

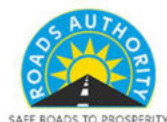




## ENVIRONMENTAL MANAGEMENT PLAN (EMP)



**PROPOSED UPGRADE TO LOW VOLUME SEAL ROAD  
STANDARDS OF DISTRICT ROADS  
DR3507: BUKALO – NGOMA (60 KM) & DR3559: SILUMBI  
- SIZIMBUKWA (15 KM)  
ZAMBEZI REGION**

**JULY 2023**



| DOCUMENT INFORMATION   |   |              |
|--|---|--------------|
| <b>Title</b>   | Environmental Management Plan (EMP) for upgrading of DR3507 Bukalo – Ngoma & DR3559 Silumbi – Szimbukwa to Low Volume Seal Standards  |              |
| <b>ECC Application Reference number</b>  |   |              |
| <b>Listed Activity</b>   | <p>Activity 10: Infrastructure:<br/>10.1 The Construction of (b) Public roads</p> <p>Activity 3: Mining and Quarrying Activities:<br/>3.2 The Other forms of mining or extraction of any natural resources whether regulated by law or not</p> <p>Activity 8: Water Resource Development<br/>8.1 The abstraction of ground or surface water for industrial or commercial purposes</p> |              |
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## Executive Summary

This Environmental Management Plan (EMP) is compiled to guide construction activities for the proposed upgrade of the two roads to bitumen standards, DR3507 Bukalo – Ngoma and DR3559 Silumbi – Sizimbukwa.

The road has a total length of approximately 75km and will form a vital link to the national road network, through provision of access to communities living along the two routes. Roads are the veins of economic development and facilitate the movement of goods and services (logistics). The Ministry of Works and Transport is mandated to extend service provision to all Namibians, including road upgrades in rural areas. Meaning, a comprehensive Road network is one of the key building blocks for socio-economic development in the country. However, road construction requires significant quantities of gravel material and Water. Henceforth, mining for gravel material and water abstraction are inevitable (cannot be avoided).

Tortoise Environmental Consultants were appointed to undertake the environmental assessment and compile the requisite Environmental Scoping Report (ESR) and Environmental Management Programme (EMP) for submission to the Department of Environmental Affairs. The assessments are useful in executing project planning and route designs from the start of the project right through to the finish. During the Environmental Assessment process the concerns of the local communities as well as other stakeholders were considered when the feasibility of the road upgrade is to be determined. All relevant natural environmental and cultural considerations were also considered while compiling this EMP.

The Environmental Management Plant (EMP) recommends mitigation measures to ensure that the recommended road construction activities and associated activities are conducted in an environmentally friendly manner. Upon approval of the Environmental Clearance Certificate, the proponent (Roads Authority) should comply with the Environmental Management Act of 2007 and EIA regulations of 2012 and adhere to the recommended mitigation and rehabilitation measures as prescribed in the Environmental Management Plant (EMP). Furthermore, the EMP outlines specific roles and responsibilities for the proponent (Roads Authority and sub-contractors) and non-compliance is punishable.

## ACRONYMS

|       |   |
|-------|---|
| BID   | Background Information Document               |
| DEA   | Department of Environmental Affairs           |
| DSR   | Draft Scoping Report                          |
| EA    | Environmental Assessment                      |
| EAP   | Environmental Assessment Practitioner         |
| ECC   | Environmental Clearance Certificate           |
| ECO   | Environmental Compliance Officer              |
| EIA   | Environmental Impact Assessment               |
| EMA   | Environmental Management Act (No. 7 of 2007)  |
| EMP   | Environmental Management Plan                 |
| I&APs | Interested and Affected Parties               |
| MEFT  | Ministry of Environment, Forestry and Tourism |
| PPE   | Personal Protective Equipment                 |
| RA    | Roads Authority                               |
| SM    | Site Manager                                  |
| TEC   | Tortoise Environmental Consultants            |

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## 1. INTRODUCTION

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### 1.1. Background

The Roads Authority recognizes the importance of maintaining a good road network across rural areas throughout the country. Road construction projects are generally intended to improve the economic and social welfare of people. Travelling times can then be reduced with increased road capacity which also lowers the costs of vehicle use, while further increasing access to markets, jobs, education, and health services.

### 1.2. Upgrade of roads DR3507 Bukalo – Ngoma & DR3559 Silumbi-Sizimbukwa

It is against this background that the authority proposes to upgrade the two gravel roads DR3507 Bukalo – Ngoma (60 km) and DR3559 Silumbi – Sizimbukwa (15 km) to Low Volume Seal Standards (Bitumen or tared road). The total length of the two roads is approximately 75 km long and will form a vital link to the national road network, through provision of access to communities living along the route. Construction of these roads will help alleviate the current problems that the locals are faced with in accessing basic services such as clinics, markets and schools.

Site Location: GPS coordinates:  
Latitude 17°44'28.46"S and Longitude 24°31'23.94"E

The upgrade to Low Volume Seal roads will improve the traffic flow and provide an all-year-round access to clinics, schools and villages along the route. Communal farmers will also be able to transport their livestock to available markets. Considering the socio-economic benefits generated by the labour-based construction method, unemployed locals will be employed temporarily and Small-Medium Enterprise contractors will get an opportunity to be involved, and learn construction techniques necessary for their development in the construction industry.

The proposed road upgrade would require authorization in terms of the Namibian environmental legislation (Environmental Management Act (No. 7 of 2007)) (EMA) and the Environmental Impact Assessment (EIA) Regulations (Government Notice 30 of 6 February 2012). For this, an environmental assessment must be conducted followed by the compilation of a Scoping Report (SR) that is submitted to the Ministry of Environment and Tourism: Department

of Environmental Affairs (MET: DEA) for a decision on issuing an Environmental Clearance Certificate (ECC).

Tortoise Environmental Consultants (TEC) has been appointed to carry out the requisite scoping assessment and develop an Environmental Management Plan (EMP). The scoping process has investigated the potential significant positive and negative biophysical and socio-economic impacts associated with construction activities for the proposed road upgrade. In addition to reporting on the potential impacts, the scoping process also serves to provide an opportunity for Interested and Affected Parties (I&APs) to provide comments and participate in the process.

### **1.3. Environmental versus Economic Development**

A comprehensive Road network is one of the key building blocks for socio-economic development in the country. However, road construction requires significant quantities of Gravel and Water that are often sourced from the surrounding areas.

Namibia's economy is highly dependent on a healthy environment and striking a balance in meeting demands for economic development such as road construction and maintaining biological diversity can be a challenge. Therefore, it is of utmost importance that the environment and development sectors should work together and identify synergies in order to ensure that natural resources are harvested in an acceptable and sustainable manner.

Development takes place on land (in the environment) and hence the quest for economic development requires a trade-off with certain parts of the environment in-order for the development to be realized. Meaning, for development to take place, some part of the environment will be affected. However, it is of utmost importance that such impacts are mitigated through an Environmental Management Plan (EMP).

The aim of environmental assessments is to guide the sustainable utilization of natural resources and to mitigate negative impacts that would otherwise compromise the environmental integrity and future ecosystem benefits.

### **1.4. Environmental management plan (EMP) Context**

This document constitutes the Environmental Management Plan (EMP) for the proposed upgrade of MR74 to bitumen standards by the Roads Authority.



## 1.5. What is an EMP?

The Environmental Management Plan (EMP) is a tool used to mitigate potential environmental risks associated with the proposed project / activity, and provides a risk management strategy and logical framework for implementation of the activities associated with the proposed road upgrade. This is done to minimize potential environmental and social impacts identified during the EIA process, in accordance with the provisions of the Environmental Management Act (Act No.7 of 2007), EIA Regulations of 2012 and any other relevant / applicable legislation.

As a result, the EMP recommends mitigation measures in order to ensure that the recommended road construction activities and associated activities are conducted in an environmental friendly manner, and in accordance with the provisions of the Environmental Management Act and EIA regulations

Furthermore, the EMP outlines specific roles and responsibilities for role-players against which they can be evaluated and non-compliance is punishable.

## 1.6. Purpose of the EMP

The purpose of the EMP is to identify potential environmental and social impacts associated with the road upgrade activities, in-order to ensure compliance to the EMA.

The aim of the EMP is to ensure that the activities undertaken during the renewal of the sand mining activities are conducted in accordance with the following:

- i. Environmental Management Act (No. 7 of 2007),
- ii. EIA regulations of 2012 (GN: 30), and
- iii. Best environmental practices (benchmarks)
- iv. Any other applicable legislation (*as presented in Table 3.1 to 3.3*)

The EMP provides environmental guidelines to be followed throughout the lifespan of the sand mining activities and comprise of the following:

- a) Environmental Aspects,
- b) Management Objective,
- c) Mitigation Measures / Actions Required,
- d) Monitoring Indicators, and
- e) Party Responsible

## 1.7. Objective

The objective of the EMP is to prevent / minimize (where possible), unacceptable and adverse environmental, social or economic impacts that may arise from the proposed development. Overall, the EMP aims to minimise negative impact/s (real, potential or perceived) that may result from the proposed road upgrade activities.

## 1.8. EMP Scope

The EMP does not only focus, and it is not limited to the road construction activities, but it includes the bigger picture, and serve as the guiding tool to protecting the natural, bio-physical and socio-economic environment on both the specific site and the surrounding area. The bigger picture is important because, some impacts may not be confined to the immediate construction sites.

## 1.9. Possible adjustments to the EMP

The EMP is an open-ended document and maybe considered inconclusive. In other words, the EMP should allow room for adjustments if new information becomes available at a later stage, in which new / additional mitigation measures may become necessary.

The necessity of possible adjustments to the EMP at a later stage may be attributed to:

- a) Lack of information at the time of drafting the initial EMP,
- b) Evolution or addition of new activities, or
- c) Unintended omission of potential impacts during the initial EIA scoping exercise and development of the initial EMP.
- d) Development of industry best practice.

This implies that, in-addition to the information contained herein, any other relevant information that may surface during the construction operations, through internal monitoring or auditing by the Environmental Compliance Officers (ECOs), can be added to the EMP (evolution of activities), and such changes or inclusions will be binding to the proponent and all contractors / sub-contractors.

## 1.10. Implementation Framework and Accountability to the EMP

For effective implementation of the EMP, the Institutional roles are presented below. However, the specific roles and responsibilities are defined and broken down as presented in Sections 4 and 5, respectively.

*Table 1:1: Role players, Institutional Framework*

| <b>Role-player</b>                       | <b>Company / Institution</b>  | <b>Role</b>  |
|--|---|--|
| Proponent                                | Roads Authority   | Compliance to the EMP  |
| Environmental Consultant                 | Tortoise Environmental Consultants (TEC)  | Development of the EMP   |
| Environmental Compliance Officer/s (ECO) | Ministry of Environment & Tourism (MET) – Department of Environmental Affairs (DEA) | Monitoring Compliance to EMP:<br><ul style="list-style-type: none"> <li>➤ Un-announced spot checks,</li> <li>➤ Corrective measures, warning, penalties / fines, license suspension, etc</li> </ul> |
| Public                                   | Interested and affected parties (I&APs)   | Report to the ECOs, any activity of environmental concern (e.g Pollution, safety risks, etc)   |

## 2. PROJECT INFORMATION

### 2.1 Project Location and Route Description

The Zambezi Region, known as the “*The Arm of Namibia*” is situated on the north-eastern part of Namibia. It connects Namibia to four neighboring countries, Angola, Botswana, Zambia and Zimbabwe. The region is also known for its ever-green vegetation and abundant wildlife as a result of good rainfall. The region receives the country’s highest annual rainfall and is virtually surrounded by perennial rivers, making it the logical target for agricultural development in an otherwise arid country. The region is the third smallest in Namibia, covering a total land area of 14 785 km<sup>2</sup> and is susceptible to pressure from potentially conflicting land use demands.

District Road (DR) 3507 starts at the junction with TR8/7 which is situated 40 km east of Katima Mulilo at Bukalo and follows a southern direction for about 25 km to Muyako near Lake Liambezi. The road then continues in the northern direction for about 35 km towards Ngoma.

DR3559 starts at the junction with DR3507 at Silumbi and it connects to TR8/7 about 15 km at Sizimbukwa Village. DR3507 is one of the first gravel roads to be constructed in Zambezi Region, and the area is also a source of gravel material for all road construction in the region. DR3559 connects Salambala Conservancy Camp Site, which is a tourist destination area for wildlife viewing. Both roads are proclaimed and important for regional economic development. This existing gravel roads pass through shallow areas that get inundated with water and these slippery conditions pose a risk to road users (Please refer to *Figure 1* below).



*Figure 1: The current condition of the gravel roads DR3507 & DR3559 with some sections being too flat and susceptible to flooding during rainy season.*

## 2.2 The Physical Environment

In contrast to the rest of Namibia, Zambezi Region has a hot tropically humid climate with higher rainfall, lower evaporation and warmer winters. During the summer months the average temperature during the day reaches 35°C, falling to about 20°C at night. In winter the daytime temperature rises to around 28°C, but the highest nights can be comparatively cold, at 7°C or less. Summer days in Zambezi region are often cloudy, becoming more during the morning and afternoon. This results in temperatures being fairly low, particularly during the middle to late summer months.

Even though the Zambezi Region receives more precipitation, rainfall is highly variable from year to year, and from one place to another. It also experiences periodic droughts. Average annual rainfall in the landscape is around 500 – 650 mm. Almost all rain falls in the summer months, November to April, peaking in January and February.

## 2.3 Bio-physical Environment

Zambezi region can be described as particularly flat without a single feature recognisable as a hill. The highest areas are found in the extreme west with elevations of about 1100m above sea level, which gradually drop to 930m near Impalila Island in the east. Slight changes can be observed in the elevations in river valleys and between the vegetated dunes and dune valleys; however, they are often not more than 30m. The region is covered in thick deposits of Kalahari sands, exposing very little of the underlying geology, except along some sections of the river courses and on Impalila Island. The landscape is shaped by two features, which are extensive Kalahari sands and the rivers with their associated floodplains, channels and deposits.

The major distinction between the Zambezi Region and the rest of Namibia is the abundance of water. The region being of relatively flat topography further means that the area is susceptible to flooding. Hence the need to upgrade the road network to bitumen standards to mitigate for high accidents resulting from slippery gravel roads.

## 2.4 Flora and Fauna

Due to the higher rainfall, less evaporation and warmer winters than the rest of Namibia, the region is home to many tropical plants that would not be able to survive in other parts of the country.

Zambezi region has a substantial number of community conservancies, community forests and national parks. The fact that the region is in the centre of the Kavango Zambezi Transfrontier, it provides opportunities for the region to be further involved in conservation efforts. Tourism plays an important role within the economy of the region, hence provision of a good road network would provide significant value to tourism services.



Figure 2: Road signs notifying road users the importance of wildlife in the region as they often the main roads



Figure 3: The vegetation in the region and road reserve

The project area is densely covered by a mixture of vegetation including grass, shrubs and large trees. Some trees that are encroaching into the road reserve will need to be cleared. Tall trees found in the area consists largely of *Parinari*, *Kigelia Africana*, *Diospyros mespiliformis*, *Trichilia emetica*, *Acacia sieberana*, *Lonchocarpus capassa* and *Azelia quanzensis*.

The sandy areas are largely covered by high *Terminalia sericea* woodlands, the river channels on the other hand would have margins of reeds and stands of *Syzygium guineense*, *Rhus quartiniana*, *Trichilia emetic*, *Garcinia livingstonei*, and *Kigelia africana* on the drier margins.

## 2.5 Socio-economic Profile of the Project Area

According to the national census of 2011, Zambezi Region had a population of 90 596 people of which 46 497 were women and 44 099 men. Most of the population of the region about 69% lives in rural areas. Unemployment rate is widely regarded as one of the key labour market indicators and a good measure of current economic activity in a specific region. The latest labour force survey (NSA, 2018), the unemployment rate for both sexes in Zambezi Region is recorded at 26.6%. Statistics further shows that the overall unemployment rate is higher for females (32.6%) than males (22%).

Approximately 66% of the population aged 15 years and up belong to the labour force (i.e., economically active) in the Katima Mulilo. 49% of the population is employed while 51% are unemployed. The inactive group, which consists of homemakers 24%, students 65% and the severely disabled, retired or old age income recipients 11%, makes up the rest of the constituency's population.

The main source of income is from wages and salaries at 57%. Business and non-farming activities at 28% and farming at 2%. Cash remittance makes up 8% of the income, while the older age group contributes 3% of the income (NPC, 2011). The following data is presented from a regional perspective. The main languages spoken at home in the Zambezi Region are Zambezi languages at 90%. There are 21,283 private households with an average size of 4.2 members. Approximately 31% of the total population is located in urban parts and 69% in rural parts of the region (NPC, 2011).



Figure 4: Some of the social amenities in the project site (left, local shops and right one of the schools)



Figure 5: The school boundary on the road reserve, as such the road upgrade may need to be diverted to prevent obstruction to the school

## 2.6 Technical Approach to Road Construction

Construction of gravel roads requires various types of sand and gravel aggregates. A geotechnical investigation for preliminary construction materials prospection such as gravel and water is being conducted and it will inform the number of gravel pits that will need to be established.

An investigative study entailing surveying and analysis of material quality was undertaken to assess the factors such as terrain, soil stability, drainage and water supply. A detailed design plan was thereafter developed, which outlines road alignment, cross sections, amongst others.

The materials investigation was conducted in accordance with the Roads Authority's Manual. The investigations for construction material sources (subgrade, general, selected, wearing course, building sand and concentrate aggregates) were carried out in the phases described below;

### 2.6.1 Road works

The following road works shall be undertaken as part of upgrading the two gravel roads to bitumen standards.

- Bush clearing and grubbing:
- Opening burrow pit areas to source gravel material and rehabilitating them afterwards
- Construction of the road formation, including roadbed preparation, cut and fill,
- Construction of a 150mm gravel wearing course compacted to 95% of Modified AASHTO density, as Subbase layer
- Construction of a 150 mm G4, Natural gravel wearing course compacted to 95% of modified AASHTO density, as Base layer.
- LVS Surfacing layer to be 19 mm Cape seal with double slurry seal.
- Supply and installation of road signs



- Supply and erection of fences (where the road will infringe on properties); and
- Finishing the road and road reserve.

Construction work will be carried out using a labour-based construction technique. Activities will be undertaken in such a manner that will enable traffic to still be accommodated on existing tracks or in the road reserve. Temporary road signs and traffic control measures will, however, be employed to ensure safety for all road users.

### **2.6.2 Drainage Works**

The drainage works on this gravel road shall comprise the following;

- Construction of earth berms and open drains where indicated on site by the Engineer; to accommodate runoff during rainfall events
- Provision of erosion protection
- There are numerous box culverts already available. These culverts would need upgrading, an increase of their capacity, provision of additional structures in line with the applicable return period, major or minor repairs, lengthening or replacement works, whichever is applicable to the specific drainage structures.
- Construction of required additional box culverts (minimum 900mm X 600mm) with cast in situ concrete floor slabs, concrete walls and precast concrete beams or cast in situ concrete deck slabs
- Construction of concrete inlet and outlet structures with cast in situ concrete floors at all culverts.

## **2.7 Accommodation of Traffic**

Construction work is to be carried out in a manner that enables accommodation of traffic on the existing roads/ tracks or in the road reserve. Temporal road signs and traffic control measures will be erected to warn road users of the ensuing construction activities; and ensure safe passage of public traffic in accordance with the requirements of the specifications.

## **2.8 Field Investigations**

During the site visits, areas along the two gravel roads were investigated for signs that show the presence of road construction materials. These signs include the type of vegetation, topography, land-use and geographical characteristics. Community members were also consulted for guidance on areas that are

traditionally used for earth dams and wells as they predominantly contain gravel material.

The road surface of the existing gravel roads consist of well compacted to loosely compacted calcrete material throughout the road sections of DR3507, whereas most of the calcrete on sections of DR3559 have eroded away.

## 2.9 Supporting Infrastructure

Road construction involves a range of activities that require a host of supporting infrastructure to ensure that the project is completed efficiently and effectively. Effective planning, design, and management are essential to ensure the construction of safe, reliable, and long-lasting roads. The items described below are some examples of supporting infrastructure that is required for upgrading the road section.

### i) Centreline Material Investigation and Soil Profiling for DR3507

Centerline tests and observations were carried out on the road sections at intervals of 5km apart. The intervals were selected due to wet, water-logged as well as visible changes in the surface appearance of the road sections. Investigations were conducted during the rainy season.

Observations from chainage 0+000 until 35+000 shows that the wearing course layers seem to be intact varying from a depth of 100mm up to 300mm. The material changed from wearing course (w/c) type of material, well compacted material at a depth of 0-140mm to a dark brown fill material from a depth of 140 – 290mm, then to a light brown calcrete materials as shown in the table and picture below.

| Soil Profile @ 0+250 | Thickness (mm)          | Description          |
|----------------------|-------------------------|----------------------|
|                      | <b>140</b>              | White Calcrete       |
|                      | <b>150</b>              | Dark Calcrete Fill   |
|                      | <b>80</b>               | Light Brown Calcrete |
|                      | <b>50</b>               | Brown Clay           |
|                      | <b>In-situ material</b> |                      |



| Soil Profile @ 25+000 | Thickness (mm)   | Description     |
|-----------------------|------------------|-----------------|
|                       | 300              | White Calcrete  |
|                       | 200              | White Calcrete  |
|                       | 200              | Dark Brown Fill |
|                       | In-situ material |                 |



Observations from chainage 40+000 until 56+500 the wearing course layers are very thin varying from a depth of 40mm up to 100mm. The material changed from wearing course (w/c) type of material, well compacted material at a depth of 0-140mm to a dark brown fill material. It was further observed that the soil strata along DR3507 road are divided into two sections: Km 0+000 – 35+000, km 35+000– 56+500.

Table 2: Road centreline results for DR3507

| Chainage (Km) | Depth (mm) | Quality | Plastic Index | Layer                                     |
|---------------|------------|---------|---------------|---|
| 0+250         | 0 – 140    | G4      | SP            | Dense, compacted wearing coarse material  |
| 0+250         | 140 – 290  | > G9    | 17            | Dense, compacted dark brown material      |
| 0+250         | 290 – 370  | G4      | 18.1          | Dense, compacted calcrete material        |
| 5+000         | 0 – 150    | G7      | SP            | Dense, compacted wearing coarse material  |
| 10+000        | 0 – 170    | G7      | 3.0           | Dense, compacted wearing coarse material  |
| 10+000        | 170 – 370  | > G9    | SP            | Dense, compacted dark brown fill material |
| 15+000        | 0 – 140    | G8      | SP            | Dense, compacted wearing coarse material  |
| 20+000        | 0 – 110    | G4      | SP            | Dense, compacted wearing coarse material  |
| 20+000        | 110 – 310  | G5      | SP            | Dense, compacted dark brown fill material |
| 25+000        | 0 – 300    | G6      | 9.5           | Dense, compacted wearing coarse material  |
| 30+000        | 0 – 150    | G4      | 6.1           | Dense, compacted wearing coarse material  |
| 30+000        | 150 – 350  | > G9    | 5.4           | Dense, compacted dark brown fill material |
| 35+000        | 0 – 100    | G5      | 7.1           | Dense, compacted wearing coarse material  |
| 40+000        | 0 – 90     | G4      | 6.3           | Loose, Compacted wearing coarse material  |
| 40+000        | 90 – 290   | > G9    | 6.5           | Dense, compacted dark brown fill material |
| 45+000        | 0 – 40     | G6      | SP            | Loose, Compacted wearing coarse material  |
| 50+000        | 0 – 60     | G4      | 8.3           | Loose, Compacted wearing coarse material  |
| 50+000        | 60 – 160   | G4      | 5.3           | Dense, compacted calcrete material        |
| 55+000        | 0 – 40     | G6      | 9.3           | Loose, Compacted calcrete material        |
| 56+500        | 0 – 100    | G6      | 7.7           | Dense, compacted wearing coarse material  |
| 56+500        | 100 – 350  | G4      | 5.5           | Dense, compacted dark brown fill material |
| 56+500        | 350 – 550  | G8      | NP            | Loose Sand Material                       |

## ii) Centerline Material Investigation and Soil Profiling for DR3559

Observations on D3559 from chainage 0+000 until 16+500 indicated that majority of the road did not have visible calcrete material, with some sections having very little wearing course, varying from a depth of 20mm

up to 30mm. The material changed from this loose wearing course (w/c) type of material to well compacted dark brown material at a depth of 20-200mm, to a dark brown fill material from a depth of 220 – 420mm as shown in the table below.

| Soil Profile @ 5+000 | Thickness (mm)          | Description           |
|----------------------|-------------------------|-----------------------|
|                      | 30                      | Light Yellow Calcrete |
|                      | 200                     | Dark Brown Fill       |
|                      | 200                     | Dark Brown Fill       |
|                      | <b>In-situ material</b> |                       |



Table 3: Road centreline results for DR3559

| Chainage (Km) | Depth (mm) | Quality | Plastic Index | Layer                              |
|---------------|------------|---------|---------------|------------------------------------|
| 5+000         | 0 - 200    | G6      | 8.2           | Loose, Compacted Fill Material     |
| 10+000        | 0 - 20     | <G9     | 5.6           | Loose, Compacted Calcrete Material |
| 10+000        | 20 - 220   | G9      | 4.6           | Loose, Compacted Fill Material     |
| 13+500        | 0 -30      | G7      | 5.6           | Loose, Compacted Calcrete Material |

### iii) Dynamic Cone Penetrometer (DCP)

The Dynamic Cone Penetrometer (DCP) is a device that provides a close approximation of the strength of the soil. The DCP is used for assessing the strength of the subgrade for new roads, existing pavement structures on unpaved calcrete and earth roads as well as borrow pit materials. Many readings can be taken at relatively low cost, thus enabling the design engineer to subdivide the road into uniform sections to derive appropriate, environmentally optimized pavement design solutions. The DCP can also be used on site during construction to verify that the design requirements have been achieved.

75 DCP tests were conducted for the two roads to determine the bearing capacity of the road subsurfaces. The results are presented in the table below.



D3507

| Hole No. | Chainage | Offset | Depth/Penetration (mm) | mm/blow | In-Situ (CBR) |
|----------|----------|--------|------------------------|---------|---------------|
| 1        | 1+000    | LHS    | 331.00                 | 7.36    | 43.34         |
| 2        | 2+000    | RHS    | 300.00                 | 3.53    | 91.87         |
| 3        | 3+000    | CL     | 307.00                 | 7.68    | 48.54         |
| 4        | 4+000    | LHS    | 304.00                 | 3.87    | 92.40         |
| 5        | 5+000    | RHS    | 303.00                 | 5.20    | 53.95         |
| 6        | 6+000    | CL     | 209.00                 | 6.97    | 45.29         |
| 7        | 7+000    | LHS    | 146.00                 | 3.24    | 115.42        |
| 8        | 8+300    | RHS    | 339.00                 | 8.48    | 31.26         |
| 9        | 9+000    | CL     | 175.00                 | 5.00    | 75.05         |
| 10       | 10+000   | LHS    | 145.00                 | 5.80    | 52.38         |
| 11       | 11+000   | RHS    | 166.00                 | 6.64    | 46.86         |
| 12       | 12+000   | CL     | 124.00                 | 3.54    | 100.95        |
| 13       | 13+000   | LHS    | 127.00                 | 2.12    | 214.31        |
| 14       | 14+000   | RHS    | 121.00                 | 3.46    | 164.42        |
| 15       | 15+000   | CL     | 253.00                 | 3.89    | 102.75        |
| 16       | 16+000   | LHS    | 185.00                 | 3.36    | 85.68         |
| 17       | 17+000   | RHS    | 246.00                 | 5.47    | 50.81         |
| 18       | 18+000   | CL     | 155.00                 | 6.20    | 59.78         |
| 19       | 19+000   | LHS    | 169.00                 | 4.83    | 77.13         |
| 20       | 20+000   | RHS    | 144.00                 | 5.76    | 47.67         |
| 21       | 21+200   | LHS    | 106.00                 | 2.65    | 159.67        |
| 22       | 22+100   | RHS    | 142.00                 | 14.20   | 14.50         |
| 23       | 23+200   | CL     | 197.00                 | 3.58    | 101.06        |
| 24       | 24+000   | LHS    | 199.00                 | 5.69    | 53.61         |
| 25       | 25+000   | RHS    | 128.00                 | 5.12    | 55.87         |
| 26       | 26+150   | CL     | 104.00                 | 4.16    | 83.73         |
| 27       | 27+000   | LHS    | 167.00                 | 4.77    | 61.49         |
| 28       | 28+100   | RHS    | 108.00                 | 5.40    | 54.34         |
| 29       | 29+050   | CL     | 125.00                 | 8.33    | 33.02         |
| 30       | 30+000   | LHS    | 183.00                 | 6.45    | 36.47         |
| 31       | 31+000   | RHS    | 110.00                 | 4.40    | 81.69         |
| 32       | 32+000   | CL     | 149.00                 | 5.96    | 45.48         |
| 33       | 33+000   | LHS    | 104.00                 | 5.20    | 55.21         |
| 34       | 34+000   | RHS    | 101.00                 | 4.04    | 79.87         |
| 35       | 35+000   | CL     | 186.00                 | 4.65    | 65.57         |
| 36       | 36+000   | LHS    | 124.00                 | 4.96    | 57.95         |
| 37       | 37+150   | RHS    | 111.00                 | 5.55    | 53.05         |
| 38       | 38+000   | CL     | 130.00                 | 8.67    | 29.23         |
| 39       | 39+000   | LHS    | 117.00                 | 4.68    | 63.22         |
| 40       | 40+000   | RHS    | 114.00                 | 7.60    | 33.45         |
| 41       | 41+000   | LHS    | 126.00                 | 4.20    | 73.54         |
| 42       | 42+000   | RHS    | 322.00                 | 32.20   | 5.66          |
| 43       | 43+000   | CL     | 154.00                 | 5.13    | 54.70         |
| 44       | 44+000   | LHS    | 123.00                 | 4.92    | 57.75         |
| 45       | 45+000   | RHS    | 126.00                 | 6.30    | 42.45         |
| 46       | 46+000   | CL     | 145.00                 | 7.25    | 34.20         |
| 47       | 47+000   | LHS    | 114.00                 | 5.70    | 50.45         |
| 48       | 48+000   | RHS    | 234.00                 | 4.68    | 66.14         |
| 49       | 49+000   | CL     | 117.00                 | 5.85    | 48.35         |
| 50       | 50+000   | LHS    | 176.00                 | 11.73   | 18.70         |

| Hole No. | Chainage | Offset | Depth/Penetration (mm) | mm/blow | In-Situ (CBR) |
|----------|----------|--------|------------------------|---------|---------------|
| 51       | 51+000   | RHS    | 103.00                 | 10.30   | 22.93         |
| 52       | 52+000   | CL     | 118.00                 | 7.87    | 30.97         |
| 53       | 53+000   | LHS    | 196.00                 | 13.07   | 16.61         |
| 54       | 54+000   | RHS    | 73.00                  | 3.65    | 108.52        |
| 55       | 55+000   | CL     | 161.00                 | 8.05    | 31.81         |
| 56       | 56+000   | LHS    | 229.00                 | 4.58    | 74.98         |
| 57       | 56+700   | RHS    | 126.00                 | 2.80    | 137.10        |

D3559

| Hole No. | Chainage | Offset | Depth/Penetration (mm) | mm/blow | In-Situ (CBR) |
|----------|----------|--------|------------------------|---------|---------------|
| 58       | 1+000    | CL     | 303.00                 | 20.20   | 11.52         |
| 59       | 2+000    | CL     | 284.00                 | 14.20   | 18.94         |
| 60       | 3+000    | CL     | 371.00                 | 18.55   | 16.56         |
| 61       | 4+000    | CL     | 311.00                 | 8.89    | 12.61         |
| 62       | 5+000    | CL     | 370.00                 | 18.50   | 10.48         |
| 63       | 6+000    | CL     | 371.00                 | 24.73   | 7.71          |
| 64       | 7+000    | CL     | 336.00                 | 9.60    | 26.48         |
| 65       | 8+000    | CL     | 306.00                 | 61.20   | 59.66         |
| 66       | 9+000    | CL     | 343.50                 | 17.18   | 12.83         |
| 67       | 10+000   | CL     | 299.00                 | 9.97    | 25.70         |
| 68       | 11+000   | CL     | 320.00                 | 6.40    | 48.94         |
| 69       | 12+000   | CL     | 312.00                 | 10.40   | 23.03         |
| 70       | 13+000   | CL     | 331.00                 | 8.28    | 29.56         |
| 71       | 13+500   | CL     | 344.00                 | 8.60    | 31.92         |
| 72       | 14+500   | CL     | 323.00                 | 9.23    | 25.74         |
| 73       | 15+200   | CL     | 320.00                 | 9.14    | 38.27         |
| 74       | 15+800   | CL     | 314.00                 | 6.98    | 37.42         |
| 75       | 16+150   | CL     | 315.00                 | 7.00    | 37.26         |

#### iv) Borrow pit investigations for road construction material

Suitable gravel material is required for construction of the respective road layers, subbase, shoulder, gravel wearing course and base course. Fill material is also required to ensure a vertical alignment appropriate for the chosen design speed. To achieve the afore stated, suitable material is therefore required from borrow pits. These pits are opened using various heavy-duty machines and the material is hauled from the pit to the required sections of the road where the material is needed. It is imperative that the material excavated complies with the engineering standards required for the construction of the road and is therefore tested on a regular basis.

Eleven (11) borrow pits were sampled during the prospection for possible calcrete material to be used during the construction. Tests holes conducted where in and around the already existing borrow pits as well as in new areas suspected to yield calcrete material. The prospection was carried out to determine the suitability of the material to be used as calcrete for the



pavement layers. Sufficient bags of material were sampled from the identified existing borrow pits in the vicinity of the project area to determine the Optimum Moisture Content (OMC), Maximum Dry Densities (MDD), CBR, grading indicators for the borrow pits. No water table was encountered during the prospection of materials. The details of the identified borrow pits are shown in the table below:

Table 4: Summary of borrow pit investigation results.

|    | Number of B/Pit              | B/Pit Location | Offset | Chainage (km)                      | Coordinates               | Quality        | Possible Usage        |
|----|------------------------------|----------------|--------|------------------------------------|---------------------------|----------------|-----------------------|
| 1  | New B/P 1                    | Madololo       | LHS    | 13+850                             | -17.831652°<br>24.464253° | G4,G6,G9       | SSG                   |
| 2  | Existing B/P 2               | Madololo       | LHS    | 13+850                             | -17.834214°<br>24.464731° | G4,G9,<G9      | SSG                   |
| 3  | Existing B/P 1               | Iseke          | LHS    | 16+850                             | -17.854278°<br>24.443520° | G8,<G9         | Fill Borrow pit       |
| 4  | Existing B/P 3               | Muyako         | LHS    | 20+100                             | -17.876822°<br>24.425325° | G5,G6          | Base & Sub-Base       |
| 5  | Existing B/P (First Capital) | Muyako         | LHS    | 20+100                             | -17.875187°<br>24.426348° | G4             | Base & Sub-Base       |
| 6  | New B/P 1                    | Muyako         | LHS    | 21+200                             | -17.875170°<br>24.412250° | G5,G5,G8,      | Base, Sub-Base & Fill |
| 7  | New B/P 8                    | Muyako         | LHS    | 22+100                             | -17.883809°<br>24.421989° | G5,G6,         | Base & Sub-Base       |
| 8  | Existing B/P 4               | Muyako         | LHS    | 24+000                             | -17.898394°<br>24.423800° | G4,G5,G7,G8,G9 | Base, Sub-Base & Fill |
| 9  | Existing B/P 5               | Muyako         | RHS    | 24+500                             | -17.902968°<br>24.426426° | G8,<G9         | Fill                  |
| 10 | Existing B/P 1               | Mahundu        | RHS    | 29+950                             | -17.926275°<br>24.473094° | G4,G6          | Base & Sub-Base       |
| 11 | Existing B/P 1               | Liselo         | LHS    | 47 KM of haulage to start of D3507 | -17.574866°<br>24.223943° | G6,G7          | SSG                   |



*Figure 6: Machinery that is used to dig during borrow pit investigations.*

As shown in the table, there are good calcrete/ calcrete material in the area, with most of the borrow pit material grade ranging from G4 to G7. The material quality is of SSG, Subbase and Base, except for borrow pit Eske No.1 where the quality of material is poor and can only be used for fill.

Although the Material in most of the borrow pits demonstrated good CBR, there are other parameters to consider, one of them is Plasticity Index (PI) which can affect the performance and quality of material if not solved. Muyako BP 1 Hole 2, Madololo and Mahundu BP all have CBR of more than 80% which gives a G4 grade material, but the PI exceeded the required of 6, thus make the material not suitable to be used as it is unless blended with non-plastic sand.



Table 5: A list of existing borrow pits along DR3507

| Sample NO: | BPT NO.:                 | Hole no:    | Depth (M)  | Material Description | Sieve Analysis Percent Passing Sieve Size |      |      |      |      |      |      |     |       |       |      | Oversize Index | Grading Coefficient | Shrinkage Product | Grading Modulus | Mdd (kg/m <sup>3</sup> ) | O.M.C (%) | CBR @ % Mod AASHTO |      |     |      |      | Atterbergs |      |      |      |  |
|------------|--------------------------|-------------|------------|----------------------|---|------|------|------|------|------|------|-----|-------|-------|------|----------------|---------------------|-------------------|-----------------|--------------------------|-----------|--------------------|------|-----|------|------|------------|------|------|------|--|
|            |                          |             |            |                      | 63.0                                      | 53.0 | 37.5 | 26.5 | 19.0 | 13.2 | 4.75 | 2.0 | 0.425 | 0.075 | 100  |                |                     |                   |                 |                          |           | 98                 | 95   | 93  | 90   | LL   | PL         | PI   | LS   |      |  |
| RL23 / 170 | Madololo                 | 1           | 0.6 - 3.5  | White Gravel         | 100                                       | 93   | 87   | 82   | 65   | 44   | 31   | 22  | 12.7  | 6.7   | 24.8 | 62             | 2.35                | 2019              | 10.8            | 88                       | 56        | 28                 | 15   | 6   | 21.4 | 12.8 | 8.6        | 2.8  | G6   |      |  |
| RL23 / 168 | Madololo                 | 2           | 2.8 - 4.5  | Yellowish Gravel     | 100                                       | 100  | 100  | 100  | 100  | 100  | 97   | 75  | 40.8  | 0     | 2.9  | 110            | 0.87                | 2083              | 8.5             | 35                       | 24        | 14                 | 9    | 5   | 17.0 | 11.3 | 5.7        | 1.5  | G9   |      |  |
| RL23 / 166 | Madololo                 | 3           | 0.6 - 3.2  | White Gravel         | 100                                       | 97   | 90   | 86   | 72   | 50   | 38   | 28  | 15.1  | 3.3   | 26.0 | 58             | 2.18                | 1897              | 14.6            | 97                       | 94        | 87                 | 55   | 27  | 20.6 | 13.1 | 7.5        | 2.1  | G4   |      |  |
| RL23 / 165 | NO.2, Madololo           | 1           | 0.5 - 4.5  | White Gravel         | 100                                       | 91   | 84   | 80   | 67   | 47   | 32   | 19  | 10.6  | 9.3   | 24.3 | 67             | 2.38                | 1910              | 13.8            | 133                      | 119       | 100                | 84   | 63  | 30.8 | 19.9 | 10.9       | 3.5  | G4   |      |  |
| RL23 / 167 | NO.2 Madololo            | 2           | 2.1 - 4.5  | Yellowish Gravel     | 100                                       | 100  | 100  | 100  | 100  | 100  | 100  | 78  | 44.5  | 0     | 0.77 | 2087           | 8.2                 | 22                | 19              | 14                       | 8         | 3                  | 16.4 | 8.6 | 7.8  | 1.5  | G9         |      |      |      |  |
| RL23 / 169 | NO.2 Madololo            | 3           | 0.6 - 3.45 | White Gravel         | 100                                       | 94   | 88   | 86   | 75   | 58   | 44   | 29  | 15.1  | 6.4   | 25.6 | 60             | 2.12                | 2025              | 11.4            | 40                       | 21        | 9                  | 5    | 2   | 26.3 | 18.3 | 8.0        | 2.1  | < G9 |      |  |
| RL23 / 159 | NO.1, Muyako             | 1           | 1.1 - 4.2  | White Gravel         | 100                                       | 97   | 94   | 90   | 77   | 66   | 58   | 46  | 25.5  | 3.3   | 23.3 | 98             | 1.7                 | 2015              | 11.9            | 72                       | 62        | 51                 | 48   | 44  | 20.6 | 12.9 | 7.7        | 2.1  | G5   |      |  |
| RL23 / 162 | NO.1, Muyako             | 2           | 0.7 - 4.6  | White Gravel         | 100                                       | 97   | 94   | 92   | 82   | 59   | 52   | 42  | 20    | 3.2   | 25.0 | 176            | 1.87                | 1987              | 11.0            | 126                      | 116       | 102                | 89   | 72  | 28.6 | 16.8 | 11.8       | 4.2  | G4   |      |  |
| RL23 / 158 | NO.1, Muyako             | 3           | 1.0 - 4.1  | White Gravel         | 100                                       | 96   | 93   | 90   | 78   | 61   | 50   | 38  | 18.6  | 3.7   | 25.8 | 131            | 1.93                | 1923              | 12.2            | 80                       | 70        | 58                 | 51   | 43  | 26.5 | 16.7 | 9.8        | 3.5  | G5   |      |  |
| RL23 / 164 | NO.1, Muyako             | 4           | 0.45 - 4.0 | White Gravel         | 100                                       | 94   | 90   | 88   | 71   | 51   | 41   | 31  | 15.4  | 5.9   | 24.8 | 106            | 2.13                | 1914              | 14.9            | 26                       | 20        | 13                 | 10   | 6   | 26.7 | 16.0 | 10.7       | 3.5  | G8   |      |  |
| RL23 / 161 | NO.3, Muyako             | 1           | 0.65 - 3.8 | White Gravel         | 100                                       | 94   | 90   | 87   | 75   | 59   | 46   | 32  | 17.5  | 5.9   | 25.6 | 111            | 2.04                | 1641              | 15.7            | 59                       | 51        | 37                 | 30   | 22  | 30.4 | 19.6 | 10.8       | 3.5  | G6   |      |  |
| RL23 / 180 | NO.3, Muyako             | 2           | 0.7 - 3.8  | White Calcrete       | 100                                       | 96   | 93   | 92   | 87   | 76   | 66   | 44  | 23.9  | 3.8   | 20.4 | 216            | 1.66                | 1717              | 13.1            | 45                       | 50        | 53                 | 66   | 76  | 43.5 | 30.4 | 13.1       | 4.9  | G5   |      |  |
| RL23 / 156 | NO.3, Muyako             | 3           | 0.3 - 2.7  | White Gravel         | 100                                       | 96   | 89   | 85   | 76   | 59   | 47   | 29  | 14.9  | 4.5   | 24.6 | 124            | 2.09                | 1647              | 14.3            | 68                       | 61        | 52                 | 51   | 28  | 43.5 | 31.1 | 12.4       | 4.2  | G5   |      |  |
| RL23 / 93  | NO. 1, ESEKE             | 1           | 1.9 - 4.5  | Brownish Gravel      | 100                                       | 100  | 100  | 97   | 95   | 91   | 83   | 77  | 71    | 34.8  | 0    | 17.2           | 250                 | 1.18              | 1948            | 12.6                     | 14        | 11                 | 7    | 4   | 1    | 22.2 | 11.8       | 10.4 | 3.5  | < G9 |  |
| RL23 / 115 | NO. 1, ESEKE             | 2           | 1.6 - 4.2  | Brownish Gravel      | 100                                       | 100  | 100  | 100  | 100  | 100  | 97   | 95  | 88    | 43.5  | 0    | 5.1            | 183                 | 0.74              | 2097            | 10.1                     | 24        | 19                 | 13   | 11  | 8    | 20.4 | 13.7       | 6.7  | 2.1  | G8   |  |
| RL23 / 92  | NO.4, Muyako             | 1           | 0.25 - 2.5 | White Gravel         | 100                                       | 97   | 92   | 88   | 86   | 78   | 60   | 48  | 33    | 15.2  | 8.1  | 24             | 97                  | 2.03              | 1692            | 13.3                     | 101       | 79                 | 48   | 25  | 9    | 32.6 | 21.6       | 11   | 2.9  | G5   |  |
| RL23 / 100 | NO.4, Muyako             | 2           | 0.1 - 1.4  | White Gravel         | 100                                       | 100  | 96   | 91   | 88   | 79   | 56   | 42  | 25    | 11.5  | 3.9  | 27.9           | 139                 | 2.22              | 1557            | 15.5                     | 28        | 25                 | 20   | 17  | 14   | 39.2 | 25.4       | 13.8 | 5.6  | G7   |  |
| RL23 / 102 | NO.4, Muyako             | Stockpile 1 |            | White Gravel         | 100                                       | 100  | 96   | 92   | 87   | 76   | 56   | 38  | 21    | 10.2  | 3.8  | 30.2           | 89                  | 2.31              | 1644            | 13.9                     | 21        | 18                 | 13   | 10  | 7    | 45.1 | 33.7       | 11.4 | 4.2  | G8   |  |
| RL23 / 101 | NO.4, Muyako             | 4           | 0.7 - 2.5  | White Gravel         | 100                                       | 100  | 95   | 90   | 86   | 75   | 55   | 39  | 24    | 11.8  | 5.1  | 28             | 119                 | 2.25              | 1354            | 22.2                     | 88        | 86                 | 83   | 65  | 43   | 48.3 | 34.8       | 13.5 | 4.9  | G4   |  |
| RL23 / 97  | NO.4, Muyako             | 5           | 0.4 - 1.8  | White Gravel         | 100                                       | 100  | 100  | 100  | 100  | 100  | 90   | 79  | 63    | 30.2  | 0    | 18.8           | 177                 | 1.28              | 1711            | 14.8                     | 22        | 18                 | 13   | 7   | 3    | 30   | 21.1       | 8.9  | 2.8  | G9   |  |
| RL23 / 105 | NO.6, Muyako             | 1           | 1.2 - 3.3  | White Gravel         | 100                                       | 100  | 100  | 98   | 94   | 83   | 65   | 60  | 47    | 23.7  | 0    | 24.7           | 166                 | 1.69              | 1688            | 18.8                     | 30        | 26                 | 21   | 13  | 6    | 40   | 28.8       | 11.2 | 3.5  | G8   |  |
| RL23 / 104 | NO.6, Muyako             | 2           | 1.0 - 2.9  | White Gravel         | 100                                       | 100  | 100  | 100  | 100  | 100  | 87   | 66  | 37    | 14.9  | 0    | 29.6           | 157                 | 1.82              | 1845            | 16.7                     | 22        | 19                 | 15   | 11  | 7    | 45.5 | 32.4       | 13.1 | 4.2  | G8   |  |
| RL23 / 103 | NO.6, Muyako             | 3           | 0.15 - 3.2 | White Gravel         | 100                                       | 100  | 97   | 94   | 91   | 83   | 72   | 64  | 52    | 23.3  | 3.2  | 21.5           | 251                 | 1.6               | 1510            | 20.6                     | 18        | 16                 | 9    | 6   | 4    | 30   | 17.9       | 12.1 | 4.8  | < G9 |  |
|            |                          |             |            | 0.15                 | 1   | 1.2  |      |      |      |      |      |     |       |       |      |                |                     |                   |                 |                          |           |                    |      |     |      |      |            |      |      |      |  |
| RL23 / 157 | NO.8, Muyako             | 1           | 0.45 - 3.8 | White Gravel         | 100                                       | 96   | 90   | 86   | 79   | 62   | 46   | 31  | 17.9  | 3.9   | 27.4 | 128            | 2.05                | 1778              | 16.0            | 60                       | 57        | 52                 | 33   | 17  | 34.8 | 24.7 | 10.1       | 4.2  | G5   |      |  |
| RL23 / 160 | NO.8, Muyako             | 2           | 0.55 - 4.2 | White Gravel         | 100                                       | 97   | 92   | 89   | 81   | 68   | 59   | 49  | 26.4  | 3.3   | 22.5 | 169            | 1.66                | 1919              | 14.4            | 52                       | 45        | 37                 | 31   | 23  | 27.4 | 16.8 | 10.6       | 3.5  | G6   |      |  |
| RL23 / 163 | NO.8, Muyako             | 3           | 0.25 - 4.0 | White Gravel         | 100                                       | 100  | 100  | 100  | 100  | 100  | 100  | 71  | 40    | 0     | 0.0  | 246            | 0.89                | 1998              | 8.9             | 15                       | 11        | 7                  | 3    | 1   | 20.9 | 10.6 | 10.3       | 3.5  | < G9 |      |  |
| RL23 / 174 | First Capital Borrow Pit | Stockpile 1 |            | Yellowish Gravel     | 100                                       | 96   | 90   | 86   | 78   | 54   | 38   | 28  | 13.7  | 4.1   | 28.4 | 97             | 2.21                | 1642              | 9.9             | 133                      | 120       | 102                | 88   | 70  | 26.7 | 15.3 | 11.4       | 3.5  | G4   |      |  |
| RL23 / 172 | NO.1, Liselo (Inside)    | 1           |            | Yellowish Gravel     | 100                                       | 96   | 94   | 92   | 84   | 73   | 67   | 52  | 30    | 4     | 19.6 | 113            | 1.51                | 2038              | 9.0             | 77                       | 58        | 31                 | 16   | 6   | 23.0 | 15.5 | 7.5        | 2.2  | G6   |      |  |
| RL23 / 171 | NO.1, Liselo             | 2           | 2.7 - 4.3  | White Gravel         | 100                                       | 93   | 86   | 84   | 73   | 55   | 48   | 35  | 19.5  | 7.4   | 21.2 | 98             | 1.97                | 1969              | 10.1            | 41                       | 35        | 23                 | 15   | 8   | 26.2 | 17.5 | 8.7        | 2.8  | G7   |      |  |
| RL23 / 173 | NO.1, Liselo             | 3           | 1.7 - 3.8  | White Gravel         | 100                                       | 97   | 93   | 91   | 85   | 69   | 62   | 48  | 25.4  | 2.7   | 21.9 | 204            | 1.65                | 1980              | 10.2            | 37                       | 33        | 22                 | 14   | 8   | 30.1 | 17.8 | 12.3       | 4.2  | G7   |      |  |
| RL23 / 177 | NO.1, Mahundu            | 1           | 2.4 - 4.0  | Whitish Sand         | 100                                       | 100  | 100  | 100  | 100  | 100  | 100  | 97  | 51.5  | 0     | 0.0  | 0              | 0.52                | 1912              | 4.1             | 36                       | 33        | 27                 | 20   | 13  | 0    | 0.0  | 0          | 0    |      | G6   |  |
| RL23 / 176 | NO.1, Mahundu (Inside)   | 2           | 0.0 - 0.35 | White Gravel         | 100                                       | 93   | 88   | 83   | 66   | 45   | 31   | 19  | 10    | 6.8   | 25.9 | 40             | 2.41                | 1786              | 15.8            | 81                       | 61        | 42                 | 35   | 27  | 19.1 | 11.7 | 7.4        | 2.1  | G6   |      |  |
| RL23 / 175 | NO.1, Mahundu            | Stockpile 1 |            | White gravel         | 100                                       | 95   | 90   | 87   | 75   | 57   | 43   | 27  | 13.3  | 5.2   | 27.0 | 56             | 2.17                | 1761              | 15.1            | 93                       | 81        | 59                 | 38   | 20  | 32.3 | 24.4 | 7.9        | 2.1  | G4   |      |  |

### v) Water Source/s for Road Construction

A reliable water supply is necessary to mix concrete, prepare the road surface during compaction amongst others. Sources of water in the construction area are old borrow pits and a few boreholes. It is therefore recommended that the contractor conduct detailed water prospection to identify the sufficiency of water sources and establish borehole yields in the project area. A list of existing earth dams and boreholes along DR3507 are listed in the table below.

*Table 6: Existing earth dams and bore holes along DR3507*

| Location | Kilometre | offset | Coordinate                | Remark         |
|----------|-----------|--------|---------------------------|----------------|
| Silumbi  | 4+100     | LHS    | -17.760031°<br>24.509636° | Old Borrow pit |
| Silumbi  | 4+150     | LHS    | -17.761582°<br>24.510006° | Old Borrow pit |
| Madololo | 13+900    | LHS    | -17.834126°<br>24.466610° | Old Borrow pit |
| Madololo | 13+900    | LHS    | -17.834126°<br>24.466610° | Borehole       |
| Eske     | 16+950    | LHS    | -17.853944°<br>24.442926° | Old Borrow pit |
| Muyako   | 21+650    | LHS    | -17.883090°<br>24.411328° | Old Borrow pit |
| Muyako   | 21+650    | RHS    | -17.882410°<br>24.413286° | Old Borrow pit |

### vi) Accommodation facilities for construction workers

Accommodation facilities for road construction workers can vary depending on the location, duration of the project and the number of workers involved. The construction period of the road is expected to last for a period of approximately 18 months, and this would require establishment of a camp-site that is equipped with tents, bunkhouses, trailers, ablution facilities and other amenities.

In addition to accommodation facilities, there will be a need to designate areas that will be used to store construction material as well as parking bays for construction vehicles. Heavy equipment such as bulldozers, excavators, graders, and rollers will be required; and these need a big turning area. Therefore, due diligence would be required when selecting an accommodation area to reduce disturbances to community members.

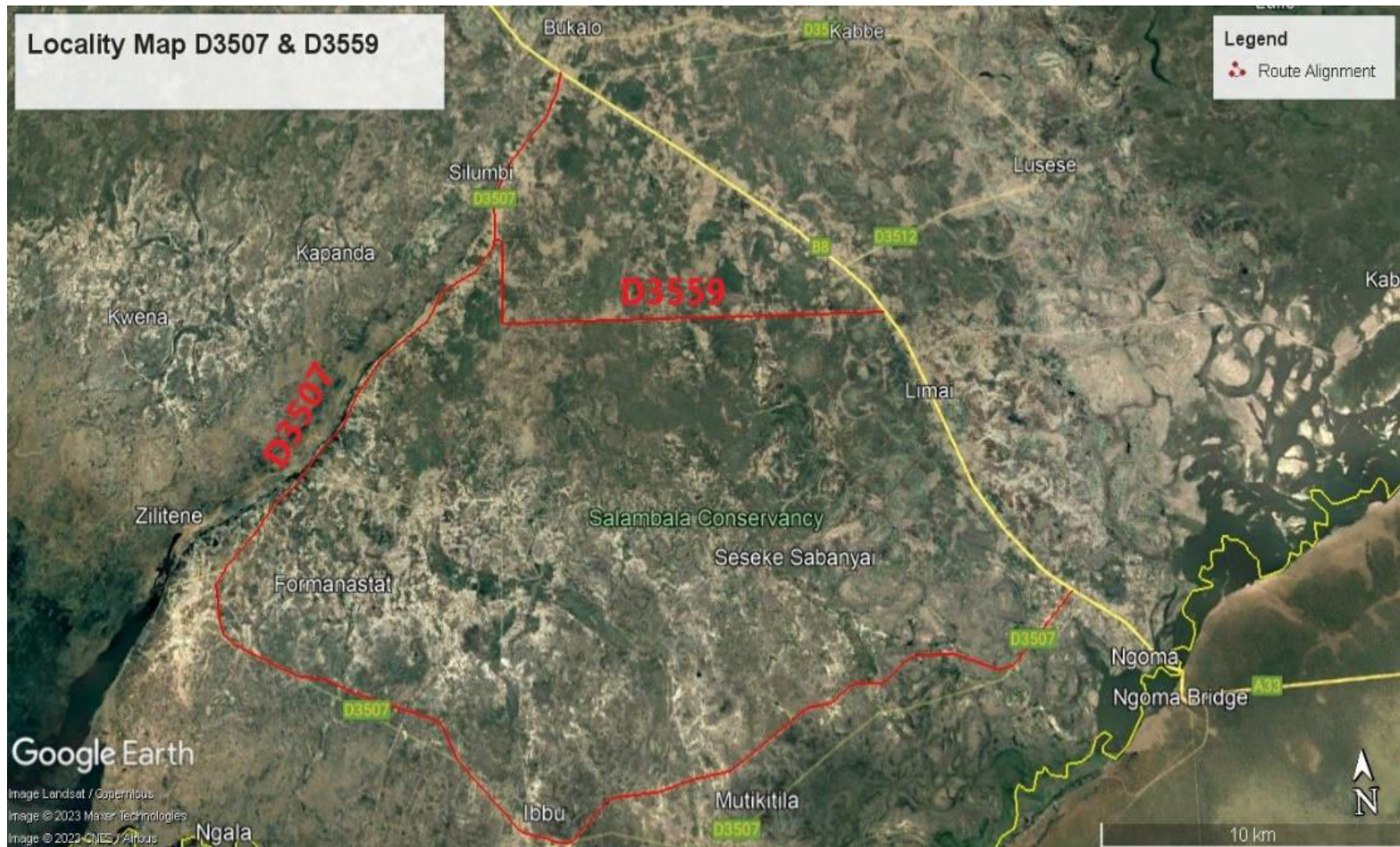


Figure 7: locality of DR3507 & DR3559 as highlighted with the green thick red line

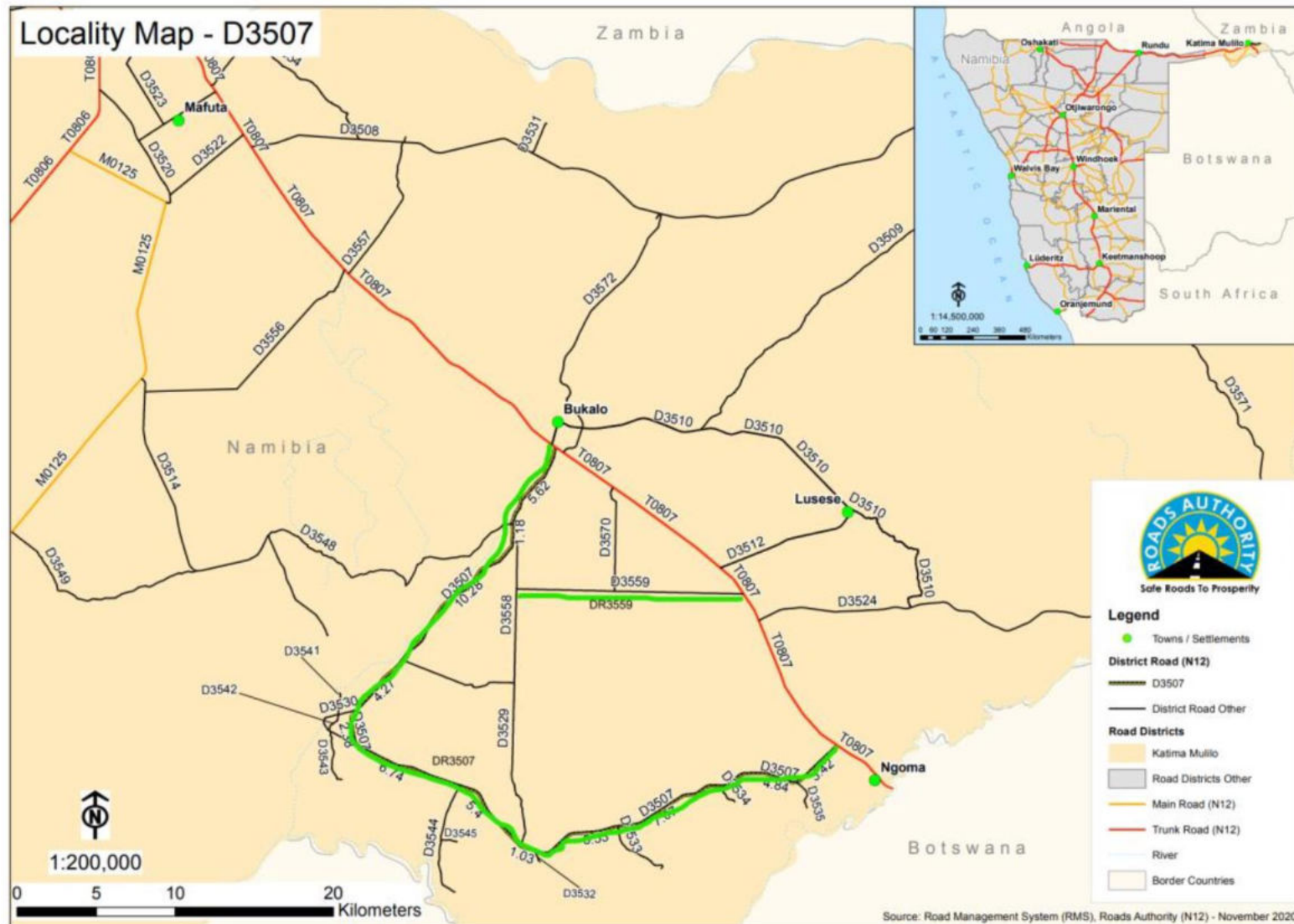


Figure 8: Locality of DR3507 & DR3559 as highlighted with the green thick line

### 3 COMPLIANCE AND LEGAL FRAMEWORK

This chapter outlines the regulatory framework applicable to the proposed road construction project. Table 2 provides an overview of applicable policies, plans and strategies and Table 3.1 provides a list of applicable national legislation.

#### 3.4 Compliance to the EMP

The EMP is binding to the proponent, and all contractors / sub-contractors. This implies that each and every entity that may have any kind of engagement or involved in / with the activities of the proposed road upgrade should comply with the EMP throughout the project lifespan. Non-compliance may have serious consequences e.g. License withdrawal.

#### 3.5 Environmental Management Act (No.7 of 2007)

Section 27 of the Environmental Management Act 2007 (Act No. 7 of 2007) (EMA) provides a list of activities that may not be undertaken without an Environmental Clearance Certificate (ECC) (herein referred to as: listed activities). The proposed expansion of the hospital triggers the following listed activities.

The EMP should conform to the provisions of the Environmental Management Act (EMA), Act No. 7 of 2007 and EIA regulations of 2012 (Government Notice: 30).

The EIA Regulations defines a '*Management Plan*' as:

*"...a plan that describes how activities that may have significant impacts on the environment are to be mitigated controlled and monitored."*

#### 3.6 EMP Requirements

Table 3:1: EMP Requirements as outlined in Section 8 of the EIA Regulations

| <b>Requirement</b>   |
|--|
| (j) a draft management plan, which includes –<br>(aa) information on any proposed management, mitigation, protection or remedial measures to be undertaken to address the effects on the |

*environment that have been identified including objectives in respect of the rehabilitation of the environment and closure;*

*(bb) as far as is reasonably practicable, measures to rehabilitate the environment affected by the undertaking of the activity or specified activity to its natural or predetermined state or to a land use which conforms to the generally accepted principle of sustainable development; and*

*(cc) a description of the manner in which the applicant intends to modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation remedy the cause of pollution or degradation and migration of pollutants.*

### 3.7 Listed Activities

Listed Activities may not be undertaken without an Environmental Clearance Certificate (ECC), and hence an Environmental Impact Assessment (EIA) is required.

As the organ of state responsible for management and protection of its natural resources, the MET: DEA is committed to pursuing the principles of environmental management. The EMA provides a list of activities that require an EIA and the proposed road upgrade is among the listed activities or activities that may not be conducted without at ECC. The purpose of listed activities for projects is to ensure that the associated impacts on the environment are carefully considered.

The road upgrade to bitumen standards triggers a number of Listed Activities as set out in the Environmental Management Act, 2007 (Act No. 7 of 2007) (herein referred to as the EMA) and the Environmental Impact Assessment Regulation, 2007 (No. 30 of 2011) (herein referred to as the EIA Regulations).

*Table 3:2: Listed Activities triggered by the proposed project*

| <b>Activity</b>   | <b>Applicability</b>   |
|---|--|
| Activity 10: Infrastructure:<br><br>10.1 The Construction of (b) Public roads   | The project entails construction activities to upgrade the two gravel roads to bitumen standards.          |
| Activity 3: Mining and Quarrying Activities<br><br>3.2 The Other forms of mining or extraction of any natural resources whether regulated by law or not | The project entails establishment of borrow pits to source gravel and other material for road construction |

|  |   |
|--|---|
| 3.3 Resource extraction, manipulation, conservation and related activities           |   |
| Activity 8: Water Resource Development   | The project entails Water abstraction for road construction |
| 8.1 The abstraction of ground or surface water for industrial or commercial purposes |   |

### 3.8 Extended developmental and Legal Framework

In addition to the EMA and the Environmental Assessment Policy, there exists a host of legal and policy documents and guidelines that must be considered when undertaking an EIA as indicated in table 3.2, below. The proponent has the responsibility to ensure that the sand mining operations conforms to all other National developmental plans and legal framework.

Table 3.2: Policies, Plans and Strategies

| National Statutes  | Relevance  | Applicability to the Proposed Project   |
|--|--|---|
| 5th National Development Plan (NDP) and Vision 2030                | Outlines the country's National Development Plans (NDPs), in line with the Harambee Prosperity Plan (HPP) and vision 2030  | The proposed project is a development that forms part of the bigger picture of achieving economic progression, social transformation and environmental sustainability.                            |
| Environmental Management Act No. 7 of 2007                         | Outlines the objectives of the Act and means to implement environmental management   | All development should be guided by the principles of sustainable environmental management. The project is therefore to be implemented in accordance with the EMA Act and associated regulations. |
| EIA Regulations GN 28, 29 and 30 of EMA (2012)                     | The regulations identify and lists certain activities that cannot be undertaken without an Environmental Clearance Certificate (ECC)                                     |   |
| Environmental Assessment Policy (1995)                             | Promotes Sustainable development and Environmental Conservation emphasize the importance of environmental assessments as a key tool towards environmental sustainability | Environmental Protection  |
| Soil Conservation, 1969 (Act 76 of 1969) and the Soil Conservation | Makes provision for the prevention and control of soil erosion   | Monitor and apply the soil conservation mechanisms  |

| National Statutes   | Relevance  | Applicability to the Proposed Project  |
|---|--|--|
| Amendment Act (Act 38 of 1971)  |  |  |
| Forest Act 12 of 2001<br>Forest Act Regulations 2015                    | To provide for the protection of the environment and the control and management of forest. Relevant sections:<br>- Approval required for the clearance of vegetation on more than 15 hectares (Section 23, subsection 1 (b)).<br>- Tree species and any vegetation within 100m from a watercourse may not be removed without a permit (Section 22, subsection 1 (b)) | Forestry permits maybe required for vegetation clearing  |
| Public Health Act (Act No. 36 of 1919)                                  | Advocates for Public Health and safety   | Protective clothing  |
| The Occupational Safety and Health Act No. 11 of 2007                   | Advocates for employee and public safety, health   | In the working context "SAFETY" implies "free from danger"   |
| Local Authority Act No. 23 of 1992 Government Notice of No.116 of 1992. | Advocates for inclusive socio-economic development   | Ensure communication with community members about the proposed developmental activities  |
| National Heritage Act, No. 27 of 2004.                                  | The Act provides provision of the protection and conservation of places and objects with heritage significance.  | No heritage features were observed within or around the site. Procedures and mitigation measures presented in the EMP should be applied. |



## 4 ROLES AND RESPONSIBILITIES

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This section outlines the roles and responsibilities of the key personnel responsible for the day to day management of activities to ensure effective implementation of the EMP.

### 4.4 Roles and Responsibilities

Assignment of responsibilities is necessary to ensure that key procedures are followed. Ultimately, the overall responsibility for the implementation of the EMP lies with the proponent (RA).

To ensure accountability, it is necessary to assign responsibilities. The key role-players for project implementation are;

- a) The **Environmental Compliance Officer (ECO)** representing the Ministry of Environment, Forestry and Tourism (MET), or an appointed independent environmental officer, who is responsible for monitoring and auditing.
- b) **The Proponent: (Roads Authority)**.
- c) **The Site Manager** the person responsible for the management of construction work throughout the duration of the road upgrade.

#### 4.4.1 The Environmental Compliance Officer (ECO):

The ECO refers to the party responsible for the environmental monitoring and auditing to ensure that the provisions of the EMP are complied with.

The ECO shall have adequate environmental knowledge to understand and interpret the EMP and pertaining environmental aspects associated with the project. The specific tasks of the ECO are as follows:

- To undertake all monitoring and auditing activities in-order to ensure compliance with the EMP.
- Conduct inspections and monitoring at reasonable intervals (e.g. every month, quarterly or annually), throughout the duration of the project. Depending on the risks, some projects may require regular inspections.
- Issue compliance or non-compliance orders to the proponent, contractors / sub-contractors.
- Compile compliance Reports pertaining to any non-compliance incident/s, and a Rehabilitation Report following the conclusion a specific activity.

- Liaise closely with all key stakeholders i.e. the Site Manager and the Environmental Commissioner.
- Provide guidance on any environmental management issues, incidents or emergencies that may arise throughout the project lifespan.
- Assist in providing recommendations for remedial action in the event of non-compliance.
- Auditing or monitoring activities may involve investigation, as well as structured observation, measurement, and evaluation of environmental data over a period of time.

#### 4.4.2 The Proponent:

The proponent, hereinafter referred to as RA, shall assume overall responsibility to ensure implementation of the EMP and will be held accountable against the remedial measures outlined herein. It is recommended that the client should appoint a Site Manager who will be responsible for monitoring of daily operations.

The specific responsibilities of The Proponent are as follows:

- Appoint a Site Manager (SM) to oversee the daily onsite activities.
- Liaise closely with the SM and ECO on any environmental management issues, incidents or emergencies.
- Ensure that all activities on and around the site are conducted in accordance with the requirements of the EMP at all times.
- Ensure that all sub-contractors and visitors to the site are conversant with the requirement of the EMP, relevant to their roles on site.
- Shall develop a **communication strategy** between The Proponent, Project Manager, workers, the ECO and any other relevant stakeholder.
- Shall develop an **organisational structure** to ensure that:
  - There are clear channels of communication;
  - There is an organisational hierarchy for effective implementation of the EMP; and
  - Conflicting or contradictory instructions are eliminated;
  - Ensure that all instructions and official communications regarding environmental matters shall follow the organisational structure as determined
  - Ensure that that EMP requirements are assigned to specific people / positions with the capacity and experience required for implementation.

#### 4.4.3 The Site Manager:

The **Site Manager (SM)** should:

- Ensure that each team recruited to work at the sites, adheres to the EMP;
- Ensure that a **copy of the EMP is kept on site at all times and as it may be requested by authorities conducting spot checks at any time.**
- Ensure that all staff attend an induction session before commencement of any work on site and that they are adequately informed of the requirements of the EMP;
- Take special care to prevent irreversible damage to the environment.

#### 4.5 Instructions

All instructions and official communications shall follow the organisational structure as determined by the Proponent. Based on the adopted structure, it is essential that responsibilities outlined are assigned to specific parties with adequate capacity and experience required to implement the EMP.

#### 4.6 Disciplinary Actions

The EMP is a legally binding document. Non-compliance with the EMP may result in disciplinary action being taken against the Proponent. Such actions may take the form of;

- Financial penalties, Legal action, fines, and/or Suspension of work.

The disciplinary action shall be determined according to the nature and extend of the non-compliance, and exact penalties are to be weighed against the severity of the incident.

## 5 POTENTIAL IMPACTS AND MITIGATION MEASURES

### 5.4 Approach to mitigation measures

To enable a systematic approach to impact identification, specific aspects have been identified and for each aspect, specific mitigation measures have been recommended Table 5. It is important to note that this EMP is for the continuation of sand mining activities from existing borrow pit to meet the township development requirements of the RA.

Table 5:1. EMP Impact Identification Section and Associated Aspects

| EMP Implementation / Potential Impact Category | Specific Aspects                    |
|--|-------------------------------------|
| A. Staff Induction                             | EMP Provisions (Do's and Don'ts)    |
|  | HIV / AIDS                          |
|  | Communication Channels              |
| B. Operational Phase                           | Access Roads                        |
|  | Site Demarcation                    |
|  | Notice Board                        |
| C. Environment and Pollution                   | Vehicle emissions                   |
|  | Oil Spills                          |
|  | Soil Erosion                        |
| D. Health and Safety                           | Safety at Work Place                |
|  | Dust                                |
|  | Noise                               |
| E. Socio Economic                              | Employment opportunities for locals |
|  | Drug and Alcohol abuse              |
|  | Working hours                       |
|  | HIV / AIDS                          |
| F. Cultural Heritage                           | Heritage resources / artefacts      |

## SECTION A: STAFF INDUCTION

| Aspect                 | Objective  | Proposes Mitigation Measures  | Monitoring Indicator  | Party responsible |
|------------------------|--|---|---|-------------------|
| <b>Staff induction</b> | To ensure that all staff / employees are conversant with the requirements of the EMP | <ul style="list-style-type: none"> <li>Induction for all staff / employees on the provisions of the EMP before work commencement, covering but not limited to: environmental awareness, emergency response, Reporting of incidents, HIV/AIDS awareness, alcohol and substance abuse, and Safety, Health and Environment (SHE) measures</li> <li>Staff operating equipment (such as loaders, etc.) shall be adequately trained and sensitized to any potential hazards associated with their tasks</li> <li>Quarterly induction reviews</li> </ul> | Induction Minutes and Attendance Register, Signed by each and every staff member<br>Staff members appointed at a later stage should also undergo induction<br>Quarterly minutes | Site Manager      |
|                        | Punitive measures for staff, to ensure compliance                                    | <ul style="list-style-type: none"> <li>Adopt a disciplinary system to discipline staff for non-compliance, such as littering, speeding, safety risk both to themselves and to others, not using ablution facilities, etc.</li> </ul>  | Number of fines/warning issued daily/Monthly  | Site Manager      |
|                        | Availability of the EMP on site for ease of reference                                | <ul style="list-style-type: none"> <li>Ensure that a copy of the EMP is kept on site and accessible to team leaders</li> </ul>  | Availability of EMP on site and accessibility to team leaders   | Site Manager      |
| <b>Communication</b>   | To ensure effective communication throughout the project lifespan                    | <ul style="list-style-type: none"> <li>Develop a communication strategy (Channel and medium of communication)</li> <li>All correspondence should be written and signed off by witnesses (e.g. Site manager)</li> <li>The contact numbers for the Site Manager or Site Foreman must be available onsite (displayed) in case of emergencies.</li> </ul>   | Communication Strategy<br><br>Letters, e-mail, Notices, Minutes   | Site Manager      |

## SECTION B: OPERATIONAL PHASE

| Aspect                      | Objective   | Action Required   | Monitoring Indicator                  | Party responsible |
|-----------------------------|---|---|---------------------------------------|-------------------|
| <b>Access Roads</b>         | Prevent driving all over the place                        | <ul style="list-style-type: none"> <li>Temporal access roads may need to be established to provide continued use of the roads (An amendment to the EMP must be done)</li> <li>Access roads should be repaired and maintained at acceptable standards to prevent dust and obstruction to road users.</li> <li>All driving must strictly be on access roads</li> </ul>  |                                       | Site Manager      |
| <b>Site Demarcation</b>     | Contain all project activities within the site boundaries | <ul style="list-style-type: none"> <li>The road construction site must be clearly demarcated by means of reflective tape (where practical).</li> <li>Permanent pegs/markers around borrow pits must be firmly erected and maintained in their correct position throughout the life of the operation.</li> <li>Ensure adequate planning is given to the layout and campsite</li> <li>Ensure that access to the site and associated infrastructure, and equipment is controlled throughout the construction phase.</li> </ul> | Visible fence around the project site | Site Manager      |
| <b>General Notice Board</b> | To notify and warn the public of the project activities   | <ul style="list-style-type: none"> <li>A general notice board is on site, and must be well maintained</li> </ul>  | Notice Board – Visible and Clear      | Site Manager      |

## SECTION C: ENVIRONMENT AND POLLUTION

| Aspect                   | Objective   | Action Required   | Monitoring Indicator  | Party responsible |
|--------------------------|---|---|---|-------------------|
| <b>Vehicle emissions</b> | Reduce greenhouse gas (GHG) emissions from poorly maintained or malfunctioning equipment (vehicles / machinery) | <ul style="list-style-type: none"> <li>All vehicles and equipment shall be kept in good working condition and serviced regularly (in accordance with the servicing frequency of the specific machinery), in order to prevent leakage and emission of poisonous smoke etc.</li> <li>Switch off engines when vehicle is not operations</li> </ul>   | <p>Vehicle servicing records</p> <p>Reports of smoke emissions from machinery</p> | Site Manager      |
| <b>Oil Spills</b>        | Manage oil spills and leak from heavy vehicles and Machinery  | <ul style="list-style-type: none"> <li>Provide drip trays to prevent potential oil leakage</li> <li>Re-fuelling of machinery (e.g excavator / front loader) must be done at appropriate site with impermeable concrete bunding</li> <li>There must be an immediate spill response kit on site and if an oil spill occurs, collect the contaminated soil, store in drums and dispose at appropriate waste disposal site (e.g. RA disposal site)</li> </ul> | Observation of soil contamination   | Site Manager      |
| <b>Soil Erosion</b>      | To mitigate soil erosion  | <ul style="list-style-type: none"> <li>Only use the existing access road to and from the site, do not form other tracks</li> <li>Implement continuous rehabilitation measures, by trimming and smoothing the slopes to be less than one third of the initial slope (1:3).</li> </ul>  | Physical Observation  | Site Manager      |
| <b>Solid Waste</b>       | To prevent littering, pollution, contamination of water and general environmental health hazards                | <ul style="list-style-type: none"> <li>All waste produced on site should be contained and disposed as required by law.</li> <li>There must be sufficient temporally ablution facility at the site for designated for males and female.</li> </ul>   | Scattered waste, Littering and any other unsightly waste at the site (eyesore)    | Site Manager      |

## SECTION D: HEALTH AND SAFETY

| Aspect                              | Objective  | Proposed Mitigation Measures   | Monitoring Indicator   | Party Responsible |
|-------------------------------------|--|--|--|-------------------|
| <b>General Safety at Work Place</b> | Ensure that the safety of workers is not compromised and adhere to the Health and Safety Regulations, Government Notice 156/1997 (GG 1617) | <ul style="list-style-type: none"> <li>• Develop a Health and safety Plan (should be part of the induction)</li> <li>• Ensure that every employee goes through a safety induction;</li> <li>• Employees must be equipped with all necessary Personal Protective Equipment (PPE). These includes, Helmet, Overall, Safety Shoes, Safety Glasses, Gloves, Welding shield, Earmuff etc;</li> <li>• Provide first aid kits to operators;</li> <li>• Only qualified personnel must be allowed to operate special machinery (e.g earthmoving machinery)</li> <li>• Adequate safety signs must be displayed on site.</li> </ul> | <p>Health and Safety included and reflected in the Induction Minutes</p> <p>Adequate protective gear for all staff</p> <p>Availability of the first aid kit onsite</p> <p>Record of warnings</p> <p>Visible safety signs on site</p> | Site Manager      |
| <b>Dust</b>                         | Mitigate dust and noise impacts to both employees and the public   | <ul style="list-style-type: none"> <li>• Provide dust masks and ear muffs to all employees operating in a dusty or noisy environment</li> <li>• Reduce vehicle speed on gravel roads</li> <li>• All vehicles transporting sand or gravel should be covered with a tarpaulin, or any other suitable material, and,</li> <li>• Industrial speed limits of 30 – 40km/h must be maintained</li> </ul>  | <p>Incident Report</p> <p>Public Complains</p>   | Site Manager      |
| <b>Noise</b>                        |  | <ul style="list-style-type: none"> <li>• Employees must NOT be exposed to noise levels above the required -85dB (A) limit over a period</li> </ul>   |  |                   |



| Aspect          | Objective                                       | Proposed Mitigation Measures   | Monitoring Indicator                                       | Party Responsible |
|-----------------|---|--|--|-------------------|
|                 |   | <p>of 8 hours. Should the noise level be higher than 85dB (A), the employer must implement a hearing conservation program such as noise monitoring;</p> <ul style="list-style-type: none"> <li>• Provide worker with earmuffs</li> <li>• Vehicles and machines must be well serviced to avoid unnecessary noise emission</li> <li>• Limit the movement of earth moving machinery and heavy vehicles (tipper trucks) to daylight: 06:00AM – 18:00 PM</li> </ul> |  |                   |
| <b>Ablution</b> | Reduce health risks and environmental pollution | <ol style="list-style-type: none"> <li>1. Ensure adequate, hygienic (clean) and user-friendly ablution facilities for all staff.</li> <li>2. Inspect ablution facilities regularly</li> </ol>  | availability, cleanliness and hygienic ablution facilities | Site Manager      |

## SECTION E. SOCIO ECONOMIC ASPECTS

| Environmental / Social Impact              | Objectives                                | Proposed Mitigation Measures  | Monitoring Indicator  | Party Responsible |
|--|---|---|---|-------------------|
| <b>Employment opportunities for Locals</b> | Promote benefits to the local community   | <ul style="list-style-type: none"> <li>• Prioritize locals to be recruited for unskilled labour</li> <li>• Where possible, procure materials from local suppliers</li> </ul>  | Employee structure and proportion of local employment                           | RA                |
| <b>Pedestrian Safety</b>                   | Minimize the risk of pedestrian accidents | <ul style="list-style-type: none"> <li>• Provide sufficient areas to serve as pick-up areas at road intersections for hitchhikers</li> <li>• Provide designated laybys with clear road markings and signage including illuminated pedestrian crossings.</li> <li>• Provide dedicated turning lanes for larger vehicles</li> </ul> | Monitor incidents involving pedestrians<br>Sufficient road markings and signage | RA                |
| <b>Alcohol and Drug use</b>                | Prevent alcohol and drug use at work      | <ul style="list-style-type: none"> <li>• Ban and warn the employees against the use of alcohol and drugs at work</li> <li>• Provide awareness on the dangers and health impacts of alcohol and drug use</li> </ul>  | Drunk / Misbehaving employees<br><br>Monitor presence of alcohol at work        | Site Manager      |
| <b>Working hours</b>                       | Adhere to the Labour Act No. 11 of 2007   | <ul style="list-style-type: none"> <li>• Operate within the prescribed working days and hours as per the Namibian Labour laws and regulations</li> </ul>  | Verification of working hours against the labour Act                            | Site Manager      |
| <b>HIV / AIDS</b>                          | Provide HIV / AIDS awareness to employees | <ul style="list-style-type: none"> <li>• The Ministry of Health and Social Services provides free condoms. Avail them to workers.</li> <li>• Arrange for HIV awareness for employees;</li> </ul>  | Availability of condoms<br>Induction training report                            | Site Manager      |

## SECTION F. HERITAGE AND ARCHAEOLOGY

| Aspect                                | Objective  | Action Required  | Monitoring Indicator                                | Party responsible |
|---------------------------------------|--|--|---|-------------------|
| <b>Heritage Resources / artefacts</b> | Reduce the impacts borehole drilling and associated earthworks on heritage resources / artefacts | <ol style="list-style-type: none"> <li>Heritage remains or artefacts discovered on site must be reported to the National Museum (+264 61 276800) or the National Forensic Laboratory (+264 61 240461).</li> <li>No artefacts must be removed or be interfered with prior to authorisation from the Namibian National Heritage Council (NHC)</li> <li>Recovery of heritage remains or artefacts discovered and removal thereof should be directed by the National Museum</li> </ol> | Sighting report/s of heritage resources / artefacts | Site Manager      |

## **6 REHABILITATION PLAN**

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Socio-economic development is very important for our livelihood and provides services, income and employment opportunities, and hence activities such as sand mining are vital and necessary for development. However, such developmental activities should be conducted in a thoughtful and forward looking manner. In other words, developmental activities, such as establishment of borrow pits to source road construction material should consider the future land use after such activity has come to an end. Therefore to ensure that the land remains valuable for other land uses in the future, rehabilitation should be part and parcel of such developmental activity right from the beginning and throughout the project lifespan.

The aim of the rehabilitation plan is to ensure soil conservation, prevent soil erosion, re-vegetation and to reduce safety risk (safety for both animals and people) and to ensure that areas such as those that were used as borrow pits for gravel material does not become an eye sore.

### **6.4 What is Rehabilitation?**

Rehabilitation is the process of repairing and taking all necessary actions to limit the damage caused by the developmental activity, to minimise potential danger, to make the land suitable for other uses or simply to beautify the affected area (so that it does not become an eyesore). Rehabilitation can also be referred to as the measures taken to repair damaged environments (example refilling of borrow pits with the overburden, re-vegetating, removal of unwanted infrastructure / cleaning up, etc).

### **6.5 Designing a Rehabilitation Plan**

A rehabilitation plan refers to a set of steps or measures to be taken in-order to ensure that negative impacts associated with the development at hand are mitigated. This however requires prior planning and integration of rehabilitation activities throughout the project lifespan. Meaning, rehabilitation measures should be taken right from the beginning of the project.

The environmental characteristics of an area where a project is located plays a vital role in designing a rehabilitation plan.

## 7 CONCLUSION

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Roads are the veins of economic development and facilitate the movement of goods and services (logistics). Meaning, a comprehensive Road network is one of the key building blocks for socio-economic development in the country. However, road construction requires significant quantities of gravel and water. Hence, sourcing of gravel and water abstraction are inevitable (cannot be avoided). The proposed road upgrades to bitumen standards may require clearance of trees and bush to pave way for road alignment. The number of indigenous trees that will be cleared is not determined as yet and it will form part of the compensation plan that the surveyors will submit to Roads Authority. It is not expected that a lot of trees will be cleared as the gravel roads are already existing. Only trees that are found to be in the road reserve will be required to be cleared. Implementation of prevention measures such as waste management, pollution prevention and control as well as effective borrow pit rehabilitation will prevent any significant long-term negative effects associated with this project during construction.

The upgraded roads will bring about the most positive impacts associated with the operational phase of the project. These include reducing the travel time for the road user, improved road user safety and ensuring better access to the nodes of Bukalo, Muyako, Sizimbukwa and other areas.

Tortoise Environmental Consultants is of the opinion that should mitigation and management measures be implemented as indicated; the project will not affect the natural environment in any detrimental sense. The competent authority should consider issuing the Roads Authority with an Environmental Clearance Certificate (ECC) as the development will bring about great positive socio- economic benefits to the project area. It is recommended that an Environmental Control Officer (ECO) or Site Manager, monitors the preparation, operational and rehabilitation of the borrow pit to ensure that the mitigation and rehabilitation measures prescribed in this report are adhered to. The aim of the EMP is to ensure legal compliance to prevent environmental fatal flaws. Non-compliance against the EMP is punishable and specific responsibilities has been assigned to role players in-order to ensure that the EMP is implemented. The key role-players are defined under section 4 should:

- **Read** the EMP (particularly the Project Manager) and ensure that they are fully conversant with provisions of the EMP,
- If need be, **Ask for clarity** from the Environmental Assessment Practitioner (EAP), Environmental Compliance Officer (ECO) or relevant authority,
- Ensure implementation of the recommended mitigation measures, and
- Communicate defaults / challenges to the ECO as soon as possible.

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