BIODIVERSITY AND WETLAND ASSESSMENT ASSOCIATED WITH THE PROPOSED ROUTES OF THE WEMBEZI POTABLE WATER SUPPLY SCHEME IN WEMBEZI, KWAZULU-NATAL

March 2017

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SYNOPSIS :

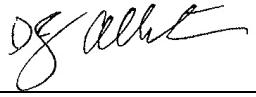
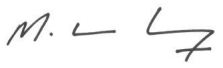
This report documents the findings of study done on the wetlands and biodiversity along the various pipeline routes associated with the upgrade of the municipal potable water supply to Wembezi, KwaZulu-Natal. The impacts on the features are considered and management recommendations are put forward.

KEY WORDS :

Wetlands, Biodiversity, Municipal Water Supply.

QUALITY VERIFICATION

This report has been prepared under the controls established by a quality management system that meets the requirements of ISO9001: 2008 which has been independently certified by DEKRA Certification under certificate number 90906882

Verification	Capacity	Name	Signature	Date
By Author	Specialist Ecologist	DJ Alletson		20 March 2017
Checked by	Specialist Ecologist	M van Rooyen		20 March 2017
Authorised by	Executive Associate	M van Rooyen		20 March 2017

CONTENT OF THIS SPECIALIST REPORT

Appendix 6 of the EIA Regulations of 4 December 2014 requires that specialist reports contain at least a number of specified items. The manner in which these items have been addressed in this document is indicated in the table below.

Specified Report Content	Reference
1. (1) A specialist report prepared in terms of these Regulations must contain-	
(a) details of- (i) the specialist who prepared the report; and (ii) the expertise of that specialist to compile a specialist report including a *curriculum vitae*;	See Appendix II
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	See Appendix II
(c) an indication of the scope of, and the purpose for which, the report was prepared;	See Sections 1, 2 and 3.
(d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	See Section 5.
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process;	See Section 4.
(f) the specific identified sensitivity of the site related to the activity and its associated structures and infrastructure;	See Section 6.
(g) an identification of any areas to be avoided, including buffers;	See Section 8.
(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	See Figures 5, 9 and 10.
(I) a description of any assumptions made and any uncertainties or gaps in knowledge;	See Section 5.
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment;	See Sections 6, 7 and 11.
(k) any mitigation measures for inclusion in the EMPr;	See Section 8.
(l) any conditions for inclusion in the environmental authorisation;	See Sections 8 and 10.
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	See Section 9.
(n) a reasoned opinion- (I) as to whether the proposed activity or portions thereof should be authorised; and (ii) if the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	See Section 10.
(o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	n/a
(p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	n/a
(q) any other information requested by the competent authority.	n/a

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BIODIVERSITY AND WETLAND ASSESSMENT ASSOCIATED WITH THE PROPOSED ROUTES OF THE WEMBEZI POTABLE WATER SUPPLY SCHEME IN WEMBEZI, KWAZULU-NATAL

1. BACKGROUND

Terratest Pty Ltd has been appointed to conduct the Application for Environmental Authorisations process necessary for authorisation of a new bulk potable water pipeline, a reservoir, and associated water reticulation in and around the township of Wembezi near Estcourt in KwaZulu-Natal. The pipelines are required partly to replace existing bulk infrastructure which is aging and partly to install new infrastructure in order to meet current and anticipated demands. This document is a specialist report which will form a component of the Application for Environmental Authorisation as well as a component of the application for the Water Use Licence in accordance with the National Water Act (Act 36 of 1998) which will be required for the wetlands and watercourse crossings along the various routes of the new pipelines.

The Application for Environmental Authorisation will follow a Basic Impact Assessment process in accordance with the requirements of the National Environmental Management Act (Act 107 of 1998) (NEMA) and the 2014 Environmental Impact Assessment Regulations. The competent authority in this regard is the KwaZulu-Natal Department of Economic Development, Tourism and Environmental Affairs (EDTEA).

In addition to the Environmental Authorisation required for the project, a Water Use License will be required in accordance with the National Water Act (Act 36 of 1998). This requirement is as a result of the number of wetlands and watercourses that the pipeline routes will cross.

2. PROJECT DESCRIPTION

The proponent of the project is the uThukela District Municipality. The planned infrastructure consists of a bulk potable water pipeline together with associated reticulation pipelines. Further details are as follows:

- Bulk pipeline
  - ✓ 8 000m of Ø 400mm HDPE pipe
  - ✓ Scour Valves
  - ✓ Air Valves
  - ✓ Isolating Valves

  - ✓ Meters
  - ✓ Pipejacking under the N3 highway
- Water reservoir
  - ✓ 10 ML concrete reservoir
- Water reticulation
  - ✓ 160 993 m of pipelines ranging from Ø75 uPVC to Ø500 HDPE
  - ✓ Air valves
  - ✓ Scour valves
  - ✓ Isolating valves
  - ✓ Fire hydrants
  - ✓ Pipeline ancillaries such as marker posts, thrust blocks, chambers etc.
  - ✓ Replacement of yard connections
  - ✓ Replace or repair household toilet systems, leaking taps, leaking geysers and household plumbing.
  - ✓ Water meters on each house connection

The water supply to the bulk water line will be supplied from the existing Pump Station at the George Cross Water Treatment Works located between Wembezi and Estcourt. The relevant 1:50 000 map sheet is 2929BB Estcourt. See Figure 1.

3. STUDY AREA

The study area consisted of an area around the bulk water pipeline and around the network of associated reticulation lines. This study area was defined by a 500m wide buffer strip around the outer edge of the pipeline routes. The purpose of the expanded area was to identify wetlands within 500m of the pipelines so as to meet the requirements of the regulations under the National Water Act (Act 36 0f 1998). The buffer area was split into two sections which are related to the bulk potable water rising main and the associated reticulation. See Figure 5. The two areas do overlap to some extent but they remain useful in consideration of possible impacts from the various pipelines.

4. STUDY PROCEDURE

This study was undertaken in three phases which were, a desktop survey, site visits, and data processing and reporting.

It was recognised at the outset that a shortcoming of the study would be that the site surveys would be done in the dry season when wetland-related features are at their most inconspicuous. However, in the field, it was always possible because of the amount of surface water, to find traces of wetland conditions and wetland vegetation even if it could not be identified to species level. Most common were Bullrush (*Typha capensis*) stubble, and dry stalks of various Knotweed (P*ersicaria*) and Sedge (*Cyperaceae*) species. Thus, although comprehensive biodiversity surveys were not possible, the presence or otherwise of wetlands could be detected. Despite the above, changes to the reticulation routes necessitated later surveys undertaken during wetter conditions and these found nothing to contradict or extend the earlier findings.

4.1 Desktop Survey

The desktop survey consisted primarily of searching for any information which might suggest the presence of wetlands in the study area. Reference was made to the Ezemvelo KZN Wildlife Minset Database, the protected areas database, and the wetland database to see if any wetland-related features are recorded for the study area. In addition, the National Freshwater Ecosystem Priority Areas (NFEPA) was also interrogated to search for palustrine[1] wetlands in that area. Google Earth was used to gain an initial impression of the study area and the images were closely examined for any wetland or watercourse features. A list of these was prepared, with their geographic coordinates, and was used as an initial guide in the field survey which followed.

[1] "Palustrine": Palustrine wetlands include inland marshes and swamps as well as bogs, fens, tundra and floodplains. Palustrine systems include any inland wetland which lacks flowing water, contains ocean-derived salts in concentrations of less than 0.05%, and is non-tidal.

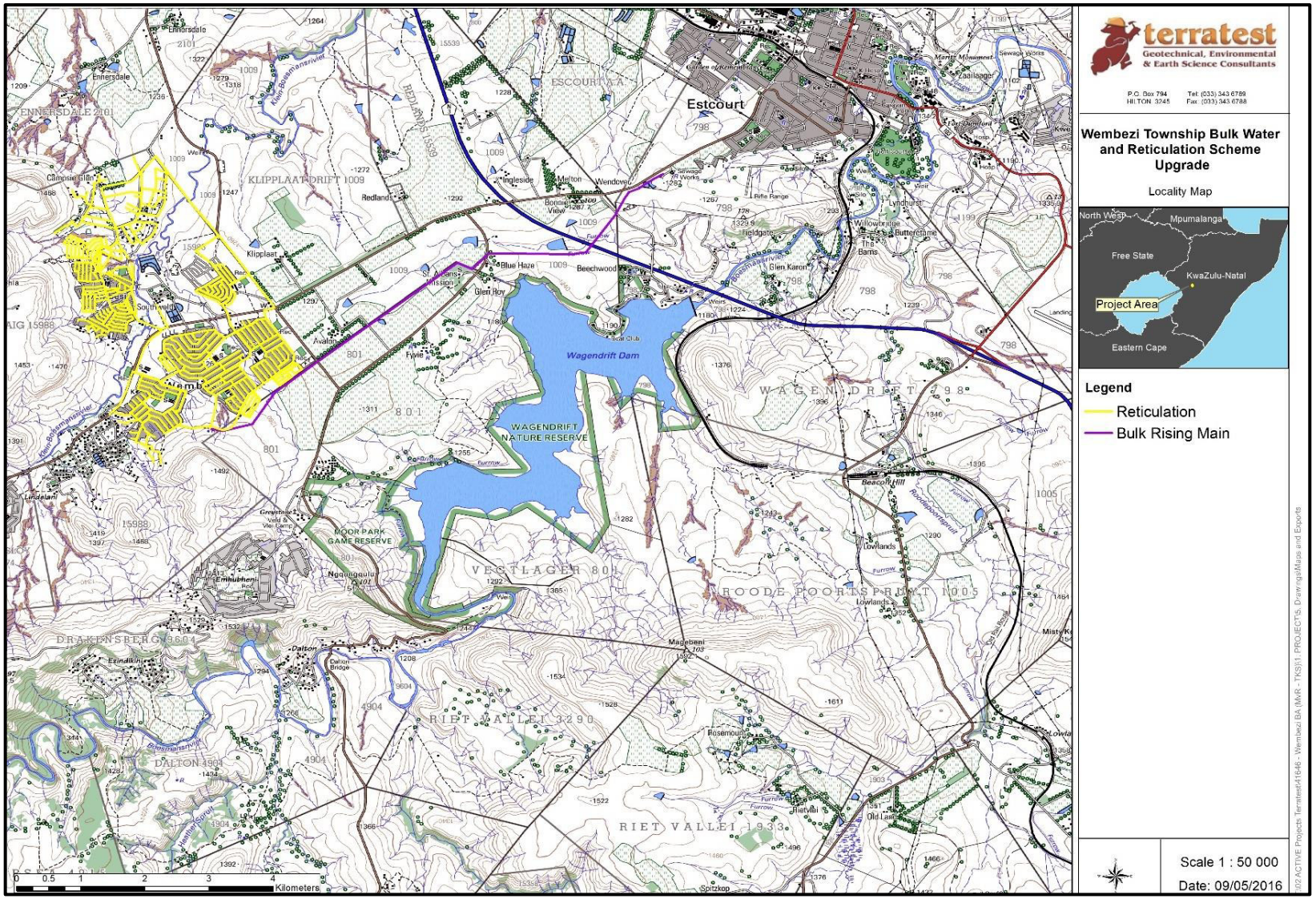

Figure 1: Locality plan indication the project area in relation to the town of Estcourt.

4.2 Site Surveys

The entire study area was visited during the site survey and, using the list of sites from the desktop study as a guide, wetland and watercourse features which lay within it were visited and assessed.

It was found that some of the features seen on Google Earth were not wetland-related, but some additional features which had not been identified in the desktop study were observed in the field.

At every observed feature, the following actions were undertaken:

- Watercourses with either flowing water or channels where water obviously flows at times were visited and key features, including the vegetation in the riparian zone were noted. At one site a fish survey, done with a Samus 12v DC electro-fishing apparatus, and a SASS survey were undertaken.
- Wetlands. Where wetlands were encountered in the study area, they were delineated and note was made of their type. Use was made of a soil auger and the guidelines of the Department of Water Affairs and Forestry (DWAF, 2005) were followed. The indicators used include the following:
    - ✓ The Terrain Unit Indicator. This indicator helps identify those parts of the landscape where wetlands are likely to occur.
    - ✓ The Soil Form Indicator. This indicator consists of soil forms which are associated with prolonged and frequent water saturation. However, since the study was done during the dry season, it was only possible to auger test holes at a few sites.
    - ✓ The Soil Wetness Indicator. This indicator is based on soil characteristics which develop as a result of prolonged and frequent water saturation.
    - ✓ The Vegetation Indicator. This indicator is based on vegetation which consists either entirely or largely of plant species which are associated with frequently or permanently saturated soils. Such species and vegetation are described as being “hydrophilic”.
    - ✓ Further pointers to the possible presence of wetlands were searched for. Most important of these were seepage zones in the river banks. Such zones indicated the presence of water near the soil surface and so infer that wetlands could exist nearby. This indicator is useful in places where the original soil

characteristics have been destroyed by ploughing or other such agricultural activities.

- ✓ "Negative" pointers were searched for. These pointers consist of features which are not associated with wetlands. An example is the presence of termite colonies as these animals avoid wet soils.

Use was made of a screw-type auger for checking soils and soil conditions and the auger point locations were recorded by means of a hand-held GPS unit with a stated accuracy tolerance of three metres. The associations between wetland vegetation and soils is illustrated in Figure 2.

However, for wetlands within 500 m of the development, but which would not be impacted upo, the delineation was done on the basis of Google Earth imagery. To ensure that as much wetland as possible was mapped in the way, images from at least three different time periods were used. When considering what impacts the pipelines may or may not create, consideration was given to not only hydrological factors but also to possible impacts on mobile species such as birds, frogs, and mammals such as Otters and the Water Mongoose.

Plate 1: Typical wetland soil from the intermittently saturated zone on the edge of a wetland. Note the mottling in the gleyed matrix.

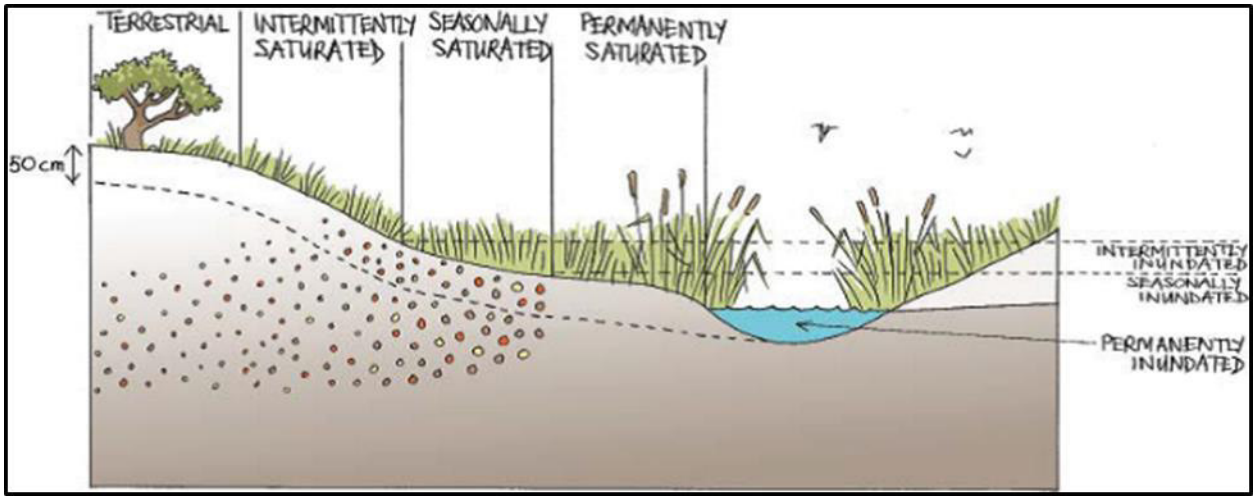

Figure 2: Cross section through a wetland, indicating how the soil wetness and vegetation indicators change (Ollis, et al., 2013)

Biodiversity was not comprehensively surveyed but note was made of species seen. Fish and SASS5 surveys were done in the Little Bushmans River.

4.3 Data Processing

4.3.1 Wetland Condition (PES)

The wetlands which had been delineated and which might be impacted upon were assessed by means of the WET-Health model (Macfarlane *et al*, 2008). This model produces a value for the Present Ecological State (PES) of a wetland. Since hydrology, geomorphology and vegetation are interlinked in the model, their scores are aggregated to obtain the overall PES health score using the formula:

Health = ((Hydrology value) x3 + (Geomorphology value) x2 + (Vegetation value) x2)) ÷ 7

Table 1: Health Categories used for describing the integrity of wetlands. From Teixeira-Leite and Macfarlane (2012).

Impact Category	Description	Impact Score Range	Present State Category
None	**Unmodified, natural**	**0 to 0.9**	**A**
Small	**Largely Natural** with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	**1.0 to 1.9**	**B**
Moderate	**Moderately Modified.** A moderate change in ecosystem processes and loss of natural habitats has taken place, but the natural habitat remains predominantly intact.	**2.0 to 3.9**	**C**
Large	**Largely Modified.** A large change in ecosystem processes and loss of natural habitat and biota has occurred.	**4.0 to 5.9**	**D**
Serious	**Seriously Modified.** The change in ecosystem processes and loss of natural habitat and biota is great, but some remaining natural habitat features are still recognizable.	**6.0 to 7.9**	**E**
Critical	**Critical Modification.** The modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	**8.0 to 10**	**F**

4.3.2 Ecosystem Services Delivered by the Wetlands

The WET-EcoServices Model was used to score the ecosystem services delivered by wetlands in the study area. This model considers the biophysical and social conditions around a wetland and then delivers scores for a series of defined ecosystem services that the wetland delivers, or could deliver. The services include the following:

- Flood Attenuation
- Sediment trapping
- Nitrate Assimilation
- Erosion control
- Maintenance of biodiversity
- Provision of harvestable resources
- Cultural significance
- Education and research
- Streamflow regulation
- Phosphate assimilation
- Toxicant Assimilation
- Carbon storage (sequestration)
- Provision of water for human use
- Provision of cultivated food
- Tourism and recreation

The maximum score for any service is a value of 4 and the rating of the probable extent of the service is shown in Table 2.

Table 2: Ecoservices rating of the probable extent to which a benefit is being supplied

Score	Rating of likely extent to which a benefit is being supplied
< 0.5	Low
0.6 - 1.2	Moderately Low
1.3 - 2.0	Intermediate
2.1 - 3.0	Moderately High
> 3.0	High

4.3.3 Fish and SASS Surveys

No fish were found and so no data processing was done. The SASS results were assessed by means of the Biological Bands of Dallas (2007).

5. UNCERTAINTIES AND DATA GAPS

The initial field survey was conducted in August 2016 with a follow-up survey in January 2016. Before second visit, a small amount of rain had fallen but prior to this time the area had been subject to dry conditions. While plant growth was generally good it was apparent that the peak flowering season was over and hence that a number of species could not be identified and so were excluded from the survey. This deficiency is considered to be a potential weakness in the results obtained. However, since the project area is already very highly transformed from the original natural condition, it is unlikely that further surveys would reveal any new species of concern.

6. STUDY FINDINGS

6.1 Desktop Study

The findings of the desktop study were as follows:

- **Vegetation Type**. The predominant vegetation in the study area is KwaZulu-Natal Highland Thornveld (Gs 6) as classified by Mucina and Rutherford (2006). This is found in areas of moderate rainfall (750 mm – 850 mm per annum) and is generally not rich in wetlands other than in the lower lying area along river valleys.

  In the extreme west some of the study area lies in Drakensberg Foothill Moist Grassland (Gs 10). The type is found in a large area along the lower slopes of the Drakensberg in moderately rolling and mountainous country which is incised by river gorges of drier vegetation types and by forest, and covered in forb-rich grassland

dominated by short bunch grasses including *Themeda triandra* and *Tristachya leucothrix.*

- **Wetlands**. The Ezemvelo KZN Wildlife and NFEPA wetland databases show substantial wetland systems in the study area. These are classified as "Alluvial Wetlands: Temperate Alluvial Vegetation" in the KZN Wetlands database and as "Natural" in the NFEPA database. The databases contain similar spatial data although NFEPA includes man-made features such as dams and their surrounds. These are classified as "Artificial". See Figure 4.
- **Conservation priorities**. The Ezemvelo KZN Wildlife Minset database was interrogated to search for wetland-related conservation priorities. It was found that, other than for some of the wetlands in the area, nothing relevant to this study was listed.
- **Threatened Ecosystems**. No threatened ecosystems, as listed in the SANBI database, are present anywhere near the pipeline routes.
- **Game Reserves, Nature Reserves, and Wildlife Conservancies**. The pipelines do not pass through any provincial protected areas but lie within the buffers of the Wagondrift Dam Public Resort Nature Reserve, Moor Park Nature Reserve, and the Dalton private Reserve. See Figure 3. However, since the development is restricted to the existing built up areas, none of the reserves will be affected in any way.
  The new Formosa Conservancy just reaches to the bulk pipeline route near the water treatment works. While the area in question is grassland and is not wetland, especial care will be called for in regard to construction activities there.
- **Important Bird Areas**. Important Birds Areas have been designated at sites where the avifauna is of particular value, either in regard to bird diversity, or as habitat for migratory or rare bird species. There are none within the study area.

6.2 Field Study

Conditions were found to be very much wetter than had been expected under the prevailing drought conditions. Virtually every roadside drain, especially in the northern area of Wembezi C, had flowing water in its lower reaches. On investigation, it was found that this water originates from leaking water infrastructure. In addition to the above flows of potable water it was also found that broken or leaking sewers contributed substantially to streamflow at a number of sites. Possibly the worst such leak which was seen was located at 29° 1'56.70"S, 29°46'13.90"E where the discharge was into a drainage line. See Photograph 1. Other sites where sewage was noted are listed in Table 3.

Plate 2: Site of a major and enduring leakage from a sewage line. The discharge is into a drainage line and wetland system.

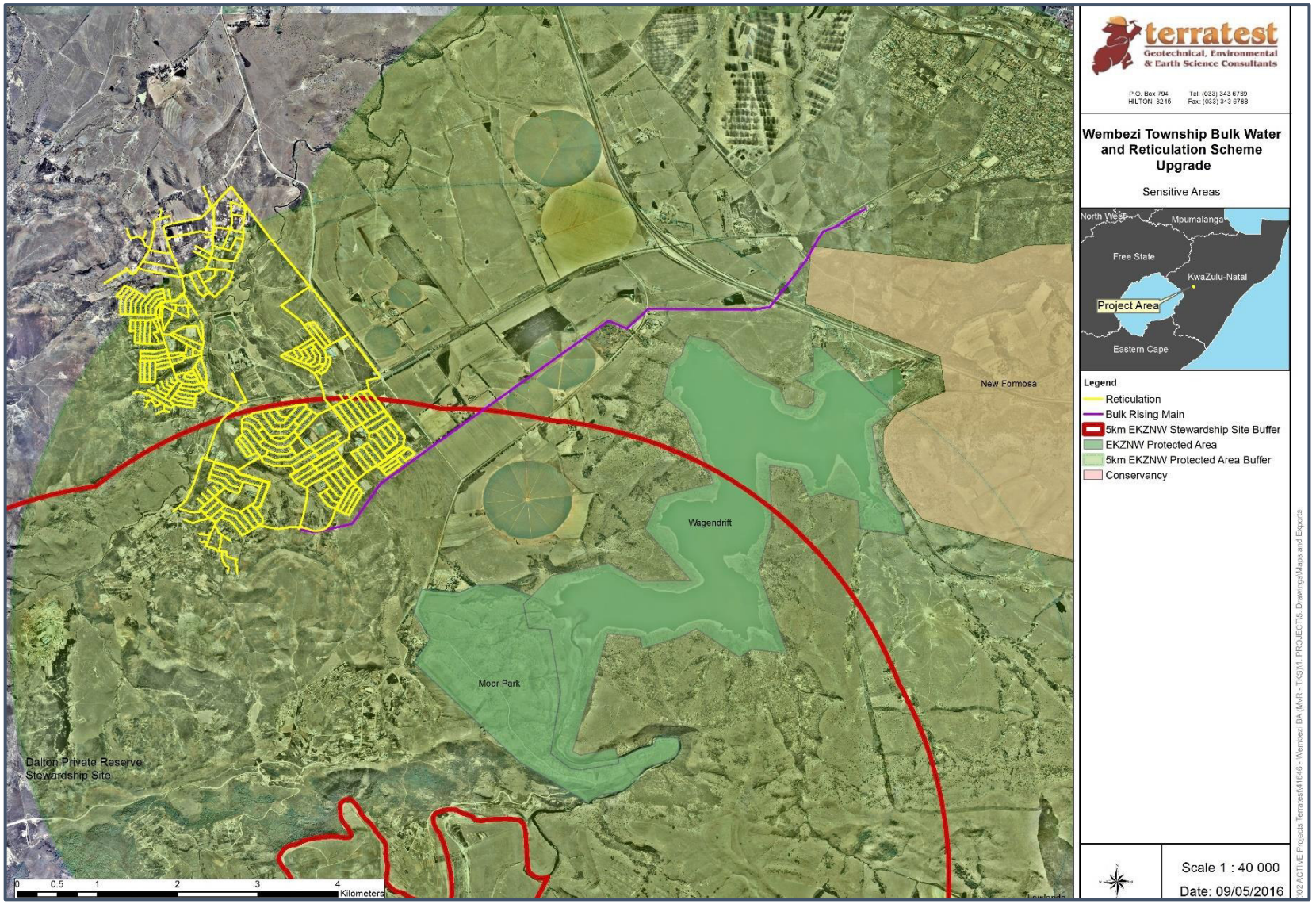

Figure 3: Sensitive areas adjacent to the project area.

Table 3: Additional sites at which leakage of sewage was observed.

Latitude	Longitude	Receiving Environment
29° 02'29.70"	29°46'16.30"	Drainage line
29° 02'36.85"	29°47'05.55"	Grassland
29° 03'15.40"	29°46'24.94"	Drainage line
29° 02'19.79"	29°46'43.85"	Grassland
29° 02'46.20"	29°47'16.80"	Drainage line

The findings of the field survey were as follows:

6.2.1 Terrestrial Vegetation

The natural vegetation in the area is primarily KwaZulu-Natal Highland Thornveld. In the west is a small strip in Drakensberg Foothilll Moist Grassland, and wetlands are present in places. However, in the built-up area of the town where the reticulation lines will be placed, the vegetation is almost entirely eradicated as a result of the urban development. As a result, no new impacts on terrestrial vegetation are anticipated.

The rising bulk potable water main passes through relatively intact vegetation for a distance of approximately 850m after leaving the George Cross Water Treatment Works. After passing under the road which leads to Wagondrift Dam the alignment passes through an area which has been cultivated and then continues for approximately 250m through grassland before reaching the N3 highway. Thereafter it passes through transformed areas all the way to the bulk reservoir in Wembezi.

It is to be noted that the pipeline is to be placed in the servitude of the existing pipeline for its whole length and making the entire alignment degraded to some extent. It is therefore concluded that the bulk water pipeline will have little impact on indigenous terrestrial vegetation although special care must be taken in the areas where grassland still exists.

6.2.2 Wetlands and Drainage Lines

It was found that the KZN Wetlands and the NFEPA mapping are very similar. See Figure 4. However, they are highly inaccurate in terms of the areas which they record as showing wetland characteristics. Thus, although the indicated wetland polygons which were noted in the desktop survey were visited, it was found that these polygons were largely inaccurate. This being the case, a more detailed delineation process was undertaken.

This was done by means of the soil and vegetation indicators as in the DWAF (2005) guidelines where there was the possibility of wetlands being impacted upon by the proposed development. The delineated wetlands are shown in Figure 5.

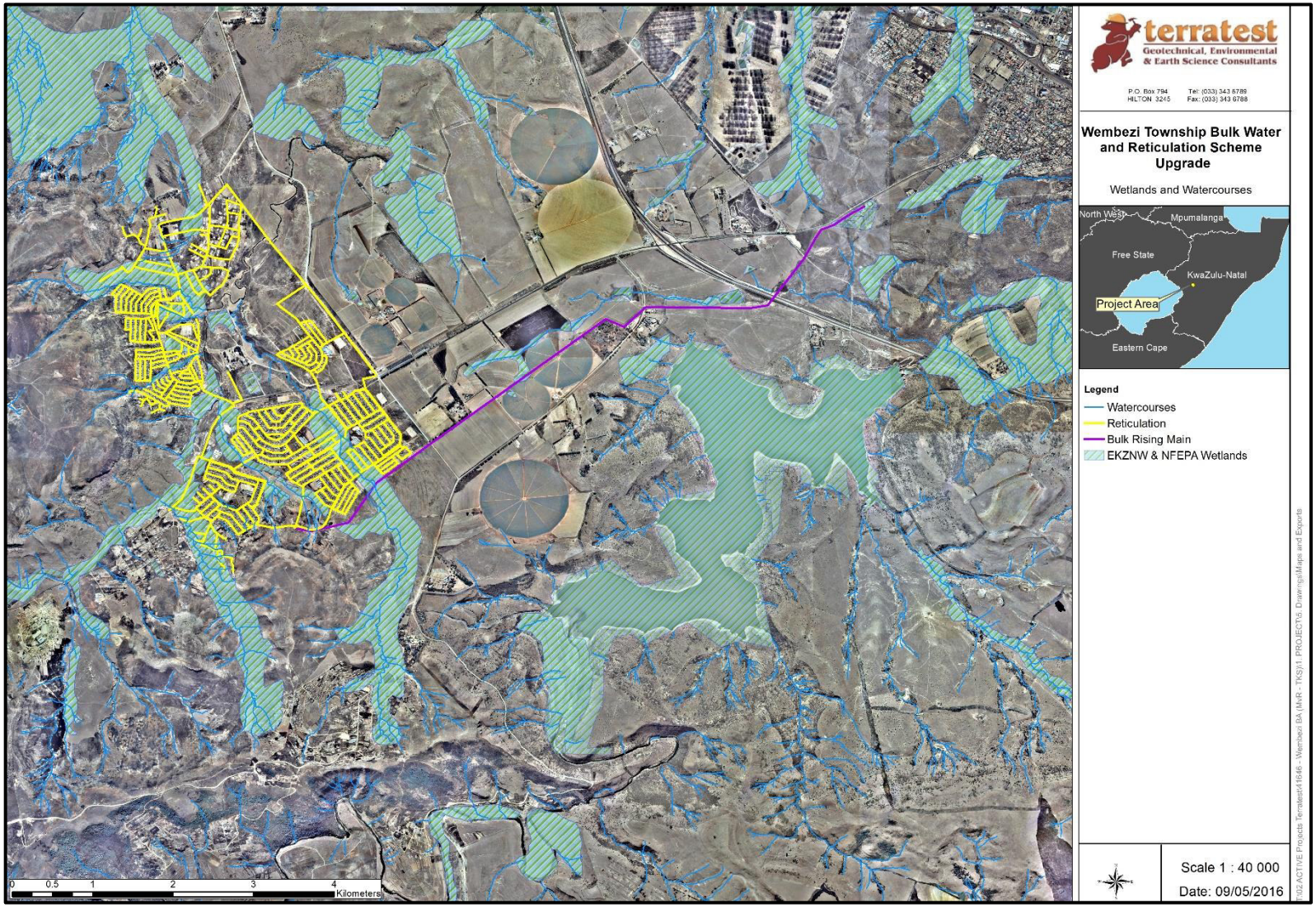

Figure 4: KZN and NFEPA wetlands and watercourses in the Wembezi area.

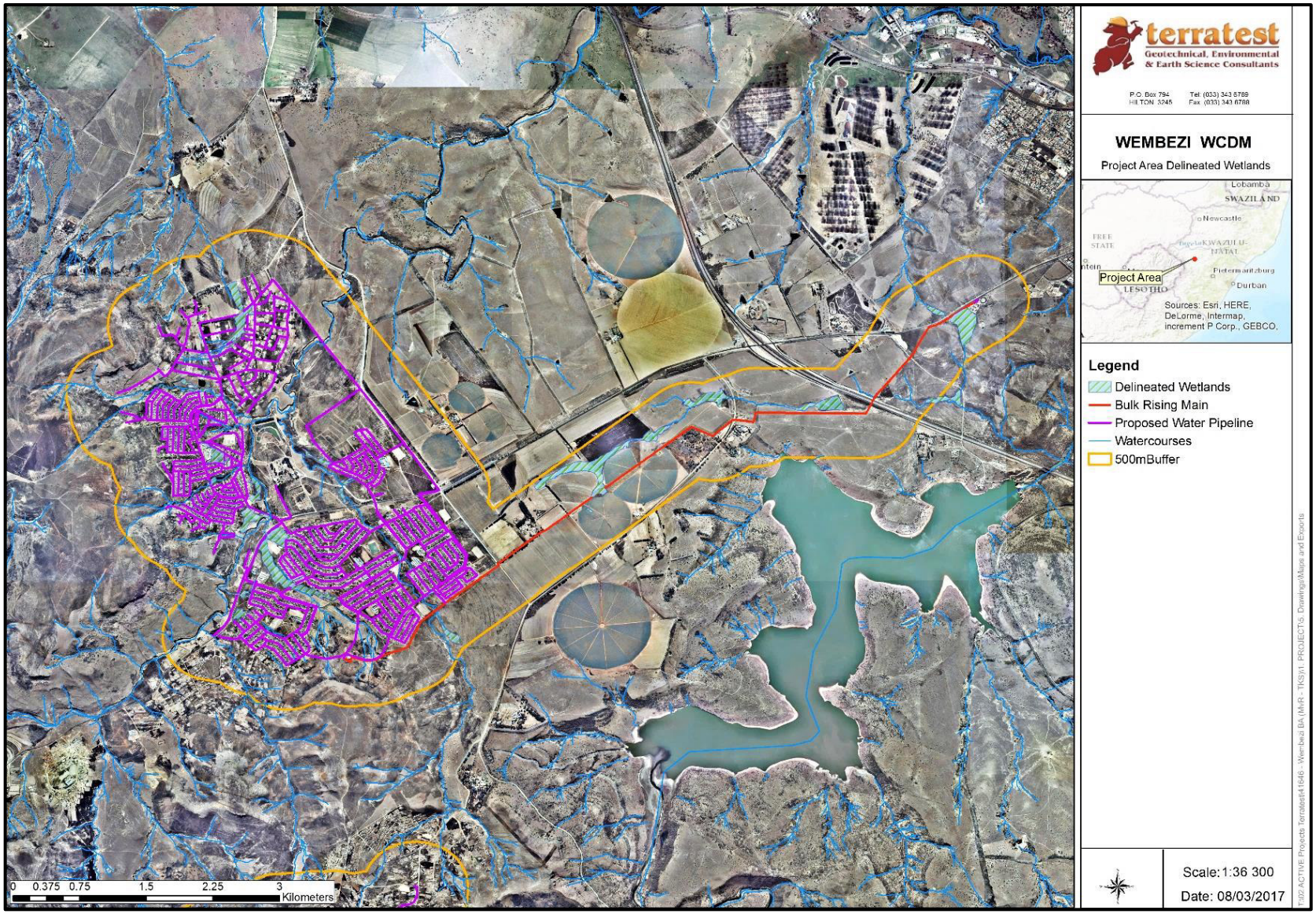

Figure 5: Wetlands delineated within the study area.

The wetlands within the domestic reticulation study area are generally severely degraded as a result of the human activities in their proximity. Most of the damage has been done incidentally as a result of trampling by cattle or other livestock and possibly as a result of over-frequent veld fires. At the present time the four extant wetland types are Channelled and Unchannelled Valley Bottoms, Hillslope seeps, and Toeslope Seeps.

It was apparent that, at the time of the study, almost all of the water in the wetlands originated from unnatural sources such as running taps or sewage leaks. For this reason the systems were more biologically active than they would otherwise have been under the prevailing dry weather conditions. The vegetation within them had been heavily grazed by livestock but it was apparent that most cover would consist of sedges and grasses. In a few places stands of Reeds (*Phragmites australis*), Bulrushes (*Typha capensis*), Snakeweed (*Persicaria* spp.), and the large Sedge *Cyperus fastigiatus* were evident. Unexpectedly, a small stand of Job's Tears (*Coix lacryma*), which is not indigenous, was found at one site. This is well outside the normal altitude range of the species and is an anomaly.

Connecting the various wetlands, or linking them to the larger Little Bushmans River, are a number of drainage lines of widths which vary from a metre to 30m. Originally many of these were probably wetland systems but are now so severely eroded that no wetland elements remain. Typically, the banks are high and are either very steep or are vertical. The substrate is loose argillaceous alluvium of up to gravel particle size, with occasional bedrock bands of either dolerite or shale/sandstone of the Estcourt Formation of the Beaufort Group, Karoo Supergroup.

Plate 3: A watercourse which was probably a wetland but which is now very severely eroded. Note the vertical banks and the gravel channel substrate.

Plate 4: Water which has run down the road from a single tap which is located near the row of trees in the background. This leak supports a thriving wetland system and is also a watering point for livestock.

6.2.3 Wetland Health

The condition of the wetlands in the study area varies from that of total destruction and loss, through to relatively pristine. While no effort was made to assess the severely degraded or lost wetlands which would have to be awarded a PES Category of "E" or "F", two of the systems which are in better condition were modelled with the WET-Health model. The systems chosen for this were the northernmost wetland in the Wembezi area as it contains the highest levels of biodiversity and is crossed by pipelines at two points. The other wetland area assessed, runs parallel to a long section of the bulk main pipeline and through which the line passes at one point. The results are shown in Tables 4 and 5.

Table 4: Outputs of the WET-Health Model for the Wembezi Northern Wetland

HGM Unit	Ha	Hydrology		Geomorphology		Vegetation	
		Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score
1	7.2	3.5	0	1.0	-1	1.2	-1
PES Category		**C**	→	**B**	↓	**B**	↓

Using the formula provided for the model, the overall PES score of the system is 2.1 which is in Category "C". This score is considered to be realistic for a wetland that is in a highly transformed area.

The bulk main pipeline was considered to consist of three hydro-geomorphic units because of the presence of three dams within it.

Table 5: Outputs of the WET-Health Model for the Bulk Main Pipeline Wetland

HGM Unit	Ha	Hydrology		Geomorphology		Vegetation	
		Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score
1	4.5	1.0	0	1.0	0	0.7	0
2	2.4	1.0	0	0.0	0	0.6	0
3	6.5	1.0	0	0.0	0	0.2	0
Area weighted impact scores		1.0	0	0.3	0	0.5	0
PES Category		**B**	→	**A**	→	**A**	→

Using the formula provided for the model, the overall PES score of the system is 0.65 which is in Category "A". Since the wetland itself, although surrounded by crop lands and pastures, is in good condition the overall score is considered to be reasonable. The presence of the small dams in the system depressed the hydrology score but this was overridden by the Geomorphology and Vegetation results. For the purpose of consistency, the same two wetlands were assessed for the ecosystem services which they might yield. The results are shown in Tables 6 and 7 and Figures 6 and 7.

Table 6: Ecosystem Service scores obtained for the Wembezi Northern Wetland.

Ecosystem Service					Score
Ecosystem Services Supplied by Wetlands	Indirect Benefits	Regulating and supporting benefits	Flood attenuation		2.1
			Streamflow regulation		2.0
			Water Quality enhancement benefits	Sediment trapping	1.6
				Phosphate assimilation	2.3
				Nitrate assimilation	1.8
				Toxicant assimilation	1.9
				Erosion control	2.4
			Carbon storage		0.7
	Direct Benefits	**Biodiversity maintenance**			1.8
		Provisioning benefits	Provisioning of water for human use		0.8
			Provisioning of harvestable resources		1.2
			Provisioning of cultivated foods		0.8
		Cultural benefits	Cultural heritage		0.5
			Tourism and recreation		0.1
			Education and research		1.0
				Total:	21.0
				Average:	1.4

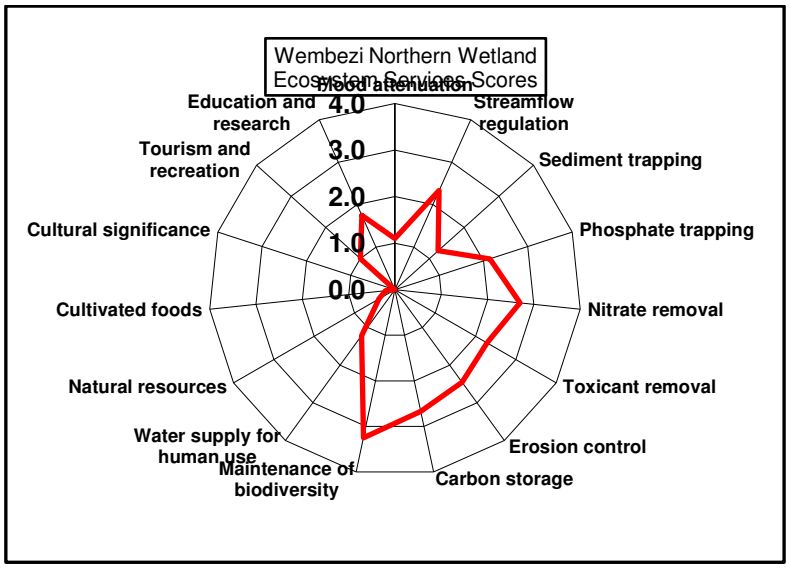

Figure 6: Ecosystem Services Scores for the Wembezi Northern Wetland.

The scores for the ecosystem services suggest that the Wembezi Northern Wetland is of relatively low value although it does have some flood attenuation, soil retention, and phosphate assimilation capability. Conditions in the upstream catchment area are such that these three impacts are likely to happen and so there is cause to ensure that the wetland is protected to some extent.

Table 7: Ecosystem Service scores obtained for the Bulk Main Pipeline Wetland.

Ecosystem Service					Score
Ecosystem Services Supplied by Wetlands	Indirect Benefits	Regulating and supporting benefits	Flood attenuation		1.1
			Streamflow regulation		2.3
			Water Quality enhancement benefits	Sediment trapping	1.3
				Phosphate assimilation	2.1
				Nitrate assimilation	2.7
				Toxicant assimilation	2.3
				Erosion control	2.5
			Carbon storage		2.7
	Direct Benefits	Biodiversity maintenance			3.3
		Provisioning benefits	Provisioning of water for human use		1.2
			Provisioning of harvestable resources		0.4
			Provisioning of cultivated foods		0.2
		Cultural benefits	Cultural heritage		0.0
			Tourism and recreation		1.0
			Education and research		1.8
				Total:	24.8
				Average:	1.7

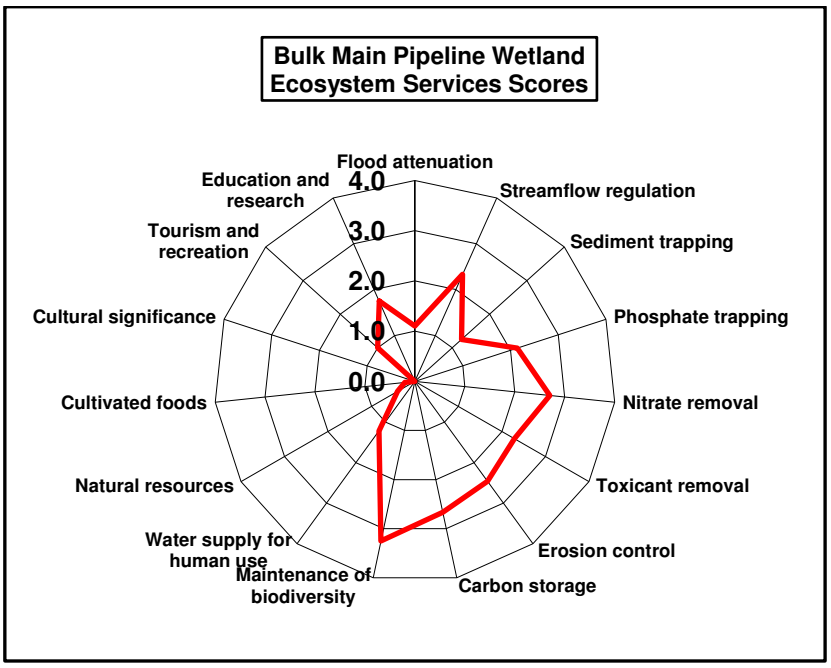

Figure 7: Ecosystem Services Scores for the Bulk Main Pipeline Wetland.

The results of the ecosystems services assessment indicate that the Bulk Main Wetland serves useful functions in regard to phosphate, nitrate, and toxicant removal, and for erosion

control, carbon storage, and biodiversity maintenance. The other services scored lower simply as there is no known demand for them.

6.2.4 Watercourses and Little Bushmans River

The drainage in the project area consists of two systems. The larger is the Little Bushmans River catchment which includes the Wembezi area, while smaller is a stream which flows from the area around most of the bulk supply pipeline.

Many of the watercourses in the project area were probably originally wetlands but are now so severely degraded that they have lost all their original characteristics and there is no realistic possibility of rehabilitation. Elsewhere, the watercourses are largely seasonal or ephemeral and only hold natural water after rainfall events. Under present conditions, however, some have prolonged flows as a result of water and/or sewage leaks, and of runoff from irrigation schemes in the agricultural area. In almost all cases the ecological condition of these systems is poor and, in terms of their functionality, are considered to be Category "D" systems at best but most are in PES Categories "E" or "F" as defined in Table 1. Those which are in better condition are concentrated in the agricultural area and have a PES in Category "C".

The Little Bushmans River is the largest river flowing from the project area. It rises in the Ntabanhlope area and flows through Wembezi and the town of Estcourt, to the Bushmans River. The channel distance from the northern edge of Wembezi to the Bushmans River confluence is approximately 18km. Flows in the river are perennial but vary seasonally. See Figure 8. However, at the time of the study, it was apparent that a considerable portion of the flow was derived from leaking infrastructure within the Wembezi area since flows below the town were visibly greater than those upstream of the town.

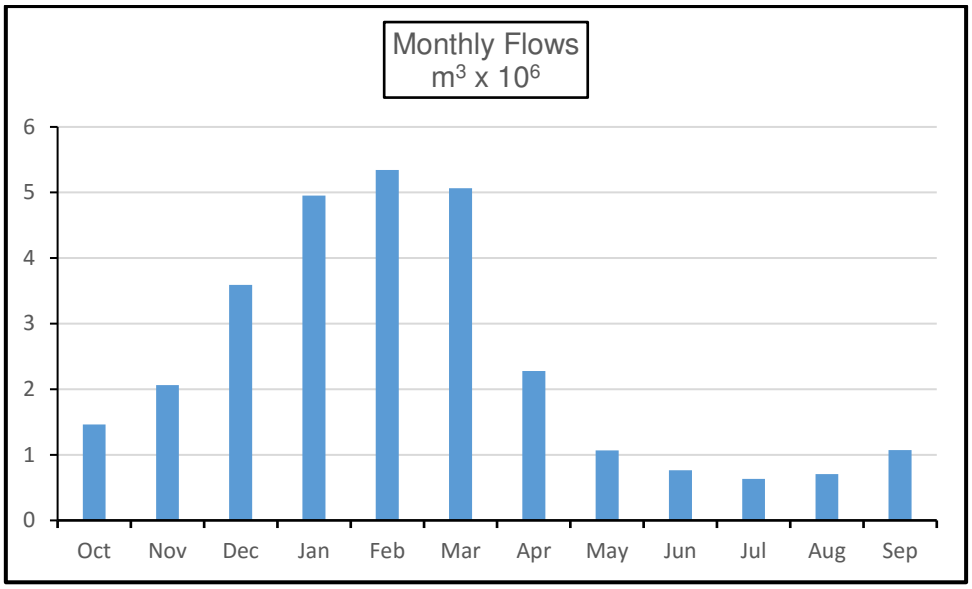

Figure 8: Monthly flow rates for the Little Bushmans River at Station V7H012 in Estcourt Town.

The planned crossing point of the Little Bushmans River is well downstream of Wembezi at approximately 29° 1'38.11"S, 29°46'56.97"E. The channel at this point is deeply (> 4 m) incised but cattle have broken down the banks at a number of places in order to gain access to the water. The vegetation along the banks within the channel is dominated by grasses but some alien trees are present along the margins. These include Willow (*Salix* sp.), Black Wattle (*Acacia mearnsii*) and River Bean (*Sesbania punicea*).

Plate 5: Channel of the Little Bushmans River at the designated pipeline crossing point.

Examination of the river in the vicinity of the crossing point showed that the banks are somewhat lower at a point close upstream. It is recommended that the route be changed to make use of those conditions as the construction process will be simplified. The SASS survey was done at a point near Wembezi. The results are shown in Table 8.

Table 8: Results of the SASS survey done on the Little Bushmans River.

Biotope		Scores
Stones-in-current Stone-out-of-current	SASS Score	40
	No. Taxa	9
	ASPT	4.4
Mud, Sand, and Gravel	SASS Score	37
	No. Taxa	11
	ASPT	3.4
Vegetation	SASS Score	No habitat available due to low flows
	No. Taxa	
	ASPT	
Composite	SASS Score	49
	No. Taxa	12
	ASPT	4.1
River Ecoregion	North-eastern Uplands	
River Class	E/F	

The finding that the River Class was "E/F" is not considered to be a fair reflection of the system. The NFEPA Rivers database (1999) classifies it as a Class "C" system. Under better flow conditions and in the warmer months of the year, that score is probably more realistic.

6.2.5 Fauna

The fauna in the study area was not intensively surveyed but note was made of species which were either seen or were detected by other means such as calls, quills, burrows, and spoor. Those observed are listed in Table 9. Because of the degree of development in the Wembezi area, virtually no indigenous fauna other than for birds and a few small mammals (rodents) remain there. The greatest diversity was seen either at the site of the aeration ponds or in the northern wetlands.

The only species of conservation concern which was found was Blue Crane (*Anthropoides paradiseus*) which is red data listed as being regionally "Near Threatened" (Taylor *et al*, 2015). Two birds were seen near the long wetland to the west of the N3 and a farm worker said that they are seen there on a regular basis. It is however highly unlikely that the construction of the pipeline will impact on these birds.

Undoubtedly a dedicated survey would reveal more species but because of the nature of the development, which will leave the landscape virtually unchanged once construction is completed, a detailed assessment of the biodiversity is not considered to be necessary.

Table 9: List of animal species seen in the Wembezi and in the bulk rising main pipeline farming area.

Taxon	Scientific Name	Common Name	Status	Wembezi Area	Bulk Pipeline Farming Area
Mammals	*Redunca arundinum*	Common Reedbuck	Least Concern		X
	Orycteropus afer	Antbear (Aardvark)	Least concern		X
	Hystrix austroafricana	Porcupine	Least Concern		X
	Atilax paludinosus	Water Mongoose	Least Concern	X	
	Rhabdomys pumilio	Striped field Mouse	Least Concern	X	X
	Otomys irroratus	Vlei Rat	Least Concern	X	
Birds	*Anthropoides paradiseus*	Blue Crane	Near Threatened		X
	Bostrychia hagedash	Hadedah Ibis		X	X
	Ciconia ciconia	White Stork			X
	Ardea melanocephala	Black-headed Heron		X	X
	Fulica cristata	Red-knobbed Coot		X	
	Tachybaptus ruficolis	Little Grebe		X	
	Anas undulata	Yellowbill Duck		X	
	Dicrurus adsimilis	Fork-tailed Drongo		X	X
	Lanius collaris	Common Fiscal.		X	X
	Chrysococcyx caprius	Diderick Cuckoo		X	X
	Vanellus armatus	Blacksmith Lapwing		X	X
	Gallinago nigripennis	African snipe		X	
	Saxicola torquatus	Stone Chat		X	X
	Corvus capensis	Cape Crow		X	X
	Vidua macroura	Pin-tailed Whydah			X
	Euplectes axillaris	Fan-tailed Widow		X	X

Taxon	Scientific Name	Common Name	Status	Wembezi Area	Bulk Pipeline Farming Area
	Euplectes progne	Long-tailed Widowbird		X	X
	Hirundo abyssinica	Lesser Striped Swallow		X	X
	Riparia paludicola	Brown-throated Martin		X	X
	Columba guinea	Speckled (Rock) Pigeon		X	
	Streptopelia semitorquata	Red-eyed Dove		X	X
	Motacilla capensis	Cape Wagtail		X	
	Macronyx capensis	Cape Longclaw			X
	Cisticola tinniens	Levaillant's Cisticola		X	
Frogs	*Afrana angolensis*	Common River Frog		X	
	Ptychadena porosissima	Striped Grass Frog		X	

7. CONSIDERATION OF FINDINGS AND DEFINITION OF IMPACTS

The full list of wetland and water course crossing sites is shown in Table 10 and their locations are shown in Figures 9 and 10.

Table 10: Positions of wetland and watercourse crossings in the project area.

Pipeline System	Crossing Type		Position		Comment
	Wetland	Watercourse	South	East	
Bulk Supply Pipeline	x		29° 1'26.68"	29°50'49.27"	Passes close by a wetland.
	x		29° 2'32.21"	29°48'39.13"	
		x	29° 1'57.82"	29°50'18.81"	
		x	29° 3'16.05"	29°47'38.98"	Two watercourse channels.
		x	29° 3'34.10"	29°47'15.69"	
		x	29° 3'34.09"	29°47'12.00"	
Reticulation Pipelines		x	29° 3'33.60"	29°46'59.03"	
		x	29° 3'31.85"	29°46'50.66"	Very small.
	x		29° 3'14.04"	29°46'53.09"	Very small. Two pipelines.
	x		29° 3'05.94"	29°46'32.13"	Very small. Two pipelines.
		x	29° 3'20.95"	29°47'10.37"	Two channels
		x	29° 3'33.44"	29°47'15.79"	
		x	29° 3'33.40"	29°47'12.30"	
		x	29° 3'11.65"	29°47'33.17"	
		x	29° 2'57.30"	29°47'27.10"	
		x	29° 2'45.99"	29°47'16.35"	
	x		29° 3'6.76"	29°46'46.23"	
	x		29° 2'48.18"	29°46'37.26"	
	x		29° 2'58.11"	29°47'25.62"	
	x		29° 3'10.07"	29°46'26.25"	
	x		29° 3'11.44"	29°46'31.11"	Small headwater crossing.
		x	29° 2'41.54"	29°46'38.86"	Little Bushmans River.
		x	29° 2'48.38"	29°46'19.88"	
		x	29° 2'37.86"	29°46'1.77"	
		x	29° 2'23.19"	29°46'27.58"	
		x	29° 2'12.43"	29°46'12.37"	Two channels.
		x	29° 2'5.63"	29°46'16.38"	
		x	29° 2'4.16"	29°46'12.08"	
		x	29° 2'2.79"	29°46'19.49"	
		x	29° 2'2.38"	29°46'22.81"	
		x	29° 1'57.11"	29°46'20.79"	
		x	29° 1'43.91"	29°46'16.29"	
		x	29° 1'38.64"	29°46'23.09"	
		x	29° 1'38.12"	29°46'57.34"	Little Bushmans River.
		x	29° 1'37.47"	29°46'14.13"	

Pipeline System	Crossing Type		Position		Comment
	Wetland	Watercourse	South	East	
	x		29° 2'40.19"	29°46'35.62"	Wetland edge.
	x		29° 2'29.24"	29°46'16.30"	
Reticulation Pipelines	x		29° 2'21.80	29°46'21.29"	Several crossings near this point.
	x		29° 2'14.57"	29°46'13.32"	Wetland edge.
	x		29° 1'43.17"	29°46'13.69"	Drain.
	x		29° 1'42.45"	29°46'15.63"	
	x		29° 1'38.44"	29°46'24.81"	
	x		29° 1'33.11"	29°46'27.35"	Large wetland.
	x		29° 1'27.90"	29°46'27.39"	Large wetland.
	x		29° 2'27.70"	29°47'8.93"	Two small crossings.

7.1 Background

The findings of the study undertaken on the wetlands, watercourses, and biodiversity in the footprint of the proposed new Wembezi water reticulation project and its new bulk potable water supply pipeline indicate that the project will be undertaken in an area which is already very substantially transformed from the natural state. In the Wembezi area the transformation relates to formalised urban residential and commercial activities. The density of development is high and it is known that the municipality plans to develop the area further as a result of the need for additional housing. Further loss of the remaining semi-natural environment will obviously take place when these proposed developments take place.

The construction of the new bulk water supply line is to be done within the servitude of the existing supply line. The corridor through which the servitude passes is almost entirely through developed farm lands. These primarily consist of either crop fields or pastures with small sections being under other uses such as rough grazing in unimproved veld. Close to Wembezi the pipeline passes through an area which is under communal tenure but is severely degraded as a result of overgrazing and over-frequent veld burning. Along its length the servitude passes by or through two wetland areas.

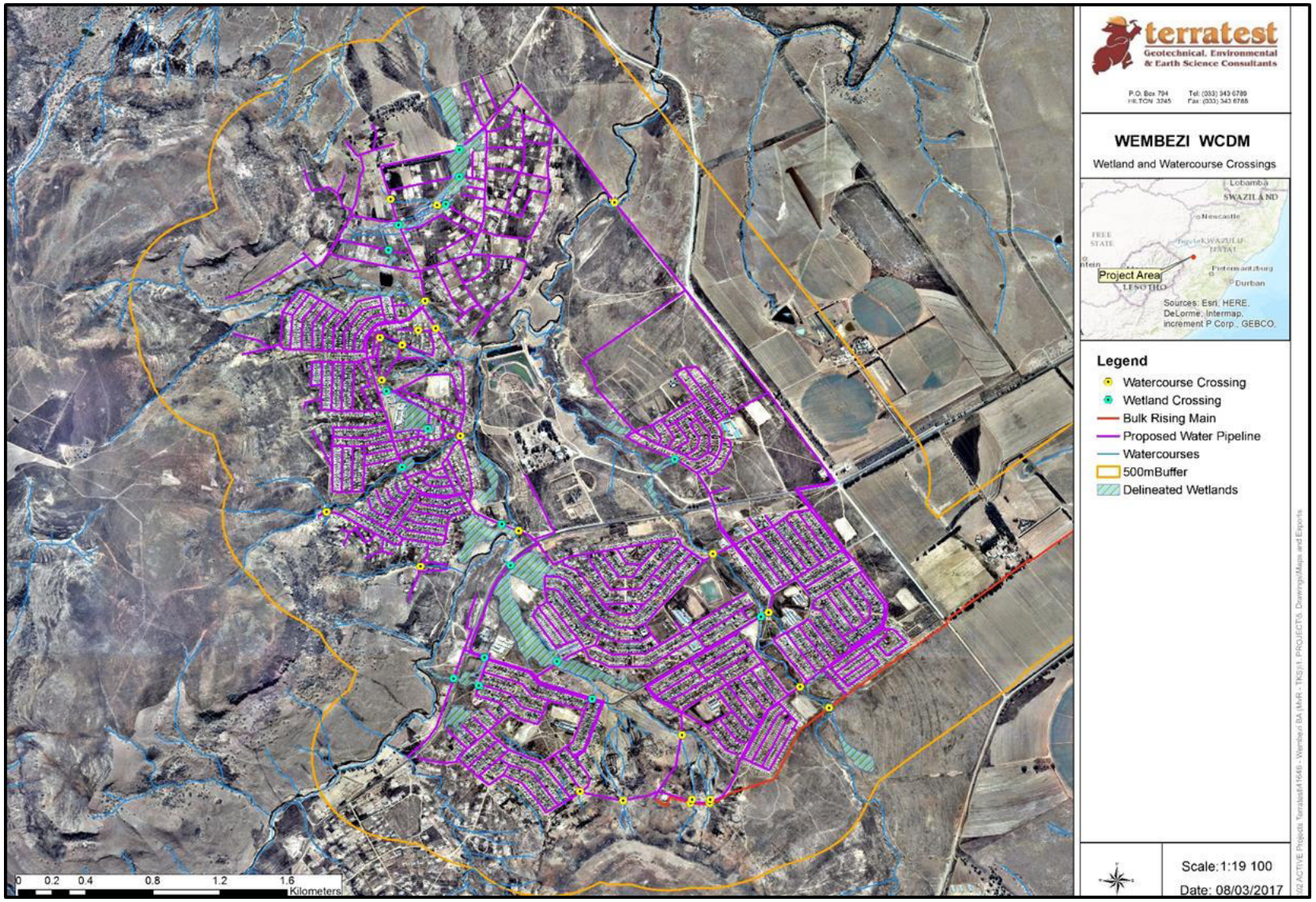

Figure 9: Wetland and watercourse crossings identified in the Wembezi area.

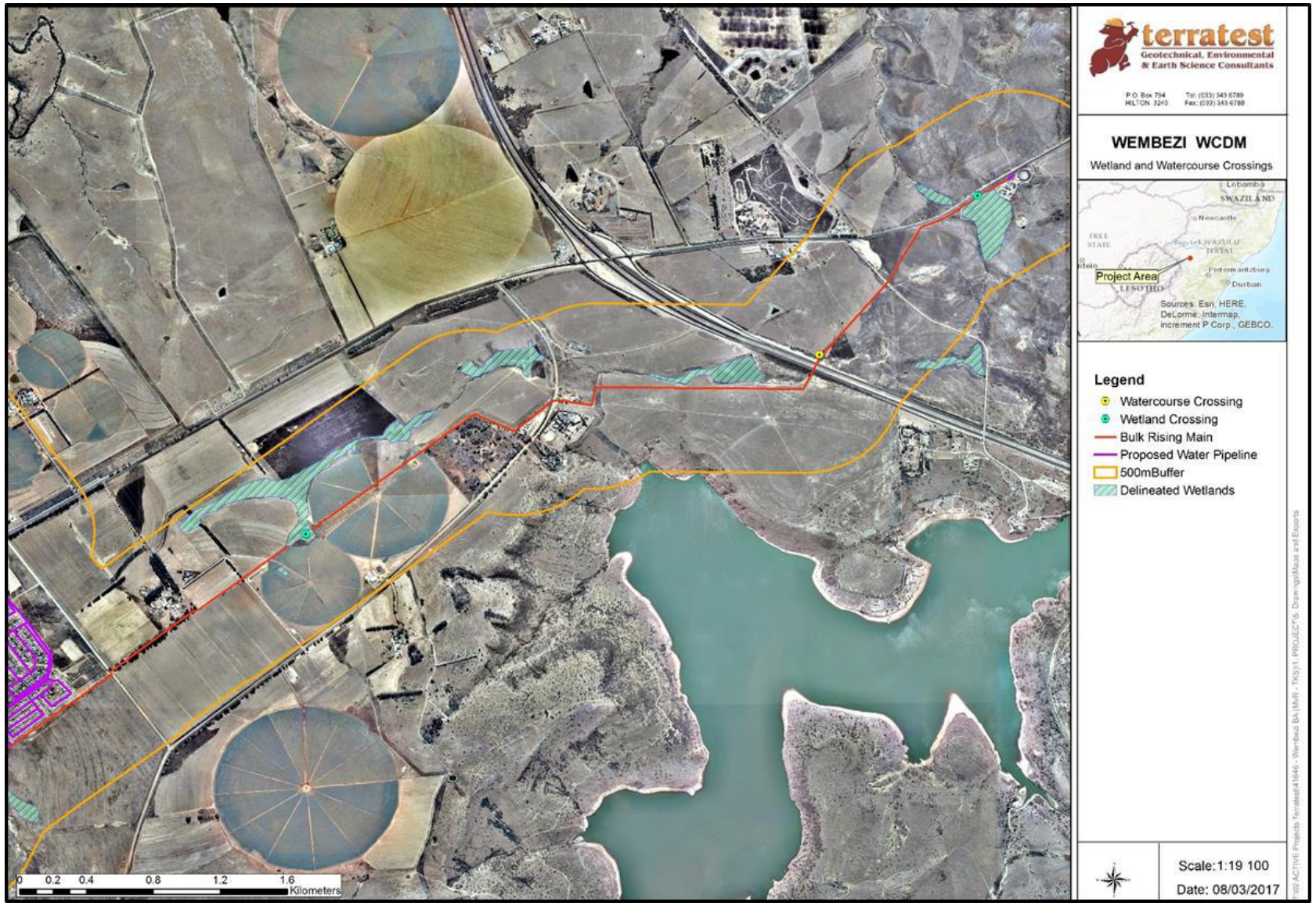

Figure 10: Wetland and watercourse crossings identified along the route of the bulk water main pipeline.

7.2 Foreseeable Impacts

7.2.1 Loss of Vegetation

The natural vegetation in the project area is already severely degraded and so it is anticipated that the project will create few new impacts in this regard. Provided that the rehabilitation of the pipeline trenches is properly done and that the working area is revegetated the greatest potential risk arises from the spread of alien weed species with bramble being the greatest threat.

7.2.2 Impacts on wetlands

The bulk water pipeline passes by a wetland close to the treatment works at its origin and through two arms of a single wetland in the farming area. The wetland at the treatment works includes settling ponds which were linked to the works and so it is not considered to be a natural system. Since the pipeline follows the servitude past this system, impacts there will be minimal. The two wetland crossings do have potential to result in some impacts. One site is within an irrigated pasture but the other has semi-natural vegetation. Fortunately, both sites are at the head of the local system arms and so the flow through them will be smaller than would be the case further downstream. Rehabilitation at these sites will be of great importance and will relate to maintenance of sub-surface water flows and to restoration of the existing vegetation type.

Within the Wembezi area there are 17 wetland crossings. All but three of these are at the points where roads pass through the systems so there are existing impacts at those points. It may be possible to use the road crossing structures to carry the pipelines but otherwise attention must be given to sub-surface flows and vegetation.

7.2.3 Impacts on watercourses and the Little Bushmans River

Because of their poor ecological state, the watercourses provide relatively little habitat for aquatic biodiversity. For this reason most impacts will be related to channel and bank stability. Because of the highly erodible soils the risk of impacts is considerable and the consequences would be additional sedimentation of the system and further secondary degradation of the biodiversity.

The Little Bushmans River is similar to the other watercourses in the area in terms of its channel morphology at the crossing site. It is, however, larger than the other drainage lines

making the risk of bank erosion larger. For this reason it is recommended that the crossing site be moved upstream to a point where the banks are lower.

7.2.4 Loss of fauna

The fauna in the area is already greatly reduced from the natural state. Since the completed pipelines will be non-intrusive in the landscape it is not anticipated that they will create any new impacts on the fauna. Attention must be paid to the Blue Cranes since the birds could be scared away from the area during the construction process. Recommendations to reduce the possibility of this impact by doing construction work in that area out of the birds' breeding season are put forward.

7.2.5 Alternatives to the proposed development

The reticulation of potable water to household and other users in the Wembezi area is a development that has no alternatives in terms of its need or desirability. Attention was given to alternative alignments of some pipelines but it was found that the same wetlands and watercourses would be crossed anyway and so no advantage was gained in terms of environmental impacts. In addition, there may have been engineering design consequences as hydraulic parameters would be changed. Therefore, the present routes are adhered to.

7.2.6 Cumulative impacts.

Once the construction phase is complete and the rehabilitation has been done, the project will leave no new cumulative impacts on the environment since it makes provision for an upgrade of existing facilities. The reduction in water leakage from the current infrastructure and wastage will however result in some wetlands being dried out and in flows in the Little Bushmans River being reduced.

Recommendations for addressing the construction impacts are included in Section 8.

8. IMPACT ASSESSMENT

The terms used in the assessment of impacts are defined in Appendix I and the impacts on the natural environment are assessed below.

8.1 Impacts on the Indigenous Vegetation

Because the typical vegetation in virtually the entire project area is already either totally lost, or is at least partially transformed, no new impacts in this regards are foreseen as is indicated in Table 11.

Table 11: Assessment of impacts originating from loss of indigenous terrestrial vegetation along the pipeline trenches.

Assessment Criterion	Rating	Reason(s)
Certainty of Assessment	**High**	The vegetation in the project area is known to be severely degraded.
Probability of Occurrence	**Probable**	There is already so much degradation that the project will probably not make any difference providing that the rehabilitation is done.
Impact (Intensity)	**Low**	There is already so much degradation that the project will probably not make any difference providing that the rehabilitation is done.
Impact (Significance)	**Low**	There is already so much degradation that the project will probably not make any difference providing that the rehabilitation is done.
Impact (Spatial Extent)	**Site to Local**	The impact will be limited to the site and its close surrounds.
Impact (Duration)	**Construction Phase**	The construction phase includes the time to undertake rehabilitation.
Impact (Effect)	**Negative**	The impact on the environment would be Negative if alien weeds are allowed to invade.
Need for Mitigation	**Moderate**	The pipeline trenches must be revegetated with indigenous grass species and a programme of alien weed control must be followed until such time as the vegetation cover is complete.
Locality of Mitigation	**On Site**	The mitigation measures are to be undertaken on the site of the potential impacts.

The mitigatory measures put forward include the following actions:

- The soil excavated from the trenches must be retained and be returned in the reverse order to which it was removed so as to re-establish the original soil profiles as best possible.
- A rigorous programme of alien weed control must be implemented and sustained until the vegetation (grass) cover over the trenches is well established and complete.
- Indigenous grass species suitable for the rehabilitation of the trenches are as follows:
  - ✓ Kweek grass. *Cynodon dactylon*. 15%
  - ✓ Love grass. *Eragrostis curvula*. 65%
  - ✓ Thatch grass. *Hyparrhenia hirta.* 20%

The above grasses are tolerant of grazing pressure from domestic livestock. Other species which are more attractive to grazers are not recommended as they will not be able to become established. The percentage figures are the proportion of each species by mass in the seed mixture.

The above measures are intended to quickly cover the soil along the working area and so to prevent erosion. In time other species will colonise from the surrounding areas possibly resulting in a slight improvement in diversity. The measures to prevent invasion of weed species, especially bramble, must be adhered to.

8.2 Impacts on the Wetlands

In order to assess the impacts on the wetlands the Department of Water and Sanitation Risk Assessment Matrix was used to determine the level of risk to the two systems. The output from the matrix is shown in Table 12. The overall impacts are all estimated to be “Low Risk”. The most substantial risk associated with the pipeline construction is an impact on the sub-surface water movement in the wetlands. Such changes can lead to the formation of preferential flow channels which can eventually emerge as surface channels and set off further erosion. This issue is addressed in the mitigatory measures which are provided.

The impacts on wetlands in the Wembezi area and in the farming area are presented in Tables 13 and 14.

The mitigatory measures put forward for the Wembezi wetlands include the following actions:

- The soil excavated from the trenches must be retained with the topsoil and the subsoil being stockpiled separately. They must then and be returned to the trench in the reverse order to which they were removed so as to re-establish the original soil profiles as best possible.
- Compaction of the soils to match the porosity of the surrounds must be done.
- The trenches must be rehabilitated with a vegetation cover which matches that of the surrounds. It is recommended that any wetland plants which are excavated should be set aside and be kept moist until they can be returned for use on the trench.
- A rigorous programme of alien weed control must be implemented and sustained until the vegetation cover over the trenches is well established and complete.

Because the pipelines will either be within an existing servitude or be confined to narrow corridors within the built up area of Wembezi, and because virtually all of the pipeline routes are within transformed areas, it was not possible to consider wetland buffers in the usual way. It is however, recommended that the working servitudes be kept well within the planning servitude spaces.

Table 12: Scores from the Department of Water and Sanitation Risk Assessment Matrix for the impacts arising from the Wembezi water project.

Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence Level	Control measures
Installation of the water reticulation in Wembezi	Disruption of sub-surface water flows.	WEMBEZI AREA. Impacts which might arise out of this project include disruption of sub-surface water percolation, and creation of preferential drainage channels on the surface. Vegetation damage will happen but rehabilitation must ensure that it does not persist past the construction phase.	1.25	5.25	10.0	52.5	**Low Risk**	80%	The soil profiles, including compaction, must be re-established when the trenches are filled.
	Creation of new channels through erosion along the trench.		2.0	6.0	8.0	48.0	**Low Risk**	90%	Original surface topography and vegetation cover must be re-established. Plugging of any existing drainage ditches in the immediate vicinity of the pipeline route would help in this regard.
	Damage to wetland vegetation.		2.0	5.0	8.0	40.0	**Low Risk**	90%	The pipeline trenches must be revegetated with a cover matching that of the surrounds.
Installation of the bulk pipeline through the wetland in the pasture area.	Disruption of sub-surface water flows.	BULK PIPELINE. Impacts which might arise out of this project include disruption of sub-surface water percolation, and creation of preferential drainage channels on the surface. Vegetation damage will happen but rehabilitation must ensure that it does not persist past the construction phase.	1.25	5.25	10.0	52.0	**Low Risk**	80%	The soil profiles, including compaction, must be re-established when the trenches are filled.
	Creation of new channels through erosion along the trench.		1.5	3.5	8.0	28.0	**Low Risk**	90%	The affected area is cultivated and under pasture so the risk of causing surface drainage is low.
	Damage to wetland vegetation.		1.0	3.0	8.0	24.0	**Low Risk**	90%	There is no indigenous vegetation but the damage to the pasture must be repaired.
Installation of the bulk pipeline through the wetland at the western end of the farming area.	Disruption of sub-surface water flows.	BULK PIPELINE. Impacts which might arise out of this project include disruption of sub-surface water percolation, and creation of preferential drainage channels on the surface. Vegetation damage will happen but rehabilitation must	1.25	5.25	10.0	52.5	**Low risk**	80%	The soil profiles, including compaction, must be re-established when the trench is filled.
	Creation of new channels through erosion along the trench.		2.0	6.0	8.0	48.0	**Low Risk**	80%	Original surface topography and vegetation cover must be re-established.

Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Confidence Level	Control measures
	Damage to vegetation.	ensure that it does not persist past the construction phase.	2.5	5.25	8.0	42.0	**Low Risk**	80%	The pipeline trench must be revegetated with a cover matching that of the surrounds.

Table 13: Assessment of impacts originating from loss of wetlands in the Wembezi area.

Assessment Criterion	Rating	Reason(s)
Certainty of Assessment	**Moderate to High**	The extent to which the wetlands will be impacted upon is well understood.
Probability of Occurrence	**Probable**	It is not definite that the pipeline installation will cause loss of wetland.
Impact (Intensity)	**Low**	The loss of wetland as a result of the development will not be extensive.
Impact (Significance)	**Moderate**	The significance of the impact will be Moderate because many sites might be affected.
Impact (Spatial Extent)	**Site to Local**	The impact will only be evident within a small area. The two downstream dams will mask the effects at a wider scale.
Impact (Duration)	**Construction Phase**	The impact on the wetlands must be repaired by the construction contractor.
Impact (Effect)	**Negative**	The impact on the environment would be negative.
Need for Mitigation	**Moderate to High**	All damage from the pipelines must be rehabilitated.
Locality of Mitigation	**On Site**	The wetland repair measures are to be undertaken at the site.

Table 14: Assessment of impacts originating from loss of wetlands in the farming area.

Assessment Criterion	Rating	Reason(s)
Certainty of Assessment	**Moderate to High**	The extent to which the wetlands will be impacted upon is well understood.
Probability of Occurrence	**Probable**	It is not definite that the pipeline installation will cause loss of wetland but it is probable that there will be some effect.
Impact (Intensity)	**Low**	The loss of wetland, if any, as a result of the development will not be extensive.
Impact (Significance)	**Moderate to High**	The significance of the impact will be Moderate because a part of the wetland is in good condition and because a red data listed bird species is known to be present at times.
Impact (Spatial Extent)	**Site to Regional**	Impacts could occur both at the site and also over a wider area if the Red data species is affected.
Impact (Duration)	**Construction Phase**	The impact on the wetlands must be repaired by the construction contractor.
Impact (Effect)	**Negative**	The impact on the environment would be negative.
Need for Mitigation	**High**	All damage from the pipelines must be rehabilitated.
Locality of Mitigation	**On Site**	The wetland repair measures are to be undertaken at the site.

The mitigatory measures put forward for the farming area include the following actions:

- The construction of the pipeline in the vicinity of the wetland in the farming area must be done during the dry season when the Blue Cranes are not breeding. The birds are

probably accustomed to some agricultural activity but additional disturbance could prevent them from breeding for a season.

- The soil excavated from the trenches must be retained with the topsoil and the subsoil being stockpiled separately. They must then be returned to the trench in the reverse order to which they were removed so as to re-establish the original soil profiles as best possible.
- Compaction of the soils to match the porosity of the surrounds must be done.
- The trenches must be rehabilitated with a vegetation cover which matches that of the surrounds. It is recommended that any wetland plants which are excavated should be set aside and be kept moist until they can be returned. In the case of the wetland which is under pasture the rehabilitation must be done in collaboration with the farm owner or manager.
- A rigorous programme of alien weed control must be implemented and sustained until the vegetation cover (wetland plants or pasture) over the trench is well established and complete.

8.3 Impacts on Watercourses and the Little Bushmans River

The greatest impact on watercourses and the Little Bushmans River is likely to be a result of accelerated bank erosion which would lead to further deposition of sediment in the channels with an associated drop in water quality and in loss of vegetation in the surrounds. The impacts are assessed in Table 15.

Table 15: Assessment of impacts on the watercourses and Little Bushmans River.

Assessment Criterion	Rating	Reason(s)
Certainty of Assessment	**Moderate to High**	The extent to which the channels will be impacted upon is well understood.
Probability of Occurrence	**Highly Probable**	It is Highly Probable that there will be some damage to the watercourses.
Impact (Intensity)	**Moderate**	The damage to the channels could be considerable if construction is not done properly.
Impact (Significance)	**Moderate**	The significance of the impact will be Moderate because many sites might be affected.
Impact (Spatial Extent)	**Site to Regional**	The impact could extend from the construction site to some distance downstream. Some impacts will be as a result of greater sediment loads.
Impact (Duration)	**Short to medium Term**	The impact on the channels could last from the construction phase for a period of several years until the banks achieve a stable state.
Impact (Effect)	**Negative**	The impact on the environment would be negative.
Need for Mitigation	**Moderate to High**	All damage must be rehabilitated.

Assessment Criterion	Rating	Reason(s)
Locality of Mitigation	**On Site**	The channel repair measures are to be undertaken at the site.

The construction of the pipeline in the vicinity of the watercourses and the Little Bushmans River must be done with due consideration of the stability of the banks. It is imperative that the banks be left in a stable condition at the end of the construction phase. The mitigatory measures put forward for the watercourses and the Little Bushmans River include the following actions:

- Bank slopes must be graded to the lowest possible angle and must be well below the slip angle of the material concerned.
- Banks must be planted with indigenous grasses and the following mix is suggested:
  - ✓ Kweek grass. *Cynodon dactylon*. 15%
  - ✓ Love grass. *Eragrostis curvula*. 65%
  - ✓ Thatch grass. *Hyparrhenia hirta*. 20%

  The above grasses are tolerant of grazing pressure from domestic livestock. Other species which are more attractive to grazers are not recommended as they will not be able to become established. The percentage figures are the proportion of each species by mass in the seed mixture.
- Where necessary use must be made of gabions, rock packs, or other such hard stabilising structures. However, the use of retaining walls constructed of bricks, blocks, or concrete, is not recommended as such structures are often ineffective and can accelerate erosion processes in some cases.
- No surplus soil or other such material may be disposed of in the channels.

8.4 Impacts on the Fauna

The fauna in the project area is generally severely depleted from the natural state. The impacts are assessed in Table 16.

Table 16: Assessment of impacts on the fauna in the project area.

Assessment Criterion	Rating	Reason(s)
Certainty of Assessment	**High**	The extent to which the fauna will be impacted upon is well understood.
Probability of Occurrence	**Unlikely**	It is not definite that the pipeline installation will cause any new impacts on the fauna. However, the Blue Cranes in the farming area are a possible exception and are addressed accordingly.
Impact (Intensity)	**Low**	The loss of fauna, if any, as a result of the development will be minimal.

Assessment Criterion	Rating	Reason(s)
Impact (Significance)	**Low**	The significance of the impact will be Low because most of the fauna in the area has already been lost. The species that remain will be tolerant of the project. The Blue Cranes are an exception to the above and are addressed accordingly.
Impact (Spatial Extent)	**Site to Regional**	Impacts could occur both at the site and also over a wider area if the Red data species is affected.
Impact (Duration)	**Construction Phase**	The impact on the wetlands must be repaired by the construction contractor.
Impact (Effect)	**Negative**	The impact on the environment would be negative.
Need for Mitigation	**Low**	Special attention must be given to the Blue Cranes.
Locality of Mitigation	**On Site**	The mitigatory measures that are called for must be implemented at the construction sites.

The mitigatory measures put forward for the fauna include the following actions:

- The fauna in the area will be best protected through maintenance of the vegetation, the watercourse channels, and the wetlands. Therefore, all the recommendations put forward in regard to the vegetation are relevant here.
- The Blue Cranes which are resident, for at least a large part of the time, in the vicinity of the large wetland in the farming area will require special mitigatory actions. These are as follows:
  - ✓ Prior to the planned commencement of the construction work it must be determined whether the cranes are present or not. If they are in the area, then the construction of the bulk water pipeline in the area between the N3 highway and the road which borders Wembezi should be scheduled to be done outside of the normal breeding season (between April and August).
  - ✓ No construction activities, stockpiles, stores, or personnel may go more than 30m north of the pipeline trench at any time of the year.
  - ✓ The wetland rehabilitation guidelines are to be very strictly adhered to.

9. MONITORING PROGRAMME

While the management recommendations in relation to Blue Cranes call for some surveys before the construction of the bulk supply pipeline past the wetland where the birds are present may proceed, it will also be necessary to undertake a monitoring programme both during the construction phase of the project, and for a time after its completion. This will include the following actions:

- The Environmental Control Officer (ECO) who oversees the various components of the construction of the pipelines must be thoroughly familiar with the recommendations put forward in Section 8 and also with the content of the project Environmental Management Programme. The construction process must then be monitored for compliance with the mandated actions. Monitoring must be done at intervals which are appropriate to the work being done, but on a monthly basis as a minimum.
- The ECO must have sight of the contractors' method statements prior to their implementation and must also have sight of the contractors' time schedules and plans.
- The ECO will be able to discuss issues that could potentially stop works with the Resident Engineer.
- The Blue Cranes must be monitored during the construction phase. If any signs of behavioural changes are noted, then then matter should be investigated further and appropriate mitigatory actions be undertaken.
- A post-construction monitoring programme must be set in place. It will include examination of at least the following items:

    - ✓ **Infilling of the pipeline trenches**. The correct placement of the soil layers must be done. This is of key importance in wetland crossings. At such sites the compaction of the soil must also be done correctly.
    - ✓ **Rehabilitation of the pipeline trenches**. The trenches must be revegetated with either the recommended grass mix or with salvaged plants which are demonstrably viable.
    - ✓ **Rehabilitation of the working servitude**. The working servitude must be returned to its pre-construction condition or better.
    - ✓ **Stability of watercourse banks**. The banks must be left in a stable condition.
    - ✓ **Soil erosion.** No soil erosion anywhere in the working area, including site camps and laydown areas, may be accepted.
    - ✓ **Alien weed invasion.** No alien weed invasion may be tolerated within a year of completion of the project.

It is suggested that the post construction monitoring visits should be done in September, November, and March in the 12 months following completion of the project. Note, this schedule can be applied in completed areas even while construction is still under way elsewhere. Use should be made of fixed point photos and each site inspection must be followed up with a written report. These reports will be submitted to the Resident Engineer for distribution.

If any monitoring event, at any time of the project period, does find a fault or problem, then the issue must be investigated further and be reported on. Remedial action as is appropriate must be undertaken within a time frame specified by the ECO.

10. CONCLUSION

The study undertaken on the biophysical environment in the footprint of the proposed upgrade to the water supply and reticulation systems in and near Wembezi has not found any impacts of significance. The reasons for this are as follows:

- The project area is already highly transformed as a result of both the agricultural activities along the bulk supply pipeline route, and of the existing urban development in Wembezi where a new reservoir and the fine scale domestic reticulation will be situated. The transformation has resulted in either total loss or severe degradation of the vegetation, and in an associated reduction in the fauna.
- The new water lines will largely be located within existing servitudes and so are in areas which have already been affected by the supply system.

Although the anticipated further impacts of the development are minimal, and no fatal flaw has been found, it is not implied that the construction of the pipelines may go ahead without appropriate caution. For this reason, a series of management recommendations have been put forward and are backed up by a monitoring programme. Such a programme is outlined, and it is suggested that the management recommendations and the monitoring programme are made available as a part of the construction contract documents which the contractors must agree to and sign.

Finally, it is suggested that the ECO is appointed prior to the start of construction activities, including site establishment, and that the person becomes thoroughly familiar with the project area and also gets to meet the community representatives in the affected areas.

11. REFERENCES

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APPENDIX I - Definition of the Terms used in the Assessment of Environmental Impacts

The terms used in the impact assessment process are defined below.

Assessment Term	Description
CERTAINTY	This criterion applies to the confidence of the assessor in making the assessment.
	Low. The present degree of confidence in the relevant statement is less than 40%. **Moderate.** The present degree of confidence in the relevant statement is between 40% and 80%. **High.** The present degree of confidence in the relevant statement is greater than 80%.
PROBABILITY	This criterion applies to the likelihood of the anticipated impact actually happening. It may also be used in assessing the likelihood of success of a mitigatory action.
	Unlikely. The probability of the anticipated impact happening is low (Less than 20% probable). **Probable.** The probability of the anticipated impact happening is moderate (20% - 60% probable). **Highly Probable.** The probability of the anticipated impact happening is great. (60% - 99% probable). **Definite.** It is definite that the impact will take place.
IMPACT (Intensity)	This criterion refers to the impact in relation to its effect on a (stipulated) feature.
	No Impact. There will be no discernible impact on the feature or issue under consideration. **Low.** The impact on the feature or issue under consideration will be limited in terms of effect or in time. **Moderate.** The impact on the feature will be such that there will be some damage done but that the feature will not be totally destroyed and that it will recover if the cause of the impact is removed. **High.** The impact on the feature is such that the damage done will be considerable and enduring. Recovery from the impact could, at best, be only partial. **Very High.** The impact on the feature is such that the feature will be totally destroyed and that no recovery is possible. **Unknown.** The nature of the impact on the feature is not understood or cannot be predicted in any reliable fashion.

IMPACT (Significance)	This criterion refers to the effect of the impact "in the larger scheme of things". EG: If a proposed dam will inundate a particular patch of vegetation then the impact on that patch of vegetation is very high as it will be totally destroyed but, if the vegetation is of a common type which has low conservation priority, then the significance of the impact is reduced.
	No Significance. The impact is so inconsequential that it is of no significance at all. **Low.** The impact is of low intensity or consequence. It is Local in effect. **Moderate.** The impact is of sufficient intensity to warrant concern. There will be considerable disturbance to either the natural biota and/or to humans. Ecological processes will be only slightly affected. The impact may be apparent for some time. **High.** The impact is of considerable intensity. There will be severe degradation of the environment and localised losses of entire plant and animal assemblages may occur. Ecological processes are strongly disrupted. Social impacts may be severe. Recovery will only be possible in the Long Term. **Very High.** The impact is of potentially devastating intensity to both the natural environment and/or to human residents of the area. There will be total or near-total failure of ecological processes. It is unlikely that mitigation is possible in any reasonable human time scale and hence that full recovery from the impact may not be possible in any reasonable human time scale. Thus the impact must be regarded as being Permanent. **Unknown.** The consequences of the impact are not understood or cannot be predicted in any reliable fashion. Probably the precautionary principle should be applied.
LEVELS OF SPATIAL EXTENT	This criterion refers to the space within which the impact will be of consequence.
	Site Level. The physical impacts of the development will not extend beyond the immediate development site. If relevant, visual impacts will only be apparent to viewers on or close to, the site. **Local Level.** The impacts of the development will only be felt or be significant at the site of the development or within a short distance (roughly 500 m) of it. In the case of visual impacts the distance may be increased to about 2 kilometres but is restricted to a narrow viewscape. **Regional Level.** The impacts of the development may be felt or be significant at a distance which is well removed from the site. In the case of visual impacts the viewscape may be increased to landscape width and breadth. **Provincial Level.** The impacts of the development are sufficient so as to be significant throughout the province. **National Level.** The impacts of the development are sufficient so as to be significant throughout the Republic of South Africa. **International Level.** The impacts of the development are sufficient so as to be significant beyond the borders of the Republic of South Africa.
TIME PERIODS	This criterion refers to the length of time for which the impact may be apparent or in effect.
	Construction phase. The time period during which geotechnical surveys and/or construction or other such work is done. Note: This phase will include all the time from the start of any geotechnical work that is done to the end of the construction period and

	includes any associated rehabilitation work that may be called for. **Operational phase.** The time period for which the operation or development continues to function. This is of particular relevance for developments which have a very large footprint, such as timber plantations or urban expansion, or opencast mines which keep on expanding as they operate. **Short term.** A period of time including the Construction Phase and up to two years further. Note: This time period is defined as it is considered that it covers the period in which the footprint of the construction operation will be sustainably revegetated and wildlife will return to the disturbed areas. **Medium term.** A period of up to five years from the end of the Construction Phase. Note: This time period includes the criteria described for the Short Term but includes the time necessary for woody vegetation, if appropriate, to become established on the development area. **Long Term.** A period of at least ten years, but possibly more, from the end of the Construction Phase or the Operational Phase. Note: This time period includes the criteria described for the Medium Term but includes the time necessary for trees to reach a "fair" size at which they will largely soften the appearance of the development. **Permanent.** The change which would be brought about by the development cannot in any way be reversed *in situ*. The only mitigation options which may be available will be those which are conducted off site.
EFFECT	This criterion refers to the nature of the change brought about by an impact.
	Positive. The impact will have predominantly beneficial results or connotations. **Negative**. The impact will have predominantly detrimental results or connotations. **Neutral**. There will be a change but it cannot be described as being either particularly beneficial or particularly detrimental.
NEED FOR MITIGATION	This criterion refers to the extent to which an anticipated impact will require that mitigatory action is taken.
	Low. The need for mitigation is slight but the conditions demand that some effort be made. **Moderate.** The need for mitigation is definite but there is not requirement for major and costly works. Any proposed mitigatory measure must have good potential to reduce the impact. **High.** The need for mitigation is such that major and costly works are justifiable. Any proposed mitigatory measure must have definite and demonstrable potential for reduction of the impact before the proposed development may be given authorisation to proceed. **Obligatory.** The nature of the impact is such that, unless mitigation can very largely nullify the consequences, it must be regarded as a potential fatal flaw which will halt the proposed development. If such mitigation cannot be achieved, it will be necessary to modify the development so that the impact will be reduced or even obviated.
LOCALITY OF MITIGATION	This criterion refers to the place at which the stipulated mitigation must take place.
	On Site. The necessary mitigation must be undertaken at the site of the impact.

	Off Site. The necessary mitigation need not necessarily be at the site of the impact. Compensatory action may be undertaken at another, preferably similar, site on the property. Eg. Loss of a wetland due to construction of a dam may be mitigated by rehabilitation of a similar wetland in the immediate vicinity.

APPENDIX II – CV and Declaration of Independence

ABBREVIATED CURRICULUM VITAE

ALLETSON, D.J.

Name :	Dacre James Alletson
Date of birth :	10/4/1948
Nationality :	South African
Profession :	Consulting Ecologist
Specialisation :	Aquatic and terrestrial ecology, environmental impact assessment, landscape scale conservation science and planning
Years of experience :	41
Academic qualifications :	Bsc (Biological Sciences) University of Natal. 1968. BSc Hons (Zoology) Rhodes University. 1972.

APPLICABLE EXPERIENCE

Mr Alletson has long experience in the fields of conservation and management of the natural environment and has specialised in aquatic species and systems and in conservation at the scale of landscape. After graduating he was employed at the Oceanographic Research Institute in Durban where he worked on a number of projects in both the estuarine and marine environments. In 1975 he joined to the Natal Parks Board where he served for 21 years in a number of positions. His activities in this time included research and management of certain fish species, management of a trout hatchery, provision of an extension service relating to wetlands and rivers, and participation in management of game and nature reserves including drafting of management plans. From 1984 onwards he served as the Board's river and wetland specialist ecologist and was involved in wetland-related research and management activities. In the process he instigated the development of the KwaZulu-Natal Environmental Atlas and participated in environmental impact assessments including that of the St Lucia Eastern Shores dune mining where he led the wetland component.

In 1997 he formed Alletson Ecologicals, an environmental consultancy and has undertaken a wide variety of environmental investigation and monitoring programmes. Amongst these are some 100 Environmental Impact Assessments. These range from small-scale developments such as timber planting permits, gravel pits, and irrigation dams, through to coal mines, large state dams, housing schemes, private property developments, and pipelines. Some of these projects were undertaken as a member of a team of specialists while in others all facets of impact assessment were undertaken. In the course of this work he has gained a good understanding of the requirements of the National Environmental Management Act (NEMA) and the Biodiversity Act (NEM:BA). He has developed a standardised procedure for assessing and describing impacts and this has become widely used by others. He also consults for government departments and quasi-government organisations. For DWAF he has worked on

numerous projects including the raising of Hazelmere Dam, Mearns Weir, the Mooi-Mgeni Transfer Scheme (Spring Grove Dam, Receiving Streams, Fish surveys, etc.), the TuVa canals decommissioning, and parts of reserve studies for the Upper Tugela Catchment, Ngagane Catchment, and the Umkomaas Catchment. The Mooi-Mgeni project was given the 2003 excellence award by the SA Institute of Civil Engineers. Similar projects have included water quality studies on the proposed Metolong Dam in Lesotho, a water reticulation scheme in and around Taung (North West Province), fishways on the Komati River, and wetland rehabilitation studies, and aquatic ecosystem monitoring including both fish and SASS surveys.

He has worked on a number of forestry related studies for the Department of Agriculture and Environment Affairs and has given training to staff in relation to afforestation issues, including both infield site analysis, and facets of impact assessment.

A number of dam, pipeline and wetland studies (past and current) have been done for Umgeni Water and he also took part in regional planning studies for the Town and Regional Planning Commission. Numerous studies have been done on wetland and environmental assessment for various housing and other infrastructure upgrade projects.

Apart from the planning and impact studies, Mr Alletson also acts as Environmental Control Officer for construction projects and carries out routine aquatic monitoring around coal mines which are being rehabilitated as a part of the closure process.

Since 2012 Mr Alletson has worked with Jeffares & Green (Pty) Ltd and has, amongst other activities undertaken a number of wetland delineations, assessments, and also aquatic surveys for river health assessments and Water use Licence applications. He has also undertaken terrestrial biodiversity surveys as components of impact assessments and planning projects.

PUBLICATIONS AND REPORTS

Has produced approximately 200 reports alone and about 50 more in collaboration with others, since January 1997. A list is available on request.

RECENT WETLAND RELATED EXPERIENCE

Name of Project 1:	**Greater Mbizana/Flagstaff Regional Bulk Water Supply Scheme**
Years (From - To):	2009 - 2012
Location:	Eastern Cape
Client:	Alfred Nzo District Municipality *via* Umgeni Water
Main project features:	Environmental Impact Assessments and Environmental Management Plans for the Greater Mbizana/Flagstaff Regional Bulk Water Supply Scheme. Scoping and EIA studies on a regional water supply dam, borrow pits, and on the bulk raw and potable water pipelines.
Positions held:	Assessment Practitioner, Environmental Control Officer
Activities performed:	River and wetland studies, terrestrial biodiversity studies, Environmental Impact Assessment. Construction site monitoring and control.

Name of Project 2:	**Sikoto Dam and Associated Bulk Works Ozwathini Bulk Water Supply Scheme (Two studies)**
Years (From - To):	1997 - 2011
Location:	KwaZulu-Natal
Client:	uMgungundlovu District Municipality *via* Umgeni Water
Main project features:	Environmental Impact Assessments and Environmental Management Plans for the Greater Ozwathini Bulk Water Supply Scheme. Scoping and EIA studies on a regional water supply dam, and on the bulk raw water pipeline.
Positions held:	Assessment Practitioner, Environmental Control Officer
Activities performed:	Environmental Impact Assessment. River and wetland studies.
Name of Project 3:	**Mooi – Mgeni Water Transfer Scheme**
Years (From - To):	2009-2014
Location:	Mooi River - Ligetton region
Client:	Umgeni Water
Main project features:	Environmental Impact Assessment for the Potable Water Pipeline.
Positions held:	Specialist Ecologist. Impact Assessment.
Activities performed:	River and wetland studies, terrestrial biodiversity studies, Environmental Impact Assessment, Environmental Management Plan.
Name of Project 4:	**Delineation of Wetlands (Multiple Projects)**
Years (From - To):	2008 - 2017
Location:	Various
Client:	Various
Main project features:	Delineation of wetlands and wetland assessment
Positions held:	Specialist Ecologist
Activities performed:	Delineation of wetlands in relation to a number of proposed development projects. Impact assessments performed in some instances.
Name of Project 5:	**Biodiversity Assessment – Proposed New Durban Dig-out Container Port**
Years (From - To):	2012 - 2013
Location:	Durban
Client:	Transnet SOC

Main project features:	Assessment of Floral and Faunal Biodiversity, Wetland Studies, Estuary and Marine Studies, Impact Assessment, Management Recommendations. Biodiversity offsets.
Positions held:	Project Team Leader, Wetland Specialist, Bird and Invertebrate Studies, Report Writing and Compilation.
Activities performed:	Team Management, Client Liaison, Wetland and Biodiversity Surveys, Reporting.
Name of Project 6:	**Water Use Licence Applications (Multiple Projects)**
Years (From - To):	2014 - 2017
Location:	Throughout KwaZulu-Natal
Client:	Municipalities, Sanral, Property Developers, Private Development Projects.
Main project features:	Wetland surveys, Wetland health, Wetland Ecoservices, River studies, Management recommendations.
Positions held:	Specialist Wetland Ecologist
Activities performed:	Wetland assessments. Impact Assessments. Biodiversity, fish and SASS surveys.
Name of Project 7:	**Wetlands Search and Delineation Along the Route of a Proposed New Bulk Raw Water Supply Pipeline from Spioenkop Dam to Ladysmith Water Treatment Works**
Years (From - To):	2015
Location:	Ladysmith, KwaZulu-Natal
Client:	uThukela District Municipality
Main project features:	Development of a new 35 km bulk potable water pipeline to service the Ladysmith area.
Positions held:	Specialist Wetland Ecologist
Activities performed:	River and wetland studies, terrestrial biodiversity studies, wetland modelling, management guidelines.
Name of Project 8:	**Survey of the Biodiversity at the Site of a Proposed New Lodge Development Adjacent to Lake Bhangazi South in the Isimangaliso Wetland Park World Heritage Site**
Years (From - To):	2016
Location:	Isimangaliso Wetland Park World Heritage Site
Client:	ERM Southern Africa (PTY) Ltd
Main project features:	Assessment of the biodiversity within the area of a proposed new community lodge in the World Heritage Site.
Positions held:	Wetland ecologist, survey team leader.

Activities performed:	Historic data collection. Wetland delineation and status assessment. Bird and mammal survey, act as project leader for the team of botanists. Report writing and compilation.
Name of Project 9:	**Development of a Truffle Farm in the Kamberg area near Nottingham Road, KwaZulu-Natal.**
Years (From - To):	2017 - 2017
Location:	Kamberg area, KwaZulu-Natal.
Client:	Private Land Owner
Main project features:	Assessment of aquatic and terriestrial biodiversity and wetland delineation and assessment.
Positions held:	Wetland ecologist, survey team leader.
Activities performed:	Historic data collection. Wetland delineation and status and functionality assessment. Bird and mammal survey, act as project leader for the team of botanists. Report writing and compilation.

edtea
Department :
Economic Development, Tourism and Environmental Affairs
PROVINCE OF KWAZULU-NATAL

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	DC/
NEAS Reference Number:	
Date Received:	

Application for an environmental authorisation in terms of section 24(2) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) or for a waste management licence in terms of section 20(b) of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008).,

PROJECT TITLE

ASSESSMENT OF WETLANDS AND BIODIVERSITY AT THE SITE OF A PROPOSED TRUFFLE FARMING DEVELOPMENT IN THE NOTTINGHAM ROAD AREA

Specialist:	Wetland Specialist		
Contact person:	D.J. Alletson		
Postal address:	PO Box 794, Hilton		
Postal code:	3245	Cell:	083 7871584
Telephone:	033 3436700	Fax:	033 3436701
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Professional affiliation(s) (if any)	IAIA SA		

Project Consultant:	JG Afrika (Pty) Ltd		
Contact person:	M. van Rooyen		
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Telephone:	033 343 6700	Fax:	033 343 6788
E-mail:	vanrooyenm@jgafrika.com		

4.2 The specialist appointed in terms of the Regulations_

I, **D.J. Alletson** , declare that --

General declaration:

- I act as the independent specialist in this application;
- do not have and will not have any vested interest (either business, financial, personal or other) in the undertaking of the proposed activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2014;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I am aware that a person is guilty of an offence in terms of Regulation 48 (1) of the EIA Regulations, 2014, if that person provides incorrect or misleading information. A person who is convicted of an offence in terms of sub-regulation 48(1) (a)-(e) is liable to the penalties as contemplated in section 49B(1) of the National Environmental Management Act, 1998 (Act 107 of 1998).

Signature of the specialist:

JG Afrika (Pty) Ltd

Name of company (if applicable):

20 March 2017

Date:

HERITAGE SURVEY OF THE PROPOSED WEMBEZI WATER AND SEWERAGE RETICULATION PROJECTS, ESTCOURT, KWAZULU-NATAL

FOR TERRATEST

DATE: 29 JUNE 2017

By Gavin Anderson

Umlando: Archaeological Surveys and Heritage Management

PO Box 102532, Meerensee, 3901

Phone/fax: 035-7531785 Fax: 0865445631

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Abbreviations

HP	Historical Period
IIA	Indeterminate Iron Age
LIA	Late Iron Age
EIA	Early Iron Age
ISA	Indeterminate Stone Age
ESA	Early Stone Age
MSA	Middle Stone Age
LSA	Late Stone Age
HIA	Heritage Impact Assessment
PIA	Palaeontological Impact Assessment

INTRODUCTION

The project consists of two proposed developments, the proposed Wembezi Bulk Water and Reticulation development and the proposed Wembezi Sewerage Reticulation Upgrade development. Both proposed developments fall within the same study footprint.

The proposed Wembezi Bulk Water and Reticulation development is a water conservation and demand management scheme upgrade for the Wembezi Township, located in the Inkosi Langalibalele Local Municipality. In this regard, the old existing infrastructure, including the bulk main and reticulation, is proposed to be upgraded with new infrastructure. This is required to stop the current water loses experienced as a result of the old and damaged network infrastructure. The upgrade will occur in the existing servitude.

The bulk pipeline with serve Wembezi and the associated reticulation network as described below. Further, the bulk pipeline will also serve the Ntabamhlope Township, which is located adjacent to Wembezi. Due to the estimated loss of 9,0 Ml of water per day from the existing Wembezi distribution network, the Ntabamhlope Community is unable to receive a constant supply of water and most areas do not receive water at all. The proposed scheme will alleviate the water loss and will ensure a constant supply to the Ntabamhlope Community. Further, the bulk pipeline will supply a future housing development and shopping centre proposed to be constructed in the area. In this regard, the upgraded network will also provide water to an additional future 3 000 households and a new 10 000m2 shopping centre.

The following proposed infrastructure is required to upgrade the existing Water and Sanitation schemes which will benefit both Wembezi and Ntabamhlope Townships:

Bulk Water

The existing bulk AC rising main is to be decommissioned and a new 750 mm HDPE rising main is to be constructed from the existing Pump Station at George Cross Water Treatment Works, to a proposed Wembezi 10Ml bulk storage reservoir. The bulk pipeline is to run alongside an existing pipe in an existing pipeline servitude.

The key components of the scheme are:

- 8 000m of Ø 750mm HDPE;
- Scour Valves;
- Air Valves;
- Isolating Valves;
- Pipeline ancillaries such as pipe marker posts, thrust blocks, chambers etc.;
- Pipe Jacking under N3 Highway or alternatively utilising an existing culvert on the N3;
- Bulk ultrasonic water meters; and
- Construction of a 10 Ml of a reinforced concrete reservoir.

Water Reticulation

The proposed reticulation will feed Wembezi only. Water supply will be gravity fed from the 10 Ml reinforced concrete reservoir at an elevation of 1318 m.

The key components of the water reticulation scheme are:

- 160 993 m of reticulation pipelines ranging from Ø75 uPVC to Ø500 HDPE;
- Air valves;
- Scour valves;
- Isolating valves;
- Fire hydrants;
- Pipeline ancillaries such as marker posts, thrust blocks, chambers etc.;
- Replacement of yard connections;

- Replace or repair household toilet systems, leaking taps, leaking geysers and household plumbing; and
- Water meters on each house connection.

The proposed Wembezi Sewerage Reticulation Upgrade development will involve the replacement of the existing sewerage reticulation in the area of Wembezi. As a result of the excessive leakages experienced by the current Wembezi water reticulation network, substantial pressure has been placed on the existing sewerage network, to the extent that it cannot cope with the high water throughput and as a result the sewerage reticulation is laden with leakages and breakages. All sewerage reticulation will be upgraded in existing footprints.

Umlando was appointed by Terratest to undertake the heritage survey of the bulk water and reticulation pipelines, as well as the sewerage reticulation pipelines.

FIG. 1 GENERAL LOCATION OF THE STUDY AREA

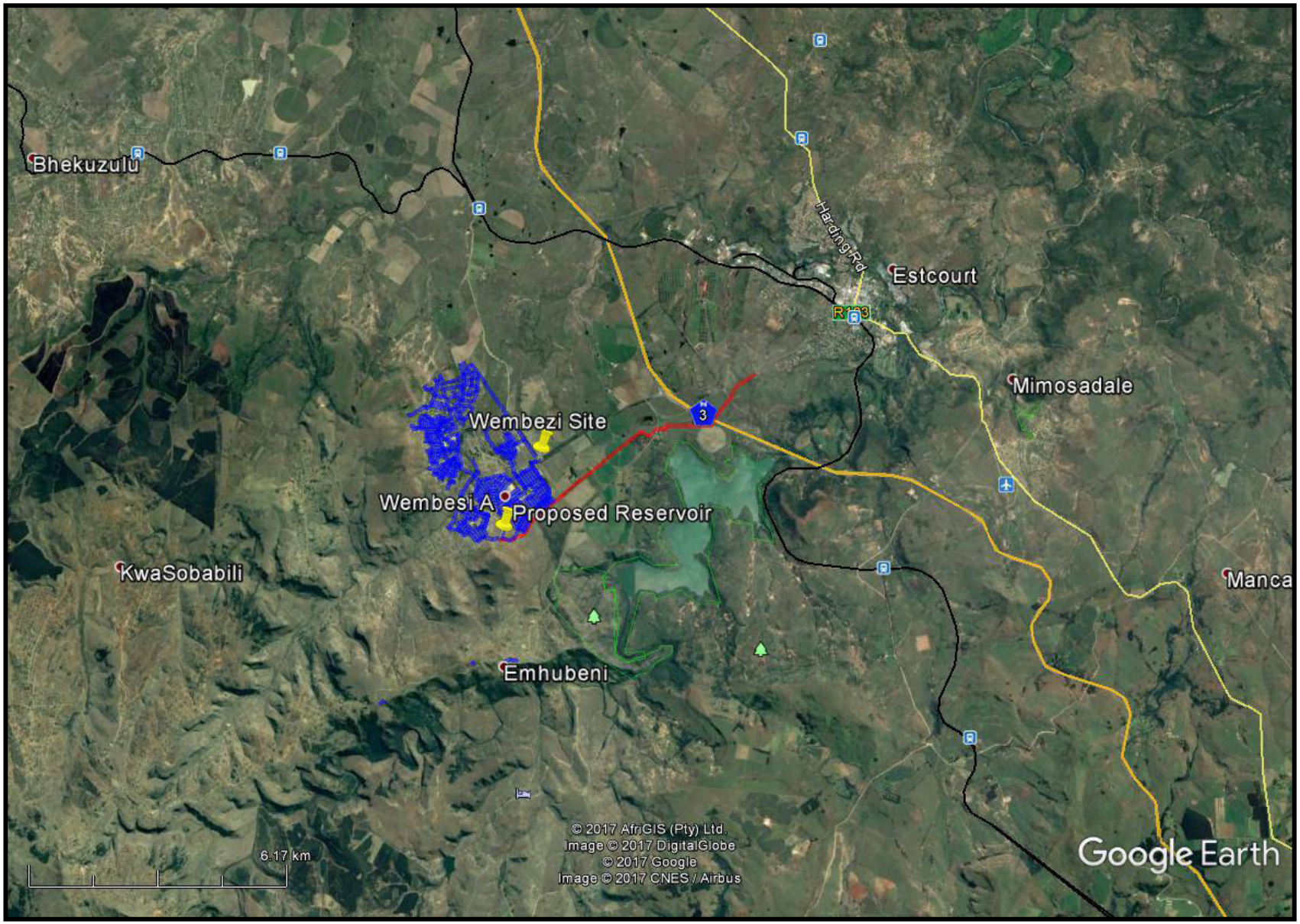


FIG. 2: AERIAL OVERVIEW OF THE STUDY AREA

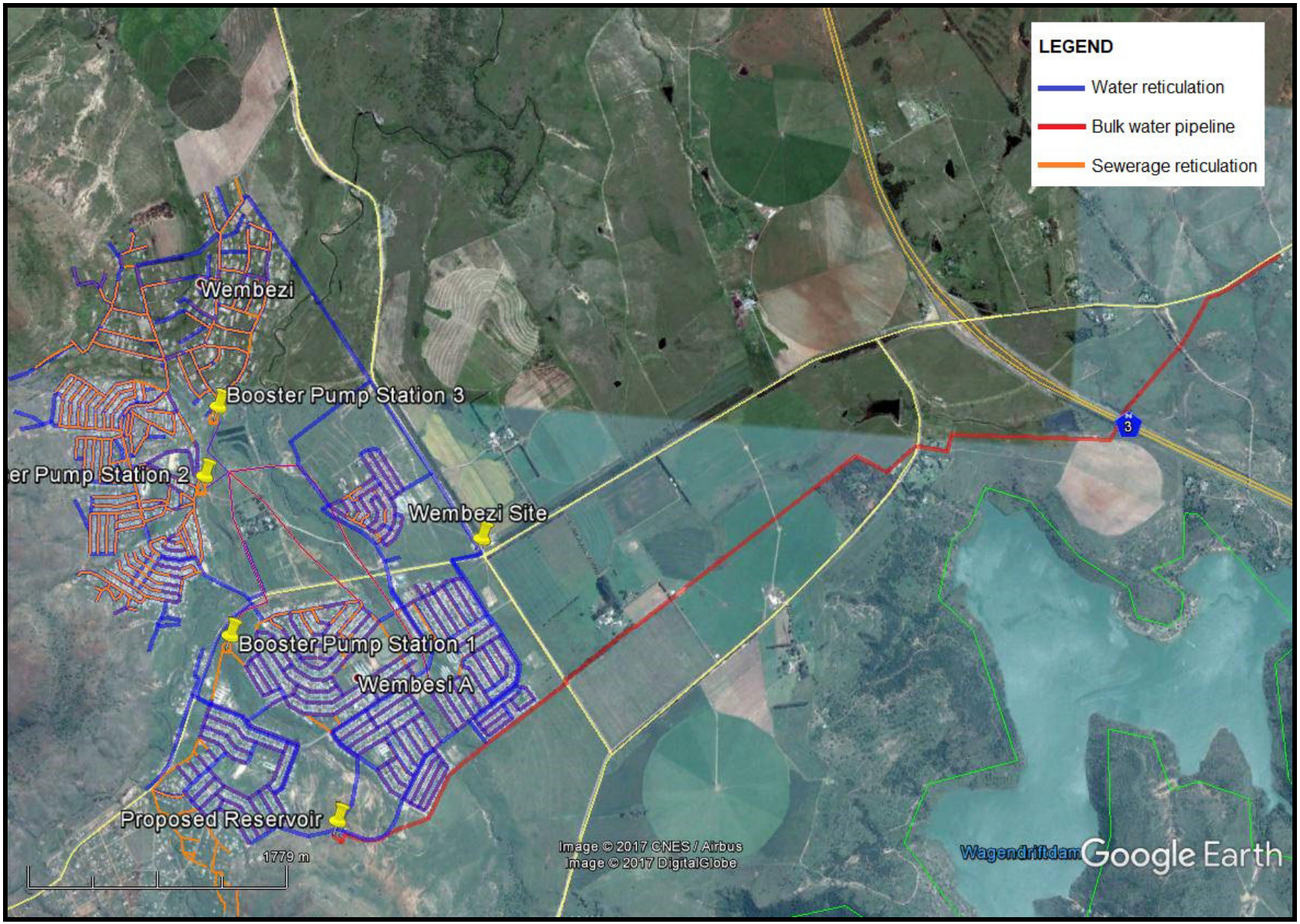


FIG. 3: TOPOGRAPHICAL OVERVIEW OF THE STUDY AREA (WATER)

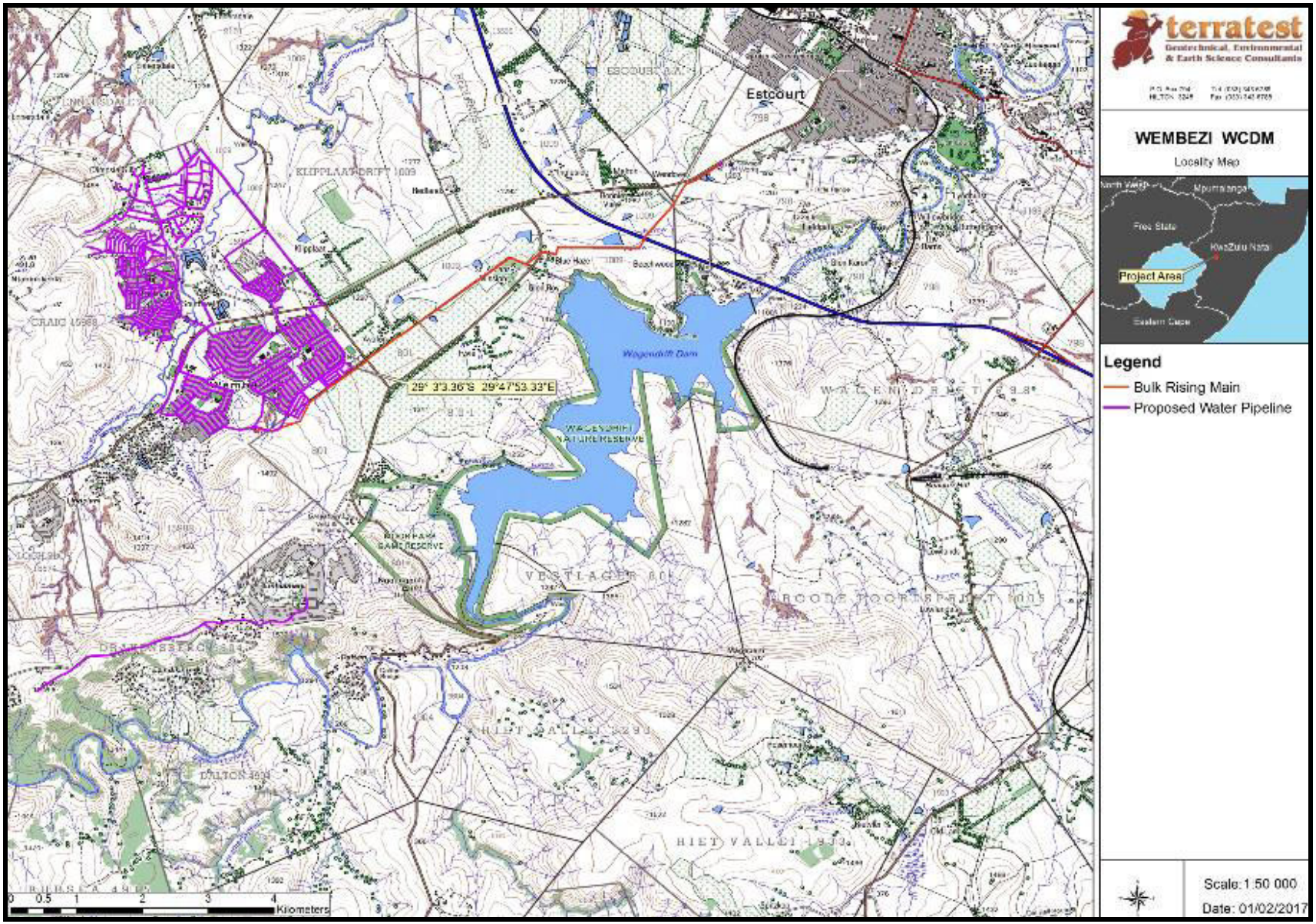


FIG. 4: TOPOGRAPHICAL OVERVIEW OF THE STUDY AREA (SEWERAGE)

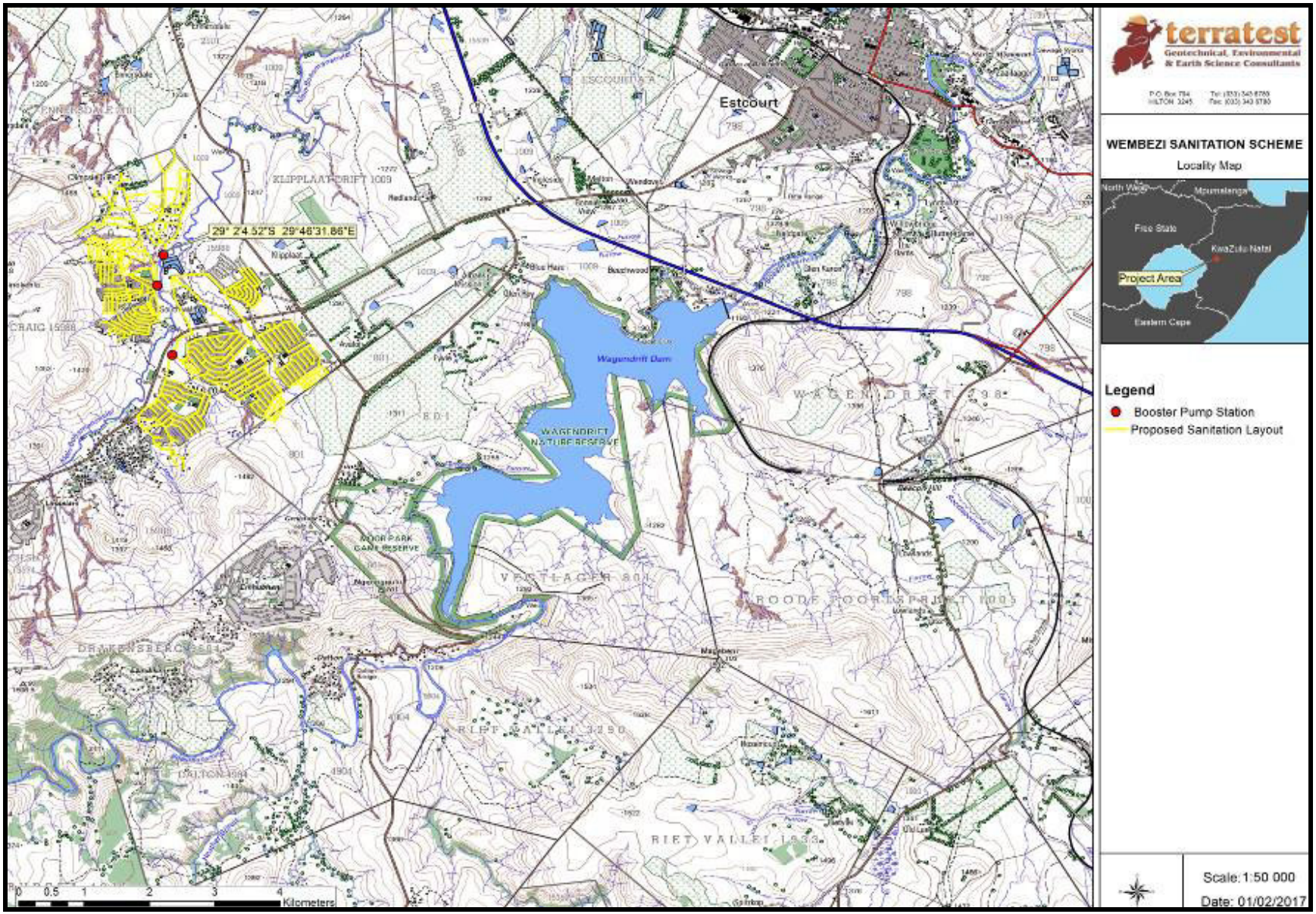


FIG. 5: SCENIC VIEWS OF THE PIPELINE ROUTE

KWAZULU-NATAL HERITAGE ACT NO. 4 OF 2008

"General protection: Structures.—

- No structure which is, or which may reasonably be expected to be older than 60 years, may be demolished, altered or added to without the prior written approval of the Council having been obtained on written application to the Council.
- Where the Council does not grant approval, the Council must consider special protection in terms of sections 38, 39, 40, 41 and 43 of Chapter 9.
- The Council may, by notice in the *Gazette*, exempt—
- A defined geographical area; or
- defined categories of sites within a defined geographical area, from the provisions of subsection where the Council is satisfied that heritage resources falling in the defined geographical area or category have been identified and are adequately protected in terms of sections 38, 39, 40, 41 and 43 of Chapter 9.
- A notice referred to in subsection (2) may, by notice in the *Gazette*, be amended or withdrawn by the Council.

General protection: Graves of victims of conflict.—No person may damage, alter, exhume, or remove from its original position—

- the grave of a victim of conflict;
- a cemetery made up of such graves; or
- any part of a cemetery containing such graves, without the prior written approval of the Council having been obtained on written application to the Council.
- General protection: Traditional burial places.—
- No grave—
- not otherwise protected by this Act; and
- not located in a formal cemetery managed or administered by a local authority, may be damaged, altered, exhumed, removed from its original position, or otherwise disturbed without the prior written approval of the Council having been obtained on written application to the Council.

The Council may only issue written approval once the Council is satisfied that—

- the applicant has made a concerted effort to consult with communities and individuals who by tradition may have an interest in the grave; and
- the applicant and the relevant communities or individuals have reached agreement regarding the grave.

General protection: Battlefield sites, archaeological sites, rock art sites, palaeontological sites, historic fortifications, meteorite or meteorite impact sites.—

- No person may destroy, damage, excavate, alter, write or draw upon, or otherwise disturb any battlefield site, archaeological site, rock art site, palaeontological site, historic fortification, meteorite or meteorite impact site without the prior written approval of the Council having been obtained on written application to the Council.
- Upon discovery of archaeological or palaeontological material or a meteorite by any person, all activity or operations in the general vicinity of such material or meteorite must cease forthwith and a person who made the discovery must submit a written report to the Council without delay.
- The Council may, after consultation with an owner or controlling authority, by way of written notice served on the owner or controlling authority, prohibit any activity considered by the Council to be inappropriate within 50 metres of a rock art site.
- No person may exhume, remove from its original position or otherwise disturb, damage, destroy, own or collect any object or material associated with any battlefield site, archaeological site, rock art site, palaeontological site, historic fortification, meteorite or meteorite impact site without the prior written approval of the Council having been obtained on written application to the Council.
- No person may bring any equipment which assists in the detection of metals and archaeological and palaeontological objects and material, or excavation equipment onto any battlefield site, archaeological site, rock art site, palaeontological site, historic fortification, or meteorite impact site, or

use similar detection or excavation equipment for the recovery of meteorites, without the prior written approval of the Council having been obtained on written application to the Council.

- The ownership of any object or material associated with any battlefield site, archaeological site, rock art site, palaeontological site, historic fortification, meteorite or meteorite impact site, on discovery, vest in the Provincial Government and the Council is regarded as the custodian on behalf of the Provincial Government." (KZN Heritage Act of 2008)

METHOD

The method for Heritage assessment consists of several steps.

The first step forms part of the desktop assessment. Here we would consult the database that has been collated by Umlando. These databases contains archaeological site locations and basic information from several provinces (information from Umlando surveys and some colleagues), most of the national and provincial monuments and battlefields in Southern Africa (http://www.vuvuzela.com/googleearth/monuments.html) and cemeteries in southern Africa (information supplied by the Genealogical Society of Southern Africa). We use 1st and 2nd edition 1:50 000 topographical and 1937 aerial photographs where available, to assist in general location and dating of buildings and/or graves. The database is in Google Earth format and thus used as a quick reference when undertaking desktop studies. Where required we would consult with a local data recording centre, however these tend to be fragmented between different institutions and areas and thus difficult to access at times. We also consult with an historical architect, palaeontologist, and an historian where necessary.

The survey results will define the significance of each recorded site, as well as a management plan.

All sites are grouped according to low, medium, and high significance for the purpose of this report. Sites of low significance have no diagnostic artefacts or features. Sites of medium significance have diagnostic artefacts or features and these sites tend to be sampled. Sampling includes the collection of artefacts for future analysis. All diagnostic pottery, such as rims, lips, and decorated sherds are sampled, while bone, stone, and shell are mostly noted. Sampling usually occurs on most sites. Sites of high significance are excavated and/or extensively sampled. Those sites that are extensively sampled have high research potential, yet poor preservation of features.

Defining significance

Heritage sites vary according to significance and several different criteria relate to each type of site. However, there are several criteria that allow for a general significance rating of archaeological sites.

These criteria are:

1. State of preservation of:

1.1. Organic remains:

1.1.1. Faunal

1.1.2. Botanical

1.2. Rock art

1.3. Walling

1.4. Presence of a cultural deposit

1.5. Features:

1.5.1. Ash Features

1.5.2. Graves

1.5.3. Middens

1.5.4. Cattle byres

1.5.5. Bedding and ash complexes

2. Spatial arrangements:

2.1. Internal housing arrangements

2.2. Intra-site settlement patterns

2.3. Inter-site settlement patterns

3. Features of the site:

3.1. Are there any unusual, unique or rare artefacts or images at the site?

3.2. Is it a type site?

3.3. Does the site have a very good example of a specific time period, feature, or artefact?

4. Research:

4.1. Providing information on current research projects

4.2. Salvaging information for potential future research projects

5. Inter- and intra-site variability

5.1. Can this particular site yield information regarding intra-site variability, i.e. spatial relationships between various features and artefacts?

5.2. Can this particular site yield information about a community's social relationships within itself, or between other communities?

6. Archaeological Experience:

6.1. The personal experience and expertise of the CRM practitioner should not be ignored. Experience can indicate sites that have potentially significant aspects, but need to be tested prior to any conclusions.

7. Educational:

7.1. Does the site have the potential to be used as an educational instrument?

7.2. Does the site have the potential to become a tourist attraction?

7.3. The educational value of a site can only be fully determined after initial test-pit excavations and/or full excavations.

8. Other Heritage Significance:

8.1. Palaeontological sites

8.2. Historical buildings

8.3. Battlefields and general Anglo-Zulu and Anglo-Boer sites

8.4. Graves and/or community cemeteries

8.5. Living Heritage Sites

8.6. Cultural Landscapes, that includes old trees, hills, mountains, rivers, etc related to cultural or historical experiences.

The more a site can fulfill the above criteria, the more significant it becomes. Test-pit excavations are used to test the full potential of an archaeological deposit. This occurs in Phase 2. These test-pit excavations may require further excavations if the site is of significance (Phase 3). Sites may also be mapped and/or have artefacts sampled as a form of mitigation. Sampling normally occurs when the artefacts may be good examples of their type, but are not in a primary archaeological context. Mapping records the spatial relationship between features and artefacts.

The above significance ratings allow one to grade the site according to SAHRA's grading scale. This is summarised in Table 1.

VEGETATION TYPE.

The predominant vegetation in the study area is KwaZulu-Natal Highland Thornveld (Gs 6). This is found in areas of moderate rainfall (750 mm – 850 mm per annum) and is generally not rich in wetlands other than in the lower lying area along river valleys. In the extreme west some of the study area lies in Drakensberg Foothill Moist Grassland (Gs 10). The type is found in a large area along the lower slopes of the Drakensberg in moderately rolling and mountainous country which is incised by river gorges of drier vegetation types and by forest, and covered in forb-rich grassland dominated by short bunch grasses including *Themeda triandra* and *Tristachya leucothrix.*

TABLE 1: SAHRA GRADINGS FOR HERITAGE SITES

SITE SIGNIFICANCE	FIELD RATING	GRADE	RECOMMENDED MITIGATION
High Significance	National Significance	Grade 1	Site conservation / Site development
High Significance	Provincial Significance	Grade 2	Site conservation / Site development
High Significance	Local Significance	Grade 3A / 3B	
High / Medium Significance	Generally Protected A		Site conservation or mitigation prior to development / destruction
Medium Significance	Generally Protected B		Site conservation or mitigation / test excavation / systematic sampling / monitoring prior to or during development / destruction
Low Significance	Generally Protected C		On-site sampling monitoring or no archaeological mitigation required prior to or during development / destruction

RESULTS

DESKTOP STUDY

The desktop study consisted of analysing various maps for evidence of prior habitation in the study area, as well as for previous archaeological surveys. The archaeological database indicates that there are archaeological sites in the general area (fig. 6). These sites include all types of Stone Age and Iron Age sites. No sites occur in the study area.

No national monuments, battlefields, or historical cemeteries are known to occur in the study area.

The 1947 1:50 000 topographical map indicates that most of the area was under wattle afforestation (fig. 7). Two farm labourers houses occur to the east of the N3 (see Table 2 for their locations). These houses would probably included human burials. These occur 30-60m from the proposed lie. A few buildings occur in the now Wembezi area, but they do not exist anymore.

TABLE 2: LOCATION OF TW0 HOUSES NEAR THE LINE

NAME	SOUTH	EAST
H1	29° 1'53.15"	29°50'18.58"
H2	29° 1'53.98"	29°50'30.50"

FIG. 6: LOCATION OF KNOWN HERITAGE SITES NEAR THE STUDY AREA

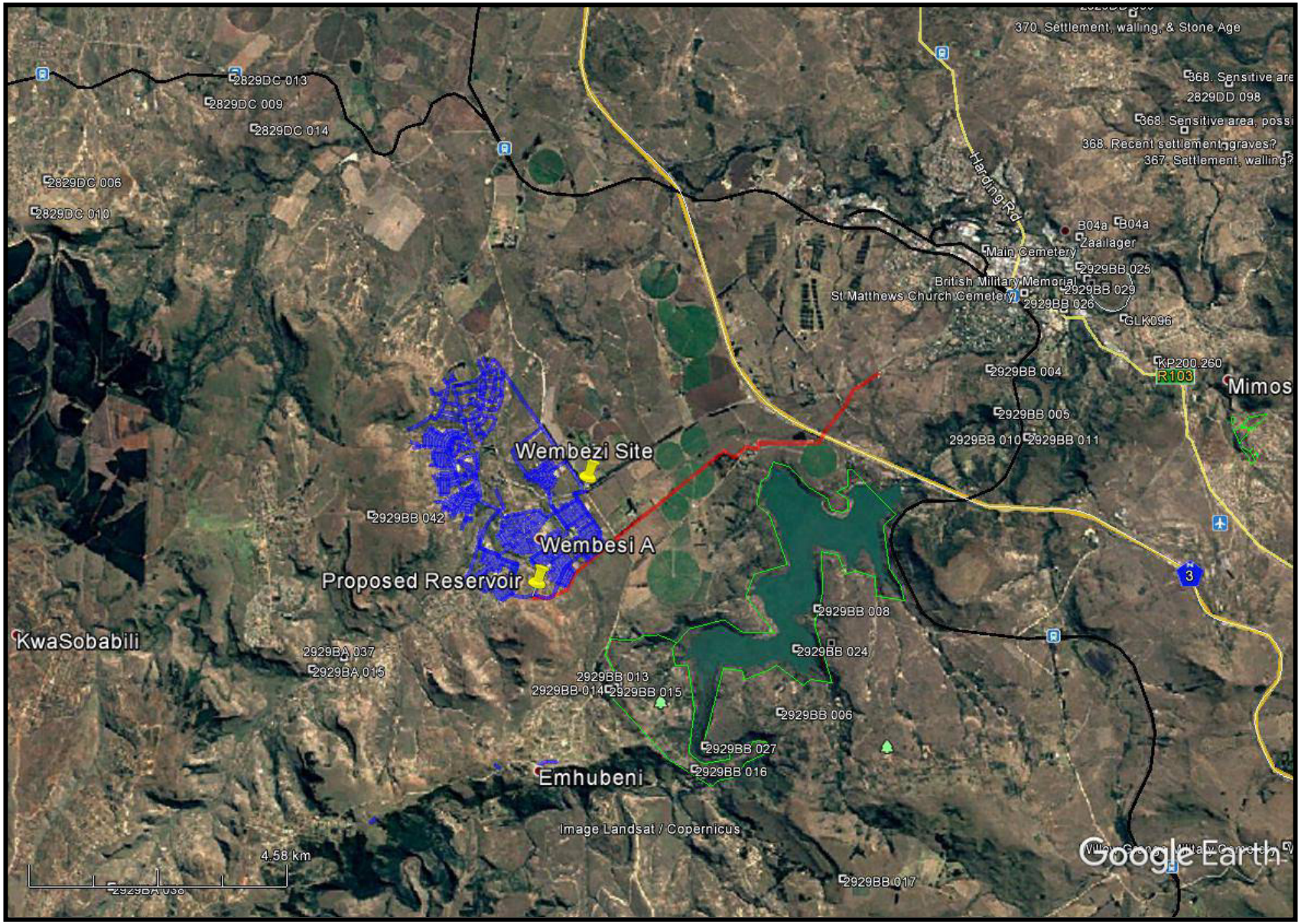
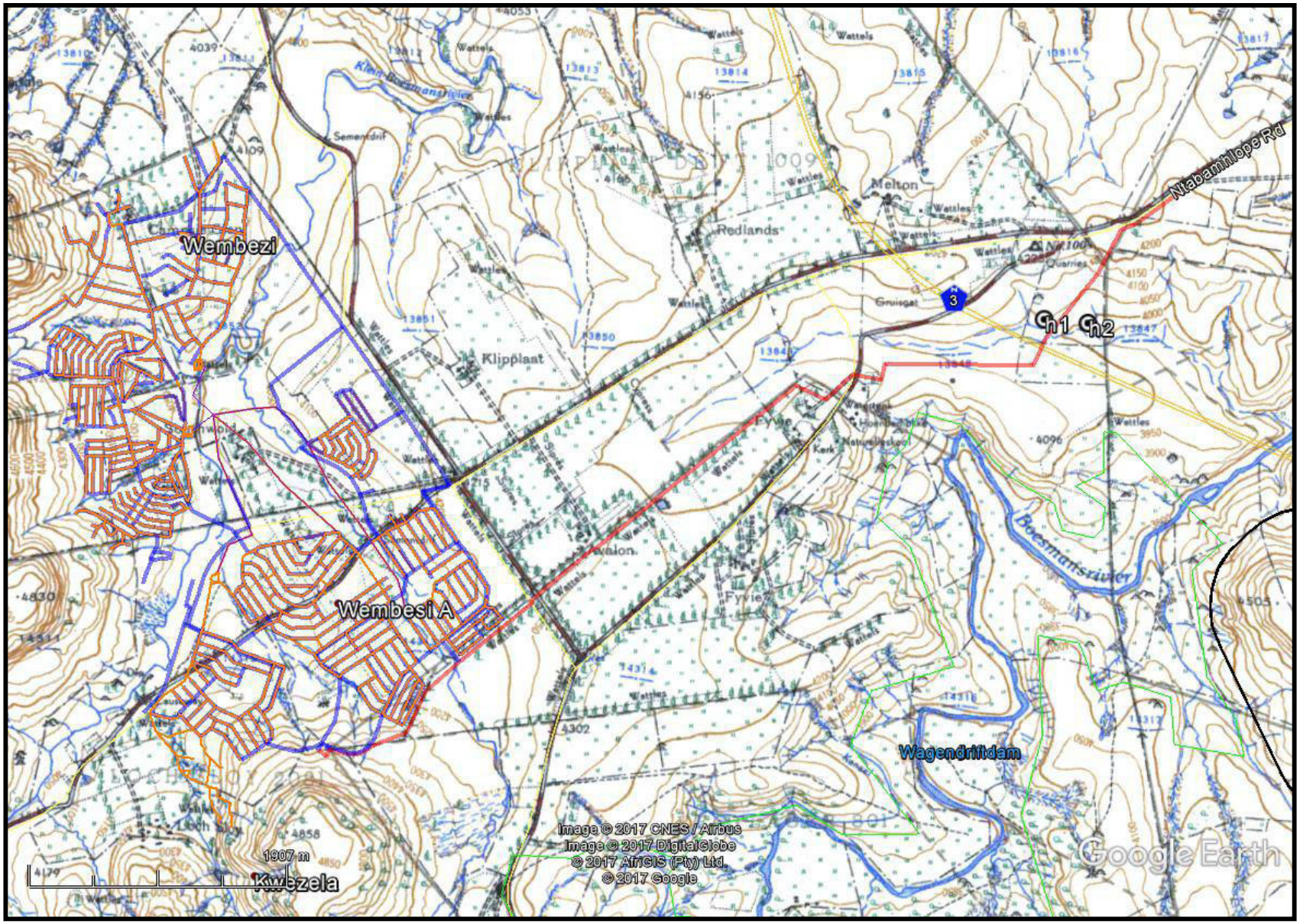


FIG. 7: STUDY AREA IN 1947



FIELD SURVEY

The field survey was undertaken on 22 June 2017. The area between the water treatment works and the freeway was of medium visibility due to the long grass. The rest of the survey had very good visibility as it the lines were alongside the road, farm boundaries or in old and existing agricultural fields. The smaller lines within Wembezi were omitted from the survey as they are in existing road servitudes that have been effected by the various infrastructures. The proposed reservoir occurs besides the existing reservoir, and there are two smaller reservoirs there already.

Three heritage features were recorded during the survey: two cemeteries and ruins of a building. Table 3 lists these locations.

SITE	SOUTH	EAST
Cemetery 1	29° 2'59.24"S	29°47'59.14"E
Cemetery 2	29° 1'56.52"S	29°47'10.50"E
Ruins (Southwold)	29° 2'23.79"S	29°46'40.59"E

Cemetery 1

This cemetery occurs between the district road and the southeastern part of Wembezi. It covers an area of ~200m x 200m. A line of oak trees separates the cemetery and the proposed water pipeline (fig 9).

Significance: The cemetery is of high significance.

Mitigation: Technically, there should be at least 20m buffer between a cemetery and a development. However, the line of trees forms a natural buffer between the pipeline and cemetery.

FIG. 8: LOCATIONS OF RECORDED HERITAGE SITES

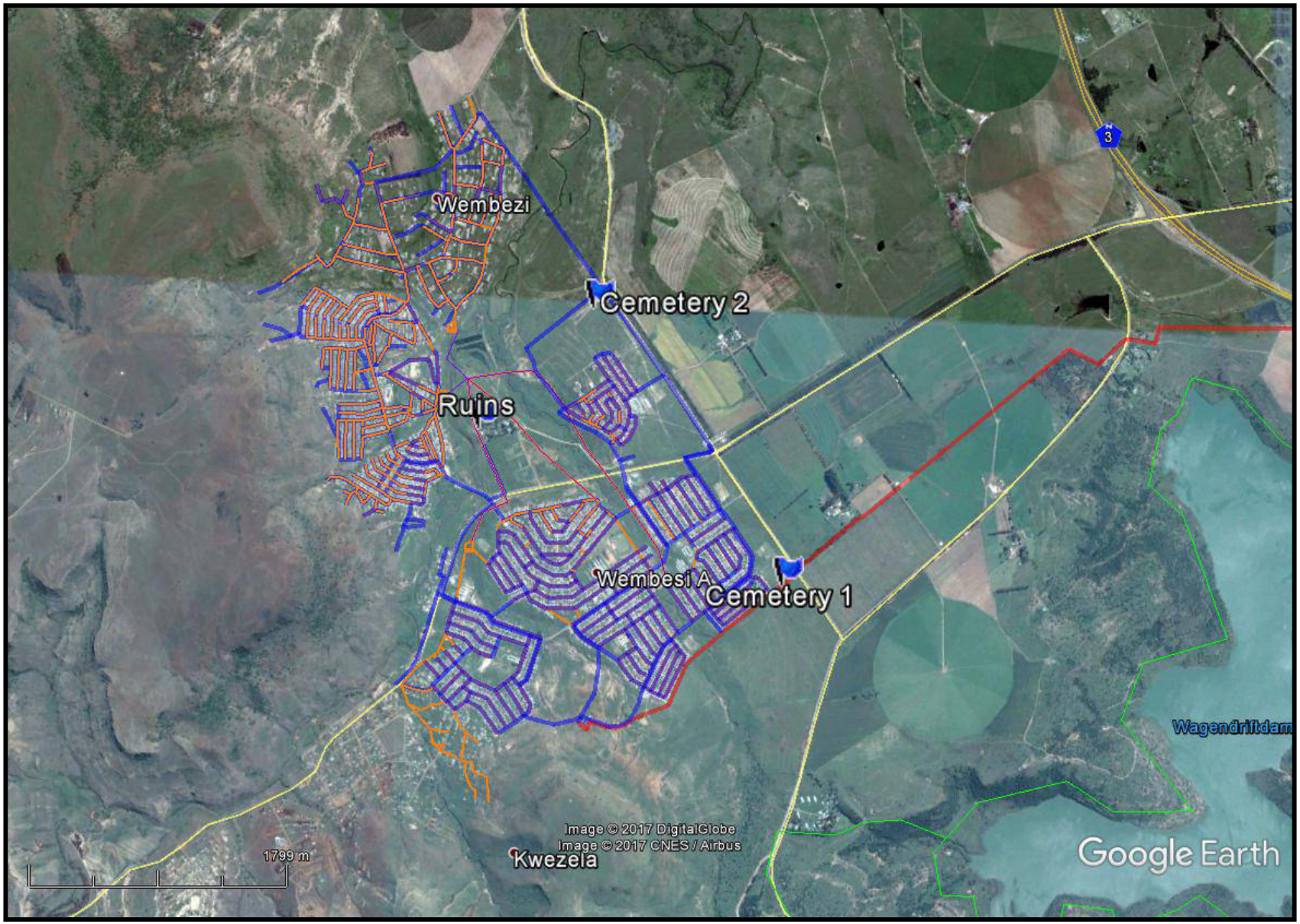


FIG. 9: CEMETERY 1

FIG. 10: CEMETERY 2

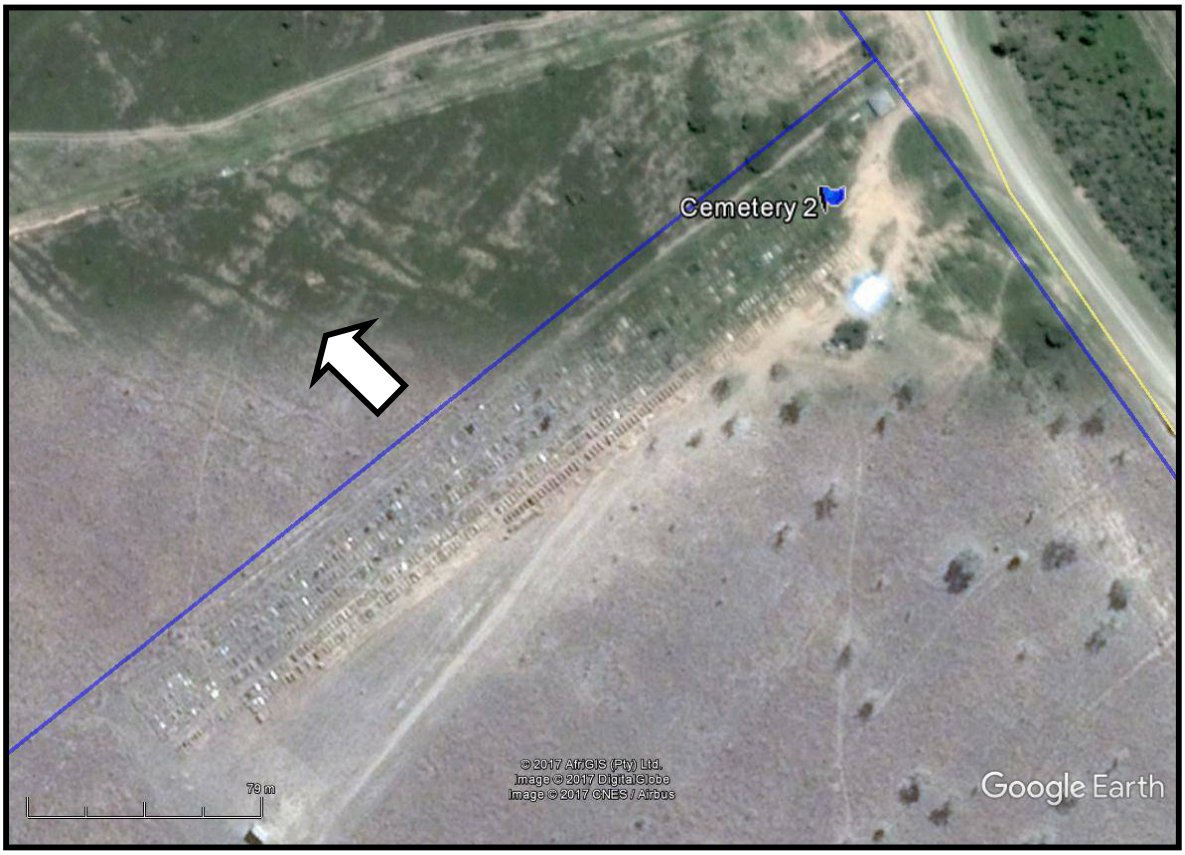
Cemetery 2

Cemetery 2 occurs along the eastern side of the reticulation. The one part of the line is between the main road and the access road to the cemetery. The line then turns southwest and runs adjacent to the cemetery. The southwest line is ~10m from the cemetery. Figure 11 shows the current line.

Significance: The cemetery is of high significance.

Mitigation: The existing line is too close to the cemetery. It needs to be at least 20m from the southwestern branch (see fig. 10). A clear boundary fence should be erected between the cemetery and the edge of the footprint.

FIG. 11: CURRENT LOCATION OF RETICULATION LINE AND CEMETERY 2



Southwold Ruins

The Farm Southwold occurs near the water treatment works. Very little of the farmhouse and related structures remain (fig. 12). These are mostly the form of the house floors. No middens were observed.

Significance: The ruins are of low significance.

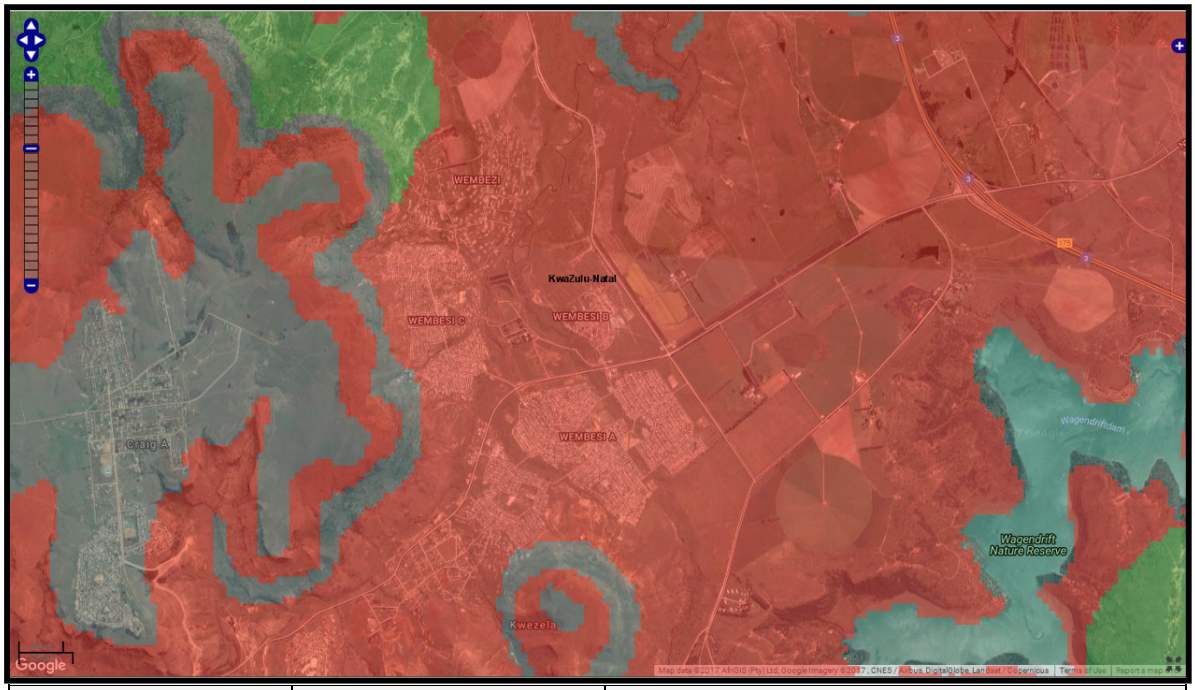
Mitigation: The reticulation does not affect the ruins and thus no further mitigation is required.

FIG. 12: SOUTHWOLD RUINS

PALAEONTOLOGICAL IMPACT ASSESSMENT

The palaeontological sensitivity of this is area is very high according to the SAHRIS map (fig. 13). The area was so sensitive that a 'Chance Find Protocal' was initiated by Dr Gideon Groenewald and several fossils were excavated. The detailed palaeontological report will be submitted separately.

FIG. 13: PALAEONTOLOGICAL SENSITIVITY MAP



COLOUR	SENSITIVITY	REQUIRED ACTION
RED	VERY HIGH	field assessment and protocol for finds is required
ORANGE/YELLOW	HIGH	desktop study is required and based on the outcome of the desktop study, a field assessment is likely
GREEN	MODERATE	desktop study is required
BLUE	LOW	no palaeontological studies are required however a protocol for finds is required
GREY	INSIGNIFICANT/ZERO	no palaeontological studies are required
WHITE/CLEAR	UNKNOWN	these areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map.

CONCLUSION

A heritage survey was undertaken for the Wembezi Bulk Water and Sewerage Reticulation and upgrade projects. The pipeline will occur in the existing pipeline servitude. The area is well known for Late Iron Age stone walled settlements and well preserved palaeontological remains.

The paleontological aspect of the heritage survey yielded several fossils and the details occur in a separate report. No archaeological sites were noted in the servitude footprint. Two cemeteries were noted during the survey. The northern cemetery requires mitigation in the form of demarcation before construction begins. The other cemetery and Southwold Farm ruins require no further mitigation.

REFERENCES

2830BB Nondweni 1:50 000 topographical map 1947
2929BB Estcourt 1:50 000 topographical map 2000
Natal Museum Site Record Database
SAHRIS Database
Umlando database

EXPERIENCE OF THE HERITAGE CONSULTANT

Gavin Anderson has a M. Phil (in archaeology and social psychology) degree from the University of Cape Town. Gavin has been working as a professional archaeologist and heritage impact assessor since 1995. He joined the Association of Professional Archaeologists of Southern Africa in 1998 when it was formed. Gavin is rated as a Principle Investigator with expertise status in Rock Art, Stone Age and Iron Age studies. In addition to this, he was worked on both West and East Coast shell middens, Anglo-Boer War sites, and Historical Period sites.

DECLARATION OF INDEPENDENCE

I, Gavin Anderson, declare that I am an independent specialist consultant and have no financial, personal or other interest in the proposed development, nor the developers or any of their subsidiaries, apart from fair remuneration for work performed in the delivery of heritage assessment services. There are no circumstances that compromise the objectivity of my performing such work.

Gavin Anderson
Archaeologist/Heritage Impact Assessor

PHASE 1 PALAEONTOLOGICAL ASSESSMENT AND "CHANCE FIND PROTOCOL" FOR THE PROPOSED WEMBEZI BULK WATER AND SEWERAGE RETICULTATION PROJECTS, INKOSI LANGALIBALELE LOCAL MUNICIPALITY, UTHUKELA DISTRICT MUNICIPALITY, KWAZULU-NATAL PROVINCE

FOR

HIA CONSULTANTS
UMLANDO

DATE: 20 July 2017
By

Gideon Groenewald
Cell: 078 713 6377

EXECUTIVE SUMMARY

Gideon Groenewald was appointed to undertake a Phase 1 Palaeontological Assessment Survey, for the proposed Wembezi Bulk Water and Sewerage Reticulation Projects, Inkosi Langalibalele Local Municipality, Uthukela District Municipality, Kwazulu-Natal Province.

The purpose of this Phase 1 Palaeontological Impact Assessment is to identify exposed and potential Palaeontological Heritage on the site of the proposed developments, to assess the impact the developments may have on this resource, and to make recommendations as to how this impact might be mitigated. The field survey indicated the requirement of a "Chance Find Protocol" that will be included in this Phase 1 PIA report.

This Palaeontological Assessment forms part of the Heritage Impact Assessment (HIA) and complies with the requirements of the South African National Heritage Resource Act No 25 of 1999, as well as the KwaZulu-Natal Heritage Act No 4 of 2008. In accordance with Section 38 of the National Resources Act No 25 of 1999 (Heritage Resources Management), a HIA is required to assess any potential impacts to palaeontological heritage within the development footprint.

The development site for the proposed Wembezi Bulk Water and Sewerage Reticulation Projects, Inkosi Langalibalele Local Municipality, Uthukela District Municipality, Kwazulu-Natal Province is underlain by Permian to Triassic aged sedimentary rocks of the Normandien Formation of the Beaufort Group, Jurassic aged igneous dolerite of the Drakensberg Group, Karoo Supergroup, as well as Quaternary aged sediments of the Masotcheni Formation and alluvium.

Significant trace and vertebrate fossils were observed during the field investigation. The potential for finding significant fossils in any excavation into sediments of the Normandien Formation is Very High, with potential to find fossils in the Masotcheni Formation and alluvium rated as Very High as well. Significant new fossils were observed during the field assessment and a short information session was held to inform the site managers of the fossils that might be expected. If fossils are observed during construction, the HIA consultant must be notified and the fossils collected by a suitably qualified palaeontologist. No fossils will be associated with areas underlain by dolerite.

It is recommended that:

- The EAP and ECO must be informed of the fact that a Very High Palaeontological sensitivity is retained for all the sections of the developments that are underlain by shale and sandstone of the Normandien and Masotcheni Formations and alluvium. Although highly weathered, fossils might be recorded during the initial phase of construction when excavations exceed 1.5m.
- A Professional Palaeontologist must be appointed to inspect the site during the on-going weeks of excavation for the infrastructure and a "Chance Find Protocol" document (CFP, included with this report) must be updated on a monthly basis. If fossils are recorded, a suitably qualified palaeontologist must be appointed to inspect all areas where excavation of deeper than 1,5m is made into sediments of Normandien and Masotcheni Formations and a protocol for the chance find of fossils must then be developed and discussed with the contractor on site.
- These recommendations must be included in the EMPr for these projects.

Sssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssss

CHANCE FIND PROTOCOL FOR PALAEONTOLOGICAL HERITAGE

WEMBEZI BULK WATER RETICULATION PROJECT - 2017

It is essential that the appointed palaeontologist, in consultation with the JG Afrika Project Managers and the contractors of the excavation works develop a short-term strategy for the recovery of significant fossils during the excavation operation.

The development site for the proposed Wembezi Bulk Water and Sewerage Reticulation Projects, Inkosi LangalibaleleLocal Municipality, Uthukela District Municipality, Kwazulu-Natal Province, falls on Very Highly significant shale and thin bands of sedimentary rocks (Normandien and Masotcheni Formations) and alluvium that might contain significant fossils. No fossils are expected in the dolerite.

Fossils were recorded during the first site studies in these rock formations. The potential for finding significant vertebrate, plant and trace-fossils, in any excavation into sediments of the Normandien and Masotcheni Formations, is always Very High and the cooperation of the entire team of JG Afrika and the contractors, is of critical importance. The interest and cooperation of the management team will be highly appreciated and it is essential that the

excavation be monitored during the entire period of excavation and that this "Chance Find Protocol" be updated on a monthly basis during the life-time of the excavation period for the project. It is essential that the Palaeontologist be notified of the final sign-off of the project date, for final posting of the "Chance Find Protocol" on the SAHRIS Website for record purposes. No fossils will be associated with areas underlain by dolerite, but significant Quaternary aged fossils can be present in the Masotcheni Formation and alluvial cover on these geological formations.

It is recommended that:

- The EAP and ECO must be informed of the fact that a Very High Palaeontological Sensitivity was allocated to the entire development and due to the highly weathered nature of the material, significant fossils is expected after the start of excavations for foundations that exceed 1.5m.
- The allocated team members at the community can be introduced to Palaeontological material that is likely to be found on site. A once-off information session with the Palaeontological specialist must be arranged, to present a simple and understandable (preferably audio-visual presentation in an "interpreted voice") of the majority of the contractual workers on site (isiZulu) during the initial site visit that must form part of the EMPr for the project.
- This "Chance Find Protocol" must be included into the EMPr of the project and a reasonable budget must be allocated to ensure compliance with the legal responsibility of the developer in terms of the proper conservation of and storage of Palaeontological Heritage.
- The AMAFA and SAHRA must be informed of the content of this "Chance Find Protocol" and EMPr arrangements by the EAP or the developer, for final approval of the ROD documentation during the EIA process.

ACKNOWLEDGEMENTS

The Palaeontologist acknowledges the help of Mr Sanjay Maharaj and his Family, Mr Themba Ndulini, Mr Ayanda Shangase and Mr Jan Kotze, as well as the EAP team for their assistance with the Phase 1 PIA field visit arrangements. Without the support of these people the study would have been much poorer in it's final analysis.

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INTRODUCTION

Gideon Groenewald was appointed to undertake a Phase 1 Palaeontological Assessment Survey, for the proposed Wembezi Bulk Water and Sewerage Reticulation Projects, Inkosi Langalibalele Local Municipality, Uthukela District Municipality, Kwazulu-Natal Province (Figure 1).

Figure 1 Layout of the Wembezi Bulk Water and Sewerage Reticulation Projects

The purpose of this Phase 1 Palaeontological Impact Assessment is to identify exposed and potential Palaeontological Heritage on the site of the proposed developments, to assess the impact the development may have on this resource, and to make recommendations as to how this impact might be mitigated. The field survey indicated the requirement of a “Chance Find Protocol” that will be included in this Phase 1 PIA report.

This Project will require a Phase 2 PIA investigation and the recommendations contained in the “Chance Find Protocol” must be included in the EMPr for the Project, with a clear indication of a budget to remove fossils during excavations of deep (>1.5m) trenches into the Normandien Formation.

Legal Requirements

This Palaeontological Assessment forms part of the Heritage Impact Assessment (HIA) and complies with the requirements of the South African National Heritage Resource Act No 25 of 1999, as well as the KwaZulu-Natal Heritage Act No 4 of 2008. In accordance with Section 38 of the National Resources Act No 25 of 1999 (Heritage Resources Management), a HIA is required to assess any potential impacts to palaeontological heritage within the development footprint.

Categories of heritage resources recognised as part of the National Estate in Section 3 of the Heritage Resources Act, and which therefore fall under its protection, include:

- geological sites of scientific or cultural importance;
- objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens; and
- objects with the potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage.

Aims and Methodology

A Phase 1 investigation is often the last opportunity to record the fossil heritage within the development footprint. These records are very important to understand the past and form an important part of South Africa's National Estate.

Following the "*SAHRA APM Guidelines: Minimum Standards for the Archaeological & Palaeontological Components of Impact Assessment Reports*" the aims of the palaeontological impact assessment are:

- to identifying exposed and subsurface rock formations that are considered to be palaeontologically significant;
- to assessing the level of palaeontological significance of these formations;
- to comment on the impact of the development on these exposed and/or potential fossil resources and
- to make recommendations as to how the developer should conserve or mitigate damage to these resources.

Prior to the field investigation a preliminary assessment (desktop study) of the topography and geology of the study area was made using appropriate 1:250 000 geological maps (2928 Drakensberg) in conjunction with Google Earth. Potential fossiliferous rock units (groups, formations etc) were identified within the study area and the known fossil heritage within each rock unit was

inventoried from the published scientific literature, previous palaeontological impact studies in the same region and the author's field experience.

Priority palaeontological areas were identified within the development footprint to focus the field investigator's time and resources. The aim of the fieldwork was to document any exposed fossil material and to assess the palaeontological potential of the region in terms of the type and extent of rock outcrop in the area.

The likely impact of the proposed development on local fossil heritage is determined on the basis of the palaeontological sensitivity of the rock units concerned and the nature and scale of the development itself, most notably the extent of bedrock excavation envisaged. The different sensitivity classes used are explained in Table 1 below.

Table 1 Palaeontological sensitivity analysis outcome classification

PALAEONTOLOGICAL SIGNIFICANCE/VULNERABILITY OF ROCK UNITS	
The following colour scheme is proposed for the indication of palaeontological sensitivity classes. This classification of sensitivity is adapted from that of Almond et al (2008, 2009) (Groenewald et al., 2014).	
RED	Very High Palaeontological sensitivity/vulnerability. Development will most likely have a very significant impact on the Palaeontological Heritage of the region. Very high possibility that significant fossil assemblages will be present in all outcrops of the unit. Appointment of professional palaeontologist, desktop survey, phase I Palaeontological Impact Assessment (PIA) (field survey and recording of fossils) and phase II PIA (rescue of fossils during construction) as well as application for collection and destruction permit compulsory.
ORANGE	High Palaeontological sensitivity/vulnerability. High possibility that significant fossil assemblages will be present in most of the outcrop areas of the unit. Fossils most likely to occur in associated sediments or underlying units, for example in the areas underlain by Transvaal Supergroup dolomite where Cenozoic cave deposits are likely to occur. Appointment of professional palaeontologist, desktop survey and phase I Palaeontological Impact Assessment (field survey and collection of fossils) compulsory. Early application for collection permit recommended. Highly likely that a Phase II PIA will be applicable during the construction phase of projects.

GREEN	Moderate Palaeontological sensitivity/vulnerability. High possibility that fossils will be present in the outcrop areas of the unit or in associated sediments that underlie the unit. For example areas underlain by the Gordonia Formation or undifferentiated soils and alluvium. Fossils described in the literature are visible with the naked eye and development can have a significant impact on the Palaeontological Heritage of the area. Recording of fossils will contribute significantly to the present knowledge of the development of life in the geological record of the region. Appointment of a professional palaeontologist, desktop survey and phase I PIA (ground proofing of desktop survey) recommended.
BLUE	Low Palaeontological sensitivity/vulnerability. Low possibility that fossils that are described in the literature will be visible to the naked eye or be recognized as fossils by untrained persons. Fossils of for example small domal Stromatolites as well as micro-bacteria are associated with these rock units. Fossils of micro-bacteria are extremely important for our understanding of the development of Life, but are only visible under large magnification. Recording of the fossils will contribute significantly to the present knowledge and understanding of the development of Life in the region. Where geological units are allocated a blue colour of significance, and the geological unit is surrounded by highly significant geological units (red or orange coloured units), a palaeontologist must be appointed to do a desktop survey and to make professional recommendations on the impact of development on significant palaeontological finds that might occur in the unit that is allocated a blue colour. An example of this scenario will be where the scale of mapping on the 1:250 000 scale maps excludes small outcrops of highly significant sedimentary rock units occurring in larger alluvium deposits. At least one site visit by a competent palaeontologist is compulsory. Collection of a representative sample of potential fossiliferous material is recommended.
GREY	Very Low Palaeontological sensitivity/vulnerability. Very low possibility that significant fossils will be present in the bedrock of these geological units. The rock units are associated with intrusive igneous activities and no life would have been possible during implacement of the rocks. It is however essential to note that the geological units mapped out on the geological maps are invariably overlain by Cenozoic aged sediments that might contain significant fossil assemblages and archaeological material. Examples of significant finds occur in areas underlain by granite, just to the west of Hoedspruit in the Limpopo Province, where significant assemblages of fossils and clay-pot fragments are associated with large termite mounds. Where geological units are allocated a grey colour of significance, and the geological unit is surrounded by very high and highly significant geological units (red or orange coloured units), a palaeontologist must be appointed to do a desktop survey and to make professional recommendations on the impact of development on significant palaeontological finds that might occur in the unit that is allocated a grey colour. An example of this scenario will be where

	the scale of mapping on the 1:250 000 scale maps excludes small outcrops of highly significant sedimentary rock units occurring in dolerite sill outcrops. It is important that the report should also refer to archaeological reports and possible descriptions of palaeontological finds in Cenozoic aged surface deposits. At least one site visit by a suitably qualified palaeontologist is recommended.

When rock units of moderate to high palaeontological sensitivity are present within the development footprint, palaeontological mitigation measures must be incorporated into the Environmental Management Plan for this project.

Scope and Limitations of the Phase 1 Investigation

The scope of a phase 1 Investigation includes:

- an analysis of the area's stratigraphy, age and depositional setting of fossil-bearing units;
- a review of all relevant palaeontological and geological literature, including geological maps, and previous palaeontological impact reports;
- data on the proposed development provided by the developer (e.g. location of footprint, depth and volume of bedrock excavation envisaged); where feasible, location and examination of any fossil collections from the study area (e.g. museums); and
- an on-site investigation to assess the identified palaeontological sensitive areas within the development footprint/study area rather than formal palaeontological collection. The investigation focussed on the bedrock exposure where excavations would most probably require palaeontological monitoring.

The results of the field investigation are used to predict the potential of buried fossil heritage within the development footprint. In some investigations, (this study), this involves the examination of similar accessible bedrock exposures, such as road cuttings and quarries, along roads that run parallel to or across the development footprint.

Locality and Proposed Developments

The Wembezi Bulk Water Reticulation Development forms part of the planned supply of and upgrading of existing water infrastructure in the Wembezi urban area. The Wembezi Sewerage Reticulation Development forms part of the planned upgrading of the existing sewerage infrastructure in the Wembezi urban area. Both projects fall within the same site development footprint, west of

Estcourt in the Inkosi Langalibalele Local Municipality, Uthukela District Municipality, Kwazulu-Natal Province. Both projects are managed by JG Afrika Engineering and Environmental Consulting and is a subsection of an integrated upgrade of the entire water and sewerage infrastructure in the region.

The activities forms part of the urban development area of the Wembezi Development area (Figure 2) and although the entire development area is shown in Figure 2, the emphasis in this report is on the geology and potential impact of the developments on Palaeontological Heritage for the pipeline development nodes as provided to the Palaeontologist.

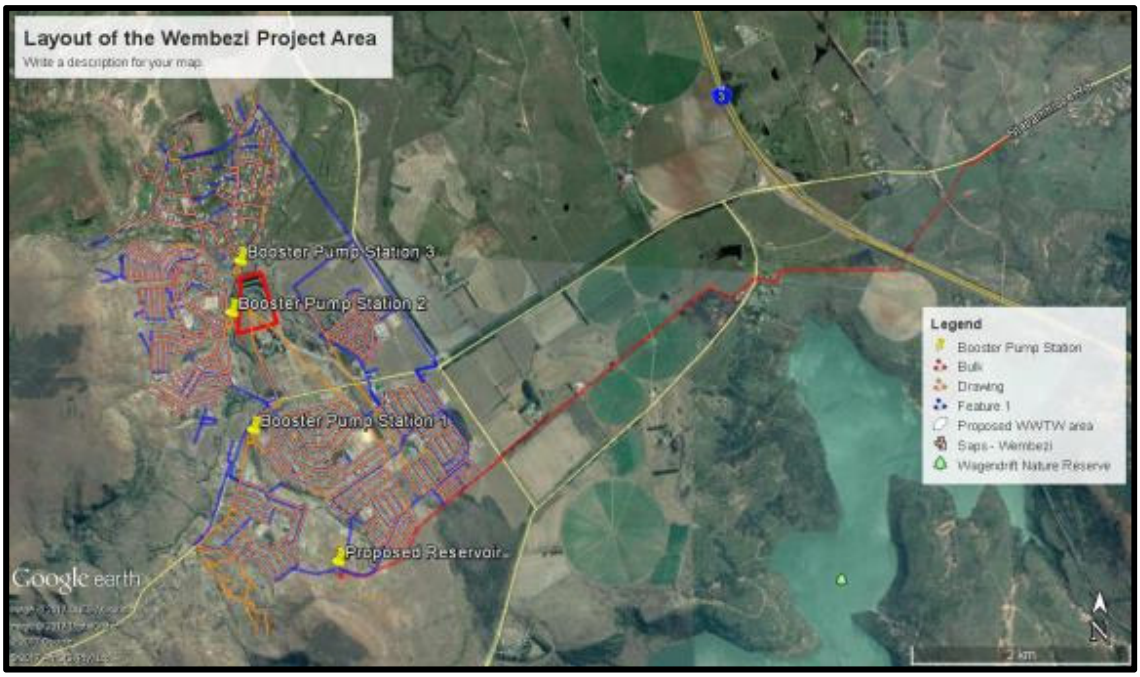


Figure 2 Layout of the Wembezi Project Area

GEOLOGY

The study area is underlain by Permian aged sedimentary rocks of the Beaufort Group, as well as Jurassic aged dolerite of the Karoo Supergroup and alluvial deposits (Figure 3). The cover of Quaternary aged Masotcheni Formation (Qm) sediments are shown on the published 1:250 000 scale map (2928 Drakensberg) and field investigation confirmed that most of the area is underlain by a very thick (>1.5m) cover of this formation. Very little research has been done on this formation in the study area and it is highly likely that significant fossil

finds can be associated with this extensive cover of Quaternary aged sediments at Wembezi.

Karoo Supergroup,

Beaufort Group

Adelaide Subgroup [Estcourt Formation (Pe) pre 2015] Normandien Formation (Pn, post 2015)]

The Permian to Triassic aged Normandien Formation (also mapped as the Adelaide Subgroup [Pa] and Estcourt Formation [Pe] on older versions of 1:250 000 sheets of South Africa) underlies the entire study area (Figure 3). The Formation consists of a series of fluvial sandstone and mudstone, representing

Figure 3 Geology of the area underlying the Wembezi Project Area (blue). The area is mainly underlain by Permian aged mudstone of the Normandien Formation (Pes), Jurassic aged Dolerite sills (Jd) and Quaternary aged clay of the Masotcheni Formation (Qm).

the first influx of fluvial sediments into a dominantly deltaic environment of the upper Ecca Group (Groenewald 1990; 1996; Johnson et al, 2009; Groenewald, 2012; Groenewald et al, 2014 and Groenewald 2016).

The Normandien Formation has been subdivided into distinctive Members by Groenewald (1990) but these members were not mapped in the study area. The most distinguishable upper, brightly colored and red mudstone Member, named

the Harrismith Member (Johnson et al 2009) forms the upper part of the Normandien Formation and can be correlated with the Palingkloof Member of the Balfour Formation of the Adelaide Subgroup in the southern part of the Karoo Basin (Groenewald, 1996).

Dolerite (Jd)

Jurassic aged dolerite dykes and sills represent a volcanic episode that occurred during the breakup of Gondwanaland.

Masotcheni Formation and Alluvium

The Quaternary aged Masotcheni Formation is a sandy to clay-rich Quaternary aged deposit of sediments that collect during sheetwash or covering of the footslopes of the hills during colluvial movement of sediments over the entire study area (Jonson et al, 2009). Although the alluvium deposits are not indicated on the 1:250 000 scale geological sheet 2928 Drakensberg, the sediments are very important indicators of the 100 year flood line of the rivers, and the developer must be very aware of the fact that some of the points indicated for development of pipeline facilities falls well within this flood line. It is very urgently recommended that the developer ensure proper planning of the crossing of these wetland areas during construction of the pipelines, Bad planning of pipeline crossings can lead to exposure of dispersive and expansive sediments with a very high risk of unwanted erosion and tunneling. Although not part o gtj brief for this investigation, these extreme formation of dongas can result in significant exposure of Palaeontological Heritage in the long run.

PALAEONTOLOGY

Karoo Supergroup

Beaufort Group

Adelaide Subgroup [Estcourt Formation (Pe)] Normandien Formation

The Permian to Triassic Normandien Formation (**Pe** in Figure 3) is Internationally known for the wealth of trace, plant and vertebrate fossils that is present in this Very Highly sensitive Palaeontological Zone of South Africa. The study area falls in the Permian Extinction time-zone (252 millions years ago) in South Africa and the Formation is home to the *Glossopteris* Assemblage of plants, the *Daptocepohalus* and *Lystrosaurus* Assemblage Zones of Vertebrates as well as well-known trace fossils, including casts of vertebrate burrows (MacRae, 1999; McCarthy and Rubidge, 2005, Johnson et al 2009; Groenewald, 2012 and Groenewald et al 2014; Groenewald, 2016).

The most famous vertebrate fossils belong to the *Daptocephalus* (formally known as the *Dicynodon* Assemblage Zone) as well as the *Lystrosaurus* Assemblage Zones (Figure 4) with good examples of fossil bones and a well-preserved skull roof (to be prepared and identified) discovered during the present investigation (Table 2).

Very well preserved remains of insect wings are known from the nearby town of Estcourt (Van Dijk, Johnson et al, 2009), and it will be very significant if some of these unique fossils can be discovered during excavations of foundations and trenches for this project.

Well-preserved petrified wood and other plant fossils were recorded in the vicinity of the study area (Table 2) and these fossils contribute significantly to our understanding of the palaeo-environments that existed during the Late Permian, beginning of the Triassic periods in this part of the Karoo Basin (McCarthy and Rubidge, 2005).

The Harrismith Member is very well known for the presence of extremely well-preserved remains of vertebrates belonging to the *Lystrosaurus* Assemblage Zone over the entire outcrop area of this unit in the Karoo Basin of South Africa (Johnson et al, 2009). The remains of *Lystrosaurus* sp were discovered at two sites associated with this this Project (Table 2). The remains of this animal is also known from the quarry site north of the study area at Loskop (Table 2).

Figure 4 Palaeontological reconstruction of a possible scene from the Permian and Early Triassic environments in the study area

Dolerite

Due to its igneous character dolerite will not contain fossils.

Masotcheni Formation and Alluvium

Significant sinkholes were discovered during the field investigation and the sinkholes are very clearly used by modern animals for shelter. If these animals are caught in flash flood episodes the remains will be preserved as Tertiary aged fossils and if exposed during construction, will provide invaluable information regarding more recent high stands of the Little Bushman River.

The Masotcheni Formation contains some broken clay pot pieces, not associated with any significant find as well as some bones of vertebrates that might be associated with recent domestic animals (cattle) or larger antelope such as Eland. Remains of a carnivore (most probably a domestic dog or hyena, were present in the upper part of the Masotcheni Formation, associated with a dried up spring site, where a drop in the water table can be associated with very deep erosion of the Masotcheni Formation (Table 2).

PRELIMINARY ASSESSMENT RESULTS

The palaeontological sensitivity was predicted after identifying potentially fossiliferous rock units; ascertaining the fossil heritage from the literature and evaluating the nature and scale of the development itself. The palaeontological sensitivity was predicted as Very Highly significance, due to the potential abundance of Permian to Triassic aged fossils in the Beaufort Group, as well as possible vertebrate fossils in the Masotcheni Formation and Alluvium. Dolerite will not contain any significant fossil remains.

FIELD INVESTIGATIONS

Dr Gideon Groenewald, experienced fieldworker, and a student technician, Mr Thabiso Mahlambi, visited the site of the proposed Wembezi Bulk Water and Sewerage Reticulation Projects , west of Estcourt in the Inkosi Langalibalele Local Municipality, Uthukela District Municipality, Kwazulu-Natal Province on Monday 3rd July 2017 to Friday 7th July 2017. Mr Ayanda Shangase, who represented JG Afrika, accompanied the team for the duration of the entire site investigation. The team was joined by Mr Sanjay Maharaj and his Family to learn more about the Palaeontological treasures of the area.

The topography of the area is undulating, albeit falling in the rugged river valley of the Little Bushmen River with dolerite batholiths and thick dolerite sills

dominating the higher ground. The general landscape is dominated by steep middle slopes and extensive foots lopes ending in a poorly defined valley floors, of the local streams and the main river of the area. The study area comprises a linear construction and development site that cuts the topography and follows the valley floor where the proposed water and sewerage pipelines will cut the streams. The area is mostly overgrown with remains of fire-climax grass species but a very high percentage of increasers indicating extensive grazing by cattle after regular burning of the veld to try and increase the palatability of the grass during the beginning of the growing season. The author will refrain from any further comments regarding this aspect, accept commenting that gabions must be constructed in dongas starting to develop in areas underlain by Normandien Formation shales and the Masotcehni Formation and alluvium. The neglect of urgent measures to cure the erosion of highly expansive and dispersive soils on this Formation (clearly visible in areas where huge (tens of meters in diameter) sinkholes are busy developing, will lead to extensive tunnelling and sudden development of huge dongas that will be extremely counter-productive in the long term planning of this project.

Field investigation confirmed that excavations for the new developments will expose siltstone and sandy mudstone of the Normandien Formation, as well as dolerite, whilst most of the areas underlain by the dolerite will expose deep red clay-rich deposits.

Detailed observations were recorded in the area that will be developed and observations were recorded photographically at GPS points (Figure 5 and Table 2).

Figure 5 GPS points for Photographic Observations (Table 2)

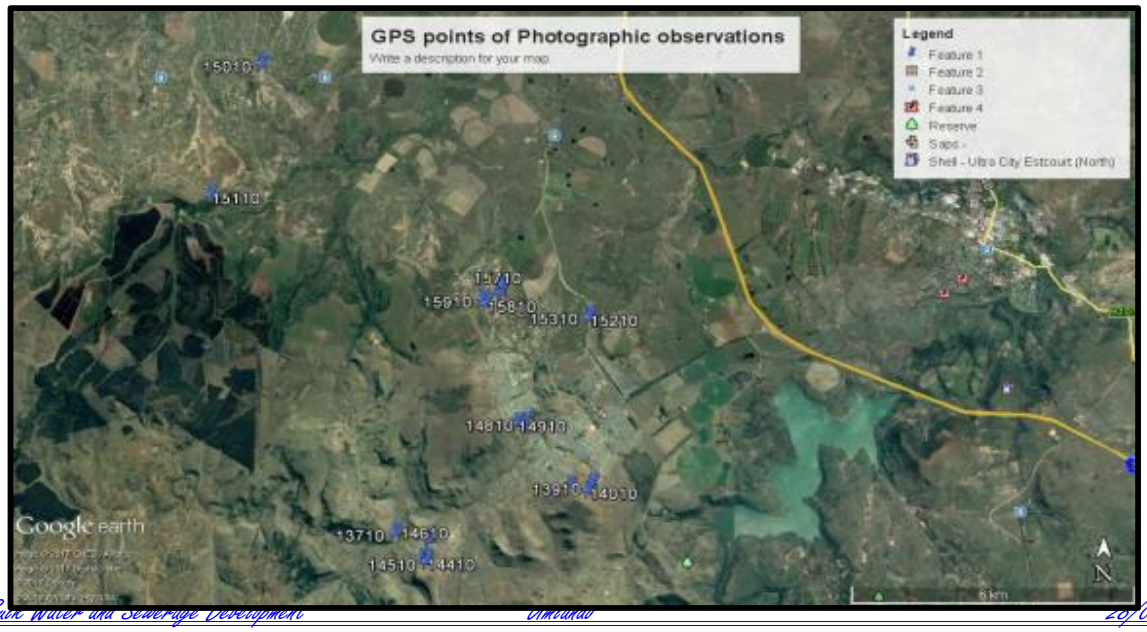
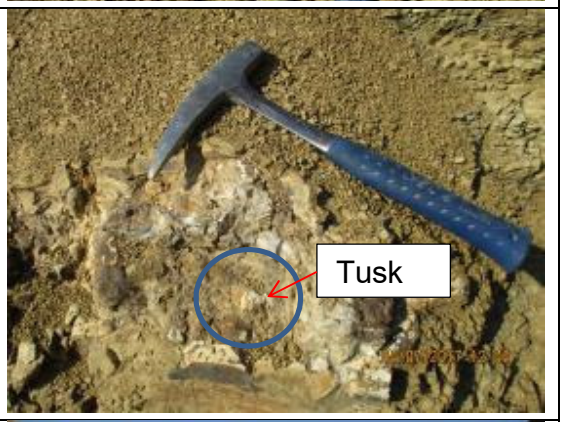


Table 2 Record of Photographic Observations (See Figure 5 for GPS sites)

Photo	(GPS station) Coordinates	Comments	Photographic Record
1	(GPS 13810) S29° 03.567' E29° 47.262'	Deep weathering into the Masotcheni Formation sediments on site. Excavation for infrastructure can expose some significant fossils from the Tertiary. No fossils were observed.	
2	(GPS 13910) S29° 03.598' E29° 47.256'	Deep weathering into the Masotcheni Formation sediments on site. Excavation for infrastructure can expose some significant fossils from the Tertiary. No fossils were observed.	
3	(14010) S29° 03.651' E29° 47.218'	Deep weathering into the Masotcheni Formation sediments on site. Excavation for infrastructure can expose some significant fossils from the Tertiary. No fossils were recorded but excavation will expose mudstone of the Normandien Formation (Harrismith Member) and the chance find of fossils is very high if excavations exceed 1.5m	

4	(14110) S29° 03.589' E29° 46.979'	Indication of a stromatolite structure or calcareous growth on an algal mat in the area underlain by the Harrismith Member. This indicates near desert conditions during deposition of the sediments. No fossil bones observed.	
5	(14210) S29° 04.510' E29° 45.042'	Normandien Formation mudstone with plant impressions. Deep weathering, but excavation will expose good examples of *Glossopteris* flora.	
6	(14310) S29° 04.538' E29° 45.094'	Vertebrate remains of a Tertiary age. These remains are associated with well-defined teeth that might be that of a domestic dog. Several pieces of broken clay pots were observed at the site, where the Palaeo-environment is interpreted as an ancient spring site.	
7	(14410) S29° 04.542' E29° 45.102'	Clay-pellet conglomerate with bone bed, associated with the Harrismith Member of the Normandien Formation. Fossils of *Lystrosaurus* expected but not observed at this site.	

8	(14510) S29° 04.547' E29° 45.110'	Deeply weathered siltstone of the Harrismith Member and concretions with bone remains. Fossils not well preserved and not identified.	
9	(14610) S29° 04.276' E29° 45.142'	Skull of a Dicynodont with very prominent tusk present in mudstone of the Normandien Formation. Material very highly weathered and no attempt was made to collect the skull.	
10	(14610) S29° 04.276' E29° 45.142'	Very deep weathering of the Normandien Formation. “Death Zone” associated with upper part of the Normandien Formation and presence of the skull of a Dicynodont in the mudstone as indicated above.	

11	(14710) S29° 04.266' E29° 45.146'	Tertiary aged fossils of a bovine, most probably domesticated cattle, associated with the Masotcheni Formation deposits on site. Scattered broken clay pots also associated with these fossils.	
12	(14710) S29° 04.266' E29° 45.146'	Bone beds associated with lower layers of the Masotcheni Formation. Excavation for infrastructure that exceeds 1.5m must be subjected to inspection as prescribed in the “Chance Find Protocol”.	
13	(14810) S29° 02.796' E29° 46.381'	Deeply weathered mudstone of the upper Normandien Formation. No fossils observed.	

14	(14810) S29° 02.796' E29° 46.381'	Expansive and dispersive nature of the deep clay deposits of the Masotcheni Formation. Excavation of more than 1.5m depth will most probably expose some fossils.	
15	(14910) S29° 02.807' E29° 46.289'	Exposures of upper Normandien Formation mudstone underlying the Masotcheni Formation clay and in turn being underlain by red mudstone of the Harrismith Member. During the field investigation no fossils were observed at this donga	
16	(15010) S28° 58.278' E29° 42.949'	Deep erosion of the Normandien Formation just to the north of the study area. Exposure of mudstone with well-preserved fossil wood remains and leaves of *Glossopteris* Assemblages.	
17	(15010) S28° 58.278' E29° 42.949'	Petrified wood (black) remains and a grinding stone (artefact) washing out of the Masotcheni Formation.	

18	(15110) S28° 59.939' E29° 42.280'	Outcrops of Harrismith Member brightly coloured mudstone. This rock unit is associated with the *Lystrosaurus* Assemblage Zone and contains significant remains of the vertebrates associated with the very productive biostratrigraphic unit in the Karoo Supergroup. It contains all the survivors of the Permian Extinction Event.	
19	(15110) S28° 59.939' E29° 42.280"	Thabiso and Ayanda finding fossil bones of *Lystrosaurus* in the mudstones of the Harrismith Member.	
20	(15110) S28° 59.939' E29° 42.280'	Fossil bone from the well-known *Lystrosaurus* Assemblage Zone at this locality. **Although not in the study area**, this exposure provided an opportunity to teach Ayanda the art of discovering significant fossil bone for this project. Due to excavations into the *Lystrosaurus* Assemblage Zone at this GPS point, all the fossils were destroyed and only a few fossil bones were collected for recording purposes.	

21	(15210) S29° 01.481' E29° 47.227'	Vertebrate remains of a Dicynodont from the Normandien Formation. Excavation of this animal revealed that the remains are restricted to only a few vertebrates and ribs. Excavation at the site eventually indicated that the site does not contain the remains of an articulated skeleton and the fossil bones will be used for educational purposes in this project.	
22	(15210) S29° 01.481' E29° 47.227'	Thabiso excavating on the remains of a non-articulated vertebrate. Several bone elements were scattered in the mudstone of the Normandien Formation at this site.	
23	(15310) S29° 01.457' E29° 47.221'	Well preserved skull of an unidentified vertebrate fossils from the Normandien Formation. The fossil might be the remains of an *Oudenodon* that will be an interesting addition to the collection of fossils from the *Daptocephalus* Assemblage Zone in this part of the Karoo Basin.	
24	(15310) S29° 01.457' E29° 47.221'	Well preserved skull of an unidentified vertebrate fossils from the Normandien Formation. The fossil might be the remains of an Oudenodon that will be an interesting addition to the collection of fossils from the Daptocephalus Assemblage Zone in this part of the Karoo Basin.	

25	(15410) S29° 01.169' E29° 46.078'	Pelvic bone and tail vertebrates of a large reptile from the *Daptocephalus* Assemblage Zone. Excavation indicated that the rest of the body is highly weathered into a brown powdery mass and only a few petrified bone remains were collected for educational purposes.	
26	(15410) S29° 01.169' E29° 46.078'	Tusk of a Dicynodont discovered in the scree of the stream by Kadyn Dylan Maharaj. The tusk probably belonged to the body excavated as reported above. The tusk will be used for educational purposes as part of the collection of fossil bones associated with this project.	
27	(15510) S29° 01.159' E29° 46.074'	Well-preserved tusk of a Dicynodont discovered at this site. Although outside the actual study area it can be used as an example of the material expected on the site of the project.	

28	(15610) S29° 01.134' E29° 46.078'	Cast of a vertebrate burrow at the site of the fossils in the Daptocephalus Assemblage Zone.	
29	(15710) S29° 01.067' E29° 46.092'	Vertebrate remains in the lower Normandien Formation at the Wembezi Project site can be Very Highly significant. The sedimentary sequence is very close to the contact zone of the Beaufort and Ecca Groups and the presence of these fossils can provide interesting information on the palaeo-environments in this part of the Karoo Basin during the middle Permian.	
30	15810 S29° 01.303' E29° 45.887'	Thick cover of Masotcheni Formation clay overlying the Harrismith Member. Several poorly preserved fossil bones of Lystrosaurus are present in these deposits that are associated with the project area.	

31	(15910) S29° 01.241' E29° 45.833'	Outcrops of Harrismith Member mudstone with remains of Lystrosaurus Assemblage Zone vertebrate fossils. The Harrismith Member is as usual, very productive and the chance find of fossils in this unit is Very High in the study area of the Wembezi Project.	
32	(15410) S29° 01.169' E29° 46.078'	Thabiso opening the remains of a large vertebrate. Unfortunately the skull was already washed out and most of the skeleton weathered into very soft remaining claystone. The fossil bones will be used for educational purposes for this project.	
33	(15310) S29° 01.457' E29° 47.221'	Fossil skull in plaster of Paris jacket. The fossil will be taken to ESI at Wits University for proper identification. The “Chance Find Protocol” describe the methodology and procedures to be followed during the lifetime of this project to ensure safe keeping and proper management of Palaeontological Heritage in this Highly sensitive geological time zone.	

PALAEONTOLOGICAL IMPACT AND MITIGATION

The predicted palaeontological impact of the development is based on the initial mapping assessment and literature reviews, as well as information gathered during the field investigation (Figure 6).

Figure 6 Palaeontological sensitivity of the geological formations in the study area

The field investigation confirms that the study area is underlain by deeply weathered sediments of the Normandien Formation, as well as deeply weathered dolerite and clay-rich colluvium of the Masotcheni Formation.

The excavations for the construction of the infrastructure for the proposed developments can expose some sediments of Very Highly sensitive geological formations and some sites revealed Very Highly significant remains of fossils (Table 2). A very small part of the excavation project might expose unexpected dolerite that will not contain any fossils.

This project area falls on the Very Highly significant Permian extinction zone in South Africa and a Phase 2 PIA will have to be included in the EMPr and budget of the Project.

CONCLUSION

The development site for the proposed Wembezi Bulk Water and Sewerage Reticulation Projects, Inkosi Langalibalele Local Municipality, Uthukela District Municipality, Kwazulu-Natal Province is underlain by Permian to Triassic aged sedimentary rocks of the Normandien Formation of the Beaufort Group, Jurassic aged igneous dolerite of the Drakensberg Group, Karoo Supergroup, as well as Quaternary aged sediments of the Masotcheni Formation and alluvium.

Significant trace and vertebrate fossils were observed during the field investigation. The potential for finding significant fossils in any excavation into sediments of the Normandien Formation is Very High, with potential to find fossils in the Masotcheni Formation and alluvium rated as Very High as well. Significant new fossils were observed during the field assessment and a short information session was held to inform the site managers of the fossils that might be expected. If fossils are observed during construction, the HIA consultant must be notified and the fossils collected by a suitably qualified palaeontologist. No fossils will be associated with areas underlain by dolerite.

It is recommended that:

- The EAP and ECO must be informed of the fact that a Very High Palaeontological sensitivity is retained for all the sections of the developments that are underlain by shale and sandstone of the Normandien and Masotcheni Formations and alluvium. Although highly weathered, fossils might be recorded during the initial phase of construction when excavations exceed 1.5m.
- A Professional Palaeontologist must be appointed to inspect the site during the on-going weeks of excavation for the infrastructure and a “Chance Find Protocol” document (CFP, included with this report) must be updated on a monthly basis. If fossils are recorded, a suitably qualified palaeontologist must be appointed to inspect all areas where excavation of deeper than 1,5m is made into sediments of Normandien and Masotcheni Formations and a protocol for the chance find of fossils must then be developed and discussed with the contractor on site.
- These recommendations must be included in the EMPr of this project.

CHANCE FIND PROTOCOL FOR PALAEONTOLOGICAL HERITAGE

WEMBEZI BULK WATER AND SEWERAGE RETICULATION PROJECTS - 2017

Mitigation for Excavation Impact on Palaeontological Heritage Resources

It is essential that the appointed palaeontologist, in consultation with the JG Afrika Project Managers and the contractors of the excavation works develop a short-term strategy for the recovery of significant fossils during the excavation operation. As part of such a strategy, the discussions with the palaeontologist must include:

- Initially, and at least for the *duration of excavation*, visit the site at least once a month, to ensure recording of all potentially significant fossil strata.
- Determine a short-term strategy and budget for the recording of significant fossils. This Strategy is simply an oral agreement on when the site is to be inspected and what the finds are that might be recorded. The site visit must include an introduction session with all the managers of the Project Team, including training of the ECO and site managers by the appointed palaeontologist, to basically train people to know what to look out for in terms of fossil heritage on site.
- In the case of any unusual structures, the Palaeontologist must be notified, and a site visit must be arranged at the earliest possible time with the Palaeontologist. In the case of the ECO or the Site Manager becoming aware of suspicious looking material that might be a “Significant Find”, the construction must be halted in that specific area and the Palaeontologist must be given enough time to reach the site and remove the material before excavation continues. Highly significant finds were recorded during the first site inspection (Phase 1 PIA, included in this document).

Mitigation Measures Normally Encountered

1. Mitigation of palaeontological material must begin as soon as possible and preferably when “trial excavation” takes place. The appointed specialists must acquaint themselves with the operation and determine feasible mitigation strategies.

2. A plan for systematic sampling, recording, preliminary sorting and storage of palaeontological and sedimentological samples will be developed during the early stages of the project, in collaboration with the Evolutionary Studies Institute (ESI) at WITS University, which is the closest Institute to the site. If appropriate,

the University of KwaZulu-Natal might be asked for their involvement in this project.

3. Mitigation will involve an attempt to capture all rare fossils and systematic collection of all fossils discovered. This will take place in conjunction with descriptive, diagrammatic and photographic recording of exposures, also involving sediment samples and samples of both representative and unusual sedimentary or biogenic features. The fossils and contextual samples will be processed (sorted, sub-sampled, labelled, boxed) and documentation consolidated, to create an archive collection from the excavated sites for future researchers.

Functional responsibilities of the Developer and JG Afrika Project Managers

1. Ensuring, at their cost, that a representative archive of palaeontological samples and other records is assembled to characterise the palaeontological occurrences affected by the excavation operation.

2. Provide field aid, if necessary, in the supply of materials, labour and machinery to excavate, load and transport sampled material from the excavation areas to the sorting areas, removal of overburden if necessary, and the return of discarded material to the disposal areas. In the case of this project it is foreseen that vertebrate and plant fossils will be present. (*If fossils of Permian, Triassic and Quaternary age are exposed, it will be very Highly significant and the Palaeontologist will obviously be in close communication with the ECO to act as required by AMAFA/SAHRA without causing undue standing time for the contractors).*

3. "Facilitate" systematic recording of the stratigraphic and palaeo-environmental features of exposures in the fossil-bearing excavations, by allowing time to describe and measure geological sections, and by providing aid in the surveying of positions where significant fossils are found. *(In the case of this specific development, the likelihood of such finds is Very High).*

4. Provide safe storage for fossil material found routinely during excavation operations by construction personnel. In this context, isolated fossil finds in disturbed material qualify as "normal" fossil finds.

5. Provide covered, dry storage for samples and facilities that is defined as a work area for sorting, labelling and boxing/bagging of samples.

6. Costs of basic curation and storage in the sample archive at the ESI, WITS University (labels, boxes, shelving and, if necessary, specifically-tasked temporary employees).

Documentary record of palaeontological occurrences

1. The contractor will in collaboration with the Palaeontologist, make the excavation plan available to the appointed specialist, in which the following information are indicated on the plan in the site office at the excavation site. This must be done in conjunction with the appointed specialist and form part of the on-going revision of the EMPr during the excavation stage of the project:

1.1. Initially, all known specific palaeontological information will be indicated on the plan. This will be updated throughout the excavation period.

1.2 Locations of samples and measured sections are to be pegged, and routinely accurately surveyed. Sample locations, measured sections, etc., must be recorded three-dimensionally if any significant fossils are recorded during the time of excavation. This information must be recorded during the first site visit and a clearance from the Palaeontologist (e-mail message will suffice) must be followed up with subsequent e-mail communications.

Functional responsibilities of the appointed Palaeontologist

1. Apply for a permit to collect fossils during the lifetime of the Project and establishment of a representative collection of fossils and a contextual archive of appropriately documented and sampled palaeoenvironmental and sedimentological geodata in collaboration with the ESI at WITS University.

2. Undertake an initial evaluation of potentially affected areas and of available exposures in excavations. A short training session of the ECO or a representative, was included in the first site visit to this project.

3. On the basis of the above, and evaluation during the early stages of excavation development, in collaboration with the contractor management team, more detailed practical strategies to deal with the fossils encountered routinely during excavation, as well as the strategies for major finds must briefly be agreed on.

4. Informal on-site training in responses applicable to “normal” fossil finds must be provided for the ECO and environmental staff by the appointed specialist. This step is needed, due to the discovery of significant fossils at the time of the Phase 1 site visit.

5. Respond to significant finds and undertake appropriate mitigation.

6. Initially, for the first three months of operation, and if the ECO indicates significant “strange looking rocks” that might be similar to the fossils indicated to the staff during the information sessions on 3 to 7 July 2017, visit at least once in two weeks to “touch base” with the monitoring progress. Document interim “normal” finds and undertake an inspection and documentation of new excavation faces. A strategy for further visits during the life of the excavation must be discussed.

7. Transport of material from the site to the ESI, WITS University.

8. Reporting on the significance of discoveries, as far as can be preliminarily ascertained. This report is in the public domain and copies of the report must be deposited at ESI, AMAFA and the South African Heritage Resources Authority (SAHRA). It must fulfil the reporting standards and data requirements of these bodies.

9. Reasonable participation in publicity and public involvement associated with palaeontological discoveries.

Exposure of palaeontological material

1. In the event of construction exposing new palaeontological material, not regarded as normative/routine as outlined in the initial investigation, such as a major fossil find, the following procedure must be adhered to:

1.1 The appointed specialist or alternates (AMAFA; SAHRA; ESI WITS University, University of KZN) must be notified by the responsible officer (e.g. the ECO or contractor manager), of major or unusual discoveries during excavation, found by the Contractor Staff.

1.2 Should a major *in situ* occurrence be exposed, excavation will immediately cease in that area so that the discovery is not disturbed or altered in any way until the appointed specialist or scientists from the ESI at WITS University, or its designated representatives, have had reasonable opportunity to investigate the find. Such work will be at the expense of the Developer.

Significant fossils were observed during the first site visit and the palaeontologist cleared the continued excavation on the proviso that any suspicious material will be indicated to the Palaeontologist via emailed photographic information.

CONCLUSION

The development site for the proposed Wembezi Bulk Water and Sewerage Reticulation Projects, Inkosi Langalibalele Local Municipality, Uthukela District Municipality, Kwazulu-Natal Province, falls on Very Highly significant shale and thin bands of sedimentary rocks (Normandien and Masotcheni Formations) and alluvium that might contain significant fossils. No fossils are expected in the dolerite.

Fossils were recorded during the first site studies in these rock formations. The potential for finding significant vertebrate, plant and trace-fossils, in any excavation into sediments of the Normandien and Masotcheni Formations, is always Very High and the cooperation of the entire team of JG Afrika and the

contractors, is of critical importance. The interest and cooperation of the management team will be highly appreciated and it is essential that the excavation be monitored during the entire period of excavation and that this "Chance Find Protocol" be updated on a monthly bases during the life-time of the excavation period for the project. It is essential that the Palaeontologist be notified of the final sign-off of the project date, for final posting of the "Chance Find Protocol" on the SAHRIS Website for record purposes. No fossils will be associated with areas underlain by dolerite, but significant Quaternary aged fossils can be present in the Masotcheni Formation and alluvial cover on these geological formations.

It is recommended that:

- The EAP and ECO must be informed of the fact that a Very High Palaeontological Sensitivity was allocated to the entire development and due to the highly weathered nature of the material, significant fossils is expected after the start of excavations for foundations that exceed 1.5m.
- The allocated team members at the community can be introduced to Palaeontological material that is likely to be found on site. A once-off information session with the Palaeontological specialist must be arranged, to present a simple and understandable (preferably audio-visual presentation in an "interpreted voice") of the majority of the contractual workers on site (isiZulu) during the initial site visit that must form part of the EMPr for the project.
- This "Chance Find Protocol" must be included into the EMPr of the project and a reasonable budget must be allocated to ensure compliance with the legal responsibility of the developer in terms of the proper conservation of and storage of Palaeontological Heritage.
- The AMAFA and SAHRA must be informed of the content of this "Chance Find Protocol" and EMPr arrangements by the EAP or the developer, for final approval of the ROD documentation during the EIA process.

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QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

Dr Gideon Groenewald has a PhD in Geology from the University of Port Elizabeth (Nelson Mandela Metropolitan University) (1996) and the National Diploma in Nature Conservation from Technicon RSA (the University of South Africa) (1989). He specialises in research on South African Permian and Triassic sedimentology and macrofossils with an interest in biostratigraphy, and palaeo-ecological aspects. He has extensive experience in the locating of fossil material in the Karoo Supergroup and has more than 20 years of experience in locating, collecting and curating fossils, including exploration field trips in search of new localities in the southern, western, eastern and north-eastern parts of the country. His publication record includes multiple articles in internationally recognized journals. Dr Groenewald is accredited by the Palaeontological Society of Southern Africa (society member for 25 years).

DECLARATION OF INDEPENDENCE

I, Gideon Groenewald, declare that I am an independent specialist consultant and have no financial, personal or other interest in the proposed development, nor the developers or any of their subsidiaries, apart from fair remuneration for work performed in the delivery of palaeontological heritage assessment services. There are no circumstances that compromise the objectivity of my performing such work.

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