APPENDIX D: SPECIALIST REPORTS

Appendix D1 – ECOLOGICAL REPORT

Vegetation and Red List plant study at Jabulani, Soweto, Gauteng Province

Prepared by

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Appointment of specialist

David Hoare of David Hoare Consulting cc was commissioned by Envirolution Consulting (Pty) Ltd to conduct a vegetation and Red List plant species assessment for a site in Jabulani, Soweto. The terms of reference were to undertake a specialist study to describe the vegetation and flora of the site, with particular reference to the threatened plant species, *Lepidium mossii*, and confirm the absence of wetlands.

Details of specialist

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Summary of expertise

David Hoare:

- Registered professional member of The South African Council for Natural Scientific Professions (Ecological Science), registration number 400221/05.
- Founded David Hoare Consulting CC, an independent consultancy, in 2001.
- Ecological consultant since 1995.
- Conducted, or co-conducted, over 200 specialist ecological surveys as an ecological consultant.
- Published six technical scientific reports, 15 scientific conference presentations, seven book chapters and eight refereed scientific papers.
- Attended 15 national and international congresses & 5 expert workshops, lectured vegetation science at 2 universities and referee for 2 international journals.

Independence:

David Hoare Consulting cc and its Directors have no connection with the development company. David Hoare Consulting cc is not a subsidiary, legally or financially, of the proponent, remuneration for services by the proponent in relation to this proposal is not linked to approval by decision-making authorities responsible for permitting this proposal and the consultancy has no interest in secondary or downstream developments as a result of the authorisation of this project. The percentage work received directly or indirectly from the proponent in the last twelve months is 0%.

Scope and purpose of report

The scope and purpose of the report are reflected in the "Terms of reference" section of this report

Indemnity and conditions relating to this report

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. David Hoare Consulting cc and its staff reserve the right to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

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TABLE OF CONTENTS

INTRODUCTION

Terms of reference

In February 2009 David Hoare Consulting cc was requested by Envirolution Consulting (Pty) Ltd to conduct a vegetation and Red List plant survey for the site as part of the Environmental Impact Assessment process. GDACE requested the following specialist studies on site:

1. Plant, with specific reference to *Lepidium mossii*.
2. Vegetation.
3. The absence of wetlands on site should be verified.

A detailed investigation into the status of the vegetation was to be undertaken, including:

- Presence of primary vegetation;
- General floristic diversity;
- Habitat suitability for Red Data flora species;
- Potential presence of Red Data flora species;

The following was to be provided / undertaken:

- A brief discussion on the vegetation type in which the study area is situated, using available literature, in order to place the study in context.
- A broad-scale map of the vegetation and landcover of the proposed alignment using available aerial photography. A description of the dominant and characteristic species within the broad-scale plant communities comprising each of these units, was to be provided. This was to cover an area up to 200 m on either side of the centre line of the alignment.
- A list of Red List plant species previously recorded within the quarter degree grids in which the study area is situated, obtained from the relevant authorities.
- Identification of sensitive habitats and plant communities. A map of sensitive areas along the proposed alignment was to be provided.
- If any wetlands were found on site, the presence of these was to be reported, although this does not constitute a wetland assessment or delineation.

Limitations

There were no major limitations. All attempts were made to cover the entire study area at a similar degree of detail. However, due to the fact that the study constituted a single survey in one season it is unlikely that all species that occur on site were located. It was, however, possible to cover the site in some detail during the field survey.

DESCRIPTION OF STUDY AREA

Study area

Location

The site of the proposed Jabulani development is situated in Soweto (Jabulani) adjacent to the Inhlazane railway station slightly to the west of the centre of Soweto (Figure 1). The site is north-west of this siding and railway line and covers most of the remaining open space in this part of Jabulani. There is a reservoir at the top of the hill on the site and a recently constructed shopping centre on the lower western boundary. There is a main road cutting through the site from west to east and some existing buildings within the site (Figure 2). The approximate centre point of the site is at 26.24805° South and longitude 27.86057° East. The study areas falls on the boundary of the quarter degree squares 2627 BB and 2627BD.

Topography

The site is moderately undulating and slopes primarily in a south-easterly direction (towards the railway line), but also northwards from the water reservoir. Aspects therefore vary primarily from south-east to north. The site varies in elevation from approximately 1640–1666 m, the steepest point being close to the water reservoir at the top of the hill and the lowest

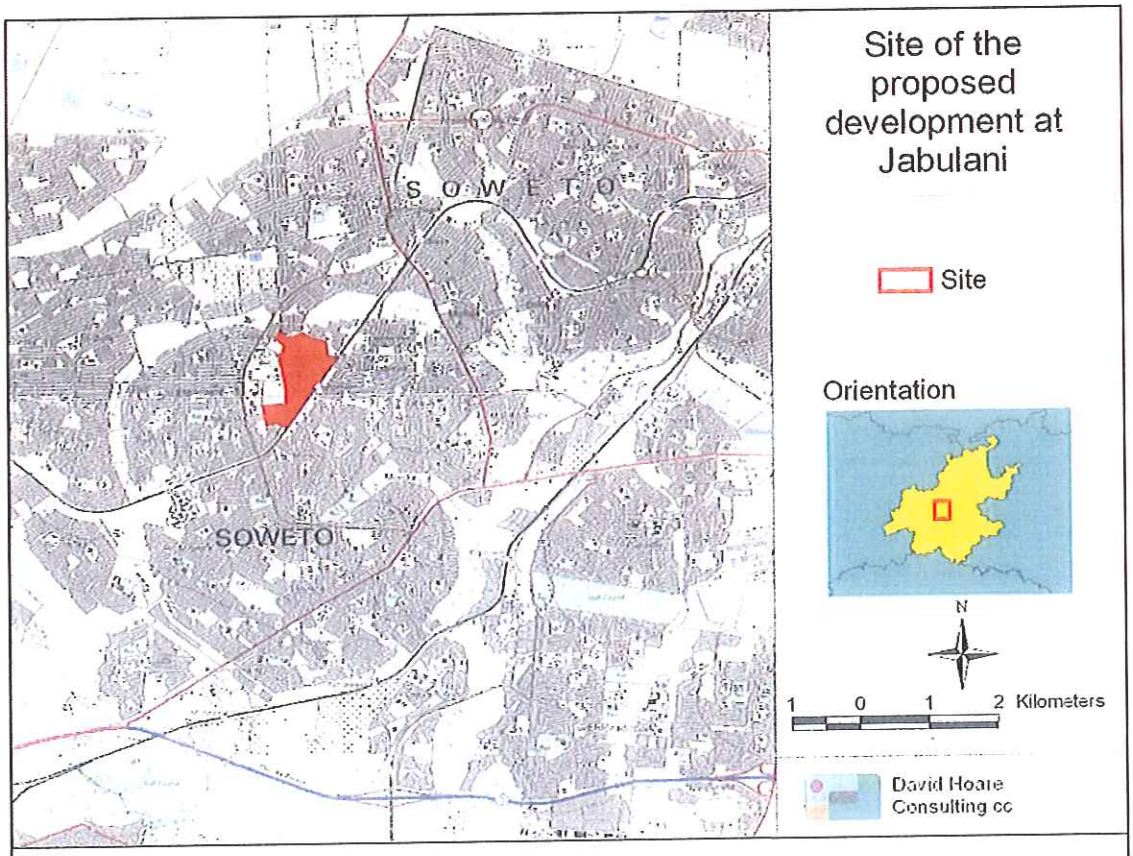

Figure 1: Location of site within Soweto.

point being along the railway line. This is a climb of 26 m over a distance of about 500 m (a 1:20 gradient). There are no major drainage lines or valleys on site. From the top of the hill (at the water reservoir) northwards is an area with scattered low rock outcrops (Figure 2).

Geology, soils and rainfall

The geology of the study area consists of one main type, Klipriviersberg Group, Ventersdorp Formation of the Randian Era, consisting primarily of andesite and tuff. Andesites are mostly dark-coloured volcanic rocks which are typically porphyritic (containing larger crystals set in a fine groundmass). They are fine-grained. These andesites often form the ridges found in the southern parts of greater Johannesburg and are relatively hard. Tuff is a type of rock consisting of consolidated volcanic ash ejected from vents during a volcanic eruption. Their fragments are of all sizes from huge blocks down to minute granular dust. The cavities are filled up with many secondary minerals, such as calcite, chlorite or quartz. The high point on the site, at the water reservoir, is probably andesite, with the surrounding areas possibly consisting of either or both rock types.

The soils of the highest points in the landscape are shallow and stony. Lower slopes tend to have deeper soils. The land type of the site, which is an area with largely uniform soils,

Figure 2: Aerial photograph of site.

topography and climate, is the Ba land type (Land Type Survey Staff, 1987). The rainfall in the study area is approximately 670 mm per annum and occurs mainly in the summer (Dent et al. 1989).

Landuse and landcover

The entire site is surrounded by dense urban residential suburbs and a shopping centre (Figure 2). The site is mostly open land, although this has been impacted upon by surrounding landcover. There is a main road running from west to east across the site (Figure 2). This provides access to a small sports stadium, a warehouse, the railway station and some commercial buildings and residential dwellings, all of which occur on site. The only other infrastructure on site is the water reservoir and water tower at the top of the hill. The opne land consists of remnant patches of grassland in various states of degradation and transformation.

Vegetation, biogeography and conservation value

There are three general descriptions of the vegetation in the study area. Acocks (1953) published the first comprehensive description of the vegetation of South Africa, which was updated in 1988. This was followed by an attempted improvement (Low & Rebelo 1998) which became widely used due to the inclusion of conservation evaluations for each vegetation type, but is often less rigorous than Acocks's original publication. Recently, a more detailed map of the country was produced (Mucina *et al.*, 2005). A companion guide to this map (Mucina & Rutherford 2006), containing up-to-date species information and a comprehensive conservation assessment of all vegetation types, has just been published. The classification of the vegetation according to the most recent publication is given below.

According to this most recent vegetation map of the country the study area falls within **Tsakane Clay Grassland**, which is considered to be Endangered, with 1.5% protected of a target of 24% and more than 60% is considered to be transformed, mostly by cultivation, urbanization, roads, building of dams and mining (Mucina & Rutherford, 2006). The topography of the site is typical of Tsakane Clay Grassland, which is described as flat to slightly undulating plains and hills (Mucina *et al.*, 2006). According to Mucina et al. (2006), Tsakane Clay Grassland is a short, dense grassland occurring on flat to slightly undulating plains and low hills. On the basis of updated field data the publication describes this grassland as being characterized by the presence of the grass species, *Brachiaria serrata*, *Cynodon dactylon*, *C. hirsutus*, *Digitaria ternata*, *Elionurus muticus*, *Eragrostis chloromelas*, *E. patentipilosa*, *E. plana*, *E. racemosa*, *Heteropogon contortus*, *Hyparrhenia hirta*, *Microchloa caffra*, *Setaria sphacelata*, *Themeda triandra*, *Trachypogon spicatus*, *Abildgaardia ovata*, *Andropogon schirensis*, *Cymbopogon caesius*, *Diheteropogon amplectens*, *Melinis nerviglumis*,

Panicum gilvum, *Setaria nigrirostris*, the herbs, *Acanthospermum australe*, *Ajuga ophrydis*, *Eriosema salignum*, *Euryops transvaalensis* subsp. *transvaalensis*, *Gerbera viridifolia*, *Helichrysum nudifolium* var. *nudifolium*, *H. rugulosum*, *Hermannia depressa*, *Lotononis macrosepala*, *Nidorella hottentotica*, *Pentanisia prunelloides* subsp. *latifolia*, *Peucedanum caffrum*, *Rotheca hirsuta*, *Selago paniculata*, *Senecio coronatus*, *S. inornatus*, *Sonchus nanus*, *Vernonia oligocephala*, *Aspidoglossum ovalifolium*, *Hypoxis rigidula* var. *pilosissima* and *Striga asiatica*, and the low shrubs, *Anthospermum rigidum* subsp. *pumilum*, *Chaetacanthus setiger*, *Tephrosia capensis* var. *acutifolia* and *Thesium impeditum*.

Besides the broad descriptions of Acocks (1988) and Low and Rebelo (1998), the vegetation of the Ba and Ib landtypes in this area has been studied in detail by Coetzee et al. (1994a, 1994b, 1995) and there have been a number of other local studies (e.g. Grobler 2000 as well as various unpublished studies). There is therefore some published information that can be used to place the current study area in context. However, much of this data has been collected at different intensities and scales over a wide area and doesn't provide site-specific information on the current study area (Mucina et al. 2000).

METHODOLOGY

Vegetation survey

The fieldwork component of this survey was conducted on the 30th of April 2009. The vegetation survey was done with the use of a hand-held GPS receiver to mark features of interest, 1:50 000 topographic maps and available aerial photographs for the study area. Vegetation was first stratified into homogenous units on the basis of physiognomy (vegetation structure and texture) using aerial photography obtained from the Google Earth website (http://earth.google.com). The delineated units were surveyed in the field.

Due to the generally transformed and/or disturbed nature of the site, no detailed quantitative data was collected. Checklists of plant species were compiled by traversing the study area on foot and recording species as they were encountered. Plant names follow Germishuizen et al. (2005). All exotic species categorised as alien invaders or weeds (as listed in amendments to Conservation of Agricultural Resources Act, 1983, Act No. 43 of 1983) were recorded. Due to the brief duration of the survey, the species list provided for the area can not be regarded as comprehensive, but is nevertheless likely to include the majority of the dominant and common species present.

Red Data plant species

Lists of historical occurrences of Threatened and Orange List plant species were obtained from GDACE for the site within the quarter degree square 2627 BB and BD. For all threatened plants that occur in the general geographical area of the site, a rating of the likelihood of it occurring on site is given as follows:

- LOW: no suitable habitats occur on site / habitats on site do not match habitat description for species;
- MEDIUM: habitats on site match general habitat description for species (e.g. grassland), but detailed microhabitat requirements (e.g. rocky grassland on shallow soils overlying dolomite) are absent on the site or are unknown from the descriptions given in the literature or from the authorities;
- HIGH: habitats found on site match very strongly the general and microhabitat description for the species (e.g. rocky grassland on shallow soils overlying dolomite);
- DEFINITE: species found on site.

Sensitivity assessment

The assessment of sensitivity on site follows the guidelines provided by GDACE in the section on Sensitivity Mapping Rules for Biodiversity Assessments in the GDACE document on

"Guidelines for Biodiversity Assessments". As per these guidelines, examples of sensitive features that may be found on site and the mapping rules are given in the table below:

Biodiversity element	Sensitivity mapping rule
River/stream	Stream + 100 m buffer zone (outside urban edge) from the edge of the riparian zone as determined according to DWAF guidelines
Wetland	Wetland + 50 m buffer zone extending from edge of wetland temporary zone
Primary vegetation classified as Endangered (SANBI VegMap)	Extent of vegetation type in moderate to good condition
Primary vegetation suitable as habitat for Red or Orange List plant species	Extent of vegetation type in moderate to good condition
Primary vegetation suitable as habitat for Red List bird or animal species	Extent of vegetation type in moderate to good condition

Information from GDACE's C-Plan version 2 as well relevant legislation, policies and Provincial guidelines was used to provide additional information on the conservation value of features within the study area.

Assumptions, uncertainties and gaps in knowledge

1. Assume databases and literature sources are adequate for determining the possible presence of threatened species. These often depend on good geographical coverage of species observations, which is seldom the case.
2. Assume species threatened status has been correctly determined and that no other species should be on the Red Lists.

Limitations

1. This report has been prepared on the strengths of the information available at the time of the assessment. The major reference works consulted is included in the reference list. There is sufficient base line information available in the literature for the area and hence the availability of baseline information was not considered a constraint.
2. There were no financial or confidentiality constraints.
3. Descriptions of vegetation are based primarily on a site visit on 30 April 2009 in combination with a literature review. Sufficient published information is available for the study area and the surveys provided sufficient site-specific information. There were, therefore, no biophysical constraints.

Exclusions

This study reports on flora and vegetation within habitats on site. Fauna is not considered in this study. Wetlands are mentioned, if they obviously occur, but this study does not constitute a wetland or riparian delineation.

RESULTS

The following section provides a description of the floristic environment that may be affected by the proposed development. This description includes patterns of flora and vegetation within the study area.

Vegetation and flora

The remaining natural vegetation on site is mostly grassland and disturbed grassland, as well as some rocky areas with low woodland and some bare areas. The most important landcover features are visible on the habitat map of the site (Figure 3).

A plant species list of species recorded during the survey is provided in Appendix 1. A total of 75 species were recorded during this survey, of which 18 are alien or naturalized exotic species. Four of these alien or exotic species are declared weeds or invader plants. The proportion of exotic and declared weeds or invader species is high (24%), a reflection of high

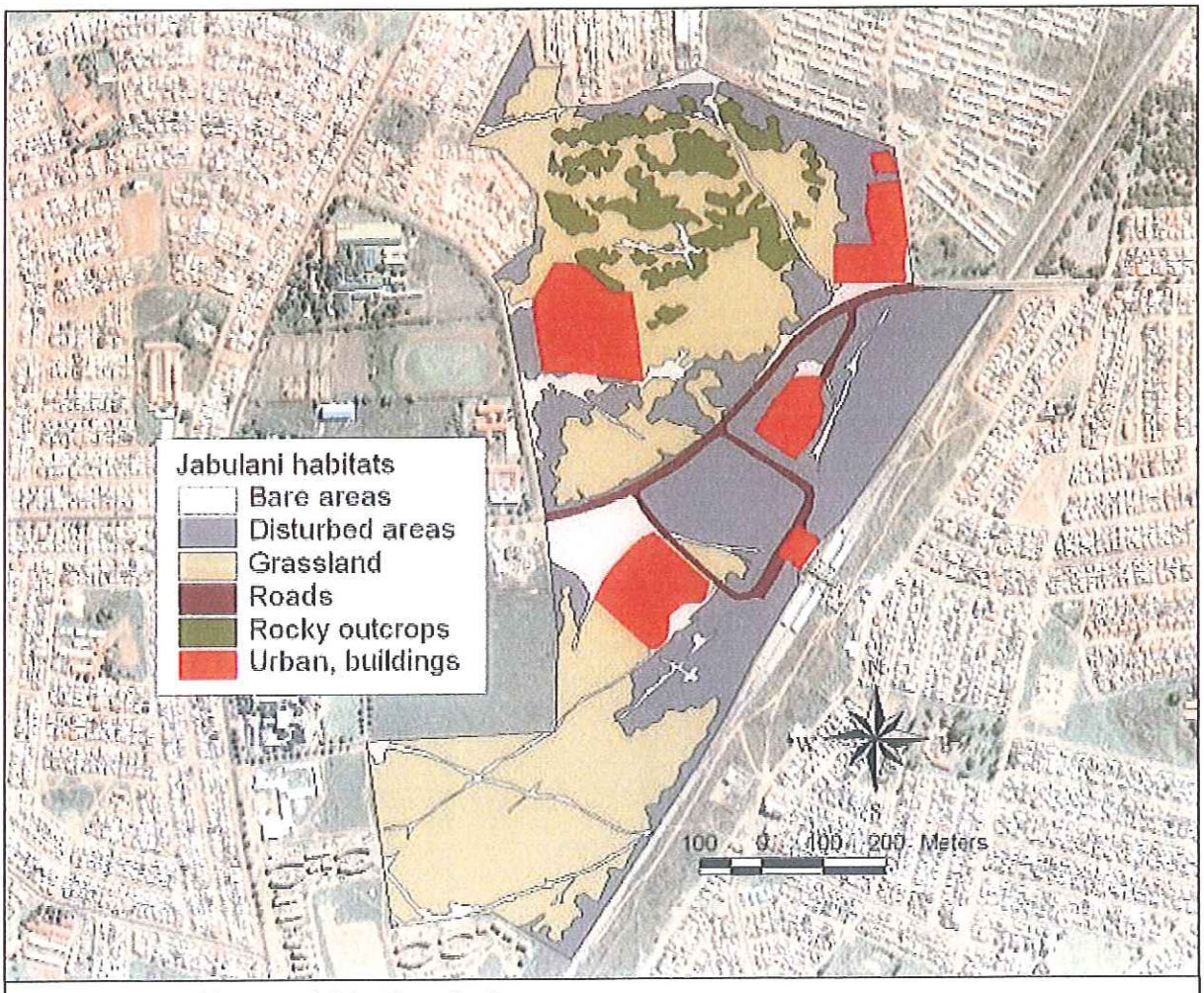

Figure 3: Habitats within the study area.

levels of disturbance and transformation on site. Of the indigenous species, 11 (15%) are considered to be indigenous weeds of disturbed places. Of the indigenous species, nine are woody species associated with rocky outcrops and at least four are herbaceous grass or forb species associated with the same habitat. There are 24 indigenous species representative of grasslands on site.

Four declared weeds or invader species were recorded during this survey (Appendix 1). The declared weeds and invaders recorded in the study area were *Pennisetum clandestinum** (proposed declared weeds), *Datura stramonium** and *Cirsium vulgare** (Declared weeds category 1) and *Pinus* species* (Declared invaders category 2).

The site occurs within the Tsakane Clay Grassland vegetation type. The species composition given in Mucina et al. (2006) provides some indication of what to expect on a site within this vegetation type (see Introduction above). The current site contains grassland in various stages of disturbance, but with relatively representative species composition relative to that expected in intact Tsakane Clay Grassland. The site is therefore a moderate example of this vegetation type.

The site can be classified into homogenous habitat areas based on the landcover and vegetation. A map of the classified site is given in Figure 3. This shows that most of the site consists of grassland and disturbed areas, along with rocky outcrops, bare ground and built-up areas. There are also roads crossing the site. The approximate areas taken up by each of the main landcover types is given in Table 1. Each main habitat type is described in a bit more detail below.

Table 1: Landcover areas on site.

Landcover	Area (ha)
Grassland	27.78
Disturbed areas	20.64
Urban, buildings	6.67
Bare areas	5.36
Rocky outcrops	4.81
Roads	1.64
TOTAL	66.90

Grassland

Natural grassland is the most extensive landcover type on site. It is found throughout the site, but in two main blocks, one in the north and one in the south (Figure 3). It is in moderate to poor condition and is disturbed by human and vehicle traffic and probably grazed heavily by

domestic livestock. Imbedded within the northern block of grassland are a number of low rocky outcrops. This area is near the summit of the low hill dominating the site and has relatively shallow soils and gravely surface in places (Figure 4 and 5). The southern block of grasslands is on slightly deeper soils, but is criss-crossed by pathways and tracks and surrounded by various disturbances.

Plant species occurring commonly in these areas include the dwarf shrub, *Stoebe vulgaris*, the grasses *Eragrostis chloromelas*, *Cymbopogon excavatus*, *Brachiaria serrata*, *Cynodon dactylon*, *Aristida congesta*, *Eragrostis curvula*, *Heteropogon contortus*, *Melinis repens*, *Themeda triandra* and *Hyparrhenia hirta* and the forbs, *Ledebouria ovatifolia*, *Crabbea angustifolia*, *Helichrysum rugulosum*, *Hermannia depressa*, *Becium obovatum*, *Felicia muricata*, *Acalypha caperonioides* and *Anthospermum rigidum*. The species richness is moderate for grasslands, but matches the general description for this vegetation type (Tsakane Clay Grassland) to a reasonable degree (see "Vegetation, biogeography and conservation value" section above).

Rocky outcrops

Low rocky outcrops are found at the summit of the hill around the water tower and reservoir (Figure 3). The vegetation consists primarily of multi-stemmed low shrubs growing upon and

Figure 4: Grassland on site.

among the rocks (Figure 5). The woody vegetation is in relatively poor condition and appears to have been disturbed a lot and harvested for fire-wood.

Plant species occurring commonly in these areas include the shrubs and trees, *Acacia caffra*, *Acacia karroo*, *Celtis africana*, *Diospyros austro-africanus*, *Diospyros lycioides*, *Ehretia rigida*, *Gymnosporia buxifolia*, *Rhus lancea* and *Rhus discolor*, the grasses *Aristida congesta*, *Brachiaria serrata*, *Heteropogon contortus*, and *Melinis repens* and the forbs, *Bidens pilosa*, *Bidens bipinnata*, *Conyza canadensis*, *Leonotus leonurus*, *Tagetes minuta* and *Verbena bonariensis*. The species richness is not high, but is typical for rock outcrops such as these.

Disturbed areas

Disturbed areas are found along most of the boundaries of the site and boundaries between natural vegetation and man-made infrastructure. There is a large area of disturbed habitat in the centre of the study area (Figure 3). The disturbed areas are parts of the site in which vegetation still occurs, but it has been disturbed to an extent where the natural character has been lost and the natural species composition is dominated by weeds and weedy species.

Plant species occurring commonly in these areas include the grasses *Cynodon dactylon*,

Figure 5: Rocky outcrops on site surrounded by grassland on shallow soil.

Figure 6: Disturbed areas on site vegetated by weeds and grasses.

Aristida congesta, *Brachiaria eruciformis*, *Chloris virgata*, *Paspalum dilatatum**, *Pennisetum clandestinum**, *Sporobolus africanus* and *Hyparrhenia hirta* and the forbs, *Alternanthera pungens**, *Bidens pilosa**, *Bidens bipinnata**, *Conyza canadensis**, *Conyza podocephala*, *Cosmos bipinnata**, *Datura stramonium**, *Gomphrena celosioides**, *Nidorella hottentotta*, *Oxalis corniculata**, *Plantago lanceolata**, *Pseudognaphalium oligandrum**, *Schkuhria pinnata**, *Solanum sisymbriifolium**, *Tagetes minuta** and *Verbena bonariensis**. Many of these are exotic weeds, some of which are declared weeds or invader plants.

Red List Plant Species

The objective of this section was to compile a list of plant species for which there is conservation concern that may be affected by the proposed infrastructure. This includes threatened, rare, declining and protected plant species.

Lists of plant species previously recorded in the quarter degree grid in which the study area is situated were obtained from GDACE. This list contains 10 species, listed in Appendix 2 together with their conservation status categories according to the IUCN Version 3.1 criteria (IUCN, 2001). Relevant information, such as habitat, flowering time, etc., is given for all

species listed. Two of these species are classified as Endangered, three as Vulnerable, two as Near Threatened, two as Declining and one as Data Deficient (see Table 2 for explanation of categories).

Table 2: Explanation of IUCN Ver. 3.1 categories (IUCN, 2001), and Orange List categories (Victor & Keith, 2004).

IUCN category	Definition	Class
EX	Extinct	Extinct
CR	Critically Endangered	Threatened
EN	Endangered	Threatened
VU	Vulnerable	Threatened
NT	Near Threatened	Orange List
LC (Declining)	Least Concern, declining taxa	Orange List
LC (Rare)	Least Concern, rare	Orange List
LC (Critically Rare)	Least Concern, rare: only one subpopulation	Orange List
LC (Rare-Sparse)	Least Concern, rare: widely distributed but rare	Orange List
DDD	Data Deficient: well known but not enough information for assessment	Orange List
DDT	Data Deficient: taxonomic problems	Data Deficient
DDX	Data Deficient: unknown species	Data Deficient
LC	Least Concern	Least Concern

According to GDACE records, one of the species listed in Appendix 2 has been previously recorded in Soweto within 5 km of the site and therefore has a high chance of occurring on site if suitable habitat is found there.

On the basis of habitat preferences the 10 species could be allocated to habitats where they are most likely to be found. On the basis of information provided by GDACE, two species were considered to have a medium or high chance of occurring in the type of habitats available on site. Of these, one is classified as Declining and one as Data Deficient. These species are discussed in more detail below in order to evaluate the risk of them occurring on site in places where they may be affected by the proposed infrastructure.

A Data Deficient species, *Lepidium mossii*, was assessed as having a high chance of occurring on site due to the fact that the habitat conditions are similar to those described for the species and the plant has been historically recorded nearby (4.5 km from the site). This is a poorly known species with possible taxonomic uncertainty, since it is possible that the type specimen (the only specimen in existence) is of hybrid origin (Victor, J.E. & Winter, P.J.D. SANBI, personal communication, 2008). There is insufficient information to assess the likelihood of occurrence with any level of confidence. Only one specimen has been previously collected in South Africa (at Nancefield station in Soweto, 4.5 km from the site at Jabulani). Extensive searches for the species at the type locality and surrounds have been unsuccessful in relocating the original population or any others (L. Mills, GDACE, personal communication,

2009). A type specimen for this species held at Zurich Herbarium, Switzerland, lists the specimen as a ruderal plant. Other members of the genus *Lepidium* are considered to be ruderal weeds of disturbed places. Solely on the basis of this information, it is considered possible that the species could occur on site due to the disturbed nature of the vegetation on the site, and therefore a thorough survey of the site was undertaken. No plants of the genus *Lepidium* were found on site during the survey.

One Declining species that was considered to possibly occur on site (*Hypoxis hemerocallidea*) is a conspicuous plant that would have been observed it occurred there. *Hypoxis hemerocallidea* also occurs in marshy or moist areas, which were not present on site. Despite a careful search of all available habitat, no plants resembling this species was found and it is considered unlikely that it occurs on site.

According to the GDACE Threatened Species Policy, there are three basic rules of conservation that apply to populations of Red List Plant Species, as follows:

1. All populations of Near Threatened and Threatened plant taxa must be conserved *in situ*.
2. All populations of Near Threatened and Threatened plant taxa must be protected with a buffer zone in accordance with guidelines as set out in the Policy.
3. An Ecological Management Plan must be compiled in respect of all actions that affect populations of Red List Plant Species, and such Ecological Management Plans must conform to the Guidelines.

Should any Red List plant species be recorded on site then these guidelines would apply.

Sensitivity assessment

The sensitivity assessment is an attempt to identify those parts of the study area that may have high conservation value or that may be sensitive to disturbance. Areas containing untransformed natural vegetation, high diversity or habitat complexity, Red List organisms or systems vital to sustaining ecological functions are considered sensitive. In contrast, any transformed area that has no importance for the functioning of ecosystems is considered to have low sensitivity. Information from GDACE's C-Plan version 2 in conjunction with observations made in the field was used to provide information on the location of sensitive features.

According to C-plan version 2 (GDACE 2006) there are some sensitive features in and around the study area, as follows:

1. parts of the site are classified as "Important" because they are considered to contain

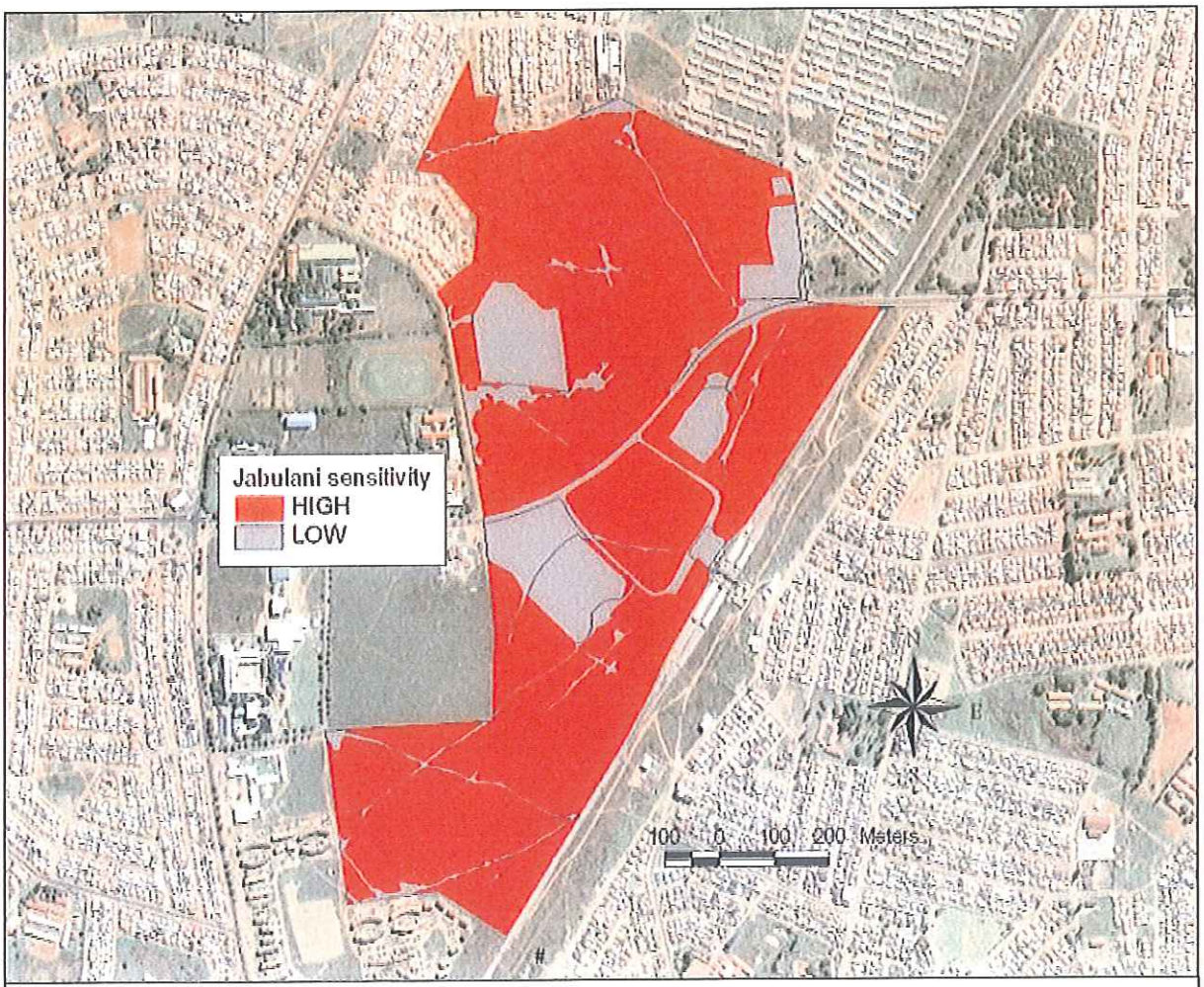

Figure 7: Vegetation sensitivity on site (see text for explanation).

primary natural vegetation which is also historical locality for a Red List plant species and is considered to be suitable habitat for a Red List plant species.

Additional requirements, as per GDACE Departmental policies and other environmental legislation are as follows:

1. The GDACE "Requirements for Biodiversity Assessments" stipulate that all untransformed grasslands have to be classified as having high sensitivity. Some of the vegetation on site is grassland.

This information was used to compile the sensitivity map (Figure 5). On the basis of current information and the requirements of all the above guidelines, policies and Acts, approximately 80% of the site is classified as having High sensitivity and 20% is classified as having Low sensitivity. A summary of the factors used to classify the different habitats is given in Table 3.

Table 3: Factors contributing to sensitivity classification of different habitats on site.

Vegetation/habitat type	Sensitivity	Reason
Grassland	High	• Primary grassland vegetation - according to GDACE Policy, must be classified as having high sensitivity. • endangered vegetation type (Tsakane Clay Grassland). • Habitat suitable for Red or Orange List plant species, including *Lepidium mossii*. • According to GDACE, falls within the buffer areas for an Orange List plant species.
Rocky outcrops	High	• Considered to be a plant community imbedded within a grassland vegetation type. Primary grassland vegetation, according to GDACE Policy, must be classified as having high sensitivity. • endangered vegetation type (Tsakane Clay Grassland). • According to GDACE, falls within the buffer areas for an Orange List plant species.
Degraded areas	High	• potential habitat for Orange List plant species. • According to GDACE, falls within the buffer areas for an Orange List plant species.

The proposed development falls within buffer zone defined by GDACE to protect a population of a Data Deficient plant species. The site is approximately 4.5 km from a site where a Data Deficient plant species has been previously collected. According to information obtained from GDACE, the site falls within a the buffer zone for this species, which means that any development of suitable habitat on site infringes on this buffer zone. The distribution of these areas is shown in Figure 7.

DISCUSSION

The requirements of this study were to undertake a specialist study to describe the vegetation and flora of the site with special reference to one plant species of possible conservation concern, and to confirm whether or not there are wetlands on site. A vegetation assessment was undertaken and the site was surveyed for plant species of conservation concern (Red or Orange List species).

Two natural plant communities and one degraded habitat were identified on site in the vegetation study (Figure 3). The natural vegetation on site consists of patches of grassland and rocky outcrops with low woodland, both of which occur within a vegetation type that is classified as an Endangered habitat, namely Tsakane Clay Grassland. In addition, GDACE policy protects any remaining areas of natural grassland and it is compulsory under this policy to designate grassland areas as being sensitive. Remaining areas of grassland on site is therefore classified as having HIGH sensitivity independently of any other factors.

On the basis of historical distribution records, the availability of habitat on site and the basic habitat descriptions for Red and/or Orange List species provided by GDACE, two species were considered to have a high chance of occurring in the types of habitats found on the site (Appendix 2). These species were carefully searched for during the field survey. The Declining species (*Hypoxis hemerocallidea*) was not encountered during the survey and it is considered unlikely that it occurs on site (see "Results" section). There is, however, suitable habitat for a Data Deficient plant species that has been previously recorded in Soweto.

A significant part of the site is in poor condition and is considered to be degraded. Such degraded habitat is, however, considered to be suitable habitat for the Data Deficient plant species that could occur on site. According to data from GDACE, the entire site falls within the buffer zone of this plant species and all suitable habitat for this species should, therefore, be designated as sensitive. All suitable habitat for this species is therefore classified as having HIGH sensitivity independently of any other factors, but this needs to be contested. Since the existence of this species is questionable, being either extinct or of hybrid origin (and thus, classified by both SANBI and GDACE as DDT) it is injudicious to classify habitat suitable for this species as having HIGH sensitivity (especially since *Lepidium* species are ruderal weeds in degraded habitat).

Further factors need to be taken into consideration in interpreting information concerning the Data Deficient plant species. The species has only ever been collected on one occasion. It was found at Nancefield station in Soweto, 4.5 km from the site at Jabulani. According to GDACE

policy, a maximum buffer zone of 600 m is required for the highest priority Red List plant species within a rural area. The site at Jabulani is 4500 m from the nearest known location of this species and is within an urban area. Although the site at Jabulani may contain suitable habitat for this species, searches during the current study and by GDACE's own staff have failed to locate any populations of this species at Jabulani, and it has therefore been confirmed that it does not occur there. According to staff at the National Herbarium at SANBI, the species is probably a hybrid between two common *Ledidium* species, both of which are widespread weedy plants (see section above on "Red List Plant Species"). There is therefore some uncertainty about the taxonomic status of this species.

No wetland habitats were identified on site, which is not unexpected since most of the site is located near the summit of a low hill.

RECOMMENDATIONS

The following is recommended:

- GDACE needs to revise their C-plan with respect to the fact that the site at Jabulani does not fall within the buffer zone of a plant species of conservation concern, since it is 4,5 km from the nearest population of this species (coupled with the fact that it is not a Red List species)

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APPENDIX 1: Preliminary checklist of plant species recorded.
Species marked with an asterisk are naturalized exotics. Species taxonomy is according to Germishuizen and Meyer (2001).

Acacia caffra
Acacia karroo
Acalypha caperonioides
Alloteropsis semialata
Alternanthera pungens*
Anthospermum rigidum
Aristida congesta subsp. congesta
Aster harveyanus
Becium obovatum
Bidens bipinnata*
Bidens pilosa*
Brachiaria eruciformis
Brachiaria serrata
Celtis africana
Chloris virgata
Cirsium vulgare* (Declared weed category 1)
Convolvulus species
Conyza canadensis*
Conyza podocephala
Cosmos bipinnata*
Crabbea angustifolia
Cymbopogon excavatus
Cynodon dactylon
Datura stramonium* (Declared weed category 1)
Diospyros austro-africanus
Diospyros lycioides
Ehretia rigida
Elionurus muticus
Eragrostis chloromelas
Eragrostis curvula
Felicia muricata
Gomphrena celosioides*
Gymnosporia buxifolia
Helichrysum nudifolium
Helichrysum rugulosum
Hemizygia pretoriae
Hermannia depressa
Heteropogon contortus
Hyparrhenia dregeana
Hyparrhenia hirta
Indigofera species
Lactuca inermis
Ledebouria ovatifolia
Leonotus leonurus
Lotononis calycina
Melinis repens
Melolobium wilmsii
Monsonia angustifolia
Nidorella hottentotta

Oenothera tetraptera*	
Oxalis corniculata*	
Paspalum dilatatum*	
Pennisetum clandestinum*	(Proposed declared invader)
Peucadanum magalismontanum	
Pinus species*	(Declared invader category 2)
Plantago lanceolata*	
Pollichia campestris	
Polygala hottentotta	
Pseudognaphalium oligandrum	
Rhus dentata	
Rhus discolor	
Rhus lancea	
Rhynchosia caribaea	
Schkuhria pinnata*	
Senecio pentactinus	
Solanum sisymbriifolium*	
Sporobolus africana	
Stoebe vulgaris	
Tagetes minuta*	
Tephrosia capensis	
Themeda triandra	
Verbena bonariensis*	
Vernonia oligocephala	
Wahlenbergia undulata	
Ziziphus zeyheriana	

[1] Extracted from Henderson (2001). Legal Status is as stipulated in 'Conservation of Agricultural Resources Act' (Act 43 of the Republic of South Africa 1983), as amended in 2001. In terms of this Act 198 alien species were listed as declared weeds and invaders and ascribed to one of the following categories:

- **Category 1:** Prohibited and must be controlled.
- **Category 2** (commercially used plants): May be grown in demarcated areas provided that there is a permit and that steps are taken to prevent their spread.
- **Category 3** (ornamentally used plants): May no longer be planted. Existing plants may be retained as long as all reasonable steps are taken to prevent the spreading thereof, except within the flood line of watercourses and wetlands.

APPENDIX 2: Red Data plant species previously recorded in the quarter degree grid 2627 BB and 2627BD.

CONFIDENTIAL: GDACE conditions for use of this data include that this list be treated as confidential and may not be attached to any document available for public perusal. Species names may not appear in the main document.

Taxon	Latest (IUCN version 3.1) Conservation Status**	Habitat	Flowering Time	Probability of occurrence*
Aloe peglerae	Endangered (EN)	Grassland, in shallow, gravelly quartzitic soils on rocky north-facing slopes or summits of ridges..	July-August	LOW, no suitable habitat, geology does not match
Cineraria longipes	Vulnerable (VU)	Grassland, on koppies, amongst rocks and along seepage lines, exclusively on basalt on south-facing slopes.	March–May	LOW, geology not basalt
Dioscorea sylvatica	Vulnerable (VU)	Wooded places with fair to reasonably good rainfall, such as the moister bushveld areas, coastal bush and wooded mountain kloofs.	October-January	LOW, no suitable habitat
Habenaria mossii	Endangered (EN)	Open grassland on dolomite or in black sandy soil.	March–April	LOW, geology and soils do not match
Holothrix randii	Near Threatened (NT)	Grassy slopes and rock ledges, usually southern aspects.	September-January	LOW, habitat unsuitable
Hypoxis hemerocallidea	Declining	Grassland and mixed woodland.	January-March	**HIGH**
Lepidium mossii	Data deficient (DD)	Unknown. All other *Lepidiums* in SA are ruderal weeds. Type specimen of *L. mossii* in Zurich herbarium is listed as ruderal.	Unknown, likely December–February	**HIGH**
Lithops leslei subsp. *leslei*	Declining	Brown shale on hilltops.	March–April	LOW, no suitable habitat, geology does not match
Melolobium subspicatum	Vulnerable (VU)	Grassland. Found on dolomitic substrates.	September-May	LOW, geology does not match
Trachyandra erythrorrhiza	Near Threatened (NT)	Marshy areas, grassland, usually in black turf marshes.	September–November	LOW, habitat does not match

** Status according to GDACE list of Red and Orange list plants and the Threatened Species Programme of the South African National Biodiversity Institute in Pretoria. Conservation Status Category assessment according to IUCN Ver. 3.1 (IUCN, 2001).

*Probability of occurrence, as follows: LOW – no suitable habitats occur on site / habitats on site do not match habitat description for species, MEDIUM – habitats on site match general habitat description for species (e.g. grassland), but microhabitat requirements are absent (e.g. rocky grassland on shallow soils overlying dolomite), HIGH – habitats on site match very strongly the general and microhabitat description for the species, DEFINITE – species found on site.

Appendix D2 HERITAGE REPORT

Gaigher & Associates

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Heritage Impact Assessment

HERITAGE IMPACT ASSESSMENT FOR THE PROPOSED URBAN DESIGN CBD IN JABULANI, SOWETO, GAUTENG PROVINCE.

PREPARED BY:
GAIGHER & ASSOCIATES

PREPARED FOR:
ENVIROLUTION CONSULTING (PTY) LTD

APRIL 2009

CREDIT SHEET

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STEPHAN GAIGHER

Disclaimer; *Although all possible care is taken to identify all sites of cultural importance during the investigation of study areas, it is always possible that hidden or sub-surface sites could be overlooked during the study. GAIGHER & ASSOCIATES and its personnel will not be held liable for such oversights or for costs incurred as a result of such oversights.*

SIGNED OFF BY: STEPHAN GAIGHER

MANAGEMENT SUMMARY

Site name and location: Proposed construction of an urban design CBD in Jabulani, Soweto, Gauteng Province.

Magisterial district: City of Johannesburg Municipality

Developer: SAFRICH

Consultant: GAIGHER & ASSOCIATES, PO Box 522, Louis Trichardt, 0920, South Africa

Date development was mooted: January 2009

Date of Report: 23 April 2009

Proposed date of commencement of development: May 2009

Findings: No sites were identified on the surface of the study areas. The possibility of sub-surface sites should be taken into consideration during the construction process.

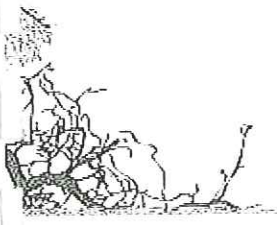


TABLE OF CONTENTS

List of Figures, Tables & Appendices

Chapter 1

PROJECT RESOURCES

HERITAGE IMPACT ASSESSMENT (HIA)

PROPOSED CONSTRUCTION OF AN URBAN DESIGN CBD IN JABULANI, SOWETO, GAUTENG PROVINCE.

INTRODUCTION

Gaigher & Associates was contracted by Envirolution Consulting (Pty) Ltd to conduct a Heritage Impact Assessment (HIA) on the proposed construction of an urban design CBD in Jabulani, Soweto, Gauteng Province.

This HIA forms part of the Environmental Impact Assessment (EIA) as required by the National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998), the Minerals & Petroleum Resources Development Act, 28 of 2002 and the Development Facilitation Act (DFA), 67 of 1995. The HIA is performed in accordance with section 38 of the National Heritage Resources Act (NHRA), 25 of 1999 and is intended for submission to the South African Heritage Resources Agency (SAHRA).

Qualified personnel from Gaigher & Associates conducted the assessment. The team comprised a Principal Investigator with a minimum of an Honours degree in an applicable science as well as at least five years of field experience in heritage management assisted by a fieldworker with at least a BA degree in an applicable science. All of our employees are also registered members of the Association of South African Professional Archaeologists (ASAPA).

A member of Gaigher & Associates performed the assessment on 20 May 2009.

The indicted study area was investigated for signs of sites with any heritage significance. Any sites identified were plotted using a Global Positioning System (GPS) using the WGS 84 datum and photographed digitally. The sites were surveyed on foot and by vehicle.

All results will be relayed in this report, firstly outlining the methodology used and then the results and recommendations for the identified resources.

PROPOSED PROJECT

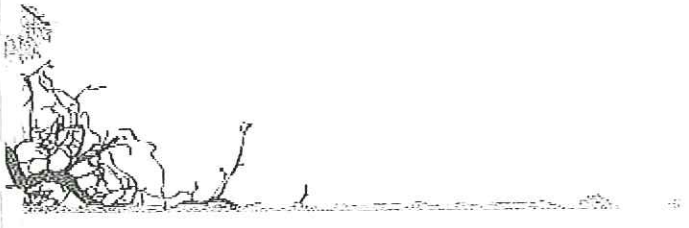
SAFRICH is proposing the development of a urban design CBD in Jabulani, Soweto, Gauteng

After researching the National Archive records as well as the SAHRA records it was determined that no information is available concerning previous archaeological or historical studies in the demarcated study area.

The project was tabled during January 2009 and the developer intends to commence as soon as possible after receipt of the ROD from the Department of Environmental Affairs.

PROJECT AREA

The study area is located within the Jabulani area, Soweto, Gauteng. The area is within a highly developed area and all the surface area has been damaged by consecutive construction and demolishing. For this reason it is unlikely that any sites of heritage significance are still to be found undamaged in the study area. There are some dilapidated buildings, but none of these seem to be of a historic nature. There is however still a marginal chance of encountering sub-surface sites during excavation activities.



The area has been subject to developments requiring deep foundation excavations and therefore even this possibility can be seen as slim. All the built environments observed were of recent nature. (See Appendix E: Location Map)

Good weather conditions were experienced during the field investigations.

Chapter 2

PROJECT RESOURCES

RESOURCE INVENTORY

This section will contain the results of the heritage site inventory. Any identified sites will be indicated on the accompanying map plotted using the ArcView Geographic Information System (GIS).

JABULANI URBAN DESIGN CBD

No sites of any heritage significance were identified within the proposed study area. As stated previously the area had been subject to much development in the past and it can be expected that most sites of heritage significance possibly located there earlier has been comprehensively destroyed. Most of the buildings located in the area, as well as the roads require deep foundation excavations and these would most probably have damaged or destroyed any heritage sites. The closest site with heritage significance is the *July 16 Memorial Park*; however this development will have no impact on this. The undeveloped areas consists of open fields with no signs of heritage significant sites.

RESOURCE EVALUATION

JABULANI URBAN DESIGN CBD

No heritage resources, or remains of any heritage resource, were identified within the indicated study area.

IMPACT IDENTIFICATION AND ASSESSMENT

JABULANI URBAN DESIGN CBD

As no sites of heritage significance was identified within the proposed study area no negative impacts are anticipated from the construction activities planned.

RESOURCE MANAGEMENT RECOMMENDATIONS

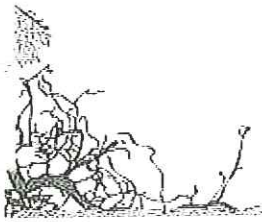
JABULANI URBAN DESIGN CBD

Although unlikely, sub-surface remains of heritage sites could still be encountered during the excavation of the foundations. Such sites would offer no surface indication of their presence due to the high state of development in the area. The following indicators of unmarked sub-surface sites could be encountered;

- Ash deposits (unnaturally grey appearance of soil compared to the surrounding substrate)
- Bone concentrations, either animal or human
- Ceramic fragments such as pottery shards either historic or pre-contact
- Stone concentrations of any formal nature

Although no sites of heritage significance were identified within the proposed study area, the following recommendations are given should any sub-surface remains of heritage sites be identified as indicated above;

- All operators of excavation equipment should be made aware of the possibility of the occurrence of sub-surface heritage features and the following procedures should they be encountered.
- All construction in the immediate vicinity (50m radius of the site should cease).



- The heritage practitioner should be informed as soon as possible.
- In the event of obvious human remains the SAPS should be notified.
- Mitigative measures (such as refilling etc.) should not be attempted.
- The area in a 50m radius of the find should be cordoned off with hazard tape.
- Public access should be limited.
- The area should be placed under guard.
- No media statements should be released until such time as the heritage practitioner has had sufficient time to analyze the finds.

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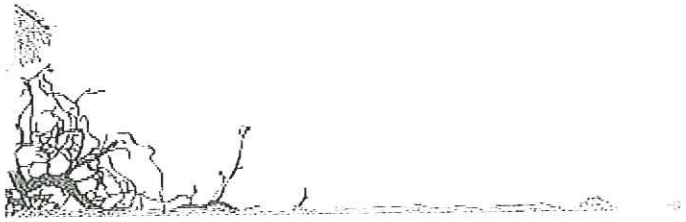

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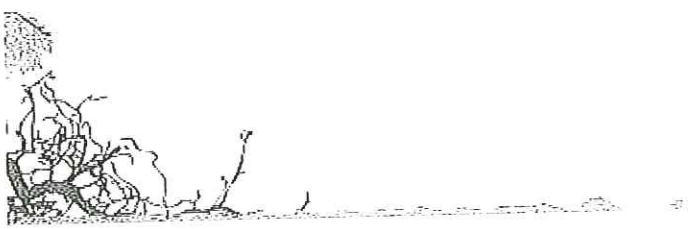


APPENDIX A

PHOTOGRAPHS

Photo 1. Study Area

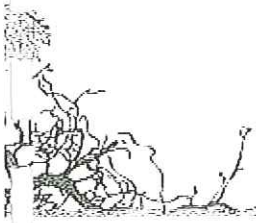
APPENDIX B

METHODOLOGY

METHODOLOGY

INVENTORY

Inventory studies involve the in-field survey and recording of archaeological resources within a proposed development area. The nature and scope of this type of study is defined primarily by the results of the overview study. In the case of site-specific developments, direct implementation of an inventory study may preclude the need for an overview.



There are a number of different methodological approaches to conducting inventory studies. Therefore, the proponent, in collaboration with the archaeological consultant, must develop an inventory plan for review and approval by the SAHRA prior to implementation (*Dincause, Dena F., H. Martin Wobst, Robert J. Hasenstab and David M. Lacy 1984)*.

Site Surveying

Site surveying is the process by which archaeological sites are located and identified on the ground. Archaeological site surveys often involve both surface inspection and subsurface testing. For the purposes of heritage investigations, *archaeological sites* refer to any site with heritage potential (i.e. historic sites, cultural sites, rock art sites etc.).

A systematic surface inspection involves a foot traverse along pre-defined linear transects which are spaced at systematic intervals across the survey area. This approach is designed to achieve representative area coverage. Alternatively, an archaeological site survey may involve a non-systematic or random walk across the survey area. Subsurface testing is an integral part of archaeological site survey. The purpose of subsurface testing, commonly called "shovel testing", is to:

(a) assist in the location of archaeological sites which are buried or obscured from the surveyor's view, and

(b) help determine the horizontal and vertical dimensions and internal structure of a site.

In this respect, subsurface testing should not be confused with evaluative testing, which is a considerably more intensive method of assessing site significance (*King, Thomas F., 1978)*.

Once a site is located, subsurface testing is conducted to record horizontal extent, depth of the cultural matrix, and degree of internal stratification. Because subsurface testing, like any form of site excavation, is destructive it should be conducted only when necessary and in moderation.

Subsurface testing is usually accomplished by shovel, although augers and core samplers are also used where conditions are suitable. Shovel test units averaging 40 square cm are generally appropriate, and are excavated to a sterile stratum (i.e. C Horizon, alluvial till, etc.).

Depending on the site survey strategy, subsurface testing is conducted systematically or randomly across the survey area. Other considerations such as test unit location, frequency, depth and interval spacing will also depend on the survey design as well as various biophysical factors. *(Lightfoot, Keng G. 1989)*.

Survey Sampling

Site survey involves the complete or partial inspection of a proposed project area for the purpose of locating archaeological or other heritage sites. Since there are many possible approaches to field survey, it is important to consider the biophysical conditions and archaeological site potential of the survey area in designing the survey strategy.

Ideally, the archaeological site inventory should be based on intensive survey of every portion of the impact area, as maximum area coverage will provide the most comprehensive understanding of archaeological and other heritage resource density and distribution. However, in many cases the size of the project area may render a complete survey impractical because of time and cost considerations.

In some situations it may be practical to intensively survey only a sample of the entire project area. Sample selection is approached systematically, based on accepted statistical sampling procedures, or judgementally, relying primarily on subjective criteria *(Butler, W., 1984)*.

Systematic Survey Sampling

A systematic sample survey is designed to locate a representative sample of archaeological or heritage resources within the project area. A statistically valid sample will allow predictions to be made regarding total resource density, distribution and variability. In systematic sample surveys it may be necessary to exempt certain areas from intensive inspection owing to excessive slope, water bodies, landslides, land ownership, land use or other factors. These areas must be explicitly defined. Areas characterized by an absence of

road access or dense vegetation should not be exempted. *(Dunnel, R.C., Dancey W.S. 1983)*.

JUDGEMENTAL SURVEY SAMPLING

Under certain circumstances, it is appropriate to survey a sample of the project area based entirely on professional judgement regarding the location of sites. Only those areas which can reasonably be expected to contain archaeological or heritage sites are surveyed.

However, a sufficient understanding of the cultural and biophysical factors which influenced or accounted for the distribution of these sites over the landscape is essential. Careful consideration must be given to ethnographic patterns of settlement, land use and resource exploitation; the kinds and distribution of aboriginal food sources; and restrictions on site location imposed by physical terrain, climatic regimes, soil chemistry or other factors. A judgemental sample survey is not desirable if statistically valid estimates of total heritage resource density and variability are required *(McManamon F.P. 1984)*.

ASSESSMENT

Assessment studies are only required where conflicts have been identified between heritage resources and a proposed development. These studies require an evaluation of the heritage resource to be impacted, as well as an assessment of project impacts. The purpose of the assessment is to provide recommendations as to the most appropriate manner in which the resource may be managed in light of the identified impacts. Management options may include alteration of proposed development plans to avoid resource impact, mitigative studies directed at retrieving resource values prior to impact, or compensation for the unavoidable loss of resource values.

It is especially important to utilize specialists at this stage of assessment. The evaluation of any archaeological resource should be performed by professionally qualified individuals.

SITE EVALUATION

Techniques utilized in evaluating the significance of a heritage site include systematic surface collecting and evaluative testing. Systematic surface collection is employed wherever archaeological remains are evident on the ground surface. However, where these sites contain buried deposits, some degree of evaluative testing is also required.

Systematic surface collection from archaeological sites should be limited, insofar as possible, to a representative sample of materials. Unless a site is exceptionally small and limited to the surface, no attempt should be made at this stage to collect all or even a major portion of the materials. Intensive surface collecting should be reserved for full scale data recovery if mitigative studies are required.

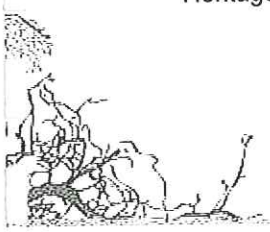
Site significance is determined following an analysis of the surface collected and/or excavated materials *(Miller, C.L. II, 1989)*.

SIGNIFICANCE CRITERIA

There are several kinds of significance, including scientific, public, ethnic, historic and economic, that need to be taken into account when evaluating heritage resources. For any site, explicit criteria are used to measure these values. Checklists of criteria for evaluating pre-contact and post-contact archaeological sites are provided in Appendix B and Appendix C. These checklists are not intended to be exhaustive or inflexible. Innovative approaches to site evaluation which emphasize quantitative analysis and objectivity are encouraged. The process used to derive a measure of relative site significance must be rigorously documented, particularly the system for ranking or weighting various evaluated criteria.

Site integrity, or the degree to which a heritage site has been impaired or disturbed as a result of past land alteration, is an important consideration in evaluating site significance. In this regard, it is important to recognize that although an archaeological site has been disturbed, it may still contain important scientific information.

Heritage resources may be of scientific value in two respects. The potential to yield information which, if properly recovered, will enhance understanding of



Southern African human history is one appropriate measure of scientific significance. In this respect, archaeological sites should be evaluated in terms of their potential to resolve current archaeological research problems. Scientific significance also refers to the potential for relevant contributions to other academic disciplines or to industry.

Public significance refers to the potential a site has for enhancing the public's understanding and appreciation of the past. The interpretive, educational and recreational potential of a site are valid indications of public value. Public significance criteria such as ease of access, land ownership, or scenic setting are often external to the site itself. The relevance of heritage resource data to private industry may also be interpreted as a particular kind of public significance.

Ethnic significance applies to heritage sites which have value to an ethnically distinct community or group of people. Determining the ethnic significance of an archaeological site may require consultation with persons having special knowledge of a particular site. It is essential that ethnic significance be assessed by someone properly trained in obtaining and evaluating such data.

Historic archaeological sites may relate to individuals or events that made an important, lasting contribution to the development of a particular locality or the province. Historically important sites also reflect or commemorate the historic socioeconomic character of an area. Sites having high historical value will also usually have high public value.

The economic or monetary value of a heritage site, where calculable, is also an important indication of significance. In some cases, it may be possible to project monetary benefits derived from the public's use of a heritage site as an educational or recreational facility. This may be accomplished by employing established economic evaluation methods; most of which have been developed for valuating outdoor recreation. The objective is to determine the willingness of users, including local residents and tourists, to pay for the experiences or services the site provides even though no payment is presently being made. Calculation of user benefits will normally require some study of the visitor population *(Smith, L.D. 1977)*.

Assessing Impacts

A heritage resource impact may be broadly defined as the net change between the integrity of a heritage site with and without the proposed development. This change may be either beneficial or adverse.

Beneficial impacts occur wherever a proposed development actively protects, preserves or enhances a heritage resource. For example, development may have a beneficial effect by preventing or lessening natural site erosion. Similarly, an action may serve to preserve a site for future investigation by covering it with a protective layer of fill. In other cases, the public or economic significance of an archaeological site may be enhanced by actions which facilitate non-destructive public use. Although beneficial impacts are unlikely to occur frequently, they should be included in the assessment.

More commonly, the effects of a project on heritage sites are of an adverse nature. Adverse impacts occur under conditions that include:

(a) destruction or alteration of all or part of a heritage site;

(b) isolation of a site from its natural setting; and

(c) introduction of physical, chemical or visual elements that are out-of-character with the heritage resource and its setting.

Adverse effects can be more specifically defined as direct or indirect impacts. Direct impacts are the immediately demonstrable effects of a project which can be attributed to particular land modifying actions. They are directly caused by a project or its ancillary facilities and occur at the same time and place. The immediate consequences of a project action, such as slope failure following reservoir inundation, are also considered direct impacts.

Indirect impacts result from activities other than actual project actions. Nevertheless, they are clearly induced by a project and would not occur without it. For example, project development may induce changes in land use or population density, such as increased urban and recreational development, which may indirectly impact upon heritage sites. Increased vandalism of heritage sites, resulting from improved

or newly introduced access, is also considered an indirect impact. Indirect impacts are much more difficult to assess and quantify than impacts of a direct nature.

Once all project related impacts are identified, it is necessary to determine their individual level-of-effect on heritage resources. This assessment is aimed at determining the extent or degree to which future opportunities for scientific research, preservation, or public appreciation are foreclosed or otherwise adversely affected by a proposed action. Therefore, the assessment provides a reasonable indication of the relative significance or importance of a particular impact. Normally, the assessment should follow site evaluation since it is important to know what heritage values may be adversely affected.

The assessment should include careful consideration of the following level-of-effect indicators, which are defined in Appendix D:

- magnitude
- severity
- duration
- range
- frequency
- diversity
- cumulative effect
- rate of change

The level-of-effect assessment should be conducted and reported in a quantitative and objective fashion. The methodological approach, particularly the system of ranking level-of-effect indicators, must be rigorously documented and recommendations should be made with respect to managing uncertainties in the assessment. *(Zubrow, Ezra B.A., 1984).*

Impact Effect	*Score*
Magnitude	0-4
Severity	0-4
Duration	0-4
Range	0-4
Frequency	0-4
Diversity	0-4
Cumulative effect	0-4
Rate of change	0-4
Total score:	0-32

Impact severity table.

Impacts will be defined along the following parameters of severity;

Effect	*Score*
No effect on site	0
Insignificant impact on site	1-5

Significant impact on site	6-16
Major destruction of site and attributes	17-24
Total destruction of sites and attributes	25-32

The study area was surveyed using standard archaeological surveying methods. The area was surveyed using directional parameters supplied by the GPS and surveyed by foot. This technique has proven to result in the maximum coverage of an area. This action is defined as;

'an archaeologist being present in the course of the carrying-out of the development works (which may include conservation works), so as to identify and protect archaeological deposits, features or objects which may be uncovered or otherwise affected by the works' (DAHGI 1999a, 28).

Standard archaeological documentation formats were employed in the description of sites. Using standard site documentation forms as comparable medium, it enabled the surveyors to evaluate the relative importance of sites found. Furthermore GPS (Global Positioning System) readings of all finds and sites were taken. This information was then plotted using a ***eTrex Legend*** GPS (WGS 84- datum).

Indicators such as surface finds, plant growth anomalies, local information and topography were used in identifying sites of possible archaeological importance. Test probes were done at intervals to determine sub-surface occurrence of archaeological material. The importance of sites was assessed by comparisons with published information as well as comparative collections.

Test excavation is that form of archaeological excavation where the purpose is to establish the nature and extent of archaeological deposits and features present in a location which it is proposed to develop (though not normally to fully investigate those deposits or features) and allow an assessment to be made of the archaeological impact of the proposed development. It may also be referred to as archaeological testing' (DAHGI 1999a, 27).

'Test excavation should not be confused with, or referred to as, archaeological assessment which is the overall process of assessing the archaeological impact of development. Test excavation is one of the techniques in carrying out archaeological assessment which may also include, as appropriate, documentary research, field walking, examination of upstanding or visible features or structures, examination of aerial photographs, satellite or other remote sensing imagery, geophysical survey, and topographical assessment' (DAHGI 1999b, 18).

All sites or possible sites found were classified using a hierarchical system wherein sites are assessed using a scale of zero to four according their importance. These categories are as follows;

Degree of significance	*Justification*	*Score*

Exceptional significance	Rare or outstanding, high degree of intactness. Can be interpreted easily.	13 – 16
High significance	High degree of original fabric. Demonstrates a key element of item's significance. Alterations do not detract from significance.	9 – 12
Moderate significance	Altered or modified elements. Element with little heritage value, but which contribute to the overall significance.	5 – 8
Little significance	Alterations detract from significance. One of many. Alterations detract from significance.	1 – 4
Intrusive	Damaging to the item's heritage significance.	0

Table 1. Site significance table for pre-contact sites.

Degree of significance	*Justification*	*Score*
Exceptional significance	Rare or outstanding, high degree of intactness. Can be interpreted easily.	29 – 24
High significance	High degree of original fabric. Demonstrates a key element of item's significance. Alterations do not detract from significance.	13 – 18
Moderate significance	Altered or modified elements. Element with little heritage value, but which contribute to the overall significance.	7 – 12
Little significance	Alterations detract from significance. One of many. Alterations detract from significance.	1 – 6
Intrusive	Damaging to the item's heritage significance.	0

Table 2. Site significance table for post contact sites.

The qualitative value of a site's significance will be calculated by tabling its significance characteristics (as outlined in appendix B & C) on a sliding value scale and determining an accumulative value for the specific site. Two tables will be used;

Site significance characteristics slide scale (Pre-Contact Criteria)

Scientific Significance	0	1	2	3	4
Public Significance	0	1	2	3	4
Ethnic Significance	0	1	2	3	4
Economic Significance	0	1	2	3	4
				Total Score	

Table 3. Pre-contact site criteria (0- no value, 4- highest value)

Site significance characteristics slide scale (Post-Contact Criteria)					
Scientific Significance	0	1	2	3	4
Historic Significance	0	1	2	3	4
Public Significance	0	1	2	3	4
Other Significance	0	1	2	3	4
Ethnic Significance	0	1	2	3	4
Economic Significance	0	1	2	3	4
				Total Score	

Table 4. Post-contact site criteria (0- no value, 4- highest value)

The values calculated (as specified in appendix B&C) are attributed to a category within the site significance table to provide the site with a quantifiable significance value. This will only be done for identified sites. Should an area under investigation not show any evidence of human activity this will be stated and no further qualifying will be done.

This information will be contained in a report that will strive to;

Review the purpose, approach, methodology and reporting of archaeological assessment and monitoring and propose guidelines on how to adequately address four key questions:

i. What is the research value and potential of the archaeological remains?
ii. What will the impact of development be?
iii. What types of mitigation (by design modification or further investigation) would be appropriate to mitigate the impact of development and/or make a useful contribution to knowledge?
iv. What will be the likely cost and timescale of any further investigation, analysis and reporting, given the nature of the archaeology and the type and extent of further work required?

Scientific Significance

(a) Does the site contain evidence which may substantively enhance understanding of culture history, culture process, and other aspects of local and regional prehistory?

internal stratification and depth

chronologically sensitive cultural items

materials for absolute dating

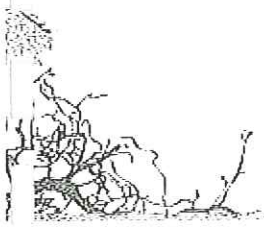
association with ancient landforms

quantity and variety of tool type

distinct intra-site activity areas

tool types indicative of specific socio-economic or religious activity

cultural features such as burials, dwellings, hearths, etc.



diagnostic faunal and floral remains

exotic cultural items and materials

uniqueness or representativeness of the site

integrity of the site

(b) Does the site contain evidence which may be used for experimentation aimed at improving archaeological methods and techniques?

monitoring impacts from artificial or natural agents

site preservation or conservation experiments

data recovery experiments

sampling experiments

intra-site spatial analysis

(c) Does the site contain evidence which can make important contributions to paleoenvironmental studies?

topographical, geomorphological context

depositional character

diagnostic faunal, floral data

(d) Does the site contain evidence which can contribute to other scientific disciplines such as hydrology, geomorphology, pedology, meteorology, zoology, botany, forensic medicine, and environmental hazards research, or to industry including forestry and commercial fisheries?

Public Significance

(a) Does the site have potential for public use in an interpretive, educational or recreational capacity?

integrity of the site

technical and economic feasibility of restoration and development for public use

visibility of cultural features and their ability to be easily interpreted

accessibility to the public

opportunities for protection against vandalism

representativeness and uniqueness of the site

aesthetics of the local setting

proximity to established recreation areas

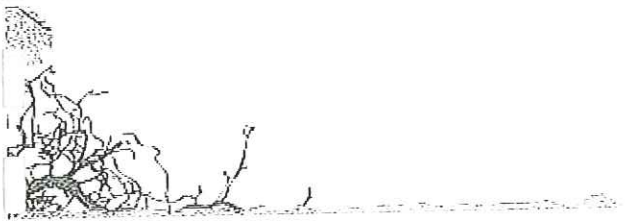
present and potential land use

land ownership and administration

legal and jurisdictional status

local community attitude toward development

(b) Does the site receive visitation or use by tourists, local residents or school groups?



Ethnic Significance

(a) Does the site presently have traditional, social or religious importance to a particular group or community?

ethnographic or ethno-historic reference

documented local community recognition or, and concern for, the site

Economic Significance

(a) What value of user-benefits may be placed on the site?

visitors' willingness-to-pay

visitors' travel costs

Scientific Significance

(a) Does the site contain evidence which may substantively enhance understanding of historic patterns of settlement and land use in a particular locality, regional or larger area?

(b) Does the site contain evidence which can make important contributions to other scientific disciplines or industry?

Historic Significance

(a) Is the site associated with the early exploration, settlement, land use, or other aspect of southern Africa's cultural development?

(b) Is the site associated with the life or activities of a particular historic figure, group, organization, or institution that has made a significant contribution to, or impact on, the community, province or nation?

(c) Is the site associated with a particular historic event whether cultural, economic, military, religious, social or political that has made a significant contribution to, or impact on, the community, province or nation?

(d) Is the site associated with a traditional recurring event in the history of the community, province, or nation, such as an annual celebration?

Public Significance

(a) Does the site have potential for public use in an interpretive, educational or recreational capacity?

visibility and accessibility to the public

ability of the site to be easily interpreted

opportunities for protection against vandalism

economic and engineering feasibility of reconstruction, restoration and maintenance

representativeness and uniqueness of the site

proximity to established recreation areas

compatibility with surrounding zoning regulations or land use

land ownership and administration

local community attitude toward site preservation, development or destruction

present use of site

(b) Does the site receive visitation or use by tourists, local residents or school groups?

Ethnic Significance

(a) Does the site presently have traditional, social or religious importance to a particular group or community?

Economic Significance

(a) What value of user-benefits may be placed on the site?

visitors' willingness-to-pay

visitors' travel costs

Integrity and Condition

(a) Does the site occupy its original location?

(b) Has the site undergone structural alterations? If so, to what degree has the site maintained its original structure?

(c) Does the original site retain most of its original materials?

(d) Has the site been disturbed by either natural or artificial means?

Other

(a) Is the site a commonly acknowledged landmark?

(b) Does, or could, the site contribute to a sense of continuity or identity either alone or in conjunction with similar sites in the vicinity?

(c) Is the site a good typical example of an early structure or device commonly used for a specific purpose throughout an area or period of time?

(d) Is the site representative of a particular architectural style or pattern?

Indicators of Impact Severity

Magnitude

The amount of physical alteration or destruction which can be expected. The resultant loss of heritage value is measured either in amount or degree of disturbance.

Severity

The irreversibility of an impact. Adverse impacts which result in a totally irreversible and irretrievable loss of heritage value are of the highest severity.

Duration

The length of time an adverse impact persists. Impacts may have short-term or temporary effects, or conversely, more persistent, long-term effects on heritage sites.

Range

The spatial distribution, whether widespread or site-specific, of an adverse impact.

Frequency

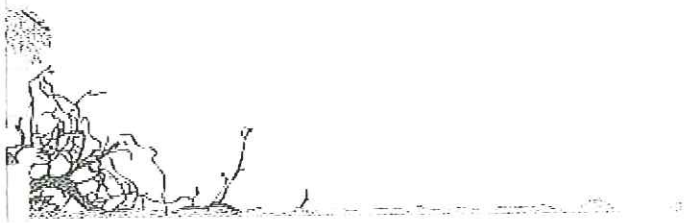
The number of times an impact can be expected. For example, an adverse impact of variable magnitude and severity may occur only once. An impact such as that

resulting from cultivation may be of recurring or ongoing nature.

Diversity
The number of different kinds of project-related actions expected to affect a heritage site.

Cumulative Effect
A progressive alteration or destruction of a site owing to the repetitive nature of one or more impacts.

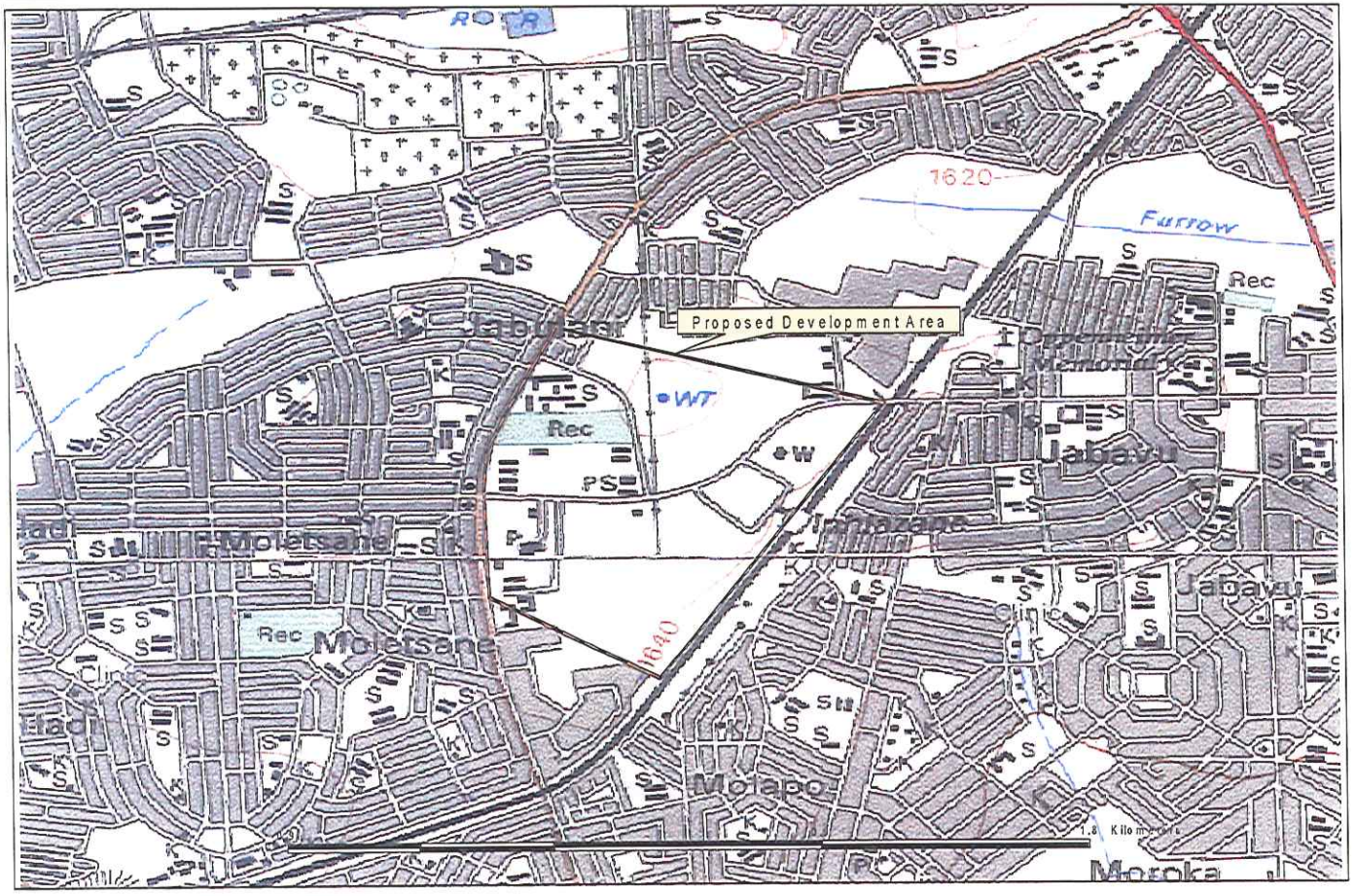
Rate of Change
The rate at which an impact will effectively alter the integrity or physical condition of a heritage site. Although an important level-of-effect indicator, it is often difficult to estimate. Rate of change is normally assessed during or following project construction.



APPENDIX E

LOCATION MAPS

Jabulani, Urban Design CBD



21 April 2009

Compiled by Gaigher and Associates

Compiled for Envirolution

1:50 000 Topo Map
Refrence: 2627bb
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Compiled using ArcView GIS 3.2 a

GIS by S. Gaigher


Zondi
Komani St
Zulu Dr
Jabulani
Proposed CBD
Jabavu
Moletsane
Tladi
Molapo
Soweto
© 2009 Google
Image © 2009 DigitalGlobe
Data © 2009 Tracks4Africa
© 2009 Tele Atlas
26°14'50.51" S 27°51'50.03" E
elev 1647 m
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Eye alt 5.84 km
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