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ENVIRO-SOCIAL CONSULTING SERVICES

Vegetation, Soil & Land Capability Assessment and Wetland Delineation for Ingula Bridge near Van Reenens in Kwa-Zulu Natal

Draft Report

This is a report compiled for Eskom Holdings (Pty) Ltd

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PURPOSE OF THIS DOCUMENT

As part of the environmental authorisation process for the aforementioned project it is required for both the Basic Assessment Process and the Water Use Licence Application that certain specialist studies be undertaken. Zitholele Consulting appointed Cymbian Enviro-Social Consulting Services to undertake the following specialist studies:

- **Ü** A Vegetation Assessment;
- **Ü** A Soil and Land Capability Assessment; and
- **Ü** A Wetland Delineation.

The purpose of this document is therefore to present the findings of the aforementioned assessments and to provide management measures to protect sensitive features located on site.

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1.0 INTRODUCTION

1.1 Project background

Eskom is in the process of constructing the Ingula Pumped-Storage Scheme (PSS), outside Van Reenen in the Free State with the main purpose of generating additional electricity supply to the national grid. The Ingula PSS comprises two reservoirs (referred to as upper and lower reservoirs), underground powerhouse complex, waterway tunnels linking the reservoirs with the powerhouse complex, access roads and transmission lines, among other components. The lower reservoir is located on the Braamhoekspruit, a tributary of the Klip River. The PSS received its Environmental Authorisation in 2004, and the access roads in April 2006, respectively. Authorisation of the access roads was a condition of the scheme's Environmental Authorization.

Approximately two kilometres downstream of the lower reservoir, a gravel road (D474) crosses the Braamhoekspruit via a low water bridge. The gravel road is used by the local communities and other road users. The bridge gets flooded during heavy rains because of its low-level technical design and specification.

Although the magnitude of flood peaks downstream of the lower reservoir will be reduced once the construction of the Ingula PSS is completed, the duration of these reduced peaks may be over longer periods, than usual, due to the attenuation effect and release system of the reservoir. This could result in longer duration of over-flowing of the low-level bridge than is experienced without the lower reservoir. To mitigate this extended period of over-flowing, Eskom is planning to upgrade the low-level bridge to a larger bridge with adequate opening to accommodate large flows without over flowing of the gravel road. This will ensure access across the Braamhoekspruit, through this gravel road when flows are released from the reservoir through its normal discharge system.

The adjacent land to the existing low water bridge is rural farm land used primarily for grazing. The water course (Braamhoekspruit) is used by local subsistence farmers for watering of live stock, and domestic potable use. There is a small rural farmstead within 100m of the proposed activity.

For Eskom to begin the upgrade of the low-level bridge, an Environmental Authorisation is required. To obtain such Environmental Authorisation for the proposed project, a Basic Assessment will be conducted in terms of the Environmental Impact Assessment Regulations under Section 24 (5) of the National Environmental Management Act (NEMA), (Act No 107 of 1998) as published in GN R385, 386 and 387. A critical element of the Basic Assessment is the public participation process that allows Interested and Affected Parties (I&APs) an opportunity to provide comments on a proposed development. Furthermore, in order for Eskom to begin with the upgrade of the low level crossing over the Braamhoekspruit the Department of Water Affairs and Forestry requires that Eskom applies for a Water Use Licence of their water uses in terms of the National Water Act (NWA) (Act No 36 of 1998).

1.2 Brief project description

For the low-level bridge to be upgraded it is anticipated that a concrete structure of about 15 m x 5 m will be constructed to lift the road sufficiently to create an opening for the water in the Braamhoekspruit to flow freely beneath. The proposed construction will take place within the existing road reserve.

As a first step towards the proposed construction, the existing gravel road (D474) has to be deviated to make way for the construction process and to ensure interim access for traffic. Once the road deviation has been completed the establishment of the upgraded structure (high water bridge) will be on the original road. By doing it this way, it is anticipated to minimize the environmental impact outside the road reserve. It is proposed to deviate the road approximately 50m north from the existing gravel road. The area where the deviated road will be constructed will be fully rehabilitated.

1.2.1 Temporary deviation of road and river crossing

It is proposed that the road deviation will be done to the northern side of the existing road along the path that seems to be a former river crossing. The river crossing will be filled with rocks and concrete pipes of sufficient size to handle the expected annual flow for the specific period and to allow free seepage. The road surface will be constructed of layers of suitable material to create a road surface. By doing it this way it is anticipated to minimize turbidity in the Braamhoekspruit during the construction phase of the cause way.

1.2.2 Demolishing of existing bridge

The demolishing of the existing bridge will be done, as far as possible, with hydraulic breakers and not explosives due to the close vicinity of local residents. The demolished material will be disposed of at a suitable place, and there is a suggestion to use that material in the rehabilitation of the temporary deviation on the cuttings on either side to reinstate the river bank to its former shape.

1.2.3 Bridge construction

The excavation of the two bridge supports will be done on either side of the river while concentrating the water in the centre by suitable means without contaminating the water through turbidity. Concreting will commence once the foundations have been inspected and approved. Concrete will be delivered from the lower reservoir's batch plant with mixer trucks. The concrete will be placed with a crane and concrete bucket.

1.2.4 Bridge deck construction

The bridge deck is a composite deck consisting of pre-cast beams and in-situ concrete. The Precast beams will be cast inspected and approved. Once the bridge supports are finished the pre-cast beams

will be placed into position with a mobile crane. Once the pre-cast beams are in place the in-situ deck and all other relevant features will be completed.

1.2.5 Road surface layer works.

The specified material will be sourced from approved sources. The material will be worked, placed and compacted to specification. The road will not be tarred, but will remain a gravel road as is.

1.2.6 Fencing and Rehabilitation

Fencing will be erected in such a manner to ensure the safety of people passing by. Site rehabilitation will be done according to specification in the Environmental Management Plan.

1.3 Regional setting and project locality

The property falls within the jurisdiction of the Ladysmith / Emnambithi Local Municipality. The property on which the low level crossing is located is Portion 3 and 4 of Portion 3 of the Farm Trekboer 1002GS (See Figure 1-1).

The site falls within the Upper Tugela catchment (Thukela Water Management Area, Tertiary Drainage Region V12). The Tugela River catchment experiences a wide variety of weather conditions ranging from generally wet and cold in the Drakensberg Mountains, to dry and hot in the Tugela Valley from Colenso down towards the coast, and hot and humid and reasonably well watered at the coast.

The region receives most of its rainfall in summer between September and April. Snow falls are common in winter along the Drakensberg Mountain peaks, which melt fairly quickly. The average rainfall ranges from about 1 500 mm per annum in the mountains to about 650 mm per annum in the central parts of the catchment. Annual runoff varies from 600 mm in the Drakensberg to as little as 50 mm in the dry bushveld areas with an estimated natural Mean Annual Runoff (MAR) of 3799 million m3 per annum at the river mouth.

1.4 Study scope

As part of the environmental authorisation process for the aforementioned project it is required for both the Basic Assessment Process and the Water Use Licence Application that certain specialist studies be undertaken. Zitholele Consulting appointed Cymbian Enviro-Social Consulting Services to undertake the following specialist studies:

- **Ü** A Vegetation Assessment;
- **Ü** A Soil and Land Capability Assessment; and
- **Ü** A Wetland Delineation.

1.5 Study approach

Cymbian undertook the aforementioned specialist studies during a two day site visit on the 18th and 19th of August 2008. The study area extended 150 m either side of the existing low level crossing on both banks of the Braamhoekspruit.

Transects were walked on either side of the river in which vegetation, soil, and wetland characteristics were sampled. Each sampling point was marked using a GPS for mapping purposes. (Please refer to the following sections for detailed descriptions of how each assessment was undertaken)

1.6 Project team

The technical project team consists of:

- Konrad Kruger – Landscape Ecologist and Environmental Consultant
- Brian Van Aswegen – Conservation Ecologist and Junior Environmental Consultant

Konrad Kruger graduate from the University of Pretoria with a BSc Honours in Geography in 2003. Konrad has been involved in a variety of environmental projects in the last three years and has become specialised in undertaking specialist studies, mapping and environmental consulting. Konrad has undertaken GIS mapping for mining, residential as well as industrial developments. Konrad is also an experienced land ecologist and will provide expertise for this project in terms of soil surveys, land capability assessments and mapping. He is currently in the process of acquiring his MSc in Geography (Landscape Ecology) from the University of Pretoria.

Brian Van Aswegen graduated from The University of the Witwatersrand with a BSc Honours in Conservation, Ecology and Environmental Management in 2007. Brian Majored in Zoology and Environmental Management and focused his research on the effect of Wild Herbivore Grazing on The Riparian zones of the Sabie and Letaba Rivers in the Kruger National Park. Brian is currently employed at Cymbian as a Junior Environmental Consultant.

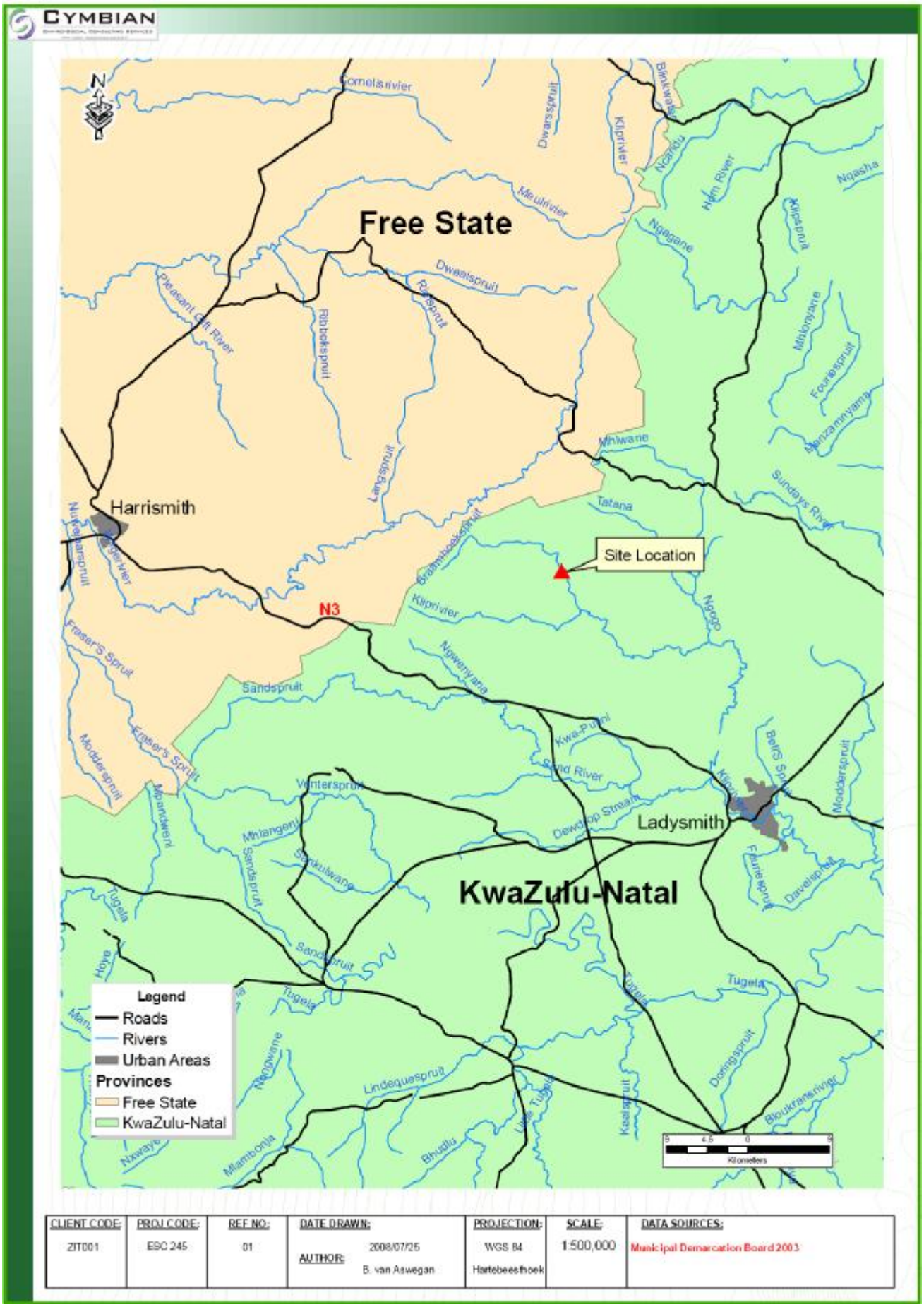


Figure 1-1: Location of the Site

2.0 RECEIVING ENVIRONMENT

This section details the receiving environment at the project location. Although the aim of this report is to detail the vegetation, wetlands and, soil and land capability component of the receiving environment; certain additional factors have been included, as they provide perspective to the soil and vegetation study. These include geology, topography, climate, surface water and land use.

2.1 Geology

2.1.1 Data Collection

The geological data was obtained from the Environmental Potential Atlas of the Department of Environmental Affairs and Tourism.

2.1.2 Regional Description

Figure 2-1 shows the lithology of the area. The Upper and Lower Reservoir sites are separated by the Great Escarpment. The lithology dominating this area consists of the following:

- Mudstone;
- Shale,
- Sandstone,
- Coal; and
- Carbonaceous Shale

2.2 Climate

2.2.1 Data Collection

Mean monthly temperatures (Table 1) and A-Pan evaporation (Table 2) have been extrapolated from the Poltech survey (1999) for the Braamhoek PSS. Data was recorded on the farm Bedford (upper reservoir, Free State Province) and the farm Braamhoek (lower reservoir, KwaZulu Natal Province). Mean Annual Precipitation data has been obtained from the South African Weather Services for the Van Reenen (upper) and Moorside (Lower) weather station.

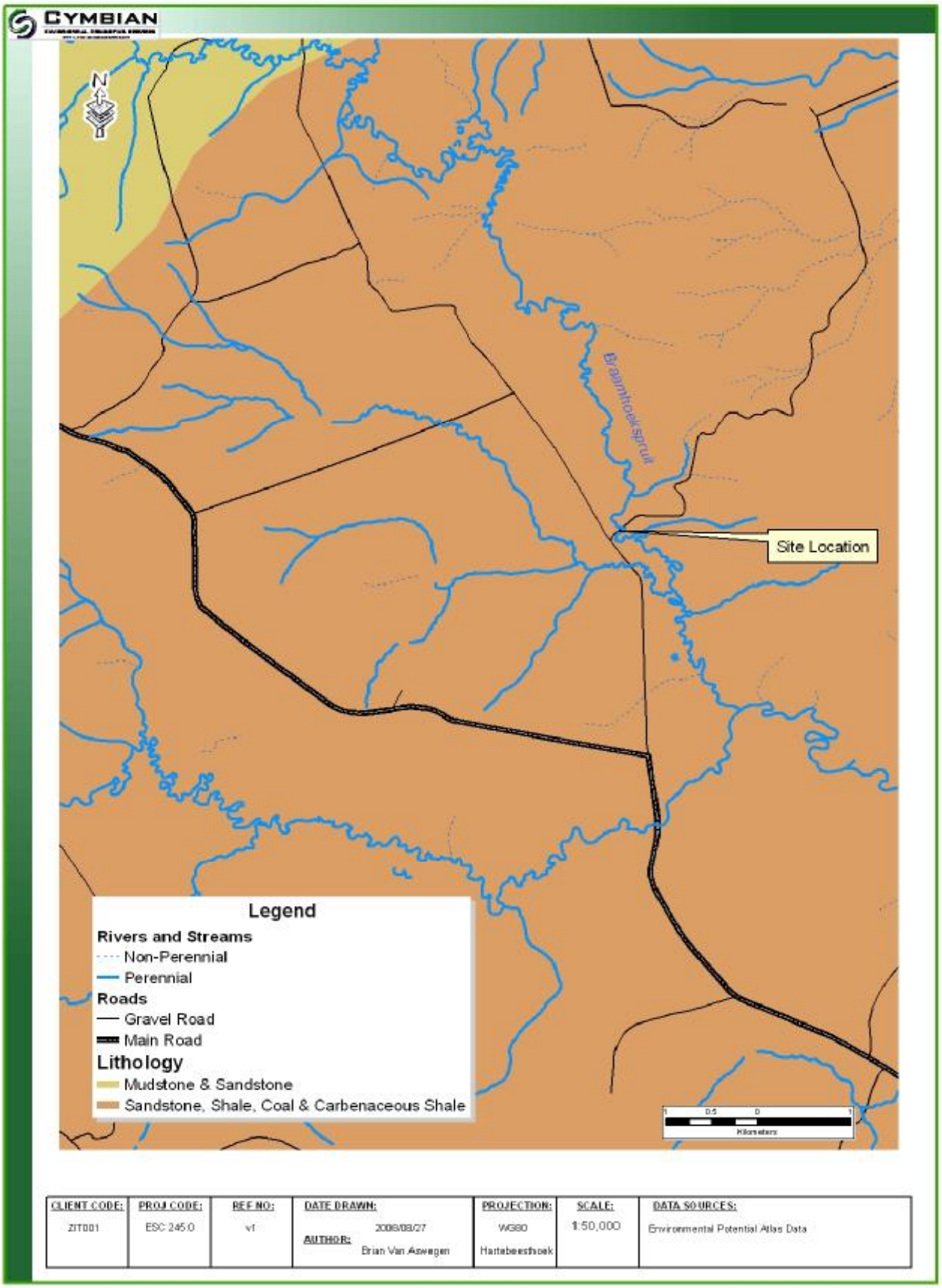


Figure 2-1: Regional Geology

Mean Monthly Maximum and Minimum Temperatures:

The mean monthly maximum and minimum temperatures for the region is given in Table 1 below. Mean monthly temperatures are on average 1.2°C warmer than those recorded on the KwaZulu Natal side of the study area. Mean monthly temperatures peak during summer (December and January) at 18.1°C and 19.2°C (Bedford and Bramhoek respectively) and dip during winter (June and July) to 8.1°C and 9.3°C respectively.

Mean Monthly Evaporation:

The mean monthly evaporation is shown in Table 2 above. Mean monthly A-pan evaporation recorded at the Bramhoek (KwaZulu Natal) site is marginally higher, particularly during the summer period from October to March. Mean annual evaporation is 1705 mm and 1763 mm for the Bedford and Braamhoek sites respectively.

Mean Annual Rainfall:

Mean annual precipitation for the area (Table 3) is significantly lower than the mean annual evaporation, with rainfall above the scarp (Van Reenen) of 1 004 mm per annum and 847 mm per annum below the scarp (Moorside), resulting in a net negative water balance for the study area.

2.3 Surface Water

2.3.1 Data Collection

The surface water data was obtained from the WR90 database from the Water Research Council. The data used included catchments, river alignments and river names. In addition water body data was obtained from the CSIR land cover database (1990) to show water bodies and wetlands.

2.3.2 Regional Description

The site falls within the Upper Tugela catchment (Thukela Water Management Area, Tertiary Drainage Region V12) according to the Department of Water Affairs and Forestry's surface water resources drainage area numbering system. The Tugela River catchment experiences a wide variety of weather conditions ranging from generally wet and cold in the Drakensberg Mountains, to dry and hot in the Tugela Valley from Colenso down towards the coast, and hot and humid and reasonably well watered at the coast.

Table 2-1: Mean Monthly Temperatures (Poltech 1999)

Catchment	Sub-Catch	Mean Monthly temperatures (0C)																					
		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Bedford	**1**	**12.1**	**24.0**	**11.8**	**23.5**	**10.4**	**22.4**	**7.3**	**20.2**	**3.7**	**18.0**	**0.7**	**15.4**	**0.7**	**15.7**	**3.0**	**17.9**	**6.1**	**20.5**	**8.2**	**21.5**	**9.9**	**22.0**	**11.2**	**23.5**
Braamhoek	**2**	**12.3**	**24.4**	**12.1**	**23.8**	**10.7**	**22.7**	**7.6**	**20.4**	**4.0**	**18.2**	**1.1**	**15.6**	**1.0**	**15.9**	**3.2**	**18.1**	**6.2**	**20.7**	**8.4**	**21.8**	**10.1**	**22.4**	**11.5**	**23.9**
	3	**12.8**	**24.7**	**12.6**	**24.2**	**11.3**	**23.1**	**8.4**	**20.9**	**5.2**	**18.6**	**2.4**	**16.0**	**2.4**	**16.4**	**4.3**	**18.5**	**6.9**	**21.1**	**8.9**	**22.1**	**10.5**	**22.8**	**11.9**	**24.3**
	4	**14.2**	**26.9**	**13.9**	**26.4**	**12.5**	**25.3**	**9.2**	**23.1**	**5.2**	**20.8**	**2.1**	**18.3**	**2.0**	**18.6**	**4.3**	**20.7**	**7.7**	**23.1**	**10.1**	**24.2**	**11.8**	**25.0**	**13.3**	**26.5**

Table 2-2: Monthly Evaporation (Poltech 1999)

Catchment	Sub-Catch	A-pan equivalent potential evaporation (mm)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bedford	**1**	179.1	149.2	143.3	119.9	104.6	89.3	101.4	137.5	157.0	164.8	168.3	190.1
Braamhoek	**2**	183.2	152.2	145.4	120.1	104.2	89.4	101.3	137.2	158.3	168.0	171.3	193.6
	3	183.6	153.8	146.1	120.6	104.5	90.0	101.7	137.5	159.1	170.0	172.0	194.3
	4	199.2	167.9	156.4	124.2	106.2	92.4	103.2	138.6	166.1	183.1	185.5	208.6

Table 2-3: Rainfall Data (Poltech 1999(

Station Number	SAWB number	Station name	Longitude		Latitude		First Year of record	Last Year of record	MAP(mm)	Altitude
			0	‘	0	‘				
11	0333682	Van Reenen	28	22	29	23	1913	1988	1044.4	1670
14	0334174	Moorside	28	24	29	37	1914	1997	847.4	1219

The region receives most of its rainfall in summer between September and April. Snow falls are common in winter along the Drakensberg Mountain peaks, which melt fairly quickly. The average rainfall ranges from about 1 500 mm per annum in the mountains to about 650 mm per annum in the central parts of the catchment. Annual runoff varies from 600 mm in the Drakensberg to as little as 50 mm in the dry bushveld areas with an estimated natural Mean Annual Runoff (MAR) of 3799 million m3 per annum at the river mouth.

The dominant rivers which drain the catchment are the Wilge River to the North-east of the site which feeds into the Vaal dam, the Katspruit south-east of the site which is a tributary of the Braamhoekspruit, and Ngwenyana river further south of the site.

2.3.3 Site Description

Figure 2-3 shows the surface hydrology of the site. The site falls in the V12A quaternary catchment. The surrounding catchments are the V12B the V12E quaternary catments.The V12A quaternary catchment drains into the Braamhoekspruit, which will be crossed by the by the proposed bridge. The Braamhoekspruit is a highly meandering perennial river with extremely steep and high river banks (Figure 2-2).

Figure 2-2: Photos of the Braamhoekspruit

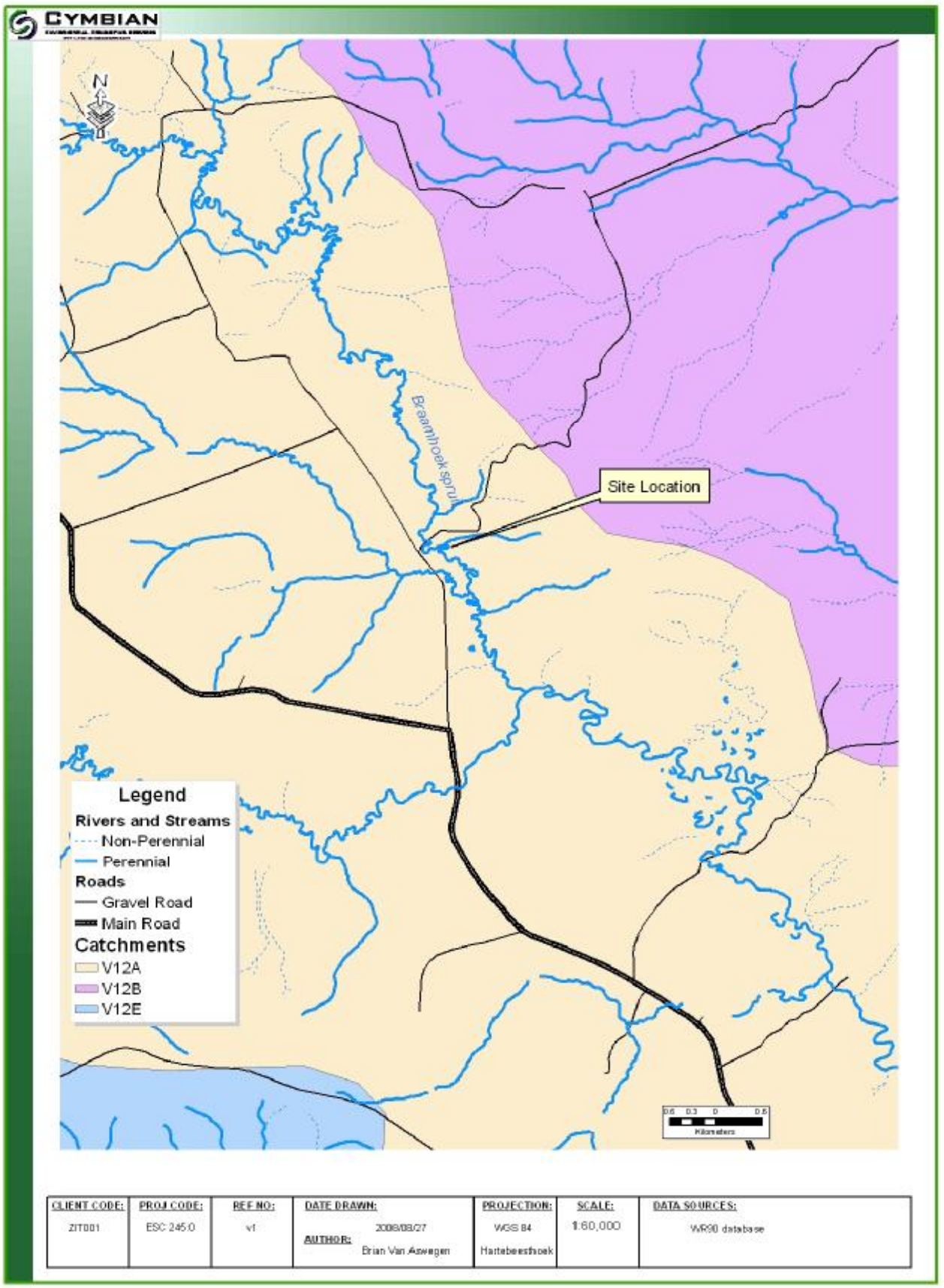


Figure 2-3: Surface Water Features Map

2.4 Topography

2.4.1 Data Collection

The topography data was obtained from the Surveyor General's 1:50 000 toposheet data for the region. Contours were combined from the topo mapsheets to form a combined contours layer. Using the Arcview GIS software the contour information was used to develop a digital elevation model of the region as shown in Figure 4 below.

2.4.2 Regional Description

The topography of the region is typical of the Drakensburg escarpment. The upper reservoir site (Bedford Farm) is situated at an altitude of 1700 m and consists of rolling grassland, with incised drainage lines. The lower Reservoir (Braamhoek Farm) is situated in the foothills of the Drakensburg escarpment at an altitude of 1220 m, in typical grassland with rolling hills, small streams, erosion gullies and a few dams.

2.4.3 Site Description

The site earmarked for development is set on a rolling plain with elevations ranging from 1 200 metres above mean sea level (mamsl) to 1 240 mamsl. The foothills of the Drakensburg escarpment located to the north-west of the site extend to 1460 mamsl. The topography slopes predominantly from north-west towards the Braamhoekspruit.

Figure 4 below illustrates the digital elevation model created from the contours of the region. The low lying areas are clearly visible in light green while the higher areas are shown in yellow and brown. The general slope of the terrain of the site is 1:65.

2.5 Soils

2.5.1 Data Collection

The site visit was conducted on the 18th and 19th August 2008. The site was divided into transects, approximately 50m apart and soils were augered at 75m intervals. Soils were augered using a 150 mm bucket auger, up to refusal or 1.5m. Soils were identified according to Soil Classification; a taxonomic system for South Africa (Memoirs on the Natural Resources of South Africa, no. 15, 1991). The following soil characteristics were documented:

- **Ü** Soil horizons;

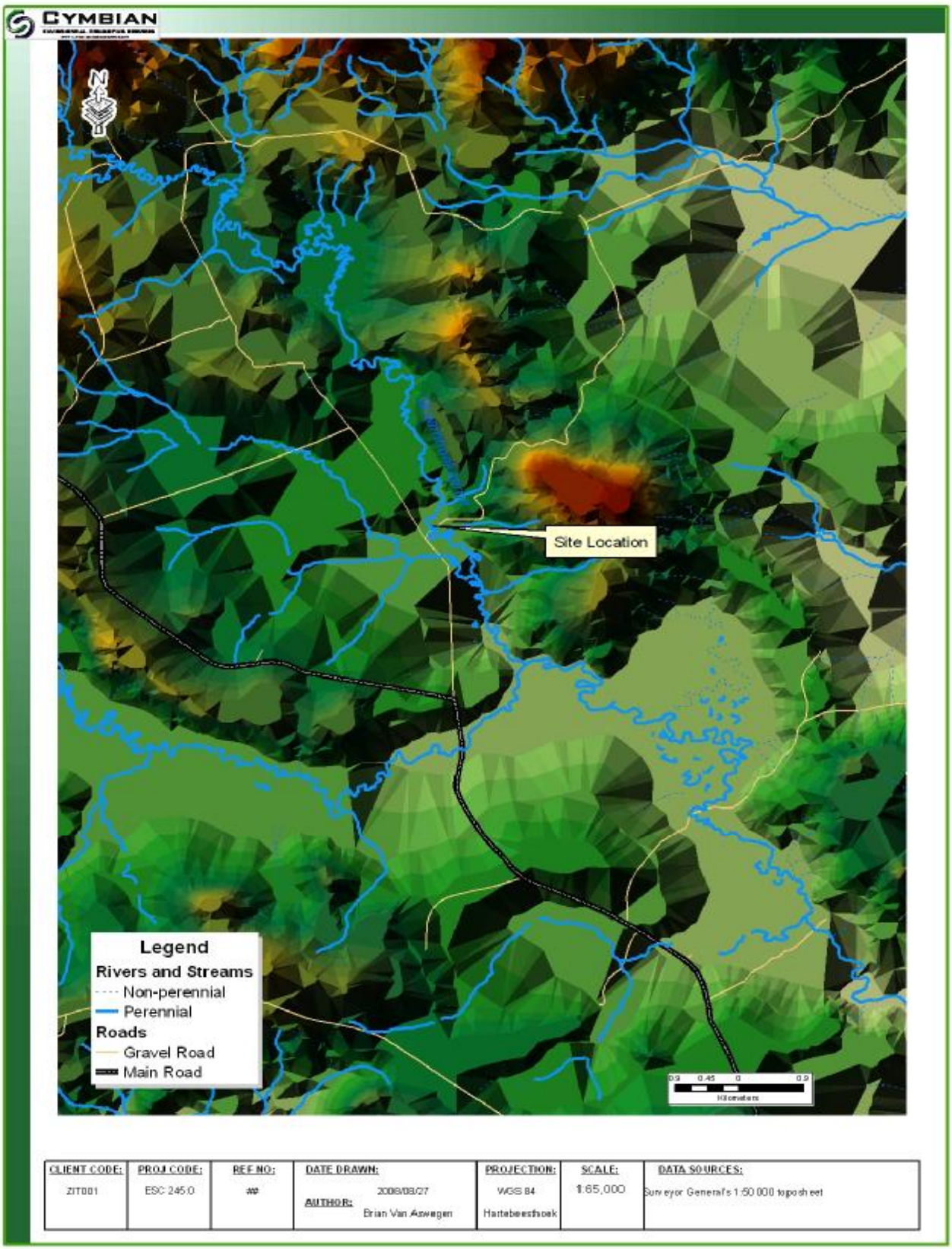


Figure 2-4: Topography of Site

- Ü Soil colour;
- Ü Soil depth;
- Ü Soil texture (Field determination)
- Ü Wetness;
- Ü Occurrence of concretions or rocks; and
- Ü Underlying material (if possible).

2.5.2 Regional Description

The soils in the region are mostly derived from the predominantly sandstone geology of the KwaZulu-Natal midlands. The soils are generally deep with a yellow-brown colour. Erosion is a common sight due to the climate and the topography of the region.

2.5.3 Site Description

Please refer to Appendix 1 for the on site soil and vegetation monitoring data. The soils on site are typical of their location in the landscape, namely the valley bottom. The soils are mainly derived from transported colluvium and alluvial deposits.

The site is located on the valley bottom of the drakensburg escarpment. The site can be subdivided into two sections on the basis of soil forms found. The alluvial floodplain vegetation unit corresponds with soils that have been deposited. The river channel and banks unit corresponds with soils that have been stratified through flooding. During the site visit the following soil forms were identified:

- Ü Mispah;
- Ü Clovelly;
- Ü Dundee; and
- Ü Huttons

Each of the soil forms are described in detail in the sections below and Figure 2-9 illustrates the location of the soil types. The land capability (agricultural potential) of the abovementioned soil form is described in more detail in Section 2.6.

2.5.4 Soils found on Site

Mispah soil form

The Mispah soil form is characterised by an Orthic A – horizon overlying hard rock. Mispah soil is horizontally orientated, hard, fractured sediments which do not have distinct vertical channels containing soil material. There is usually a red or yellow-brown apedal horizon with very low organic matter content. Please refer to Figure 2-5 for an illustration of a typical Mispah soil form.

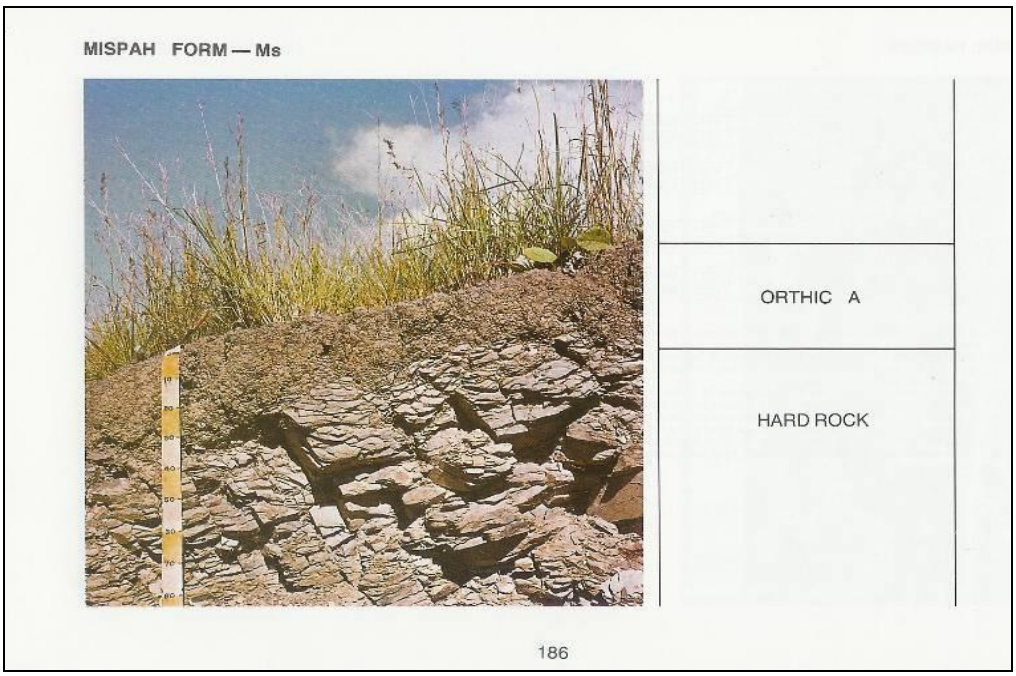
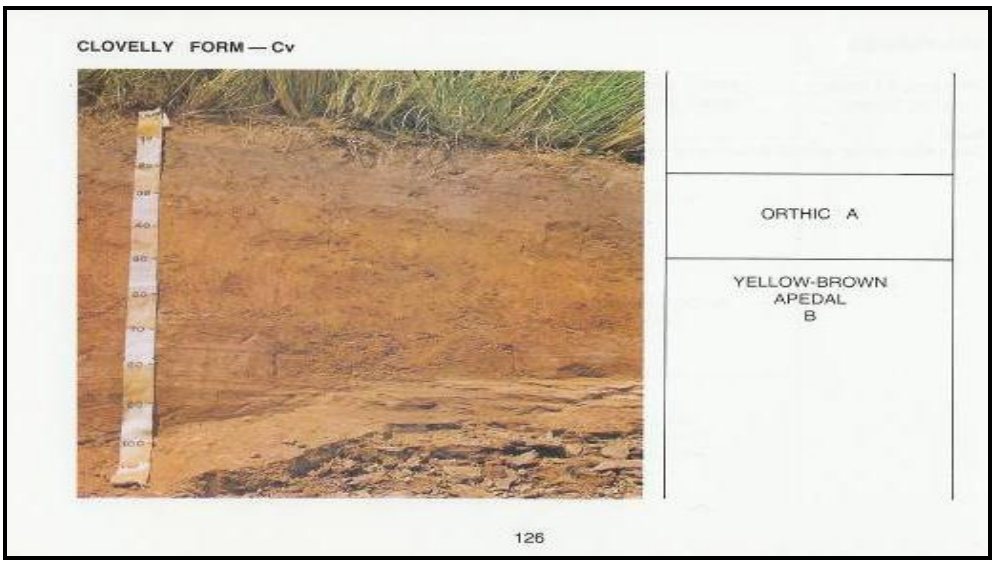


Figure 2-5: Mispah soil form (Memoirs on the Natural Resources of South Africa, no. 15, 1991).

Clovelly Soil Form

Clovelly soils can be identified as an apedal "yellow" B-horizon as indicated in Figure 2-6 below. These soils along with Hutton soils are the main agricultural soil found within South Africa, due to the deep, well-drained nature of these soils. The soils are found on the valley bottom which constitutes 83.1 % of the site.



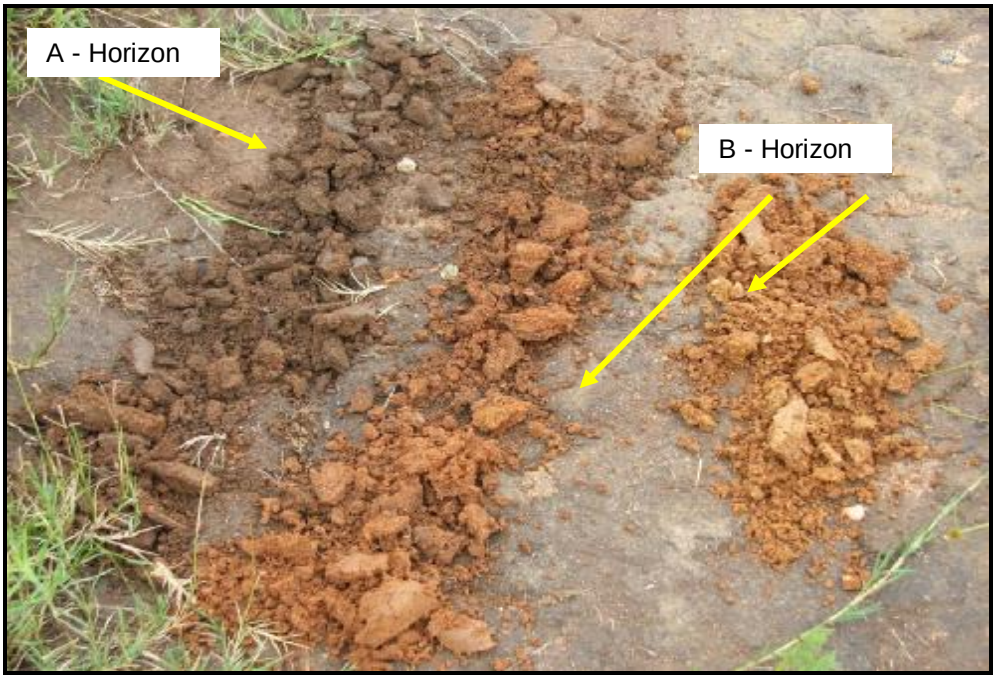


Figure 2-6: Clovelly soil form (Soil Classification, 1991 & site visit auger hole)

Hutton Soil Form

Hutton soils are identified on the basis of the presence of an apedal (structure less) "red" B-horizon as indicated in Figure 2-7 below. These soils are the main agricultural soil found in South Africa, due to the deep, well-drained nature of these soils. The Hutton soils found on the site are restricted to the very lower limits of the footslopes and floodplains.

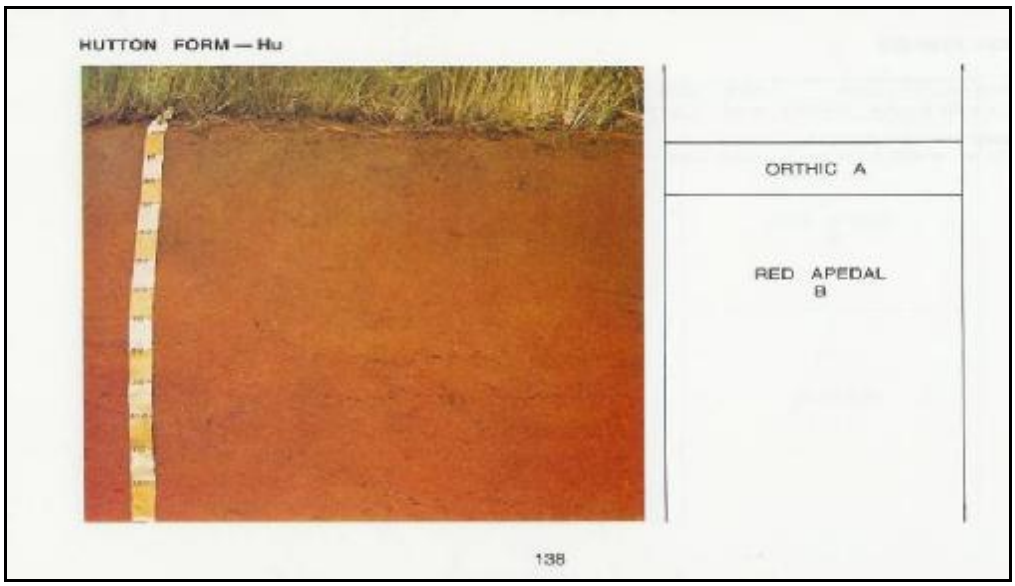


Figure 2-7: Hutton soil form (Soil Classification, 1991)

Dundee Soil Form

Dundee soils are charcterised as stratified alluvium soils. These soils do not qualify as diagnostic regic sand and are unconsolidated containing stratifications caused by alluvial or colluvial depositions. They directly underlie a diagnostic orthic or melanic A horizon or alternatively occur at the surface. Unlike soil horizons that have developed by pedogenetic processes, stratified alluvium owes its distinguishing features to a depositional process and is thus not a sequence of so called genetic horizons. These soils are found on the river banks of the Braamhoekspruit.

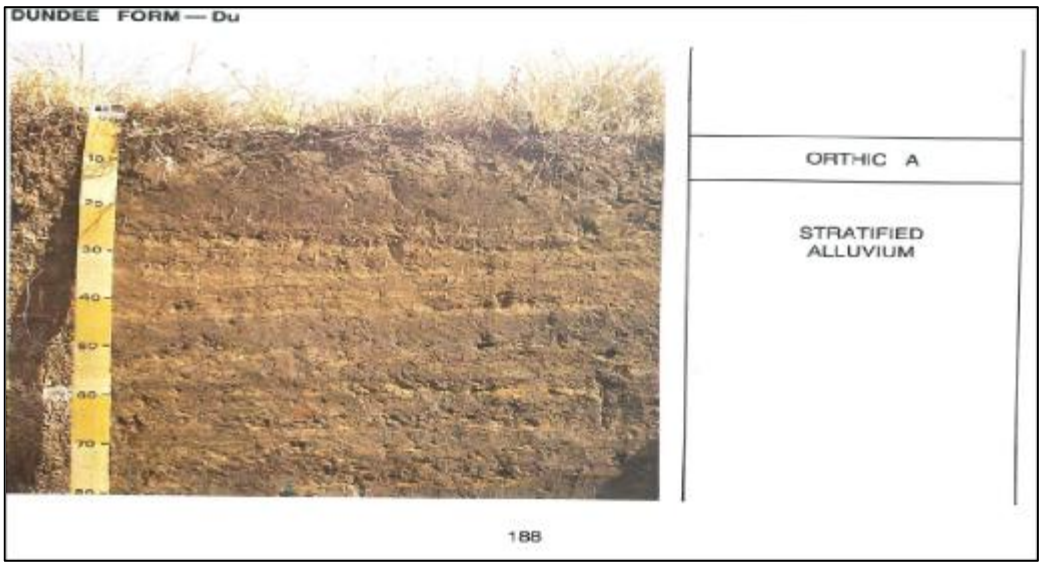


Figure 2-8: Hutton soil form (Soil Classification, 1991)

2.6 Land Capability

2.6.1 Data Collection

A literature review was conducted in order to obtain any relevant information concerning the area, including information from the Environmental Potential Atlas (ENPAT), Weather Bureau and Department of Agriculture. Results from the soil study were taken into account when determining the land capability of the site.

The land capability assessment methodology as outlined by the National Department of Agriculture was used to assess the soil's capability on site.

2.6.2 Regional Description

The regional Land Capability is consists of poor arable land that is best suited to use as grazing or agriculture with very intensive inputs required.

2.6.3 Site Description

The soils identified on site were classified according to the methodology proposed by the Agricultural Research Council – Institute for Soil, Climate and Water (2002). Factors evaluated are tabled below.

The site has a dominant land capability of class III. This indicated that the site is suitable for cultivation and can be used for a wide range of agricultural applications. Some soils are in class VII which has continuing limitations that cannot be corrected; in this case rock complexes, flood hazard, stoniness, and a shallow rooting zone constitute these limitations.

In conclusion it is clear that the site is suited to cultivation.

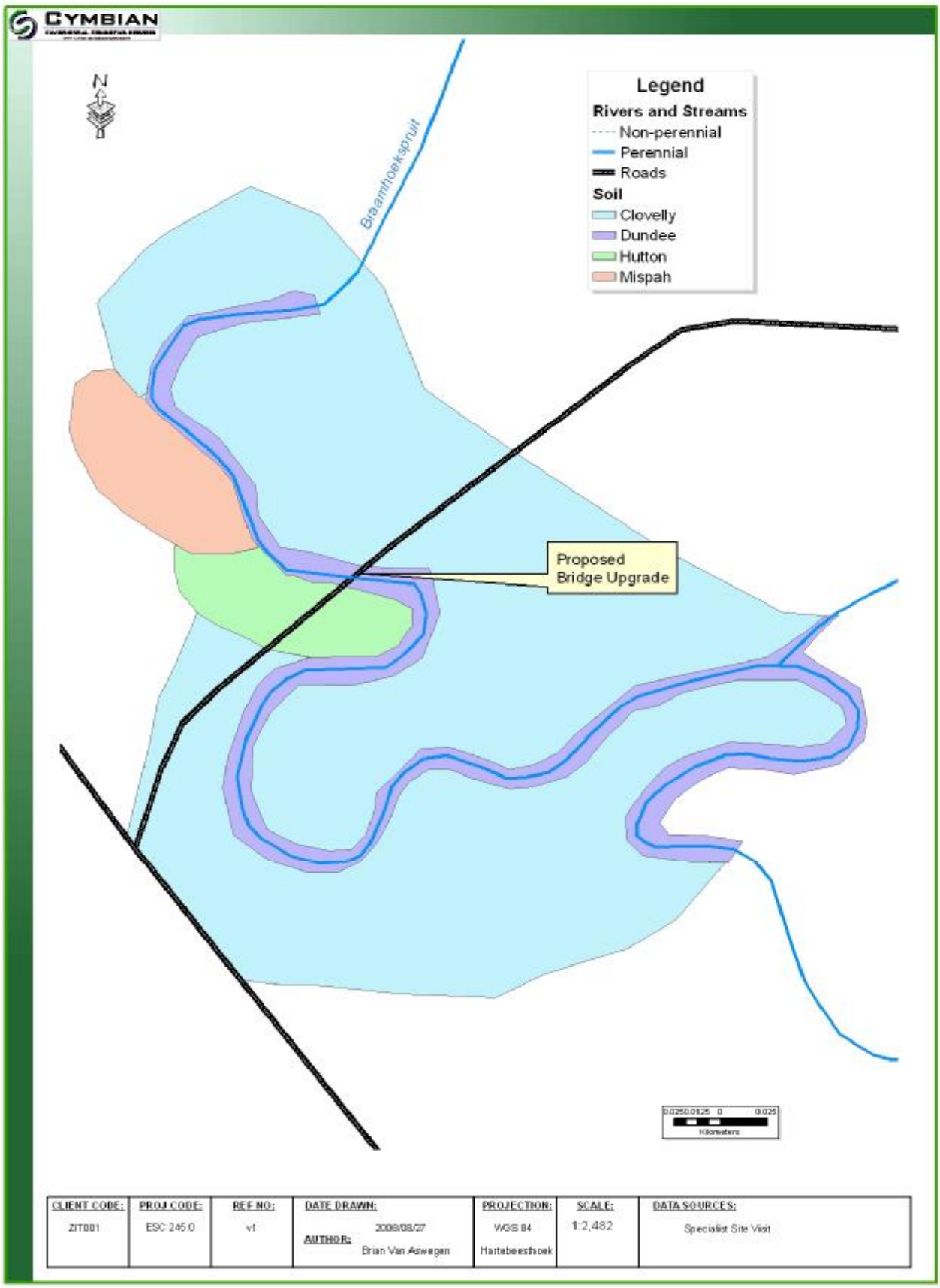
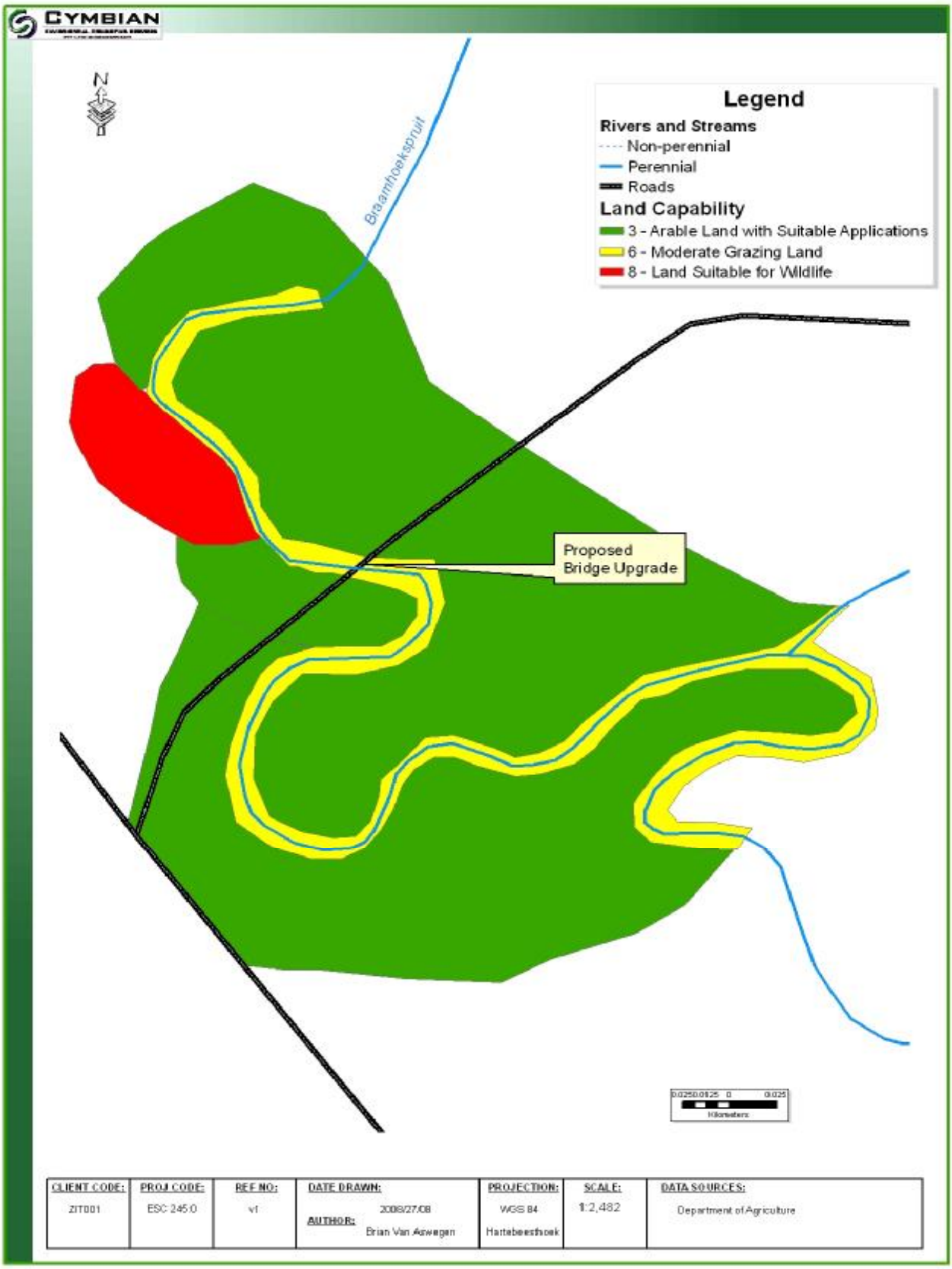


Figure 2-9: Soil Type Map

Table 2-4: Land Capability of the soils on site for agricultural use

	Hutton/Clovelly	Mispah	Dundee
% of Site	**81.6**	**5.1**	**13.3**
Rock Complex	**None**	**Yes – hard rock**	**None**
Flooding	**None**	**None**	**Common**
Erosion	**Low to moderate**	**Moderate**	**High**
Slope	**1:65**	**1:5**	**1:65**
Water Erosion	**Low to moderate**	**High**	**High**
Wind Erosion	**Low**	**Moderate**	**Low**
Texture (% clay)	**15 – 45**	**15 - 35**	**<10**
Depth (mm)	**> 800**	**100 - 299**	**<100**
Drainage	**Well drained**	**Well drained**	**Poorly drained**
Mechanical Limitations	**Ploughable**	**Very Shallow**	**MB1**
pH	**>5.0**	**>5.0**	**>5.0**
Climate Class	**High**		
Soil Capability	II / III	**VI / VII**	**VI / VII**
Land Capability	II / III – Arable Land Well adapted to cultivation		

No limitation	Low to Moderate	Moderate	High	Very Limiting



2.7 Figure 2-10: Land Capability Map

2.8 Land Use

2.8.1 Data Collection

The Land Use data was obtained from the CSIR Land Cover database and supplemented with visual observations on site.

2.8.2 Regional Description

The site earmarked for development is located in an area which is predominantly unimproved grassland. This type of land cover is associated with intensive grazing. Other land cover types in the area surrounding the site are cultivated land as well as thicket and bushland. Figure xxx indicates the land cover types in the areas surrounding the site earmarked for development

2.9 Vegetation

2.9.1 Data Collection

The site visit was conducted on the 18th and 19th August 2008. The site was divided into transects, approximately 50m apart and vegetation identified 50m intervals. Vegetation was photographed and identified on site. The occurrence of the species was described as either:

- **Ü** Very common (>50 % coverage);
- **Ü** Common (10 – 50 % coverage);
- **Ü** Sparse (5 – 10 % coverage); and
- **Ü** Individuals (< 5 % coverage).

2.9.2 Regional Description

Hilly and rolling landscapes support tall tussock grassland usually dominated by *Themedia triandra and Hyparrhenia hirta*. Open *Acacia sieberiana* woodlands encroach up the valleys.

2.9.3 Site Description

During the site assessment, it was noted that the site is comprised of two distict vegetation units, namely the riparian unit and the grassland unit. The riparian unit, as the name suggests, is found along the Braamhoekspruit and is limited to the riparian zone. Each of the vegetation units is described in more detail below.

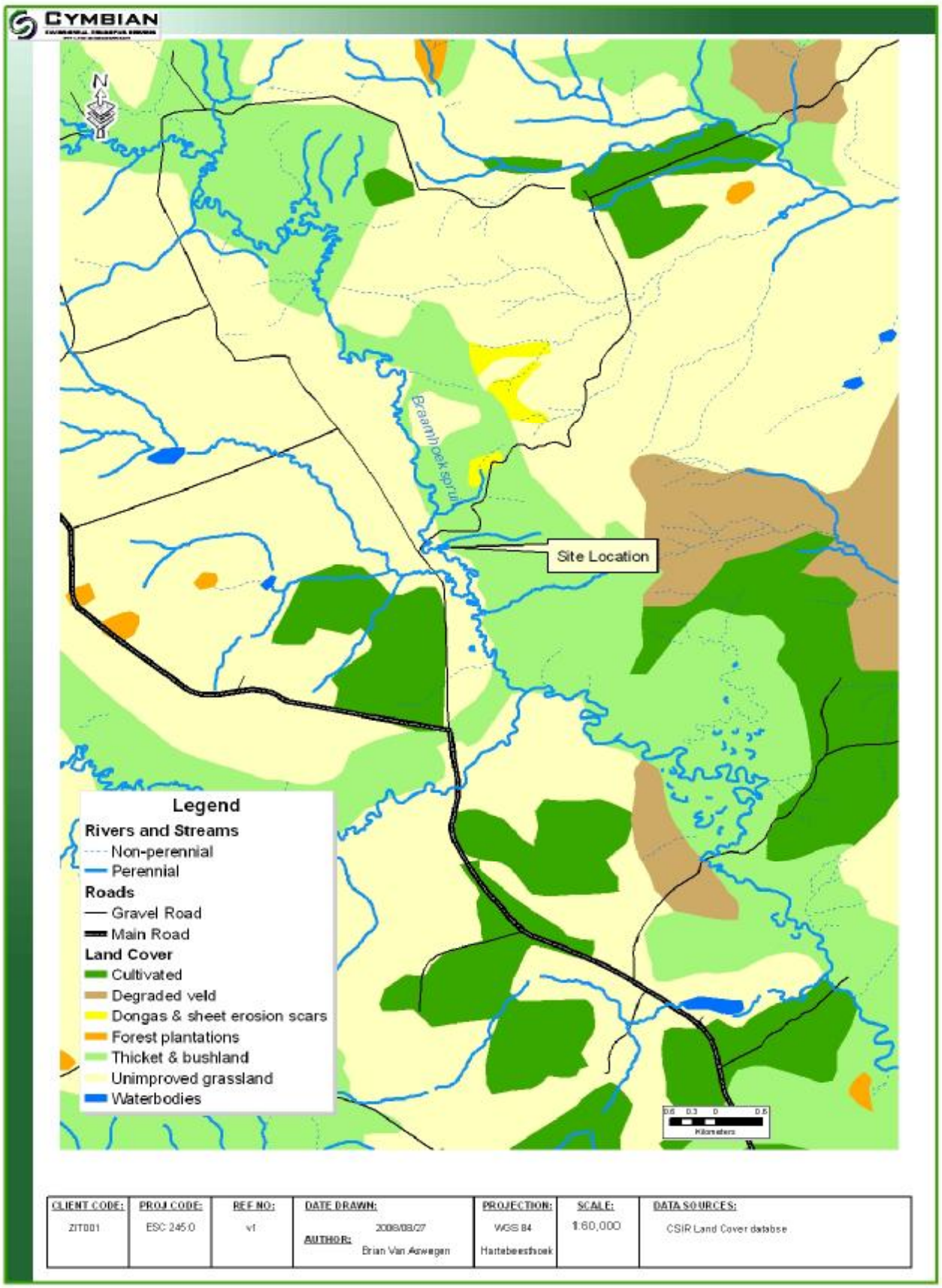


Figure 2-11: Land Use Map

Riparian Vegetation Unit

The riparian vegetation unit follows the Braamhoekspruit and is comprised mainly of water-loving grasses and Leucosidea trees. This unit is sensitive and according to the DWAF should be buffered in order to protect the essential ecological services within the unit. The vegetation unit are illustrated in Figure 2-13 below. This unit is approximately 2.4 ha in size and is buffered by a 50m buffer as prescribed by the DWAF. The buffer zone is also indicated on the figure. A list of the species that were found on site is also given in Table 2-5.

Figure 2-12: Photographs showing the Riparian Vegetation Unit

Grassland Unit

The grassland vegetation unit is extensively used for grazing of cattle and the dominant species is *Hyparrrhenia hirta*. The unit is devided by the gravel road at which the bridge upgrade will be located and the area to the north-west of the proposed bridge upgrade is heavily grazed. This is also the proposed site for the temporary by-pass road and it is suggested that all impacts be located within this area if possible. The grassland unit is a very common unit in KwaZulu Natal and rehabilitation should be easily affected. This unit comprises approximately 96 ha of the site of which 3 ha is heavily grazed. The unit is indicated on Figure 2-13 and the species list is tabled in Table 2-5. In addition photographs of the site are illustrated in Figure 2-14.

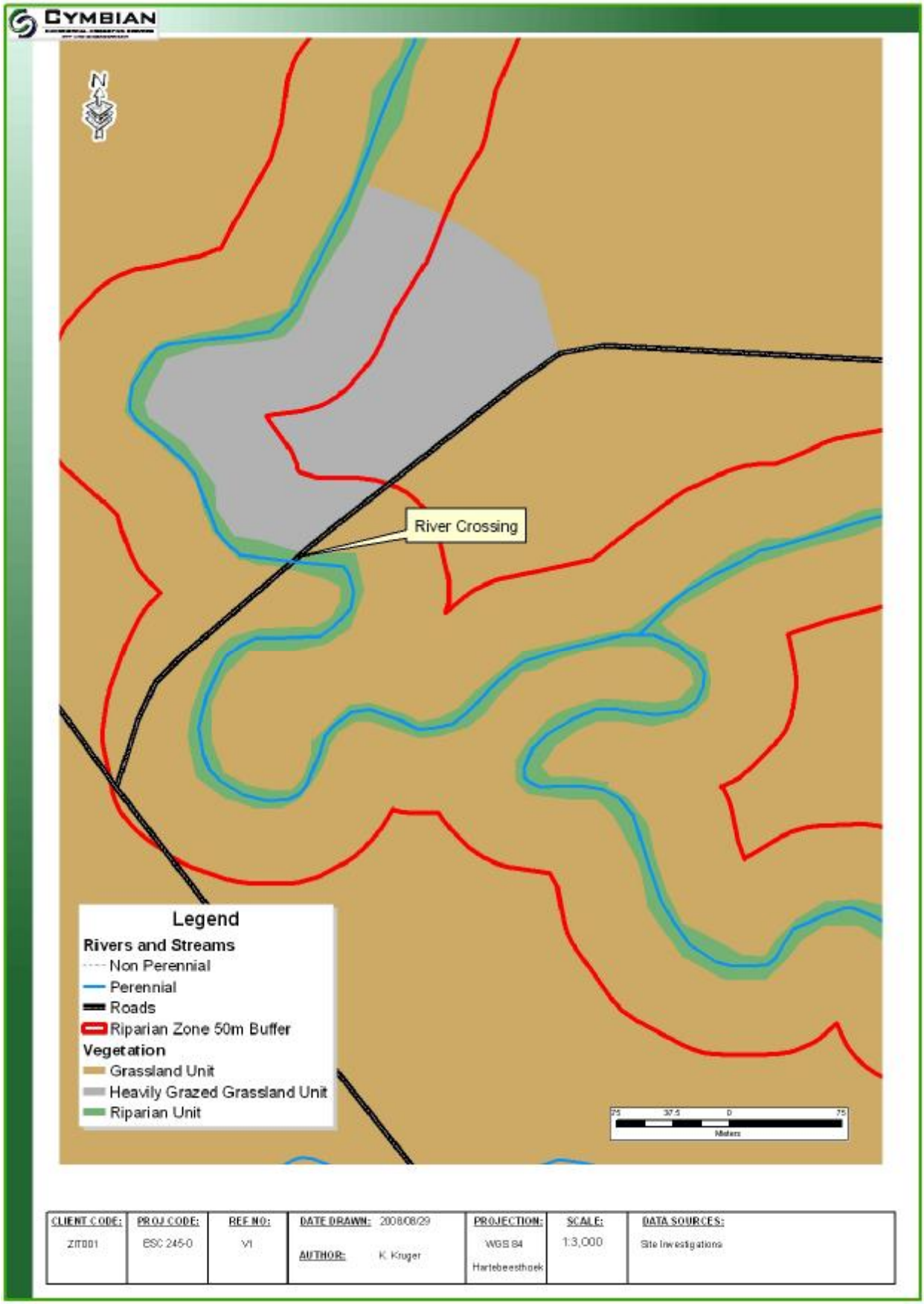


Figure 2-13: Vegetation units found on site

Figure 2-14: Photographs of the Grassland vegetation unit

Table 2-5: Plant species list

Vegetation Site Assessment			
Site Name	Ingula bridge - Braamhoekspruit Stream Crossing		
Date	2008/08/18 and 2008/08/19		
Site Condition	Disturbed with moderate to heavy grazing		
Project Number	ESC 245-0		
Plant Species List			
Scientific Name	Common Name	Status	Coverage
Grass Species			
Hypparrhenia hirta	Common Thatching Grass	Indigenous	Very common
Cynodon dactylon	Common Couch Grass	Indigenous	Common along riverbanks
Cymbopogon plurinodis	Narrow leaved Turpentine grass	Indigenous	Individuals
Eragrostis chloromelas	Narrow curly leaf	Indigenous	Common
Hemartria altissima	Swamp Couch	Indigenous	Common
Phragmites australis	Common Reed	Indigenous	Individuals
Arundinella nepalensis	River Grass	Indigenous	Individuals
Monocymbium ceresiiforme	Boat Grass	Indigenous	Common
Festuca scabra	Munnik Fescue	Indigenous	Individuals
Tree Species			
Leucosidea sericea	Oldwood	Medicinal	Common along riverbanks
Acacia karroo	Sweet Thorn	Indigenous	Individuals
Herb Species			
Leonotis microphylla	Rock Dagga	Indigenous	Individuals
Tagetes minuta	Khaki bos	Weed	Individuals
Ursinia nana		Weed	Individuals
Hermannia depressa	Rooi-opslag	Indigenous	Individuals

3.0 WETLAND DELINEATION AND RIPARIAN ZONE

3.1 Riparian Zones vs. Wetlands

3.1.1 Wetlands

The riparian zone and wetlands were delineated according to the Department of Water Affairs and Forestry (DWAF) guideline, 2003: A practical guideline procedure for the identification and delineation of wetlands and riparian zones. According to the DWAF guidelines *a wetland* is defined by the National Water Act as:

> "*land which is transitional between terrestrial and aquatic systems where the water table is usually at or near surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil."*

In addition the guidelines indicate that wetlands must have one or more of the following attributes:

- **Ü** Wetland (hydromorphic) soils that display characteristics resulting from prolonged saturation;
- **Ü** The presence, at least occasionally, of water loving plants (hydrophytes); and
- **Ü** A high water table that results in saturation at or near surface, leading to anaerobic conditions developing in the top 50 centimetres of the soil.

During the site investigation the following indicators of potential wetlands were identified:

- **Ü** Terrain unit indicator;
- **Ü** Soil form Indicator;
- **Ü** Soil wetness indicator; and
- **Ü** Vegetation indicator.

3.1.2 Riparian Areas

According to the DWAF guidelines a riparian area is defined by the National Water Act as:

> "*Riparian habitat includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas"*

3.1.3 The difference between Riparian Areas and Wetlands

According to the DWAF guidelines the difference between a wetland and a riparian area is:

> "*Many riparian areas display wetland indicators and should be classified as wetlands. However, other riparian areas are not saturated long enough or often enough to develop wetland characteristics, but also perform a number of important functions, which need to be safeguarded… Riparian areas commonly reflect the high-energy conditions associated with the water flowing in a water channel, whereas wetlands display more diffuse flow and are lower energy environments."*

3.2 Delineation

The site was investigated for the occurrence of wetlands and riparian areas, using the methodology described above and described in more detail in the DWAF guidelines.

3.2.1 Terrain Unit Indicator

The terrain on site varies from 1 200 metres above mean sea level (mamsl) to 1 240 mamsl as illustrated in Figure 2-4. Slopes dominate the property and influence the drainage of the site. The general drainage of the site is south-westerly along the Braamhoekspruit.

From Figure 2-4 it can be seen that the site is located in an area of rolling hills with the dominant terrain units on site being the midslope, footslope and valley bottom units. According to the DWAF guidelines the valley bottom is the terrain unit where wetlands are most likely to occur, but they are not excluded from any of the other terrain units.

3.2.2 Soil Form Indicator

The site is located on a slope that drains towards the Braamhoekspruit. The slopes originate from weathered sandstone. Water enters the soils profile and then flows through the profile down-slope. This action of water movement through the slope typifies the soils of the largest part of the site (eluvial soils). Closer to the stream (within the valley bottom terrain unit) the soils gradually deepen due to the down-slope transport of soil (colluvium). In addition these soils have gradually higher percentages of clays that over time have been washed down-slope and accumulate at the valley bottom where the slope angle reduces. The detailed soil mapping exercise was limited to the footslope and valley bottom area in order to delineate the wetland / riparian zones.

During a two day site visit the soils on site were identified (Refer to section 2.5). Of the soils identified on site the only soil which is indicative of a potential wetland is the Dundee soil form. According to the Department of Water Affairs and Forestry (DWAF) guideline, 2003: A practical guideline procedure for the identification and delineation of wetlands and riparian zones, the Dundee soil form is potentially characteristic of seasonal and temporary wetland zones.

3.2.3 Soil Wetness Indicator

The soils on site were subjected to a soil wetness assessment. If soils showed signs of wetness within 50cm of the soil surface, it was classified as a hydromorphic soil and divided into the following groups:

- **Ü** Temporary Zone
  - Minimal grey matrix (<10%);
  - Few high chroma mottles; and
  - Short periods of saturation.

- **Ü** Seasonal Zone
  - Grey matrix (>10%);
  - Many low chroma mottles present; and
  - Significant periods of wetness (>3 months / annum).

- **Ü** Permanent Zone
  - Prominent grey matrix;
  - Few to no high chroma mottles;
  - Wetness all year round; and
  - Sulphuric odour.

None of the soils on site had signs of wetness within the first 50cm of the soil surface.

3.2.4 Vegetation Indicator

The vegetation is described in Section 2.7 above and the Riparian vegetation unit is indicative of a riparian zone. Although the river channel contains species that only occur in wet areas, they do not occur outside of the riparian zone.

3.2.5 Wetlands and Buffer Zones

According to the methodology that was followed for delineation of wetlandsi by DWAF, there are no wetlands present on the site.

However, due the Braamhoekspruit being a riparian zone it is necessary, as per legislation, to buffer the riparian zone. Inside an urban edge the required width of the buffer is 32 m while outside the urban edge a buffer of 50 m needs to surround the riparian zone. A 50 m buffer is proposed from the edge of the riparian zone in order to protect the ecological processes found within this system. During construction of the proposed bridge, management measures will be more stringent within the buffer of the riparian zone. Figure 2-13 shows the 50 m buffer around the riparian zone of the Braamhoekspruit.

3.3 Conclusion

In conclusion the following process was followed to identify the wetlands on site:

- **Ü** The terrain of the site was investigated to identify areas most suitable for wetland presence;
- **Ü** The soils on site were mapped and classified according to the Taxonomic System for South Africa, in order to identify soil forms typical of wetlands;
- **Ü** The soils were investigated for soil wetness criteria;
- **Ü** The vegetation on site was surveyed in order to identify any wetland species (hydrophytes).

According to the methodology followed (DWAF guidelines for wetland delineation) there are **no wetlands present on site** due to the following:

- **Ü** The terrain units found on site include floodplains and river banks;
- **Ü** The soils found on site include Mispah, Clovelly, Hutton and Dundee, of which only Dundee is highlighted by DWAF as wetland soils;
- **Ü** None of the soils on site exhibited signs of wetness within the first 50cm of the soil; and
- **Ü** No hydrophytes were identified on site.

The river channel is however, classified as a riparian zone.

4.0 ENVIRONMENTAL MANAGEMENT

This section describes the commitments in terms of monitoring and measurement of environmental impacts and reporting requirements for monitoring commitments. This section addresses monitoring commitments which need to be implemented throughout the construction of the bridge which in turn will ensure that impacts to the Riparian area are avoided and otherwise mitigated during construction. Section 4.1 - 4.3 provides the management measures which should be implemented to conserve sensitive areas.

4.1 Geology and Soils

Management Component	Environmental Control Officer:	Construction Manager	Date:
Geology and Soils			
Primary Objective			
To ensure that the soils are stockpiled in the correct manner to prevent erosion and contamination of surface water runoff**.**			
Core Criteria:			Monitoring Criteria
The site and surrounding area should be shaped to permit the ready drainage of surface water and to prevent ponding.			Intermittent observations
Foundation construction methodology as described in the engineering specifications must be followed.			Geotechnical Investigations Report
The developer and design team must ensure that the design, positioning and layout of the proposed development and construction methodologies are suitable in light of the determined nature / characteristics of the geological substrate.			
All such layouts must be captured on an approved Site Development Plan. The Site Manager must approve any deviations from the Site Development Plan in consultation with the ECO. The Project Manager should be supplied with information indicating the requirement for the deviation. Significant deviations must be reported to DWAF with motivational information.			Site Development Plan and Intermitted observations
The contractor must determine the correct position of the topsoil stockpile/s such that the greater site is disturbed as little as possible, and such that the topsoil may be reused in therehabilitation of the final site.			
The position of construction related materials must be approved by the Project Manager and must ensure minimal impact to the area outside of the construction footprint.			

4.2 Vegetation

Management Component	Environmental Control Officer:	Construction Manager	Date:
Vegetation			
Primary Objective			
To ensure the control of alien invasive species and that the rehabilitation of indigenous vegetation to as close to the original state as possible.			
Core Criteria:			Monitoring Criteria
Note that the rehabilitation of vegetation refers to the actual footprint of the site, and the area of the site that has been disturbed by construction activities. Note that the footprint is taken to include the parking areas, all formal stormwater channels, as well as the access roads, including the verges thereof.			Design Evaluation and intermittent observations
Establishment will consist of maintaining the surface to the required slopes and levels without erosion or sedimentation, watering, weeding, fertilising, disease and insect pest control, or pruning.			
No construction equipment, vehicles or unauthorised personnel will be allowed onto areas that have been rehabilitated.			Complaints register and intermittent observations and ECO to Monitor
Only persons / equipment required for maintenance thereof will be allowed to operate on such areas.			ECO to monitor
All reseeding activities will be undertaken at the end of the dry season (middle to end September) to ensure optimal conditions for germination and rapid vegetation establishment.			Site Development Plan
The rehabilitated and seeded areas must be harrowed after spreading the topsoil and fertilizer uniformly.			
Inspect rehabilitated area at three monthly intervals during the first and second growing season to determine the efficacy of rehabilitation measures.			ECO to monitor
Take appropriate remedial action where vegetation establishment has not been successful or erosion is evident.			Intermittent observation
Control of alien invasive species in line with the requirements of Conservation of Agricultural Resources Act will be undertaken.			
Alien invasive plant material will be preferentially removed in entirety through mechanical means (e.g. chainsaw, bulldozer, hand-pulling of smaller specimens). Chemical control is only required as a last resort.			Site Development Plan and Intermittent observation
All exotic trees must be identified and marked for removal.			
A limited number of workers must be used to remove the vegetation i.e. 2-4.			Site Development Plan

A single ingress and egress point for all workers must be used.	
Planks are to be removed on completion of alien control activities.	
Alien invasive plant material will not be stockpiled on site. All such material removed will be removed from the site and dumped at an approved disposal site.	
If during the establishment period, any noxious or excessive weed growth occurs, such vegetation will be removed.	Site Development Plan and intermittent observation
No construction activity and disturbance will be permitted in the seasonal seepage zone.	Site Development Plan
It is the developer's responsibility to implement a monitoring programme that will be instituted to ensure that re-growth of alien invasive plants species does not occur, or that such re-growth is controlled.	Site Development Plan and intermittent observation

4.3 Rivers and Streams

Management Component	Environmental Control Officer:	Construction Manager	Date:
Rivers and streams			
Primary Objective			
To ensure that the rivers and streams are protected and incur minimal negative impact from the development as possible.			
Core Criteria:			Monitoring Criteria
The Contractor will minimise the extent of any damage to the flood plain that is necessary to complete the works, and will not pollute any river as a result of construction activities.			Stormwater Management Plan and Site Development Plan
The Contractor will not cause any physical damage to any aspects of a watercourse, other than that necessary to complete the works as specified and in accordance with the accepted method statement.			
The introduction of any construction related effluent water into any natural stream must be approved by the ECO.			
Construction activities will not permanently alter the surface or subsurface flow of water through the flood plain area.			Site Development Plan
No construction materials will be stockpiled on the 50 m buffer zone.			
No Hydrocarbons will be stored in the 50 m buffer zone			
Only vehicles which are essential for construction will be allowed in the 50 m buffer zone.			

In order to avoid erosion at stormwater discharge points a 300mm thick gabion mattress will be constructed.	
Rocks for use in gabion baskets / reno mattresses will not be obtained from a watercourse.	
The Contractor will not cause any physical damage to any aspects of a watercourse.	

5.0 CONCLUSION

In conclusion the Braamhoekspruit Bridge upgrade site was visited for two days in August 2008. the aim of the study was to investigate the soil, vegetation and wetland characteristics of the site earmarked for development as well as to provide management measures to protect sensitive features located on site.

The soil analysis found the following soils:

- Ü Mispah;
- Ü Clovelly;
- Ü Dundee; and
- Ü Huttons

No sensitivities were noted during the site visit.

The vegetation analysis found the following vegetation units:

- Ü Grassland Vegetaion Unit;
- Ü Heavily Grazed Grassland Unit; and
- Ü A Riparian Unit

Of the aforementioned vegetation units, the riparian zone was determined to be sensitive.

The wetland delineation analsysis found no wetlands on site but the riparian zone of the Braamhoekspruit was classified as a sensitive riparian zone and buffered with a 50 m buffer.

Management measures are proposed to limit the impacts to soil and vegetation during the project and more stringen controls have been put in place for the buffer zone.

Appendix 1: Onsite Soil and Vegetation Monitoring Points