Tortoise Environmental Consultants(TEC)
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ENVIRONMENTAL SCOPING REPORT (ESR)

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

ROADS AUTHORITY
SAFE ROADS TO PROSPERITY

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ECC Application Reference number		
Listed Activity	Activity 10: Infrastructure: 10.1 The Construction of (b) Public roads Activity 3: Mining and Quarrying Activities: 3.2 The Other forms of mining or extraction of any natural resources whether regulated by law or not Activity 8: Water Resource Development 8.1 The abstraction of ground or surface water for industrial or commercial purposes	
Location	Zambezi Region, Katima Rural Constituency	
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1 EAP – Environmental Assessment Practitioner

Executive Summary

This Environmental Scoping Report (ESR) and Accompanying Environmental Management Plan (EMP) are compiled to guide construction works of the proposed upgrade of DR3507 Bukalo - Ngoma and DR3559 (60 km) Silumbi – Sizimbukwa (15 km) to bitumen standards, Zambezi Region. The environmental scoping report aims to assess the potential environmental impacts associated with the upgrade of the two roads to bitumen standards. The project involves upgrading existing roads to improve quality, capacity, and safety by applying a bitumen surface. The report identified potential environmental risks and proposes mitigation measures to minimize or eliminate adverse impacts that may arise.

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 these toads. Upgrading the two roads will help alleviate the current problems that the locals are faced with in accessing basic services such as clinics, markets and schools. 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 ESR and EMP for submission to the Department of Environmental Affairs. The SR states the potential impacts that the proposed project may have on the socio-economic and bio-physical environment. 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 Scoping Report.

Potential impacts linked to the proposed road upgrade have been assessed, and mitigation measures were identified and have been recommended for adoption by the project proponent to manage the road upgrade activities. It is imperative that all activities during the duration of the road upgrade should conform to the Environmental Management Act of 2007 and EIA regulations of 2012. Upon approval of the Environmental Clearance Certificate, the proponent (Roads Authority) should commit and abide to the recommended mitigation and rehabilitation measures as prescribed herein.

ACRONYMS

BID	Background Information Document
DEA	Department of Environmental Affairs
DSR	Draft Scoping Report
EA	Environmental Assessment
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
ECC	Environmental Clearance Certificate
ECO	Environmental Compliance Officer
EIA	Environmental Impact Assessment
EMA	Environmental Management Act (No. 7 of 2007)
EMP	Environmental Management Plan
ESR	Environmental Scoping Report
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 Consultancy

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1. INTRODUCTION

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.

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).

1.2. Terms of Reference

This document is prepared as part of the Environmental Impact Assessment (EIA) and scoping exercise, aimed at obtaining an Environmental Clearance Certificate (ECC) for the proposed upgrade of two roads DR3507 and DR3559 to bitumen standards.

Tortoise Environmental Consultants (TEC) is appointed to carry out the requisite scoping assessment and develop an Environmental Management Plan (EMP). The scoping process 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.

Specific undertakings are:

a) Provide a detailed description of the road upgrade project, including its location, length and any associated infrastructure or construction activities. Highlight the reasons for the upgrade and the anticipated benefits it will bring.
b) Provide an outline of the relevant environmental legislation and regulations that apply to the project. Provide approaches to be implemented in compliance with the respective regulations, including any additional permits that may be required.
c) Provide a baseline analysis of the environmental and socio-economical conditions of the project area.
d) Identify potential impacts and provide mitigation measures to be implemented through the Environmental Management Plan.

1.3. What is an Environmental Impact Assessment (EIA)?

An Environmental Impact Assessment (EIA) is a tool to manage negative environmental impacts that may arise from the proposed development and is aimed at guiding the proposed activities to be more environmentally friendly and to comply with the provisions of the Environmental Management Act (Act No.7 of 2007).

An EIA is a systematic process of identifying, predicting, evaluating and mitigating the potential environmental and social effects that may arise from the activities of a proposed project. The aim of the EIA is to reduce negative impacts (effects) and maximize positive impacts, through the adoption of best environmental practices and application of the precautionary principle.

1.4.1 Identification and Mitigation of Impacts

The backbone of the EIA report entails identification of impacts (whether real or perceived) and recommendations on suitable mitigation measures to ensure compliance with the principles of environmental management and highlight risks and measures to ensure an environmentally friendly development.

1.4.2 Rehabilitation

The EIA should not only focus on mitigating the impacts of the activity during the active operations but also should go further and recommend rehabilitation measures at project closure (when activities cease). Rehabilitation measures should not be parked waiting for project closure but should be implemented from the beginning and incrementally throughout the project lifespan.

1.4. Project Alternatives

As stipulated in the Environmental Management Act (EMA) and EIA regulations, alternatives should be considered during the project design, to determine if an alternative route (different locality) or alternative project (different activity) would yield better environmental and socio-economic benefits.

1.5. No-Go Alternative

If this option is considered, it would mean that the current status quo will prevail. The community members will continue using the gravel roads, and Roads Authority will still incur high maintenance costs of perioding re-gravelling.

Should the no-go alternative be considered, it would also mean that the opportunity costs stemming from socio-economic boost during construction as well as operational uses of the tarred roads by the local community will not be realised. These include job opportunities for the local community members as well as provision of an improved road network.

1.6. Environment vs 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 (e.g. road upgrades) and maintaining biological diversity can be a challenge. Therefore, the environment and development sectors should work together and devise

synergies to ensure that natural resources are utilized in a 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, such impacts should be mitigated through the 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.

The importance of upgrading roads DR3507 and DR3559 to Low Volume Seal standards could be seen as follows:

a) To serve the local communities and tourists while reducing road user costs.
b) To save on maintenance costs arising from rising traffic volumes.
c) To improve the road network connection and provide easier access to amenities such as schools, police station, clinics and the various government entities.
d) Improve access to communal farmers to be able to transport their livestock to markets up to Katima Mulilo.

Considering the socio-economic benefits generated by the labour-based construction methods that will be used, unemployed locals will be employed temporarily. Small-Medium Enterprises will also be boosted through opportunities to provide services and construction material.

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^2 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 Sizmbukwa 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 with some sections being too flat and susceptible to flooding when it rains.

2.2 The Physical Environment

In contrast to the rest of Namibia, the 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.

2.3.1 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 *Afzelia 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.

2.4 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

2.5 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;

2.5.1 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.

2.5.2 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.

2.6 Approach to 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.

2.7 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.

2.8 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
	140	White Calcrete
	150	Dark Calcrete Fill
	80	Light Brown Calcrete
	50	Brown Clay
	In-situ material	

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 1: 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) Centreline 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
	In-situ material	

Table 2: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.

	Hole No.	Chainage	Offset	Depth/Penetration (mm)	mm/blow	In-Situ (CBR)
D3507	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

Hole No.	Chainage	Offset	Depth/Penetration (mm)	mm/blow	In-Situ (CBR)
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
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

	Hole No.	Chainage	Offset	Depth/Penetration (mm)	mm/blow	In-Situ (CBR)
D3559	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 3: 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° 24.464253°	G4,G6,G9	SSG
2	Existing B/P 2	Madololo	LHS	13+850	-17.834214° 24.464731°	G4,G9,<G9	SSG
3	Existing B/P 1	Iseke	LHS	16+850	-17.854278° 24.443520°	G8,<G9	Fill Borrow pit
4	Existing B/P 3	Muyako	LHS	20+100	-17.876822° 24.425325°	G5,G6	Base & Sub-Base
5	Existing B/P (First Capital)	Muyako	LHS	20+100	-17.875187° 24.426348°	G4	Base & Sub-Base
6	New B/P 1	Muyako	LHS	21+200	-17.875170° 24.412250°	G5,G5,G8,	Base, Sub-Base & Fill
7	New B/P 8	Muyako	LHS	22+100	-17.883809° 24.421989°	G5,G6,	Base & Sub-Base
8	Existing B/P 4	Muyako	LHS	24+000	-17.898394° 24.423800°	G4,G5,G7,G8,G9	Base, Sub-Base & Fill
9	Existing B/P 5	Muyako	RHS	24+500	-17.902968° 24.426426°	G8,<G9	Fill
10	Existing B/P 1	Mahundu	RHS	29+950	-17.926275° 24.473094°	G4,G6	Base & Sub-Base

11	Existing B/P 1	Liselo	LHS	47 KM of haulage to start of D3507	-17.574866° 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 4: 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^3)	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	0.0	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 5: Existing earth dams and bore holes along DR3507

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

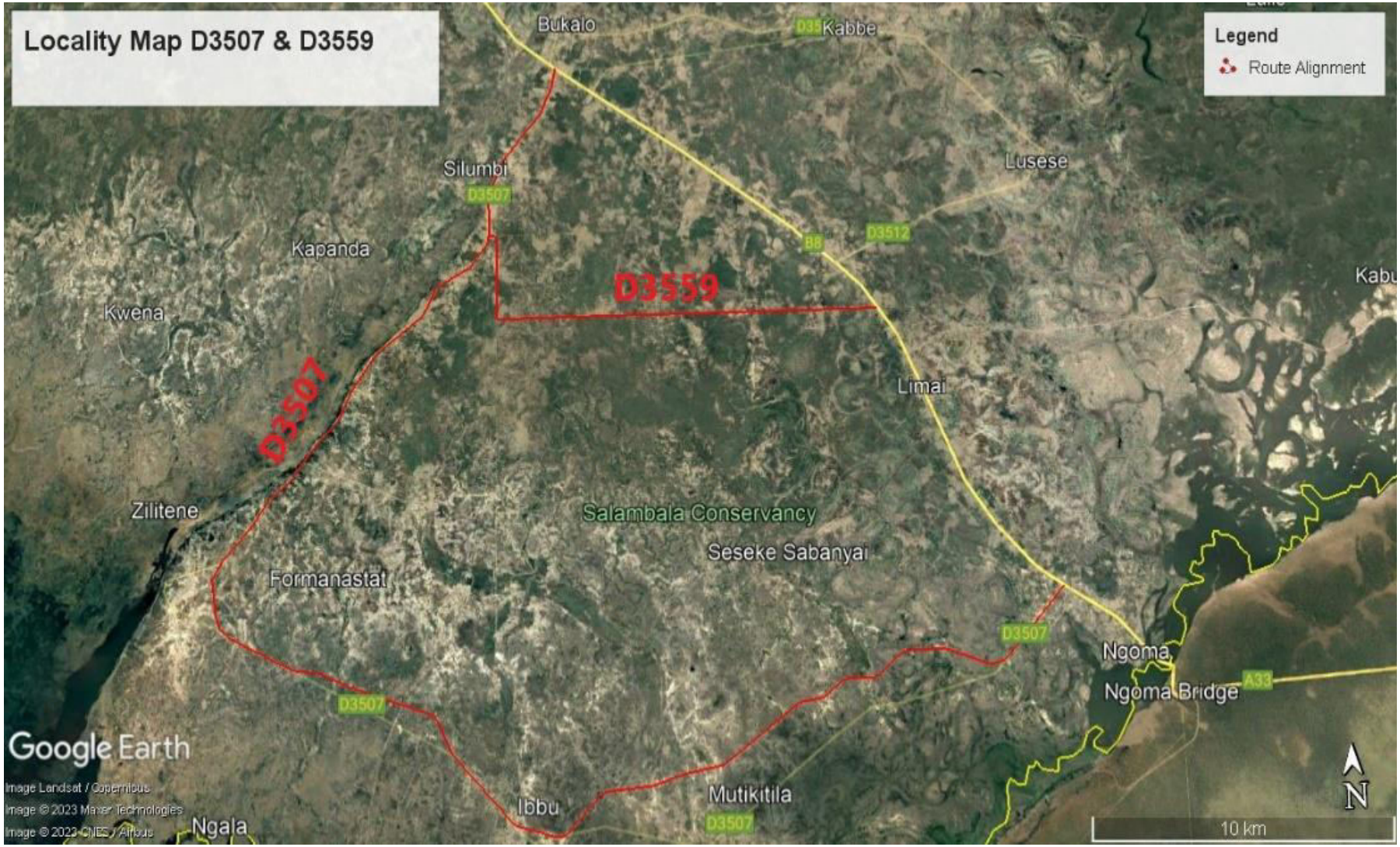

Figure 7: locality of DR3507 & DR3559 as highlighted with the green thick red line

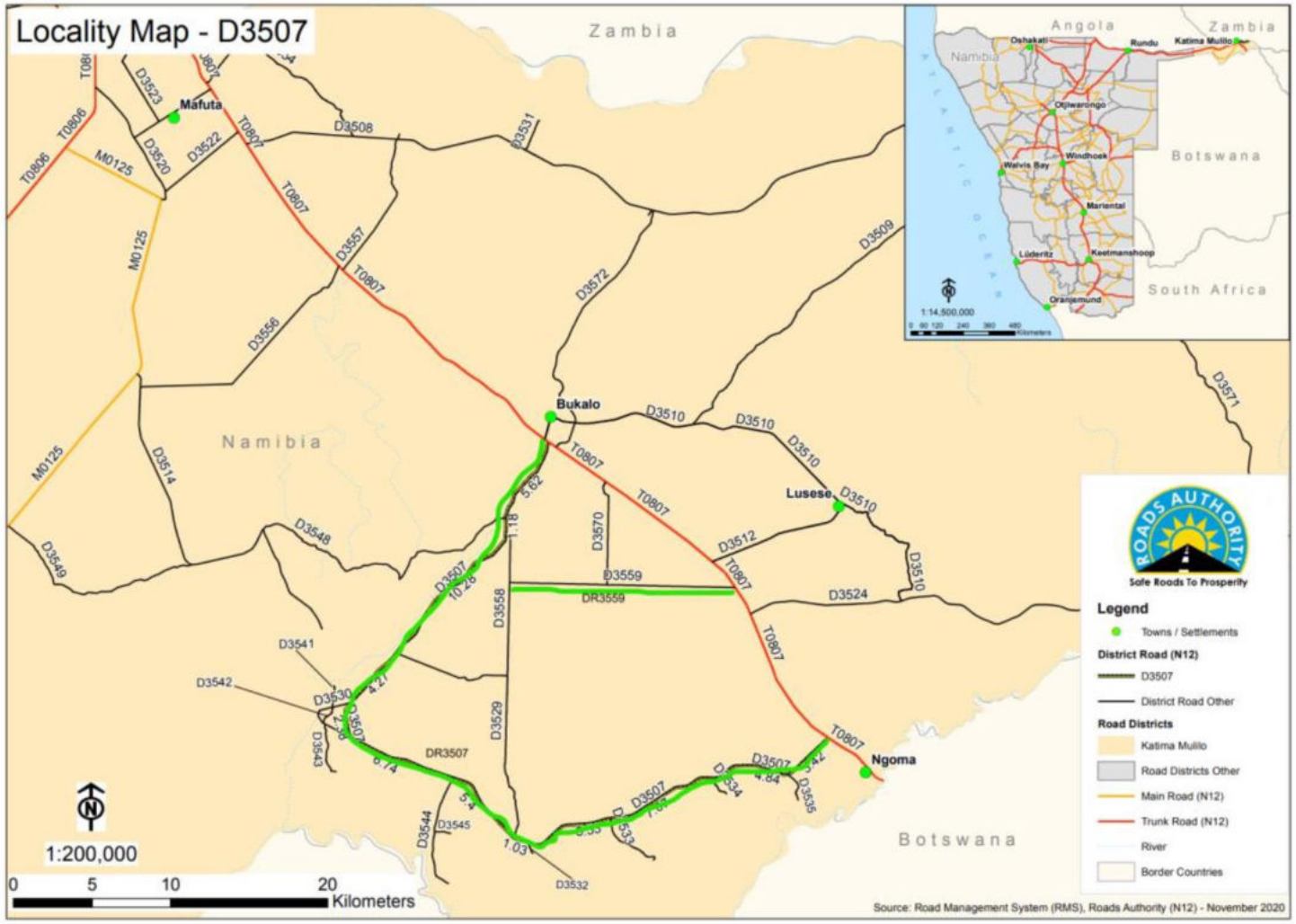

Figure 8: Locality of DR3507 & DR3559 as highlighted with the green thick line

3. LEGAL AND DEVELOPMENTAL FRAMEWORK

This chapter outlines the regulatory framework applicable to the proposed project. Table 6 provides an overview of applicable policies, plans and strategies and Table 5 provides a list of applicable national legislation.

3.1. Compliance to the EMP to the Environmental Management Act

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."

3.2. 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 proposed 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 6: Listed activities triggered by the proposed road construction.

Activity	Applicability
Activity 10: Infrastructure: 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 3.2 The Other forms of mining or extraction of any natural resources whether regulated by law or not. 3.3 Resource extraction, manipulation, conservation and related activities	The project entails establishment of borrow pits to source gravel and other material for road construction
Activity 8: Water Resource Development 8.1 The abstraction of ground or surface water for industrial or commercial purposes	The project will include water abstraction activities for road construction

3.3. Additional Permits

There might be a need to drill boreholes to supplement the available water sources in the form of old borrow pits. The contractor will determine sufficiency of water sources prior to construction.

3.4. 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 6, below. The proponent has the responsibility to ensure that the sand mining operations conforms to all other National developmental plans and legal framework.

Table 7: Legal frameworks and policies concerned with the project

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 Assessment Policy (1995)	Promotes Sustainable development and Environmental Conservation emphasize the importance of environmental assessments as a key tool towards environmental sustainability	Environmental Protection
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

National Statutes	Relevance	Applicability to the Proposed Project
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)	management. The project is therefore to be implemented in accordance with the EMA Act and associated regulations.
Soil Conservation, 1969 (Act 76 of 1969) and the Soil Conservation Amendment Act (Act 38 of 1971)	Makes provision for the prevention and control of soil erosion	Monitor and apply the soil conservation mechanisms
Forest Act 12 of 2001 Forest Act Regulations 2015	To provide for the protection of the environment and the control and management of forest. Relevant sections: - Approval required for the clearance of vegetation on more than 15 hectares (Section 23, subsection 1 (b)).	Forestry permits maybe required for vegetation clearing
Public Health Act (Act No. 36 of 1919)	Advocates for Public Health and safety	Personal Protective Equipment (PPE)
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”
Roads Authority Act, 1999	The act places a duty on the Roads Authority to ensure a safe road system	Due to the nature of the project being road upgrade, this legislation needs to be taken into consideration.
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. IMPACT ASSESSMENT METHODOLOGY

4.1 Assessment of Impact Significance

The significance of an impact is determined by considering and measuring the temporal and spatial scales and magnitude of the project and the specific activities associated with the project.

The assessment of the environmental impacts of development activities should strive to be always objective and impartial. However, environmental assessment processes can be exposed to subjectivity inherent in attempting to measure significance.

The determination of the significance of an impact depends on both the context (spatial and temporal scale) and intensity of that impact.

4.2 Impact Assessment Criteria

For each impact, the **EXTENT** (spatial scale), **MAGNITUDE** and **DURATION** will be described. These criteria would be used to ascertain the **SIGNIFICANCE** of the impact, firstly in the case of no mitigation and then with the most effective mitigation measure/s in place. The mitigation described in the Scoping Report would represent the full range of plausible and pragmatic measures.

Table 4-1: Assessment criteria for the evaluation of impacts

CRITERIA	CATEGORY	DESCRIPTION
Extent or spatial influence of impact	**National**	Beyond a 20km radius of the site
	Regional	Within a 20 km radius of the site
	Local	Within a 2 km radius of the centre of the site
	Site specific	On site or within the boundaries of the property
	Zero	
Magnitude of impact (at the indicated spatial scale)	**High**	Natural and/ or social functions and/ or processes are *severely* altered
	Medium	Natural and/ or social functions and/ or processes are *notably* altered
	Low	Natural and/ or social functions and/ or processes are *slightly* altered
	Very Low	Natural and/ or social functions and/ or processes are *negligibly* altered
	Zero	Natural and/ or social functions and/ or processes remain *unaltered*
Duration of impact	**Zero**	Zero time
	Short Term	Up to 18 months

	Medium Term	0-5 years (after operation)
	Long Term	5- 10 years (after operation)
	Permanent	More than 10 years (after operation)
Probability	**Definite**	Estimated greater than 95 % chance of the impact occurring.
	Very likely	Estimated 50 to 95% chance of the impact occurring
	Fairly likely	Estimated 5 to 50 % chance of the impact occurring.
	Unlikely	Estimated less than 5 % chance of the impact occurring.
	Zero	Definitely no chance of occurrence
Confidence	**Certain**	Wealth of information on and sound understanding of the environmental factors potentially influencing the impact.
	Sure	Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact.
	Unsure	Limited useful information on and understanding of the environmental factors potentially influencing this impact.
Reversibility	**Irreversible**	The activity will lead to an impact that is permanent.
	Reversible	The impact is reversible, within a period of 10 years.

4.3 Mitigation Measures

For each impact assessed, mitigation measures should be identified to reduce and/ or avoid negative impacts. These mitigation measures are also incorporated in the Environmental Management Plan (EMP) to ensure that they are implemented throughout the lifespan of the proposed activity. The EMP forms part of the Scoping Report, and upon project approval, the implementation thereof, would become a binding requirement.

4.4 Mitigation Hierarchy

Actions to mitigate a potential impact can be done in as systematic manner as guided by what is referred to as Mitigation Hierarchy (Figure 4).

From the onset, the positive impacts of the proposed activity should be enhanced, however, where an impact in is inevitable, the following sequence should be followed.

Impact avoidance: This step is most effective when applied at an early stage of project conceptualization and planning. It can be achieved by:

- Not undertaking certain projects or elements that could result in adverse impacts;
- Avoiding areas that are environmentally sensitive; and
- Putting in place preventative measures to stop adverse impacts from occurring.

Impact minimisation: This step is usually taken during impact identification and prediction to limit or reduce the degree, extent, magnitude, or duration of adverse impacts. It can be achieved by:

- Scaling down or relocating the proposal;
- Redesigning elements of the project; and
- Taking supplementary measures to manage the impacts.

Impact compensation: This step is usually applied to remedy unavoidable residual adverse impacts. It can be achieved by:

- Rehabilitation of the affected site or environment, for example, by habitat enhancement;
- Restoration of the affected site or environment to its previous state or better; and
- Replacement of the same resource values at another location (off-set), for example, by wetland engineering to provide an equivalent area to that lost to drainage or infill.

Figure 9: Mitigation Hierarchy

5 ENVIRONMENTAL IMPACT ASSESSMENT

Due to the type of activities associated with road construction, it is almost definite that there would be hazardous and toxic material present on site. Construction of a gravel road requires consideration of environmental and social aspects that may be affected. This section presents the potential impacts that may arise from the proposed road upgrade activities. The full mitigation measures are presented in the EMP.

The objectives of the assessment are to identify and quantify the potential positive and negative impacts which the proposed gravel road will have on the receiving biophysical and socio-economic environment. The following impacts were identified, and their mitigation measures are described below.

5.1 Landscape Alteration

With the excavations and establishment of borrow pits to source gravel material for road construction, the mining activity makes use of heavy machinery and deep excavations that has potential to alter (change) the natural view of the landscape.

<table>
<tr><td>IMPACT DESCRIPTION:</td><td colspan="3">Vegetation clearing</td></tr>
<tr><td>Predicted for (specific activity)</td><td colspan="3">Cutting and Excavations</td></tr>
<tr><td>Dimension</td><td>Rating</td><td colspan="2"></td></tr>
<tr><td>Duration</td><td>Permanent</td><td rowspan="3">Reversibility:
Reversible</td><td rowspan="3">Degree to which impact can be mitigated:
High</td></tr>
<tr><td>Extent</td><td>Site specific</td></tr>
<tr><td>Magnitude</td><td>Low</td></tr>
<tr><td>Probability</td><td colspan="2">Fairly likely</td></tr>
<tr><td colspan="4">MITIGATION:
• If possible, rehabilitate borrow pits that were used to source construction material by refilling the pit with overburden top-soil, and revegetation.
• Should the local community opt to maintain the borrow pit, the contractor must level it off in a manner that does not leave a steep gradient. The edges must be well compacted to avoid slipping of livestock and humans.</td></tr>
</table>

5.2 Borrow pit edges and steepness.

Steep borrow pit edges presents potential danger to people and wildlife and should be smoothened to create gentle slopes.

IMPACT DESCRIPTION:	**Borrow pit edges and steepness**		
Predicted for (specific activity)	**Excavations**		
Dimension	**Rating**		
Duration	**Long term**	Reversibility: **Reversible**	Degree to which impact can be mitigated: **High**
Extent	**Site specific**		
Magnitude	**Low**		
Probability	**Very likely**		
MITIGATION: • Smoothen the borrow pit edges to ensure that the angles are not steep sloped, but rather gentle sloped at less than < 30° slope angles. • The principle idea is for the borrow pit edges to gentle so that the is no tipping point, where people or livestock can fall in. Meaning even if the is water, people and livestock can go in with minimal danger.			

5.3 Biodiversity (Fauna and Flora)

Although the sites that are to be used for sourcing gravel and construction material are often barren (and cleared of vegetation), due consideration should be made to ensure minimal disturbance to the general surrounding landscape of the area.

IMPACT DESCRIPTION	**Biodiversity (Fauna and Flora)**		
Predicted for (specific activity / project phase)	**Excavation of road construction material**		
Dimension	**Rating**		
Duration	**Long term**	Reversibility: **Reversible**	Degree to which impact can be mitigated: **High**
Extent	**Site specific**		
Magnitude	**Low**		
Probability	**Unlikely**		
MITIGATION: • Stockpile the topsoil overburden, to be re-used during rehabilitation after mining operations and to aid the re-establishment of vegetation. • Implement appropriate protection measures to prevent wildlife conflict. • Observe local regulations such as wildlife crossing signage to minimize wildlife collision.			

5.4 Pollution: Noise and Dust

The proponent should ensure noise from excavator machinery and transportation trucks is kept below the recommended noise levels of -85dB.

IMPACT DESCRIPTION	**Noise and Dust**		
Predicted for (specific activity / project phase)	**Extraction and transportation of the sand**		
Dimension	**Rating**		
Duration	**Short term**	Reversibility: **Reversible**	Degree to which impact can be mitigated: **High**
Extent	**Local**		
Magnitude	**Medium**		
Probability	**Definite**		
MITIGATION: • Where possible, use dust suppression measures to mitigate dust impacts. • Provide dust masks and ear muffs to machinery operators. • Where possible, install silencers on exhaust to reduce noise levels. • Avoid working during times with excessive wind that may be a nuisance to nearby communities.			

5.5 Oil Spills (Pollution)

Soil pollution may occur as a result of oil and fuel leakages from machinery that is being used.

IMPACT DESCRIPTION	**Soil Pollution**		
Predicted for (specific activity / project phase)	**Oil Leakages from Machinery**		
Dimension	**Rating**		
Duration	**Short-term**	Reversibility: **Reversible**	Degree to whic impact can be mitigated: **Medium**
Extent	**Local**		
Magnitude	**Low**		
Probability	**Definite**		
MITIGATION: • Operators should be trained on dangers of oil pollutions & response action • There must be an oil spill response kit on site • If an oil spill occurs, collect the contaminated soil, store in drums or appropriate structures and dispose at approved waste disposal site;			

- Ensure all vehicles / machinery are well serviced, install drip trays and conduct regular leak inspection.

5.6 Ground Water abstraction and Storm water management

Proper management of storm water runoff is essential to prevent ponding and flooding. The road design must include sufficient drainage ditches, culverts, and retention ponds to control and treat stormwater runoff, thus reducing the risks.

<table>
<tr><td>IMPACT DESCRIPTION:</td><td colspan="3">Storm water management</td></tr>
<tr><td>Predicted for (specific activity / project phase)</td><td colspan="3">Drainage structures</td></tr>
<tr><td>Dimension</td><td colspan="3">Rating</td></tr>
<tr><td>Duration</td><td>Short term</td><td rowspan="3">Reversibility:
Reversible</td><td rowspan="4">Degree to which impact can be mitigated:
High</td></tr>
<tr><td>Extent</td><td>Local</td></tr>
<tr><td>Magnitude</td><td>Medium</td></tr>
<tr><td>Probability</td><td colspan="2">Highly likely</td></tr>
<tr><td colspan="4">MITIGATION:
• Ensure that sufficient space and size of drainage structures do not obstruct natural water flow regimes.
• Incorporate sufficient drainage systems to manage surface runoff and prevent water pollution.</td></tr>
</table>

5.7 Solid Waste Management

Construction camps throughout the project construction phase must be managed effectively. Such camps can have significant impacts on surrounding communities for the duration of the road construction. Waste management should be prioritized accordingly.

Domestic and waste generated at the contractor camps can be easily managed through implementation of waste management plans. Therefore, a waste management plan should be developed to minimize accumulation of construction materials. Hazardous materials such as used oil and metals must be disposed according to prevailing national regulations.

<table>
<tr><td>IMPACT DESCRIPTION:</td><td colspan="3">Solid Waste Management</td></tr>
<tr><td>Predicted for (specific activity / project phase)</td><td colspan="3">Mining Operations</td></tr>
<tr><td>Dimension</td><td colspan="3">Rating</td></tr>
<tr><td>Duration</td><td>Short term</td><td rowspan="3">Reversibility:

Reversible</td><td rowspan="3">Degree to which impact can be mitigated:
High</td></tr>
<tr><td>Extent</td><td>Local</td></tr>
<tr><td>Magnitude</td><td>Medium</td></tr>
<tr><td>Probability</td><td colspan="2">Highly likely</td></tr>
<tr><td colspan="4">MITIGATION:
• No random disposal of solid waste (use designated sites to dispose)
• Adopt the principle of what goes in the camp, goes out.</td></tr>
</table>

5.8 Socio-Economic Opportunities

The field assessment revealed that several T-Junctions, access routes and intersections (including staggered intersections) will also be upgraded as part of the road upgrade.

Often intersections are popular spots for vendors to erect business structures, as well as hitchhikers wait for a lift. Thus, this increases accident risks at such spots. Provision for properly designed pick-up areas close to intersections should be considered as this will prevent vehicles from stopping at these high accident risk zones.

Erect signage and pedestrian crossings to ensure safety of the road users at busy intersections. It is further recommended that a comprehensive community engagement approach be implemented to keep members informed on a regular basis as the project progresses. Such a mechanism would also be used to discuss concerns and provide an opportunity for feedback and ensure transparency.

5.9 Potential Positive Impacts

Positive impacts can be considered as those induced by the activity, either directly or indirectly, that provides benefits to the local communities and receiving environment. These can be identified as the following:

Short term employment opportunities

Short term opportunities of employment will be created with the commencement of the road construction and this will benefit the local communities in the area. To harness these employment opportunities, it is recommended that the contractor be compelled to prioritise locals for labour intensive construction methods. Where feasible, local sub-contractors should also be considered. The jobs created will increase spending power, from the wages and salaries earned, as well as from local procurement of goods, materials and services.

Increased safety – traffic

The gravel road will be safer to the road users. Improvement of the road signage is also a requirement. Awareness will be required to sensitize people on the danger of driving at higher speeds and to adapt their usage and lives accordingly, especially pedestrian users.

Reduced travel times and operating costs

One of the most significant benefits of the upgrading will be the decrease in travel time. This will constitute tremendous cost savings and increase production turn-around times significantly thereby stimulating the local and regional economy. Vehicle operating costs in terms of maintenance and energy inputs will be decreased through the upgrade, once again contributing to stimulating efficiency and cost savings.

Improved access to markets and commerce

Increased access will enhance the local and regional economies by allowing faster and more efficient access to local, regional and export markets. Produce spoil will also be decreased with accelerated transportation. The provision of services and commodities in the local communities and settlements will also increase with the easier access and delivery of goods. Faster access will further open the area to the easy promotion of tourism opportunities.

The road will play a critical role towards improved road infrastructure and subsequently also improved socio-economic conditions. In summary the above potential negative impacts are not significant to stop the project from proceeding due to most impacts already existing from the road which was initially constructed.

6 PUBLIC PARTICIPATION PROCESSESS

Public consultation is a requirement by law (EMA No 7 of 2007) to be incorporated into an EIA process, hence it is a fundamental part of the EIA. Public consultation ensures robust decision making by involving Interested and Affected Parties (I&APs). The PPP has therefore been structured to provide I&APs an opportunity to gain more information on the proposed project and for them to provide inputs through the review of documents/reports, and to flag any issue of concern during the PPP process.

6.1 Authority Consultation

Consultations were made with the Regional Council in Katima Mulilo where a public meeting was convened on 30 March 2023 at Zambezi Regional Council Offices. The meeting was chaired by Honorable Matengu Simushi, Councillor for Katima Rural Constituency. In attendance was the Honorable Governor of Zambezi Region as well as representatives of the Constituency Development Committee (CDC); and the general public.

Referrer to Annexure A on public participation documents.

6.2 Public Meeting

- 1st public meeting was convened on 30 March 2023 at Zambezi Regional Council Offices in Katima Mulilo.
- 2nd public meeting was convened on 30 March 2023 at Katima Rural Constituency Office in Bukalo.

The meeting participants were informed that there are people that have established structures within the road reserve of the existing gravel roads. Such structures may need to be relocated to pave way for the road upgrade. A National Compensation Policy Guidelines for Communal Land 2009 will be used in instances where communal land will need to be taken over for the purposes of the proposed road upgrade. A request was made for Roads Authority to provide a complete list of the community members that will be required to move.

There will be feeder roads that will be constructed to connect to social amenities such as schools and clinics. The members requested that Roads Authority consider upgrading the longer access routes to low volume seal.

6.3 Outcomes from Public Consultations

Meeting participants indicated that unemployment is a serious problem/concern in their area that affects their lives negatively. As a coping mechanism to unemployment and to supplement income, some community members venture into small and medium business enterprises most of which are informal. The proposed road construction is expected to improve accessibility to products and associated business services for entrepreneurs and business owners. The contractors are urged to consider giving the local community members priority especially for labour-based opportunities. These are job opportunities that may not require technical expertise, thus local labour force should be prioritised.

The road upgrade is welcomed as it will improve the current status of the gravel roads which often get slippery and dangerous during rainy seasons. The Roads Authority and respective contractors are implored to maintain communication with the office of the regional council, to ensure that information is disseminated timeously.

Public meeting at Zambezi Regional Council Offices

Public meeting at Bukalo

7 CULTURAL HERITAGE

7.1 Cultural Heritage – Legal Requirements

The principal instrument of legal protection for heritage resources in Namibia is the National Heritage Act (27 of 2004), Part V Section 46, which prohibits the removal, damage, alteration or excavation of heritage sites or remains (defined in Part 1, Definitions 1), whilst Section 48 sets out the procedure for application and granting of permits as may be required in the event of damage to a protected site occurring as an inevitable result of the proposed development. This legislation obliges a developer to identify any heritage sites before project implementation.

Furthermore, Section 51 (3) sets out the requirements for impact assessment. Part VI Section 55 Paragraphs 3 and 4 require that any person who discovers an archaeological site should notify the National Heritage Council.

In-addition to the National Heritage Act (No. 27 of 2004), international guidelines such as the World Bank OP and BP of 2006, particularly guideline no: 4.11 which refers to the "Physical Cultural Resources" (R2006-0049), and provide direction regarding project screening, baseline survey and mitigation.

Archaeological impact assessment is also a requirement of the Environmental Management Act (7 of 2007) and EIA regulations (Government Notice 30 of 2012) includes the mitigation of impacts on archaeological sites, remains or and artefacts.

7.2 Archaeological Assessment Methodology

The archaeological assessment carried out in and around the project site relies on the indicative value of surface finds for cultural and heritage artefacts.

Following standard practice both in Namibia and internationally, a chance-find procedure for cultural heritage should be recommended as a component of the Environmental Management Plan (EMP), and the necessary precautions should be taken throughout the project lifespan.

7.3 Cultural Heritage sites / artefacts within the Proposed Road upgrade area

a) **NO** cultural heritage sites or artefacts are registered by the National Heritage council in or around the proposed sand mining site.

b) **NO** cultural heritage sites or artefacts are known to occur in or around the sand mining site (local knowledge),

c) **NO** cultural heritage sites or artefacts were observed within the proposed Sand mining site,

7.4 Limitations

Although, there were no surface finds for cultural and heritage artefacts, there is a possibility that there could be cultural or heritage artefacts underground (e.g., unknown war graves, fossils etc), that could be uncovered during excavations for road works and establishment of borrow pits for road construction material.

7.5 Recommendations

Based on the limitations, it is recommended that:

i. All employees, contractors or sub-contractors working on the sand mining site should be made aware that it is a legal requirement under the National Heritage Act that if any items protected under the definition of heritage is found during the course of development should be reported to the National Heritage Council.

ii. The management of the sand mining operation should be conducted in a vigilant and cautious manner, and

iii. If any cultural artefacts are found during the sand mining activities, the necessary steps and due process as presented in the EMP should be followed.

8 REHABILITATION PLAN

Socio-economic development is very important for our livelihood and provides services, income and employment opportunities, and hence activities such as road construction 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, 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 shore.

8.1 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).

8.2 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.

9 CONCLUSION

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 as construction material are inevitable (cannot be avoided).

The proposed road upgrades will 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.

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