lalandii*	Delalande's Sandveld Lizard
	Family: Scincidae	Skinks
√	*Trachylepis capensis*	Cape Skink
√	*Trachylepis punctatissima*	Speckled Rock Skink
?	*Trachylepis varia*	Variable Skink
*	*Afroablepharus wahlbergii*	Wahlberg's Snake-eyed Skink
?	*Acontias gracilicauda*	Thin-tailed Leggless Skink
	Family: Agamidae	Agamas
?	*Agama aculeate distanti*	Eastern Ground Agama
	Family: Varanidae	Monitors
√	*Varanus niloticus*	Water Monitor
	Suborder: SERPENTES	SNAKES
	Family: Typhlopidae	Blind Snakes
?	*Afrotyphlops bibronii*	Bibron's Blind Snake
*	*Rhinotyphlops lalandei*	Delalande's Beaked Blind Snake
	Family: Leptotyphlopidae	Thread Snakes
?	*Leptotyphlops distanti*	Distant's Thread Snake
*	*Leptotyphlops scutifrons*	Peter's Thread Snake
	Family: Viperidae	Adders

DRAFT

	Scientific name	English name
?	*Bitis arietans arietans*	Puff Adder
√	*Causus rhombeatus*	Rhombic Night Adder
	Family: Lamprophiidae	
?	*Aparallactus capensis*	Black-headed Centipede Eater
?	*Atractaspis bibronii*	Bibron's Stiletto Snake
√	*Boaedon capensis*	Common House Snake
*	*Lamprophis aurora*	Aurora Snake
?	*Lycodonomorphus inornatus*	Olive Ground Snake
√	*Lycodonomorphus rufulus*	Brown Water Snake
*	*Lycophidion capense capense*	Cape Wolf Snake
√	*Psammophis brevirostris*	Short-snouted Grass Snake
√	*Psammophis crucifer*	Cross-Marked Grass Snake
?	*Psammophis trinasalis*	Fork-Marked Sand Snake
*	*Psammophylax rhombeatus*	Spotted Grass Snake
?	*Psammophylax tritaeniatus*	Striped Grass Snake
?	*Duberria lutrix lutrix*	South African Slug-Eater
?	*Prosymna sundevallii*	Sundevall's Shovel-Snout
√	*Pseudaspis cana*	Mole Snake
	Family: Elapidae	Cobras, Mambas and Others
√	*Hemachatus haemachatus*	Rinkhals
?	*Elapsoidea sundevallii*	Sundevall's Garter Snake
	Family: Colubridae	
√	*Crotaphopeltis hotamboeia*	Red-Lipped Snake
√	*Dasypeltis scabra*	Rhombic Egg Eater
	CLASS: AMPHIBIA	AMPHIBIANS
	Order: ANURA	FROGS
	Family: Pipidae	Clawed Frogs
√	*Xenopus laevis*	Common Platanna
	Family: Bufonidae	Toads
√	*Amietaophrynus gutturalis*	Guttural Toad
*	*Amietaophrynus rangeri*	Raucous Toad
√	*Schismaderma carens*	Red Toad
	Family: Hyperoliidae	Reed Frogs
√	*Kassina senegalesis*	Bubbling Kassina

DRAFT

	Scientific name	English name
	Family Phrynobatrachidae	Puddle Frog
?	*Phrynobatrachus natalensis*	Snoring Puddle Frog
	Family: Pyxicephalidae	
√	*Amietia angolensis*	Common River Frog
?	*Amietia fuscigula*	Cape River Frog
?	*Strongylopus fasciatus*	Striped Stream Frog
√	*Cocosternum boettgeri*	Boettger's Caco or Common Caco
√ ***NT***	*Pyxicephalus adspersus*	Giant Bullfrog
√	*Tomopterna cryptotis*	Tremolo Sand Frog
√	*Tomopterna natalensis*	Natal Sand Frog

√ Definitely there or have a *high* probability of occurring;

* *Medium* probability of occurring based on ecological and distributional parameters;

? *Low* probability of occurring based on ecological and distributional parameters.

Red Data species rankings as defined in Branch, The Conservation Status of South Africa's threatened Reptiles': 89 – 103..In:- G.H.Verdoorn & J. le Roux (editors), 'The State of Southern Africa's Species (2002) and Minter, *et.al*, Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland (2004) are indicated in the first column: CR= Critically Endangered, En = Endangered, Vu = Vulnerable, NT = Near Threatened, DD = Data Deficient. All other species are deemed of Least Concern.

4.3.3. Red Data Listed Herpetofauna identified

-By the Scientific Community

The study site falls outside the natural range of the Southern African python and the Nile crocodile. Both these species should not occur on the study site.

The striped harlequin snake has been recorded on this quarter degree square [2528CC (Centurion)] (Transvaal or Ditsong Museum of Natural History records), but no moribund termitaria, where this species is most likely to be found, are present on the study site. It is very difficult to confirm whether this cryptic snake is present on any study site, but this species should not occur on the study site.

The coppery grass lizard has been recorded on this quarter degree square (Transvaal or Ditsong Museum of Natural History records), but there is no pristine grassveld on the study site. Therefore this species should not occur on the study site.

DRAFT

The study site is near the Glen Austin pan, arguably the best known area in an urban setting in South Africa to see giant bullfrogs. The giant bullfrog population at Glen Austen Pan played a very important role in ground-breaking studies by Clayton Cook for his MSc and Caroline Yetman for her PhD studies on giant bullfrogs.

Giant Bullfrogs require four types of habitat in order to survive under natural conditions: 1) breeding sites, 2) burrowing soils, 3) foraging grounds and 4) dispersal corridors (Carruthers, 2009). The study site provides to larger or lesser degree all four of these habitats. Especially requirement 4, the dispersal corridors, is very important on the study site. Potential breeding sites for the giant bullfrog are present on the study site (Figure 42). These breeding sites are temporary, which bullfrogs prefer in order to avoid predation from fish. They also need water bodies of which at least one side has a very gentle gradient. A gentle gradient allows for shallow water (less than 10cm deep), which enables the female bullfrog to stand when she lays her eggs outside the water for the male to fertilise. Bullfrog tadpoles swim in schools and stay in the warm shallow water during the day for rapid development (Van Wyk *et al*., 1992).

Some parts of the study site consist of sandy soil and are very suitable as a dispersal area, which combines feeding and aestivation. It is essential that the soil be suitable for burrowing on a daily basis during the short activity period at the beginning of the rainy season and for deeper retreats during the resting periods.

It is important to note that in the latest literature (Measey (ed.) 2011 and Carruthers & Du Preez, 2011); the giant bullfrog's status has changed officially from Near Threatened (Minter *et al*, 2004) to Least Concern in South Africa.

DRAFT

4.4. PROPOSALS FOR INTEGRATION OF HABITAT AND VERTEBRATE FAUNAL ASSESSMENTS INTO THE REHABILITATION PLANNING

Vertebrates that rely on a mix of aquatic and wetland habitats and those immediately surrounding them are only a subset of those that might use such habitats if they were still supported ecologically by the surrounding species-rich Egoli Granite Grassland. Besides the clean water that would have run off from such grasslands, many animal foods such as seeds, fruits, arthropods and small vertebrates would have been obtainable from the grasslands or have entered into the watercourses. The implications of this are that any vertebrate fauna expected to be present in the existing systems, or attracted to them after rehabilitation, will also have to be species with sufficient colonisation abilities to reach them and connectivity with equivalent habitats adjacent to the study area. Feasibility of colonisation can mean direct connectivity, as within or along drainage lines and watercourses, or at least sufficient proximity between habitat patches for whatever type of progression is possible for the species. Obviously, connectivity will be easier for animal species with high mobility, especially aerial species such as bats, birds and some insects, but also for resilient terrestrial species capable of enduring unsuitable or marginal habitats along the way.

Fortunately, aquatic and wetland habitats are by their very nature variable and/or ephemeral, filling, flowing or flooded during wet periods, dropping in level or drying out in droughts, and they and their margins are also prone to sudden change through natural or imposed burning, grazing, trampling and other disturbances. Many wetland plants also have excellent dispersal abilities, often with wind- or water-borne seeds (viz. plant growth where leaks create novel wetlands) while, among vertebrates, marsh mammals, water birds and frogs are renowned for their ability to locate, move between and colonise newly formed wetlands even over considerable distances.

The relatively small extent and linearity of the habitats in the study area will limit the size of species that can form viable populations within the study area, which means that larger species, such as storks and raptors, and those higher in the food chain, usually predators, can only be expected as temporary visitors to the area. The larger species are expected to exist at lower population densities (and hence have smaller populations per unit area) even under pristine conditions, many of them predators that also require larger but lower density prey species, while only smaller species lower in the food chain can be expected to attain the higher densities necessary to sustain them and their food at significant levels. For these reasons, only smaller species with suitable habitat requirements in the study area can be expected as breeding residents, while larger species are more likely to be only passing visitors.

DRAFT

For these reasons, any rehabilitation planning and execution will have to keep four basic factors in mind as they affect vertebrates, in addition to the various more specific proposals for vegetation rehabilitation (section 3.5 above):

- **Create a mosaic or patches of diverse habitats,** at different stages of succession, so that as large a diversity of species as possible can be attracted and supported for as long as possible. This applies to such localisable disturbance or management actions as burning, grazing, trampling, gathering or development, which have the potential to promote mosaics of habitat type, stage and quality. Monitor easily detectable indicator species to assess habitat use and quality relative to the cause(s) of disturbance.
- **Ensure that connectivity of habitat types is maintained and enhanced,** ensuring that such interventions as structures (e.g. dams, weirs, crossings) and techniques (e.g. fish/frog ladders, islands, pathways) are applied to encourage connectivity of fauna and flora.
- **Designate secluded areas,** so that human impacts and disturbance can be minimised and these areas used to attract higher levels of faunal utilisation than just presence or passage, such as feeding, rest-/roosting and even breeding. Use passive or direct controls to divert pedestrian access and plant utilisation/cultivation. Add missing elements, such as roost trees, islands and nest sites (natural and/or artificial), to enhance the attraction of these secluded areas.
- **Set specific targets,** so that rehabilitation efforts can be designed, applied, monitored and measured, and so inform the direction, effort and timing of a comprehensive ongoing plan of adaptive management.

The various skills, designs and options for river, wetland and grassland management will need to be applied by specialists in these fields. We expect that each tributary and section of the drainage lines will require their own specific set of mitigations. They might include dams for flood control and flow consistency; gabions, weirs, berms, plugs and reno mattresses for flow and erosion control; wetland reclamation, demarcation and protection; grazer and fire control; reintroduction of indigenous vegetation and control of alien species; provision of ladders and corridors of like habitat to facilitate connectivity; creation of separate pools and channels outside the current wetlands; and controls of density, timing and routes of community movements. Given the relative stability and education of such an established urban community, employment of educators, guides, herders and guards

DRAFT

would seem the most feasible and fruitful, in comparison with such restrictive and discriminatory actions as fencing, fining or legal action.

Direct benefits to the community of the Kaalspruit rehabilitation, such as litter management, environmental quality (odour, air, CO_2 reduction), water presence, quality and dependability (permanency, potability, accessibility), pest control (mosquitoes, flies, rodents), and aesthetic appreciation (vegetation verdancy, floral/faunal diversity) need to explain the venture and encourage community buy-in. The failures of inconsiderate, imposed, ill-conceived and unsustained ecological management, regardless of the scale and expense, are too numerous to mention.

5. GENERAL INPUT INTO REHABILITAION

Based on the Master Plan Framework for the rehabilitation of the Kaalspruit River (November 2015), a phased approach is put forward in the Implementation Plan. A number of general guidelines should be considered in each phase as set out below. However, note that the measures as set out in 3.5 and 4.4 are not replaced by the below summaries.

5.1 RE-INSTATE THE RESOURCE PHASE

5.1.1 Alien invasive plant species:

Alien invasive species eradication and monitoring should start in this phase. Implement an alien invasive plant management strategy which is recommended to include the following three phases:

1. Initial Control: Drastic reduction of the existing populations
2. Follow-up Control: Control of seedlings, root suckers and coppice re-growth
3. Maintenance Control: Sustain low alien plant numbers/density with low annual control costs. At this phase, alien plants are no longer considered a problem. However, regular monitoring to ensure that no new infestation take place is essential.

It must be noted that all infestations cannot be cleared at once, as these species do currently play a role in stabilising soils in which initial control. Therefore, the sequence of alien plant removal should be planned, along with re-vegetation of the cleared areas.

Other general recommendations include:

- Establish alien plant species working group responsible for removal and continuous monitoring;
- Eradicate alien invasive plants from the site and ensure that new infestations are removed as soon as they become apparent; and
- Plan landscaping to exclude the use of any alien invasive plants, including the use of *Pennisetum clandestinum* (Kikuyu-grass)
- Only trained staff should apply herbicides to alien invasive plants only Re-vegetate as soon as possible to ensure that the spread and germination of alien invasive plant seeds are suppressed.
- The tree sets a large amount of seed that has built-up in the soil (soil bank). These seeds will germinate opportunistically where the soil was disturbed and continuous monitoring and follow-up control of the construction areas are necessary to avert large scale infestation.
- Manual / mechanical removal is preferred to chemical control
- All construction vehicles and equipment, as well as construction material should be free of plant material. Equipment and vehicles should be thoroughly cleaned other prior to access on to the rehabilitation site.
- Continuously monitor the emergence of alien invasive plant species in or around rehabilitated areas.

5.1.2 Re-establishment of grassland

The Master Plan Framework for the rehabilitation of the Kaalspruit River (November 2015) recommend the natural re-establishment of grassland in terrestrial areas. However, primary grasslands are species rich ecosystems, which once disturbed, are difficult, if not impossible to restore. Although grasslands can be re-created to comprise a number of grass species, the diversity of forbs and geophytes are not easy to attain. It is thought that the reproduction of most grassland species takes place vegetatively and not through seed production, particularly among bulbous plants and climax grasses. Therefore, if the original plant is destroyed, succession is slow or impossible.

Grassland species re-establish after disturbances. However, if the disturbance continued beyond a threshold (such as in the Kaalspruit-area), the grassland is unlikely to recover and succession leads to a sub-climax grassland which is usually species poor (Bredenkamp et al, 2006). Therefore, grasslands would need intervention in order to re-establish successfully. Leaving the grassland to re-establish naturally will likely result in a secondary grassland dominated by pioneer grasses such as *Hyparrhenia hirta* (common thatching grass). It is thus

DRAFT

important to determine the eventual land-use of grassland areas, to determine which rehabilitation strategy will be sufficient.

Grassland rehabilitation should be considered in areas that are not earmarked for public access, other than recreational hiking trails for example, and should include amongst others hydroseeding with grass species naturally occurring within the Egoli Granite Grassland.

5.1.3 Prevent unnecessary disturbance to fauna

Rehabilitations activities should be done in the dry season and should only be done in one locality at a time (e.g. a phased approach), so that the species can relocate during construction/development, and across only a portion of these linear habitats so that connectivity is retained around the sides.

Activities should not stray beyond the footprint of the development, with as much as possible done/stored/located/staffed away from the development and the study area. For birds this might be less imperative than terrestrial fauna, due to their easy short-distance mobility.

5.1.4 Ensure faunal movement

All rehabilitation structures and designs should take cognizance of species movement and not prevent the movement of species up and down stream.

- Involve relevant specialist and plan habitats and connectivity.
- Create a mosaic or patches of diverse habitats
- Ensure that connectivity of habitat types is maintained and enhanced, ensuring that such interventions as structures (e.g. dams, weirs, crossings) and techniques (e.g. fish/frog ladders, islands, pathways) are applied to encourage connectivity of fauna and flora.
- Take utmost care in reshaping channels and banks: these actions can easily enhance rather than control erosion.

5.2 ENHANCE THE RESOURCE PHASE

5.2.1 Planting of trees, particularly park areas

- Use only indigenous trees and shrubs, naturally occurring in Gauteng and along riparian areas. This will ensure suitable habitat for fauna species naturally occurring in the area.
- Ensure open, grassed spaces in between trees to promote water infiltration into soils
- Limit impermeable surfaces.

DRAFT

5.2.2 Incorporate fauna zones within the open space planning

- Designate secluded areas, so that human impacts and disturbance can be minimised and these areas used to attract higher levels of faunal utilisation than just presence or passage, such as feeding, rest-/roosting and even breeding.
- Use passive or direct controls to divert pedestrian access and plant utilisation/cultivation.
- Add missing elements, such as indigenous roost trees, islands and nest sites (natural and/or artificial), to enhance the attraction of these secluded areas.
- Incorporate monitoring to establish which species utilize these habitats and whether the current diversity increases with successful rehabilitation. Monitor easily detectable indicator species to assess habitat use and quality relative to the cause(s) of disturbance.

5.2.3 Agricultural Hubs

- Areas should be set aside for agriculture, avoiding areas designated as secluded fauna habitats.
- Ensure correct placement of agricultural practices, to avoid further transformation of natural vegetation, and avoid damage during floods.
- It is recommended that farmers receive training in permaculture principles and that the use of pesticides and herbicides are discouraged. Where the use of chemicals are unavoidable, only trained farmers should handle chemicals, avoiding contamination of naturally vegetated areas and the watercourse.

5.3 OPTIMISE THE LOCAL VALUE OF THE RESOURCE PHASES

From a biodiversity perspective, ongoing monitoring is important to ensure the long term success of the rehabilitation. It is suggested that the following are monitored:

- Alien invasive plant species: annual monitoring to detect re-infestation. The monitoring should lead to corrective action taken by the municipality to eradicate these plants before the infestation becomes problematic
- Successful re-establishment of grassland to ensure that these areas do not degrade and that adequate indigenous species colonized the area.
- Monitor easily detectable indicator fauna species to assess habitat use and quality relative to the cause(s) of disturbance.
- Littering and dumping: the rehabilitation success depends greatly on the buy-in from the community and continuous littering and dumping could negate rehabilitation efforts.

DRAFT

In addition, waste traps within the watercourse should regularly be cleared. It is recommended that a community group be tasked with the continuous cleaning of the rehabilitated area.

6. CONCLUSIONS

The intention to rehabilitate, or at least halt the ecological decay of the Kaalspruit system that traverses Tembisa, Gauteng, will be, as far as we know, a groundbreaking effort. To rehabilitate an area or ecosystem, it is important to compare and understand the characteristics of the unadulterated historical system with the current situation, so that the extent and success of the rehabilitation effort can be gauged as the difference between the pristine condition and the *status quo.* This report examines the historical and present diversity of plants and vertebrates in and around the study area. Only species reliant on aquatic and/or riparian and/or wetland zones and their margins are relevant to the habitats remaining for rehabilitation. This assessment found a decrease between what could be expected in this habitat compared to what are currently present or could be present.

The ecological decline of the Kaalspruit drainage system in and above the study area is a consequence of ecologically insensitive political, social and commercial development since at least the establishment of Tembisa in 1957. It has resulted in ecologically hostile habitats surrounding the drainage lines, especially high-density housing with extensive hard surfaces (e.g. roofs, roads) that exacerbate runoff, and poor waste management that delivers contaminated water, sewage, litter and debris into this aquatic, riparian and alluvial habitat. Most indigenous grassland has disappeared from the upper Kaalspruit drainage system, eliminating the important ecological services of water quality, quantity and sustainability, sediment control, and floral (seed, pollination) and faunal (food, rest, breeding, connectivity) support.

The study area forms only a section of the Kaalspruit drainage system, its borders determined by municipal rather than ecological boundaries. Hence the quality of most of the drainage entering the study area comes from its upstream sources, and its best connectivity is to the remaining grasslands immediately downstream, both falling in City of Ekurhuleni rather than City of Johannesburg Metropolitan Municipalities. Success of any rehabilitation efforts will therefore depend to a large extent on ecological management responses applied outside those controlled within the study area.

DRAFT

Within the study area itself, the remaining habitats seem to have developed with little regard to the ecology. Various cropland, landfill, settlement and building activities have extended into the margins of the drainage lines. Many extend below floodlines expected at 50-100 intervals, or to within the 32-100-m buffers, legislated for watercourse development, exposing them and their occupants to flood risk. The water colour, odour and frothing, and sedimentation within the drainage lines indicates low habitat quality, a suspicion confirmed by the apparent lack of such vertebrates as otters, marsh mongooses, fish-eating birds and frogs. Damage to the drainage lines by erosion from uncontrolled runoff and invasion by alien plan species are widespread, leaving little of the original wet- and grassland habitats. On the positive side, the regularly flooded areas, unsuitable for development unless transformed, still support extensive beds of bulrushes, reeds and other wetland plants, which supply the ecological services of flood and sediment control, water retention and biofiltration, and some support of floral and faunal diversity.

In terms of the National Water Act, all wetlands in and around the Kaalspruit must be considered as ecologically sensitive. The vegetation still supports 95-40% of indigenous species, with *Phragmites australis* and *Typha capensis* dominant or at least present over large areas of the system. The system is largely disturbed and degraded, reflected by the presence, often dominance of many weed species in the area with the proportion of exotics increasing the further one moves from the river. River systems are by nature highly dynamic, influenced by periods of low and high water and regular flooding: they represent “highways” for the transport of seeds and other plant parts that can become established along their ecosystems, mostly weedy species both woody and herbaceous. Within these habitats, only 14/45 (31% of) mammal species known historically for the study area are now expected and 166/358 (46% of) bird species (but only 36% of these with a high probability). Thirty-seven reptile and 15 amphibian species are also expected.

It is laudable that authorities are considering such an extensive exercise and including their citizenry. Only the aquatic, wetland and riparian components of the Kaalspruit system could be evaluated. Normally the 32-meter grassland buffer zone from the outer edge of the riparian zone allows for consideration of terrestrial vertebrates, but informal housing and other activities (agriculture, dumping of building rubble) encroach into this buffer and in some instances even the riparian zones. Pollutants in seepage and runoff from hard surfaces in Tembisa Township wash into the system and are carried downstream, and littering is rife, consisting mostly of plastic and polystyrene. Cosmetically, this situation is discouraging but ecologically this type of pollution is probably benign, at least physically, for most fauna. Water pollution is of fundamental importance and should be ranked highly among corrective

DRAFT

measures to be taken. Connectivity for vertebrate recruitment and gene flow remain constrained to aquatic, wet- and grassland habitats downstream of the site and in the headwaters of some smaller tributaries, except for such aerial species as bats, birds and insects.

We recognize that a solution to these issues will rely on a multifaceted effort and must involve the community. We offer more detailed guidelines on the ecological principles, and sequence and form of mitigations that we consider essential to making this rehabilitation effort a success. Details of their implementation will require specialist advice, design and implementation from such fields as geomorphology, hydrology, civil engineering, agriculture, horticulture and rehabilitation ecology, probably with separate plans for each tributary and section of the drainage lines.

This report found that limited natural vegetation and habitats remain within the areas sampled and that the likelihood of threatened species occurring are limited. No fauna or flora species of concern, other than the Declining *Hypoxis hemerocallidea,* are likely to be adversely affected by the rehabilitation. The proposed rehabilitation will therefore not impact negatively on the already transformed habitats and further vegetation and fauna studies will not significantly contribute to that which is already stated in this report. The species listed in this report and not currently thought to be present along the Kaalspruit system, gives an indication of what was lost and can potentially be improved on by rehabilitation. Instead of further studies on what is currently present, it is recommended that additional studies to monitor the success of the rehabilitation and the recolonization of the area by species should rather be considered. For example, given avian mobility, more species may return, including the threatened species that could have occasionally visited the area, prior to the degradation of the system. If the habitats can be significantly improved, it can raise the numbers of species that can be expected to utilise the area.

Although watercourses are regarded as sensitive environs, the rehabilitation is essential in restoring the ecological function thereof.

7. LIMITATIONS, ASSUMPTIONS AND GAPS IN KNOWLEDGE

The team has extensive practical experience as well as access to wide-ranging data bases (such as published records as well as unpublished data in museum archives) to consider the derived species lists with high limits of accuracy. In this instance the biodiversity of the site has *a priori* been seriously jeopardized, which renders the need for intensive field surveys unnecessary. In instances where uncertainty exists regarding the presence of a species it is

DRAFT

taken under consideration, which renders the suggested mitigation measures and conclusions more robust.

Even though every care is taken to ensure the accuracy of this report, environmental assessment studies are limited in scope, time and budget. Discussions and proposed mitigations are to some extent made on reasonable and informed assumptions built on bone fide information sources, as well as deductive reasoning. Deriving a 100% factual report based on field collecting and observations can only be done over several years and seasons to account for fluctuating environmental conditions and migrations. Since environmental impact studies deal with dynamic natural systems additional information may come to light at a later stage. The team can thus not accept responsibility for conclusions and mitigation measures made in good faith based on own databases or on the information provided at the time of the directive. This report should therefore be viewed and acted upon with these limitations in mind.

8. LITERATURE CONSULTED

Acocks, J.P.H. 1988. Veld types of South Africa, 3rd ed. *Memoirs of the Botanical Survey of South Africa.* **57**: 1–146.

Apps, P. 2012. *Smithers Mammals of Southern Africa. A Field Guide*. Struik Nature, Cape Town.

Alexander, G. & Marais J. 2007. *A Guide to the Reptiles of Southern Africa*. Struik Publishers, Cape Town.

Barnes, K.N. (ed.). 1998. *The Important Bird Areas of southern Africa*. Johannesburg, BirdLife South Africa.

Barnes, K.N. (ed.). 2000. The Eskom Red Data Book of birds of southern Africa, Lesotho and Swaziland. Johannesburg, BirdLife South Africa.

Bates, M.F. 1992. *The Herpetofauna of the Orange Free State – with special emphasis on Biogeographical Patterning*. Ph.D. University of Natal, Pietermaritzburg.

BirdLife South Africa. 2015. *Checklist of Birds in South Africa* 2014. BirdLife South Africa, Johannesburg.

Bonnevie, Bo T. 2011. Some considerations when comparing SABAP 1 with SABAP 2 data. *Ostrich* **82**: 161-162.

Boycott, R.C. & Bourquin, O. 2000. *The Southern African Tortoise Book. A Guide to Southern African Tortoise, Terrapins and Turtles*, revised edition. Privately published, Hilton.

Branch, W.R. (Editor), August 1988. *South African Red Data Book – Reptiles and Amphibians*. S.A.National Scientific Programmes, Report No. 151.

DRAFT

Branch, W.R. 1998. *Field Guide to the Snakes and other Reptiles of Southern Africa*. 3rd edition. Struik Publishers, Cape Town.

Branch, W.R. 2002. 'The Conservation Status of South Africa's threatened Reptiles': 89 – 103. In:- G.H.Verdoorn & J. le Roux (editors), *The State of Southern Africa's Species*, Proceedings of a conference held at the Rosebank Hotel, 4 – 7 September 2001. World Wildlife Fund.

Branch, W.R. 2008. *Tortoises, Terrapins & Turtles of Africa*. Struik Publishers, Cape Town.

Bredenkamp, G.J. & Brown, L.R. 2001. Vegetation – A reliable ecological basis for environmental planning. *Urban Greenfile* Nov-Dec 2001: 38-39.

Broadley, D.G. 1990. *FitzSimons' Snakes of Southern Africa*. Jonathan Ball & Ad Donker Publishers.

Bronner, G.N., Hoffmann, M., Taylor, P.J., Chimimba, C.T., Best, P.B., Mathee, C.A. & Robinson, T.J. 2003. A revised systematic checklist of the extant mammals of the southern African subregion. *Durban Museum Novitates* 28:56-103.

CARA, Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983).

Carruthers V. (2009). Amphibian Habitat Assessment for Proposed Development site at Clayville (Glen Austin) Ekurhuleni) VC Management Services CC.

Carruthers V. & Du Preez L. 2011. *Frogs & Frogging in South Africa*. Struik Nature, Cape Town.

Channing, A. 2001. *Amphibians of Central and Southern Africa*. Protea Bookhouse Pretoria.

DEAT, Department of Environmental Affairs and Tourism. 2007. National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004): Publication of Lists of Critically Endangered, Endangered, Vulnerable and Protected Species. Government Notices.

De Moor I.J. & Bruton M.N. 1988. *Atlas of Alien and Translocated Indigenous Aquatic Animals in* Southern Africa. S.A.National Scientific Programmes, Report No. 144.

Du Preez, L. & Carruthers, V. 2009. *A Complete Guide to the Frogs of Southern Africa*. Struik Publishers, Cape Town.

ECA, Environmental Conservation Act, 1989 (Act No. 73 of 1989).

Friedman, Y. and Daly, B. (editors). 2004. *Red Data Book of the Mammals of South Africa: A Conservation Asessment*: CBSG Southern Africa, Conservation Breeding Specialist Group (SSC/IUCN), Endangered Wildlife Trust, South Africa.

GDACE, Guateng Directorate of Nature Conservation. 2009. GDACE Requirements for Biodiversity Assessments, Version 2. Gauteng Provincial Government.

GDARD, 2014a. *Technical report for the Gauteng Conservation Plan (Gauteng C-Plan V3.3).* Biodiversity Management Directorate, Department of Agriculture and Rural development, Johannesburg, Gauteng.

GDARD, 2014b. *Requirements for biodiversity assessments Version 3.* Biodiversity Management Directorate, Department of Agriculture and Rural development, Johannesburg, Gauteng.

DRAFT

Harrison, J.A., Allan, D.G., Underhill, L.G., Herremans, M., Tree, A.J., Parker, V. & Brown, C.J. (eds.). 1997. *The Atlas of Southern African Birds*. Vol. 1 & 2. BirdLife South Africa, Johannesburg.

Hockey, P. A. R., Dean, W. R. J. & Ryan, P. G. (eds.). 2005. *Roberts – Birds of Southern Africa,* VIIth ed. The Trustees of the John Voelcker Bird Book Fund, Cape Town.

Knobel, J. & Bredenkamp, G. 2005. *The magnificent natural heritage of South Africa.* Roggebaai, Sunbird Publishers, Cape Town.

Low, A.B. & Rebelo, A.G. 1996. '*Vegetation Map of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria.

Low, A.E. & Rebelo, A.G. (eds). 1998. *Vegetation of South Africa, Lesotho and Swaziland*. *A companion to the Vegetation Map of South Africa, Lesotho and Swaziland.* Department of Environmental Affairs & Tourism, Pretoria.

Marais, J. 2011. *What's that Reptile? A starter's guide to reptiles of southern Africa*. Struik Publishers, Cape Town.

Marais, E. & Peacock, F. 2008. The Chamberlain Guide to Birding Gauteng. Mirafra Publishing, Centurion.

Measey, G.J. (ed.) 2011. Ensuring a future for South Africa's frogs: a strategy for conservation research. *SANBI Biodiversity Series* 19. South African National Biodiversity Institute, Pretoria.

Meester, J.A.J., Rautenbach, I.L., Dippenaar, N.J. & Baker, C.M. 1986. *Classification of Southern African Mammals*. Transvaal Museum Monograph No. 5. Transvaal Museum, Pretoria, RSA.

Mills, G. & Hes, L. 1997. *The complete book of Southern African Mammals*. Struik Winchester, Cape Town, RSA.

Minter, L.R., Burger, M., Harrison, J.A., Braack, H.H., Bishop, P.J. and Kloepfer, D. eds. 2004. *Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland*.SI/MAB Series #9. Smithsonian Institution, Washington, DC.

Mucina, L, & Rutherford, M.C. (eds.). 2006. The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.

NEMA, National Environment Management Act, 1998 (Act No. 107 of 1998).

NEMA, Environmental Impact Assessment Regulations, 2014 (Gazette No 38282 – Regulation 982).

NEMBA, National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004): Publication of Lists of Critically Endangered, Endangered, Vulnerable and Protected Species. Government Notices.

DRAFT

NEMBA, National Environmental Management Biodiversity Act, 2004. (Act 10 of 2004). Draft List of Threatened Ecosystems. Government Gazette RSA Vol. 1477, 32689, Cape Town, 6 Nov 2009.

NFA, National Forests Act, 2006 (Act 84 of 1998 as amended). Government Gazette RSA Vol. 897, 29062 , Cape Town, 8 Sept 2006.

NSPA, Natural Scientific Professions Act, 2003 (Act 27 of 2003).

Picker M. & Griffiths C. 2011. *Alien & Invasive Animals. A South African Perspective*. Struik Nature, Cape Town.

Raimondo, D., Von Staden, L., Foden, W., Victor, J.E., Helme, N.A., Turner, R.C. Kamundi, D.A. & Manyama, P.A. (Eds.). 2009. Red list of South African plants 2009. *Strelitzia* 25: 1-668.

Rautenbach, I.L. 1978. A numerical re-appraisal of the southern African biotic zones. *Bulletin of the Carnegie Museum of Natural History* 6: 175-187.

Rautenbach, I.L. 1982. Mammals of the Transvaal. *Ecoplan Monograph No. 1*. Pretoria, RSA.

Retief, E. 2013. 2528AB Pienaarsrivier – analysis of SABAP1 and SABAP2 data for the quarter degree square. *Ornithological Observations* 4: 107-118

SANBI & DEAT. 2009. *Threatened Ecosystems in South Africa: Descriptions and Maps*. Draft for Comment. South African National Biodiversity Institute, Pretoria, South Africa.

Sinclair, I, Hockey, P., Tarboton, W. & Ryan, P. 2012. *Sasol birds of southern Africa*, *4th Edn*. Struik, Cape Town

Skinner, J.D. & Chimimba, T.C. 2005. *The Mammals of the Southern African Subregion*. 3rd edition. Cambridge University Press.

Skinner, J.D. & Smithers, R.H.N. 1990. *The Mammals of the Southern African Subregion*. 2nd edition. Pretoria: University of Pretoria.

Smithers,R.H.N. 1983. *The Mammals of the Southern African Subregion.* Pretoria: University of Pretoria.

Taylor, M. (ed.). 2015. *The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland*. BirdLife South Africa, Johannesburg.

Taylor, P.J. 1998. *The Smaller Mammals of KwaZulu-Natal*. University of Natal Press: Pietermaritzburg.

Taylor, P.J. 2000. *Bats of Southern Africa.* University of Natal Press: Pietermaritzburg.

Van Wyk, J.C.P., Kok, D.J. & Du Preez, L.H. 1992. Growth and behaviour of tadpoles and juveniles of the African Bullfrog, *Pyxicephalus adspersus* Tschudi 1838. African Journal of Herpetology: Journal of the Herpetological Association of Africa **40**:56.

Van Schalkwyk, M. 2007. National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004); Publication of Lists of Critically Endangered, Endangered, Vulnerqable and Protected Species.

DRAFT

9. DETAILS OF SPECIALIST CONSULTANTS

ALAN CHARLES KEMP

Born: 7 May 1944 in Gweru, Zimbabwe

Citizenship: South African, British

Marital status: Married, 1 daughter, 1 son

Present work address

Naturalists & Nomads, 8 Boekenhout Street, Navors, Pretoria, 0184, South Africa

Tel: (27)(12)804-7637 Fax: (27)(12)804-7637

E-Mail: leadbeateri@gmail.com

or

Naturalists & Nomads, Postnet Suite #38, Private Bag X19, Menlo Park, 0102, South Africa

Qualifications:

1965 B.Sc. Rhodes University, Zoology and Entomology as majors

1966 B.Sc. Hons. Rhodes University, Zoology

1973 Ph.D. Rhodes University, Zoology of Pretoria

Thesis: (Ph.D.) on ecology, behaviour and systematics of hornbills in Kruger National Park

Professional titles:

• Pr.Sci.Nat. South African Council for Natural Scientific Professions (Zoological & Ecological Sciences) **Registration Number 400059/09**

Professional career:

Field Research Assistant to Prof. Tom J. Cade, Section of Ecology and Systematics, Cornell University, in Kruger National Park, South Africa, Nov 1966 - Apr 1969.

Department of Birds, Transvaal Museum, Pretoria, June 1969 – August 1999, Head of Department from 1971, rising to Senior Scientist and then Head Curator by 1974.

DRAFT

Elected Manager, Transvaal Museum, September 1999 – July 2001, until voluntary early retirement.

Edward Grey Institute of Ornithology, Oxford, December 2001 – April 2002, drafting specialist bird texts for Gale Publishing, USA and Andromeda Press, Oxford, UK.

Berg 'n Dal & Pretoria, April 2002 - February 2003, presenting paper and later editorial assistant for book from the Mammal Research Institute, University of Pretoria, *The Kruger Experience: ecology and management of savanna heterogeneity.*

Bangkok, March – June 2003, drafting research papers for colleague at Mahidol University; touring Laos.

Pretoria, August-December 2003, editorial assistant for book from the Mammal Research Institute, University of Pretoria, a revision of *The Mammals of Southern Africa.*

Hala-Bala Wildlife Reserve, January – December 2004, a one-year rainforest study of hornbills, raptors and owls in southern Thailand for their National Center for Genetic Engineering and Biotechnology (BIOTEC).

Pretoria, January 2005 – July 2007, organizing 4th International Hornbill Conference at Mabula Game Lodge and editing and publishing CD-ROM proceedings, and consulting on ground hornbills to Mabula, University of Cape Town and Endangered Wildlife Trust.

Bangkok, India, Singapore, Sarawak, September 2006 – April 2008. Assisted colleagues at Mahidol University, Bankok, with compilation of research paper on molecular systematics of hornbills, and travelled to see other Asian habitats and meet with other colleagues.

Bangkok, December 2011 – April 2012. Assisted colleagues at Mahidol University, Bangkok, with compilation of research papers and co-editing/writing three hornbill books together with colleagues in Singapore.

Academic career:

• Students:

- Completed post graduate students: M.Sc. 14; Ph.D. 5.

• Author of:

- 53 scientific papers or notes in refereed journals
- 48 papers at national and international congresses

DRAFT

- 6 scientific (unpublished) reports on environment and natural resources
- 74 popular scientific papers.
- 18 contributions in books

• Editorial Roles

Ostrich, African Journal of Ornithology (editor 1973-75).

Bird Conservation (International (editorial committee 1995-present)

• FRD evaluation category: C2 (Avian Biology and Systematics)

• Associate positions:

University of the Witwatersrand, Honourary lecturer, Department of Zoology (1988-2001)

Percy FitzPatrick Institute of African Ornithology, University of Cape Town, research associate (2001 – 2012).

Transvaal Museum, Honourary curator (2004-present)

Wildlife Conservation Society, New York, wildlife conservation associate (1996-present).

Membership:

American Ornithologist's Union, Corresponding Fellow (1986- present)

Birdlife South Africa (previously South African Ornithological Society), Ordinary Member (1969-present), President (1975-1993) of Northern Transvaal (Pretoria) Branch, Honourary Life Member of Pretoria Bird Club (2000 – present).

Special committees:

International Ornithological Committee of 100, elected member (1989-present).

Raptor Research Foundation, Grants assessor, Leslie Brown Memorial Fund (1985-present).

Merit awards and research grants:

DRAFT

1969-86. Annual research grants from South African Council for Scientific and Industrial Research (CSIR).

1974. Chapman Fund Award, American Museum of Natural History, for field research in Borneo and India.

1986-98. Annual research award from South African Foundation for Research Development (FRD) as "C"-graded national scientist.

1989-95. Team member of FRD Special Programme in Conservation Biology.

1989-95. Team member of FRD Special Programme in Molecular Systematics.

1991-95. Various private sector sponsorships.

1992, 1994. FRD merit award to museum scientists.

2000. Special NRF Science Liaison award to attend 10th Pan-African Ornithological Congress, Kampala, Uganda.

2001. Special NRF Science Liaison award to attend 3rd International Hornbill Workshop, Phuket, Thailand.

2004. One year's support from Thailand's National Center for Genetic Engineering and Biotechnology (BIOTEC) for rainforest survey research.

2007-2008. Six month's funding to enable specialist assistance at Department of Microbiology, Mahidol University, Thailand.

Consultant

Sept-Oct 1994 – Kruger National Park, specialist consultant on ground hornbills to BBC Natural History Unit for filming of Wildife on One programme, 6 weeks.

Oct-Nov 1996. Kruger National Park, specialist consultant on various birds to David Attenborough for BBC series Life of Birds, 3 weeks.

Sep-Oct 1998. Kruger National Park, specialist hornbill consultant to National Geographic magazine team, 4 weeks.

October 2001 – Mala Mala, specialist consulting on ground hornbills for National Geographic film unit, 1 week.

2004-present - >15 specialist birding and nature tours as a National South African Tourist Guide, registration number GP0770.

2005-present – >30 Biodiversity assessments for a Ramsar wetland proposal, Important Bird Area proposal, and general scoping, G20 and specialist avifaunal EIAs.

DRAFT

GEORGE JOHANNES BREDENKAMP

Born: 10 February 1946 in Johannesburg, South Africa.
Citizenship: South African
Marital status: Married, 1 son, 2 daughters

Present work address
Extra-ordinary Professor
Department of Plant Science, University of Pretoria, Pretoria, 0002, South Africa
Tel:(27)(12)420-3121 Fax: (27)(12)362 5099
E-Mail: george.bredenkamp@up.ac.za

or

EcoAgent CC, or Ecotrust Environmental Services CC
PO Box 25533, Monument Park, 0105, South Africa
Tel and Fax: (27)(12) 460 2525
Cell 082 5767046
E-Mail: ecoagent@mweb.co.za or ecoagent@mile.co.za

Qualifications:

1963 Matriculation Certificate, Kemptonpark High School
1967 B.Sc. University of Pretoria, Botany and Zoology as majors,
1968 B.Sc. Hons. (cum laude) University of Pretoria, Botany.
1969 T.H.E.D. (cum laude) Pretoria Teachers Training College.
1975 M.Sc. University of Pretoria, Plant Ecology .
1982 D.Sc. (Ph.D.) University of Pretoria, Plant Ecology.

Theses: (M.Sc. and D.Sc.) on plant community ecology and wildlife management in nature reserves in South African grassland and savanna.

Professional titles:

DRAFT

• MSAIE&ES South African Institute of Ecologists and Environmental Scientists

- 1989-1990 Council member

• MGSSA Grassland Society of Southern Africa

- 1986 Elected as Sub-editor for the Journal
- 1986-1989 Serve on the Editorial Board of the Journal
- 1990 Organising Committee: International Conference: Meeting Rangeland challenges in Southern Africa
- 1993 Elected as professional member

• Pr.Sci.Nat. South African Council for Natural Scientific Professions **Reg No 400086/83**

- 1993-1997 **Chairman** of the Professional Advisory Committee: Botanical Sciences
- 1993-1997: **Council** Member
- 1992-1994: Publicity Committee
- 1994-1997: Professional Registration Committee

Professional career:

• Teacher in Biology 1970-1973 in Transvaal Schools
• Lecturer and senior lecturer in Botany 1974-1983 at University of the North
• Associate professor in Plant Ecology 1984-1988 at Potchefstroom University for CHE
• Professor in Plant Ecology 1988-2008 at University of Pretoria.
• Founder and owner of the Professional Ecological Consultancy firms Ecotrust Environmental Services CC and Eco-Agent CC, 1988-present.

Academic career:

• Students:

- Completed post graduate students: M.Sc. 53; Ph.D. 14.
- Presently enrolled post-graduate students: M.Sc. 4; Ph.D. 1.

• Author of:

- 175 scientific papers in refereed journals
- >150 papers at national and international congresses

DRAFT

- >300 scientific (unpublished) reports on environment and natural resources
- 17 popular scientific papers.
- 39 contributions in books

• Editorial Committee of

- South African Journal of Botany,

Journal Grassland Society of Southern Africa,

Bulletin of the South African Institute of Ecologists.

Journal of Applied Vegetation Science.(Sweden)

- Phytocoenologia (Germany)

• FRD evaluation category: C1 (=leader in South Africa in the field of Vegetation Science/Plant Ecology)

Membership:

• International Association of Vegetation Science.
• International Society for Ecology (Intecol)
• Association for the Taxonomic study of the Flora of Tropical Africa (AETFAT).
• South African Association of Botanists (SAAB)

1988-1993 Elected to the **Council** of SAAB.
1989-1990 Elected as **Chairman** of the Northern Transvaal Branch
1990 Elected to the Executive Council as **Vice-President**
1990- Sub-editor Editorial Board of the Journal
1991-1992 Elected as **President** (2-year period)
1993 **Vice-President** and Outgoing President

• Wildlife Management Society of Southern Africa
• Suid-Afrikaanse Akademie vir Wetenskap en Kuns
(=South African Academy for Science and Art).
• Wildlife Society of Southern Africa

1975 - 1988: Member
1975 - 1983: Committee member, Pietersburg Centre
1981 - 1982: **Chairman**, Pietersburg Centre

• Dendrological Society of Southern Africa

1984 - present: Member

DRAFT

1984 - 1988: Committee member, Western Transvaal Branch

1986 - 1988: **Chairman**, Western Transvaal Branch

1987 - 1989: Member, Central Committee (National level)

1990 - 2000: Examination Committee

• Succulent Society of South Africa

1987 - present: Member

• Botanical Society of South Africa

2000 – present: Member

2001- 2008: Chairman, Pretoria Branch

2009-present Committee member Pretoria Branch

2002 – present: Chairman, Northern Region Conservation Committee

2002- 2007: Member of Council

Special committees:

• Member or past member of 10 special committees re ecology, botany, rangeland science in South Africa.

• Member of the International Code for Syntaxonomical Nomenclature 1993-1996.

Merit awards and research grants:

1968 Post graduate merit bursary, CSIR, Pretoria.

1977-1979 Research Grant, Committee re Research Development, Dept. of Co-operation and Development, Pretoria.

1984-1989 Research Grant, Foundation for Research Development, CSIR, Pretoria.

1986-1987 Research Grant, Dept. of Agriculture and Water Supply, Potchefstroom.

1990-1997 Research Grant, Dept. of Environmental Affairs & Tourism, Pretoria.

1991-present Research Grant, National Research Foundation , Pretoria.

Research Grant, Water Research Commission.

1999-2003 Research Grant, Water Research Commission.

2006 South African Association of Botanists Silwer Medal for outstanding contributions to South African Botany

Abroad:

DRAFT

1986 Travel Grant, Potchefstroom University for Christian Higher Education, Potchefstroom

Visits to Israel, Italy, Germany, United Kingdom, Portugal.

1987 Travel Grant, Potchefstroom University for Christian Higher Education, Potchefstroom.

Visits to Germany, Switzerland, Austria, The Netherlands, United Kingdom.

1990 Travel Grant, FRD.

Visit to Japan, Taiwan, Hong-Kong.

1991 Travel Grant, FRD.

Visits to Italy, Germany. Switzerland, Austria, France, The Netherlands, United Kingdom.

1993 Travel Grant, University of Pretoria.

Visits to the USA, Costa Rica, Czech Republic, Austria.

1994 Travel Grant FRD.

Visits to Switzerland, The Netherlands, Germany, Czech Republic.

1995 Travel Grant FRD, University of Pretoria

Visits to the USA

Travel Grant, University of Pretoria

Visit to the UK.

Travel Grant University of Pretoria, Visit Czech Republic, Bulgaria

Travel Grant, University of Pretoria, Visit Czech Republic, Italy, Sweden

Travel Grant, University of Pretoria, Visit Hungary, Spain, USA

Travel Grant, University of Pretoria, Visit Poland, Italy, Greece.

Travel Grant, NRF, Visit Brazil

2006 German Grant Invited lecture in Rinteln, Germany

Consultant

Founder and owner of Ecotrust Environmental Services CC and Eco-Agent CC

Since 1988 **>300** reports as consultant on environmental matters, including:

Game Farm and Nature Reserve planning,

Environmental Impact Assessments,

Environmental Management Programme Reports,

DRAFT

Vegetation Surveys,

Wildlife Management,

Veld Condition and Grazing Capacity Assessments,

Red data analysis (plants and animals).

DRAFT

IGNATIUS LOURENS RAUTENBACH

Independent Environmental Consultant – MAMMALOGY; Ph.D., Prof. Nat. Sci. .

Identity Number 421201 5012 00 5

Gender Male

Date of Birth 1 December 1942; born Germiston, RSA

Nationality South African

Home Languages Bilingual (English & Afrikaans)

Postal Address 45 Helgaard Street, Kilner Park, Pretoria, RSA 0186. Tel no +27 12 3334112, Cell +27 082 3351288. E-mail naasrauten@mweb.co.za

Former Position Retired Director: Planning, Northern Flagship Institute

Present Position Consultant – Specialist, Environmental Impact Assessments (Applied research), Photographing microstock for four agencies

Qualifications **B.Sc**. (UP) 1966, **T.H.E.D** (Pta TTC) 1967, **M.Sc.** (UP) 1971, **Ph.D**. (Un. Natal) 1971

Professional Honours 1. Professional Natural Scientist (Zoology) – S.A Council for Natural Scientific Professions, Registration # 400300/05

2. Fellow of the Photographic Society of South Africa

3. Master photographer at club level

4. Honorary life member of the S.A. Wildlife Management Association.

Notable Research Contribution In-depth survey of the Mammals of the Transvaal. 1982. 211pp. Ecoplan Monograph 1.

Notable Literary Contribution Rautenbach, Naas & Annalene Rautenbach. 2008. *Photography for Focused Beginners.* 302pp with 250 images. Green Door Studio, Pretoria.

Formal Courses Attended Computer Literacy, Project Management, Contract Design, Senior Management

Employment history

May 2001 - Present Self-employed, collaborator with Eco-Agent CC Ecological Consultants as well as Galago Environmental [environmental impact assessments], technical writing, and photography

April 1999 - August 2001 Director: Planning, Northern Flagship Institution

Jan 1991 - April 1999 Executive Director, Transvaal Museum

July 1967 - Dec 1990 Curator (in charge) of the Division of Mammalogy, Transvaal Museum. Promoted to Principal Scientist rank as of June 1985

DRAFT

March - June 1967 Research student at the Mammal Research Institute of the Zoology Department, University of Pretoria

July 1966, Nov l966 - Febr 1967 Member of the Smithsonian Institution's field teams collectively partaking in the 'African Mammal Project'

1966: Part-time research assistant to Prof. J. Meester, University of Pretoria

1962 - 1965 Temporary assistant during University holidays in the Nematology laboratories, Agricultural Technical Services

1991 - 2002 Founder member and non-executive director of the Board of Trustees of

1993 - 2001 Founder member and Trustee of the privatised Museums Pension Fund

1997 - 2001 Non-executive director of the Tswaing Section 21 Company

Professional Achievements

Managed a research institute of 125 members of staff. Solicited numerous grants totalling ≥ R1 000 000. Initiated and overseen building programmes of R30 million at the Transvaal Museum. Conceptualised and managed 12 display programmes.

Research: Author and co-author of 85 scientific publications re mammalogy in peer reviewed subject journals, 18 popular articles, 10 books, and >400 contractual EIA research reports. Extensive field work and laboratory experience in Africa, Europe, USA, Alaska, Brazil and Mexico. B -rated by FRD as scientist of international status 1983 – 1995.

Students: Additional to museum manager duties, **c**o-supervised 5 B.Sc. (Hons.), 2 M.Sc. and 2 Ph.D. students.

Public Recognition:

Public speaking *inter alia* Enrichment Lecturer on board the 6* *SS Silver Wind*, radio talks, TV appearances.

Hobbies

Technical writing, photography, field logistics, biological observations, wood working, cooking, designs.

Personal Evaluation

I am goal-orientated, expecting fellow workers and associates to share this trait. I am an extrovert, sensitive to amicable interpersonal relations. I have a wide interest span ranging from zoological consulting, photography, cooking, sport, news, gardening and out of necessity, DIY. To compensate for my less than perfect memory, I lead a structured and organised life

DRAFT

to deal with the detail of a variety of interests. Often to the chagrin to people close to me, I have an inclination to “Think Out of the Box”.

DRAFT

JACOBUS CASPARUS PETRUS (JACO)

Identity number 680804 5041 08 4
Gender Male
Date of birth 4 August 1968
Nationality South African
Home languages Afrikaans, fluent in English
Postal address P.O. Box 25085, Monument Park, Pretoria, 0105.
Tel no +27 12 347 6502, Cell +27 82 410 8871
E-mail **jcpvanwyk@absamail.co.za**
Present position Co-Department Head, Environmental Education & Life Sciences, Hoërskool Waterkloof
Consultant Specialist Environmental Assessments, EIAs, writing, photo-recording
Qualifications **B.Sc**. (U.F.S.) **B.Sc. (Hon.)** (U.F.S.), **H.E.D** (U.F.S.), **M.Sc.** (U.F.S.)
Honours Foundation of Research Development bursary holder
Professional Natural Scientist (Zoology) – S.A Council for Natural Scientific Professions, Registration # 400062/09
Notable Research Contribution In-depth field study of the giant bullfrog

Formal Courses Attended Outcomes Based Education, University of the South Africa (2002)
Introductory Evolution, University of the Witwatersrand (2008)
OBE, GET & FET training, 2002-2008, Education Department

Employment history

2000 – Present Co-Department Head for Environmental Education & Life Sciences, Hoërskool Waterkloof, Pretoria.

1995 - 1999 Teaching Biology (Grades 8 – 12) and Physics / Chemistry (Grades 8 – 9) at the Wilgerivier High School, Free State. Duties included teaching, mid-level management and administration.

July 1994 – Dec 1994 Teaching Botany practical tutorials to 1st year students at the Botany & Zoology Department of the Qwa-Qwa campus of the University of Free State, plant collecting, amphibian research

1993 - 1994 Mammal Research Institute (University of Pretoria) research associate on the Prince Edward Islands: topics field biology and population dynamics of invasive alien rodents, three indigenous seals, invertebrate assemblages, censussing king penguin chicks and lesser sheathbills, and marine pollution

1991 - 1993 Laboratory demonstrator for Zoological and Entomological practical tutorials, and caring for live research material, University of the Free State

DRAFT

1986 - 1990 Wildlife management and eco-guiding, Mt. Everest Game Farm, Harrismith

Professional Achievement Research: Author and co-author of 52 scientific publications in peer-reviewed and popular subject journals, and >60 contractual EIA research reports. Extensive field work and laboratory experience in Africa

Public Recognition: Public speaking *inter alia* radio talks, TV appearances

Hobbies: Popular writing, travel, marathon running, climbing (viz Kilimanjaro), photography, biological observations, public speaking.

DRAFT