INCEPTION REPORT

ROADS AUTHORITY

Safe Roads to Prosperity

CONTRACT NO. W/DP/RA-22/2020

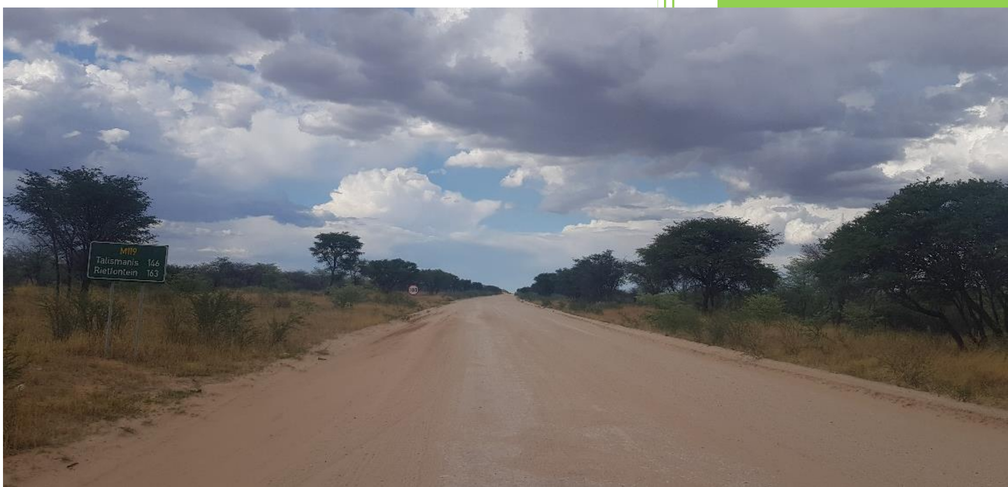
FOR

CONSULTANCY SERVICES FOR

DESIGN AND CONTRACT DOCUMENTATION TO UPGRADE 145KM OF M0119 (T0602 TO TALISMANIS) TO LOW VOLUME SEAL

INCEPTION REPORT

May 2021



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1. INTRODUCTION

1.1 OVERVIEW

Tulipamwe Consulting Engineers has been appointed for the Emergency Consulting Services for the Design and Contract Documentation for Upgrading 145km of M0119 (T0602 to Talismanus) to Low Volume Seal.

The project area is shown in Figure 1 below.

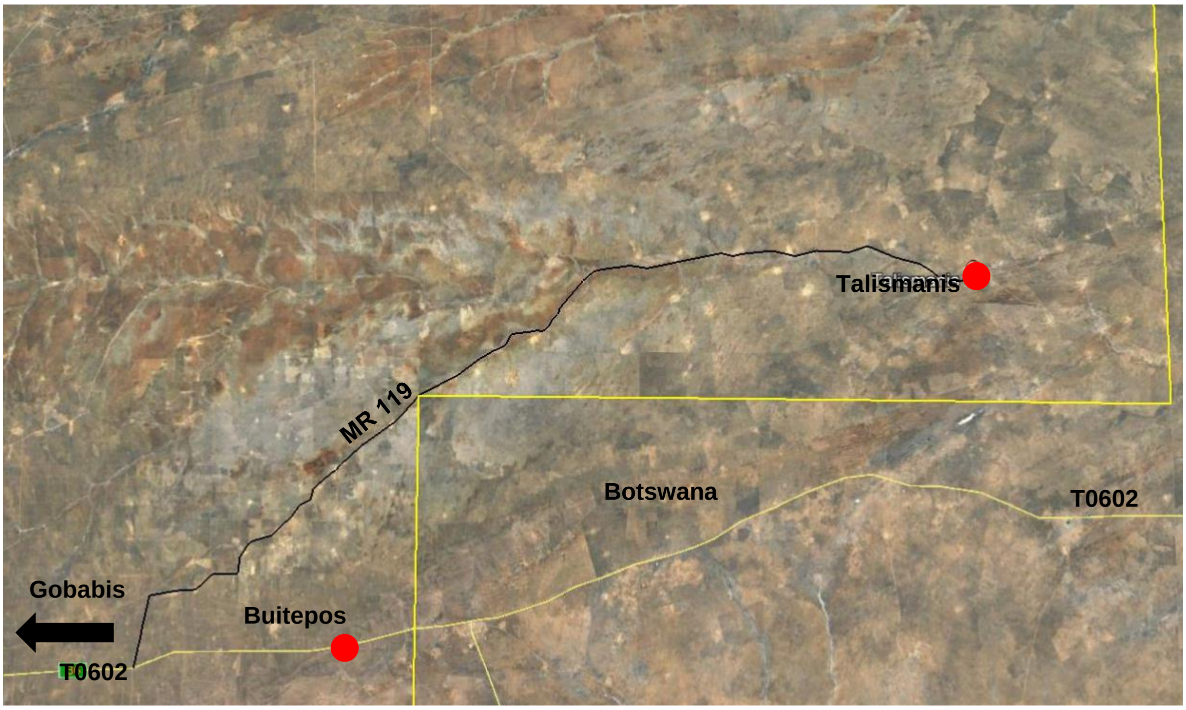

Figure 1: Locality Sketch

1.2 IMPORTANCE OF THIS PROJECT

As part of its mandate, the Roads Authority must ensure that the marginalized communities are served by the national road network. Main Road 119 provides access, to essential services like schools and medical facilities, to the Talismanis community. Maintaining the existing gravel road has become costly due to the excessive deterioration and upgrading the road is more feasible.

1.3 PURPOSE AND EXTENT OF THIS INCEPTION REPORT

The purpose of the inception stage and the preliminary investigation is to confirm the route location and establish the general design features of the proposed roads.

This Inception Report is submitted as part of the pre-construction phase for the Project and includes a brief review of the following:

- Traffic data
- Design standards (geometric, drainage, materials)
- Standard of the existing horizontal and vertical alignment
- Preliminary pavement design

- Preliminary assessment of locally available materials

1.4 SCOPE OF WORK

The scope of work for the Consulting Services is:

- Environmental impact assessment, including an environmental management plan
- Preliminary investigation and inception report
- Engineering survey
- Borrow pit survey
- Centreline soil survey
- Detailed engineering design
- Contract Documentation

1.5 METHODOLOGY

Data relevant to the design stage was collected and collated and forms the basis for the tasks performed as part of the Inception Stage.

(a) Traffic data from traffic surveys were used as input for the selection of cross-sectional dimensions (Refer to Section 3).

(b) The preliminary horizontal alignment and curve data of the existing route was determined from aerial photographs and compared to the design standards for a 100 km/h design speed to identify possible shortcomings in the route alignment (Refer to Section 4).

(c) The positions and intersection angles of the major intersections of numbered roads were determined from aerial photographs and were assessed in terms of the design (Refer to Section 5).

(d) Drainage standards were proposed (Refer to Section 6).

(e) A preliminary pavement structure was proposed.

(f) A summary of the proposed methodology for conducting the Environmental Impact Assessment (EIA) for the project (Refer Section 9)

(g) Conclusions and recommendations regarding the geometrics of the road, drainage standards, pavement design and material requirements (Refer Section 10)

2. SURVEY

The purpose of surveying and setting-out the roads is to gather the necessary information to complete the detail design and calculate quantities for contract negotiations with the designated contractor for the construction of MR 119.

Furthermore, the Consultant will provide reference beacons (benchmarks) to ensure that the road can be set out correctly during construction.

The survey has commenced and comprises the following:

(a) Control points are to be placed at approximately 4km intervals along the proposed route and the X and Y coordinates will be determined with a Global Positioning System (GPS), and the heights of the control points will be leveled with a digital level.

(b) The natural ground levels along the route will be surveyed to obtain a digital terrain model (DTM) with XYZ coordinates.

Cross-sections shall be extracted from the DTM data and used in the geometric design of the road.

The coordinate system to be used for this project will be the following (LO 22/19):

- Projection: Transverse Mercator
- Central Meridian: 19 degrees East
- Origin Latitude: 22 degrees South
- Datum: Local (obtained from trigonometric beacons in the area)

3. TRAFFIC ANALYSIS

3.1 GENERAL

The purpose of the traffic analysis is to forecast future traffic volumes as design input for the following:

- Total traffic volumes for selecting the appropriate typical cross section and geometric design standards.
- Heavy vehicle traffic as an input into the pavement design

3.2 AVAILABLE INFORMATION

Traffic volume data, obtained from the Roads Authority Traffic Surveillance System is available for the link between Trunk Road 602 to Rietfontein. The latest data available, was obtained in the year 2017.Table 3.1 presents the available historic data.

Table 3.1: Historic Data

Year	Light	Heavy	Total	% Heavy	Count Days
1994	139	18	157	11.2	7
2008	37	6	43	14.8	12
2009	51	8	59	13.2	12
2011	48	11	59	19.1	54
2012	58	10	68	15.2	27
2013	61	6	67	9.4	251
2014	63	7	70	9.8	320
2015	71	5	76	7.3	277
2016	74	6	80	7.4	282
2017	16	0	16	0	15

Based on the count days, the data recorded between the year 2013 and 2016 will be considered as more accurate for consideration in determining the growth rate of traffic for the area.

For current traffic volumes, traffic surveys were conducted on three days of the week during April 2021 and are attached in Annexure B of this report. Counts were done at the following sections:

- At the start of MR 119 where it joins unto T0602
- Intersection of DR 1851 with MR 119

- Intersection of DR 3810 with MR 119
- Intersection of DR 3813 with MR 119
- Section of road before Talismanis

Table 3.2 below, tabulates the estimated AADT for 2021.

Table 3.2: Estimated AADT for 2021

Section	Light Vehicles	Heavy Vehicles	% Heavy Vehicles
T0602/MR 119	104	18	14.8
MR 119/ DR 1851	84	7	7.7
MR 119/ DR 3810	116	9	7.2
MR 119/ DR 3813	71	11	13.4
Talismanis	94	7	6.9

The section of road between the start of MR 119 where it joins unto T0602 and its intersection with DR1851 carries the highest volume of heavy vehicles while the section between DR 1851 and DR 3810 carries the highest volume of light vehicles. The highest total estimated AADT occurs on the latter section. The percentage heavy vehicles for the different sections of the road varies between seven and fourteen percent.

3.3 TRAFFIC GROWTH

3.3.1 Normal Growth

The growth rates based on the National Transportation Master Plan Study (1996), are shown in Table 3.3 below.

Table 3.3: Normal Traffic Growth

Traffic Growth Scenario	Light Traffic	Heavy Traffic
Low growth	3%	1%
Medium growth	6%	3%
High growth	9%	5%

3.3.2 Generated and Diverted Traffic

Generated traffic are the additional vehicle trips that are generated over and above the existing traffic because the road has been improved to a higher standard, in the case of this project from a gravel road to a bituminous surfaced road. Generated traffic is closely related to the development potential of the area.

The current land use of the area traversed is mostly cattle and sheep farming, and further development potential is limited. No significant increase in traffic volumes due to additional traffic being generated is expected.

Diverted traffic is defined as the traffic that would be attracted from other routes within the influence area of the upgraded road to the new surfaced road once completed, whilst still travelling between the same origin and destination. The predicted diverted traffic for MR 119 is considered negligible.

3.4 PROJECTED TRAFFIC VOLUMES

Projected traffic volumes are used to assess the appropriateness of the typical cross-section for the road and as an input into the pavement design.

Construction is expected to be completed at the end of 2025 and traffic volumes for the different traffic growth scenarios have been estimated for the year 2025 using the normal growth rates shown in Table 3.4.

Table 3.4: Projected Traffic Volumes for the year 2025

Section: B6/MR 119	Low	Med	High
Light Vehicles	118	132	147
Heavy Vehicles	19	21	22
AADEVU	178	200	224
Section: MR 119/ DR 1851	Low	Med	High
Light Vehicles	95	107	119
Heavy Vehicles	8	8	9
AADEVU	119	133	149
Section: MR 119/ DR 3810	Low	Med	High
Light Vehicles	131	147	164
Heavy Vehicles	10	11	11
AADEVU	161	181	202
Section: MR 119/ DR 3813			
Light Vehicles	80	90	101
Heavy Vehicles	12	13	14
AADEVU	118	132	147
Section: Talismanis			
Light Vehicles	106	119	133
Heavy Vehicles	8	8	9
AADEVU	130	146	163

The difference in projected traffic volumes for light vehicles, for the three growth scenarios, ranges between eleven and twelve percent. The difference for the increase in heavy vehicles for the three growth scenarios is insignificant. The three growth scenarios requires the same cross-section.

3.5 CONCLUSIONS ON TRAFFIC DATA

Historic data, from the Roads Authority Traffic Surveillance System, was available up to the year 2017. For more accurate determination of the growth rate, data recorded from the year 2013 to 2016 will be considered.

Traffic counts were conducted to determine current traffic volumes. Based on the traffic count data, the projected traffic for 2025 yields the same cross-section for all three scenarios. The difference in the projected heavy vehicle volumes for the three scenarios are minimal and it is unlikely that the pavement structure required will be different for the three scenarios.

4. GEOMETRIC STANDARDS

4.1 GENERAL

The purpose of the preliminary geometric design is to identify possible shortcomings in the geometrics of the existing road and comment on the suitability of design standards and, where necessary, propose appropriate standards.

The following tasks form part of the investigation regarding the geometrics of the roads:

- Determine the horizontal alignment of the existing road
- Assess the geometric characteristics of the existing road in terms of the standards and identify possible shortcomings in the geometric standards of the existing road
- Comment on typical cross-section with due consideration of surfaced road standards
- Propose appropriate design standards for the horizontal alignment and vertical alignment of the roads with due consideration of the projected traffic volumes.

4.2 BASIS FOR DESIGN

The following publications are proposed as guidelines for the geometric design of MR 119:

- Draft Code of Practice for the Geometric Design of Trunk Roads (SATCC, 1998)
- Guidelines for Low-volume Sealed Roads
- NRA Geometric Design Guidelines (SA National Roads Agency Limited)
- TRH17 Geometric Design of Rural Roads
- Roads Authority Typical Drawing No. N2635

4.3 DESIGN SPEED

The Roads Authority's Geometrics Manual refers to the NRA Geometric Design Guidelines for guidance and indicates that design speeds on adjacent sections of the route should also be considered. The following design speed ranges are recommended for different types of terrain.:

Table 4.1: Prescribed Design Speeds

Type of Terrain	Minimum Design Speed
Flat	90-120 (km/h)
Undulating	80-100 (km/h)
Mountainous	60-80 (km/h)

The terrain for the project area is flat and design speeds between 90km/h and 120km/h are applicable. A design speed of 100km/h is considered appropriate considering the terrain and the low traffic volumes recorded for the roads. The design speed will be reduced for sections where the road pass through existing settlements/villages.

4.4 CROSS-SECTION

4.4.1 General

The selection of a typical cross-section is done in accordance with the Roads Authority Typical Drawing No. N2635 and depends on the Annual Average Daily Equivalent Vehicle Units (A.A.D.E.V.U) expected on the road during the first year of the design life (Refer to paragraph 4.4.2 for the determination of the A.A.D.E.V.U.).

The expected A.A.D.E.V.U was done based on the different traffic growth scenarios as discussed in Section 3 of this Report.

4.4.2 Equivalent Vehicle Units

Equivalent Vehicle Units are used for selecting the typical cross-section for the proposed trunk road in accordance with the Roads Authority Typical Drawing No. N2635.

The road cross-section is chosen by determining the “Annual Average Daily Equivalent Vehicle Units” and the corresponding traffic category. The A.A.D.E.V.U is the “Annual Average Daily Traffic” (A.A.D.T) during the first year of the design lifespan expressed in equivalent vehicle units. The A.A.D.T is the sum of the daily traffic volumes recorded for a year and divided by the number of days in the year. No A.A.D.T data is available for the project area and a three-day traffic count was conducted. The traffic volumes on the roads are very low and the road category is of low importance. A survey duration of three days was therefore deemed sufficient. The data collected was converted to average daily traffic (A.A.D.T). A light vehicle is equivalent to one unit and a heavy vehicle of mass 3t or more equivalent to three units. The Annual Average Daily Equivalent Vehicle Units A.A.D.E.V.U. was determined by multiplying the number of heavy vehicles by 3 and adding the result to the number of light vehicles *[e.g. 3 x 54 heavy vehicles + 350 light vehicle = 512].*

The A.A.D.E.V.U. in the expected completion year for different traffic growth scenarios is given in Table 4.2.

Table 4.2: Expected A.A.D.E.V.U during Year of Completion (2025)

Section	Low	Med	High
T0602/MR 119	178	200	224
MR 119/ DR 1851	119	133	149
MR 119/ DR 3810	161	181	202
MR 119/ DR 3813	118	132	147
Talismanis	130	146	163

The following is evident from Table 4.2:

- The A.D.E.V.U for each of the road sections falls within the 150 – 400 A.A.D.E.V.U. category for the low, medium and high growth scenarios for which the typical cross-section shown in Figure 4.1 is applicable.

4.4.3 Typical Cross-Section

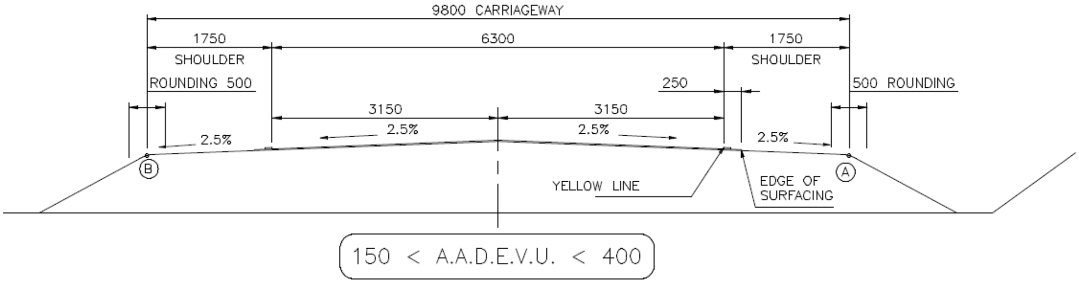

Figure 4.1: Typical Cross-Section for 150 – 400 A.A.D.E.V.U.

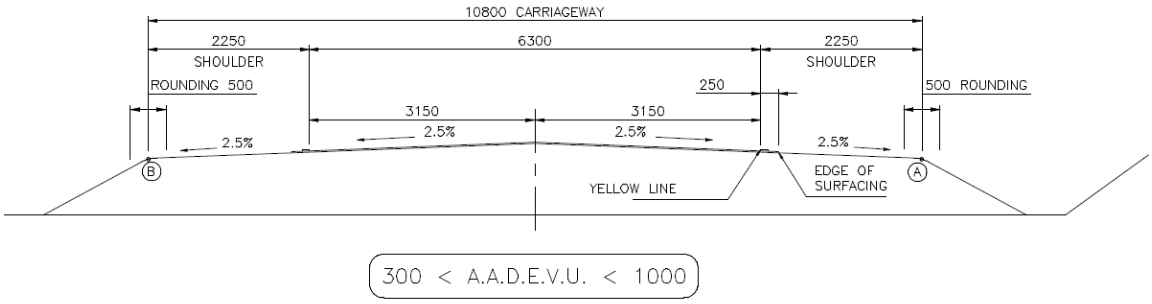

Figure 4.2: Typical Cross-Section for 300 – 1000 A.A.D.E.V.U.

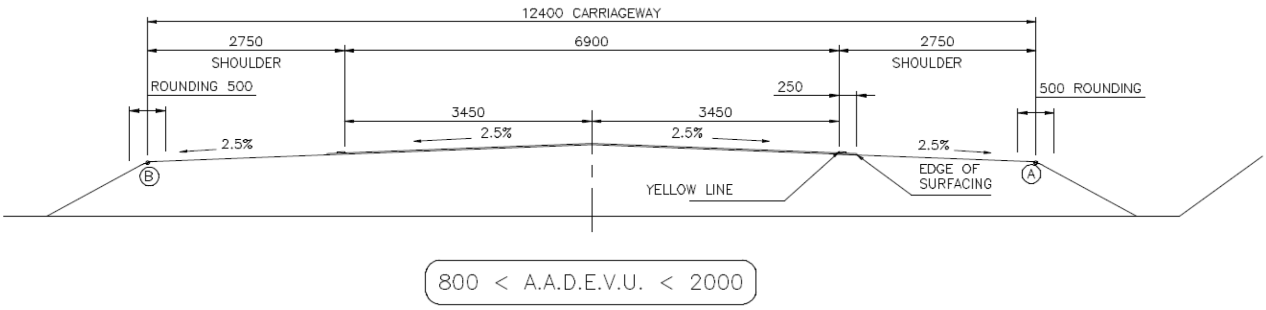

Figure 4.3: Typical Cross-Section for 800 – 2000 A.A.D.E.V.U.

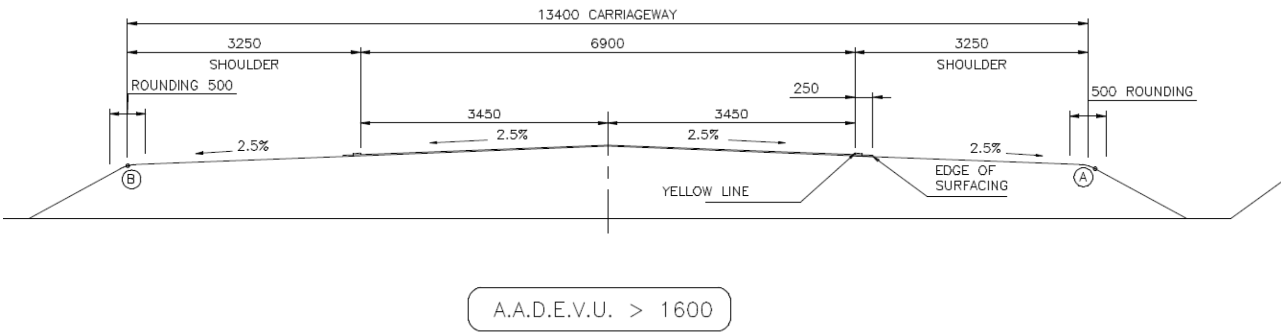

Figure 4.4: Typical Cross-Section for > 1600 A.A.D.E.V.U.

4.5 GEOMETRIC DESIGN STANDARDS

The new road should preferably comply with the design standards for a 100 km/h design speed as listed in Table 4.3.

Table 4.3: Proposed Design Standards

DESIGN PARAMETER	DESIGN STANDARD
Road reserve width	60m
Design speed	100km/h
Minimum horizontal curve radius	420m
Minimum horizontal curve length	300m
Minimum curve radius after long straight	1000m
Maximum super-elevation	6%
Maximum grade: Flat terrain	3%
Minimum grade in cuttings	0.3%
Maximum grade at intersections	3%
Min. sight distance at intersections	350m
Minimum vertical curve length	180m
Minimum crest k-value	60
Minimum sag k-value	36

4.6 HORIZONTAL ALIGNMENT

4.6.1 Curve Radii and Lengths

A minimum curve length of 300m will be used. Where space is limited an absolute minimum curve length of 150m will be considered and where the road passes through towns or villages the radii will be reduced to comply with a minimum design speed of 60km/h. The existing alignment of MR 119 consist of several curves and kinks. The alignment was assessed from aerial photographs and the assessment is tabulated in Table 4.4.

Table 4.4: Design Standards for Existing road

Curve No.	Radius (m)	Curve Length (m)	Comment
1	2400	277.572	Sub-standard curve length
2	450	119.052	Sub-standard curve length
3	660	173.811	Sub-standard curve length
4	90	107.615	Sub-standard curve radius and length
5	3500	254.206	Sub-standard curve length
6	4500	295.823	Sub-standard curve length
7	1000	708.071	Curve radius and length comply
8	250	185.847	Sub-standard curve radius and length
9	420	632.452	Curve radius and length comply
10	620	310.17	Curve radius and length comply
11	500	226.002	Sub-standard curve length
12	500	137.803	Sub-standard curve length
13	620	308.191	Curve radius and length comply
14	0	0	Kink
15	1250	314.877	Curve radius and length comply
16	700	353.936	Curve radius and length comply
17	400	361.286	Sub-standard curve radius
18	1000	648.193	Curve radius and length comply
19	3000	343.343	Curve radius and length comply
20	1200	298.475	Sub-standard curve length
21	3000	341.623	Curve radius and length comply
22	2500	290.275	Sub-standard curve length
23	2000	379.836	Curve radius and length comply
24	3000	423.313	Curve radius and length comply
25	350	167.038	Sub-standard curve radius and length
26	900	150.701	Sub-standard curve length
27	1800	199.754	Sub-standard curve length
28	4000	323.058	Curve radius and length comply
29	680	442.887	Curve radius and length comply
30	480	520.319	Curve radius and length comply
31	2520	300.977	Curve radius and length comply
32	6520	301.020	Curve radius and length comply
33	600	175.183	Sub-standard curve length
34	600	545.122	Curve radius and length comply
35	1000	300.725	Curve radius and length comply
36	700	209.498	Sub-standard curve length
37	700	374.638	Curve radius and length comply

Curve No.	Radius (m)	Curve Length (m)	Comment
38	550	254.026	Sub-standard curve length
39	1500	242.800	Sub-standard curve length
40	600	257.076	Sub-standard curve length
41	4500	392.227	Curve radius and length comply
42	2500	254.800	Sub-standard curve length
43	1300	289.678	Sub-standard curve length
44	2000	127.405	Sub-standard curve length
45	650	271.652	Sub-standard curve length
46	20000	667.157	Curve radius and length comply
47	680	302.621	Curve radius and length comply
48	640	302.011	Curve radius and length comply
49	2600	305.351	Curve radius and length comply
50	700	233.869	Sub-standard curve length
51	600	285.398	Sub-standard curve length
52	700	197.273	Sub-standard curve length
53	650	240.349	Sub-standard curve length
54	500	368.514	Curve radius and length comply
55	1500	219.286	Sub-standard curve length
56	850	282.687	Sub-standard curve length
57	2000	183.562	Sub-standard curve length
58	600	426.559	Curve radius and length comply
59	2500	301.124	Curve radius and length comply
60	4650	309.248	Curve radius and length comply
61	0	0	Kink
62	0	0	Kink

The existing alignment will be confirmed once the detailed survey is available. Sub-standard curves will be increased to conform to the design standards for a 100km/h design speed.

4.6.2 Super-elevation

The design guidelines specify a minimum radius of 420m for curves with 6% super-elevation for a design speed of 100 km/h, and the maximum super-elevation to be used during the detail design of the road design levels shall be 6%.

We propose to use lower super-elevation rates where the roads pass through settlements where the actual operating speed will be lower than the 100 km/h design speed.

4.6.3 Straight (Tangent) Length

Long straight sections of road followed by a short radius curve are not desirable and the horizontal curves at the end of a long straight (10km or more) should not have radii of less than 1000m.

4.7 VERTICAL ALIGNMENT

The road traverse flat terrain and the vertical alignment generally follows the natural ground line. The design road levels are mostly determined by the typical cross-section and the minimum height of drainage culverts. The preferred minimum height of box culverts 600mm with a 100mm thick deck and, in terms of the Drainage Manual, a 250mm minimum cover at the shoulder breakpoint gives a minimum formation height of 1.05m above the ground level at the shoulder breakpoint.

The design road levels around super-elevated curves must be high enough to ensure that there are no side drains on the inside of curves in flat areas that cannot drain.

5. INTERSECTIONS AND ACCESSES

5.1 DESIGN STANDARDS

Safety is a major design consideration for intersections and the following desirable design standards were applied:

- Maximum longitudinal grade = 3%
- Limits of intersection angles = 75° - 120° (See Figure 5.1 below)
- Minimum shoulder sight distance = 350m for a 100km/h design speed

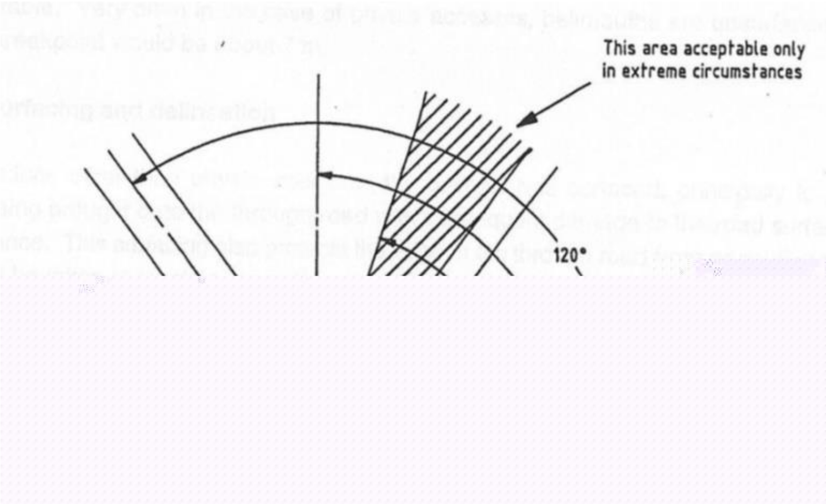

Figure 5.1: Acceptable Angles of Skew at Intersections

5.2 NUMBERED ROAD INTERSECTIONS

The standards of the existing intersections were determined from aerial photographs, and the standards of the intersections were assessed in terms of the required design standards for a 100 km/h design speed. The survey is currently underway and the existing intersection standards will be confirmed when the data is available. The intersections are evaluated in terms of the following:

- **Intersection angles** must fall within the range of acceptable angles of skew shown above in Figure 5.1.
- The **longitudinal grades** of the main road at the intersections with numbered roads should be less than the maximum allowable grade of 3%.
- The available **shoulder sight distance** at the intersections must comply exceeds the 350 m minimum required for a 100 km/h design speed.

5.2.1 T0602

MR 119 joins unto T0602 with an intersecting angle of approximately 73° which is acceptable in extreme circumstances. Re-alignment of the intersection will be investigated during the detailed design. If properties are affected by the re-alignment, it will be discussed with the owners.

5.2.2 DR 1851

DR 1851 joins unto MR 119 at approximately km 35.96. The intersecting angle is approximately 71°. This angle falls within between 60° and 75° which is acceptable in extreme circumstances. Re-aligning the intersection will be investigated during the detailed design. Re-alignment of the intersection will affect properties and will have to be discussed with the owners.

5.2.3 DR 3810

DR 3810 joins unto MR 119 at approximately km 86.56 along an existing curve. The intersecting angle is approximately 95° and the existing curve radius is sufficient in terms of sight distance.

5.3 PRIVATE ACCESSES

Numerous private accesses join unto MR 119 and it may be necessary to re-locate some of these accesses to ensure sufficient sight distance at all access points.

6. DRAINAGE

6.1 BASIS FOR DESIGN

The Drainage Design Manual of the Roads Authority shall be used.

The average annual rainfall for the project area is between 350 and 400 mm.

Run-offs shall be calculated for floods with a 20 year recurrence period and, depending on the size of discharge, the design return period shall be determined. The design return period shall be 1:15 years for flood less than 20 m^3/s and 1:25 years for floods more than 20 m^3/s but less than 150m^3/s.

The Rational Method will be used to determine the expected stormwater run-off for the relevant rainfall recurrence periods for the small catchment areas.

Drainage culverts shall be designed for inlet control in terms of the Drainage Manual for run-offs with an absolute minimum floor gradient of 1%.

As per The Roads Authority standards, box culverts will be used. In terms of the Drainage Manual the minimum size of drainage culverts is 900 x 600mm (i.e. span x height).

6.2 MAJOR WATERCOURSES

A major water course runs adjacent to the road between Helena and Talismanis and crosses the road at certain sections. Drainage structures for these sections will be provided accordingly.

6.3 EXISTING DRAINAGE CULVERTS

Existing culverts will be confirmed from detailed design.

7. PRELIMINARY PAVEMENT DESIGN

7.1 BASIS FOR DESIGN

The pavement design is done in accordance with the SATCC Guideline for Low-volume Sealed Roads in conjunction with the *Structural Design of Interurban and Rural Road Pavements (TRH 4)* and the *SATCC Code of Practice for the Design of Road Pavements.* Material specifications will be done in accordance with COTO standard specifications.

7.2 PRELIMINARY PAVEMENT DESIGN

MR 119 is a rural access road with low traffic volumes and low importance. Therefore, a Road Category D (TRH 4 Table 1) is considered appropriate.

The following preliminary pavement is proposed for MR 119:

The area is known for material that is of inferior quality and therefore improvement of the in-situ material to conform to G7 requirements is proposed.

Subbase (150mm) to conform to G6 requirements

Basecourse (150mm) to conform to G5 requirements

The proposed seal is a 19mm Cape Seal

Centre line soil surveys are currently underway, and the final pavement design will be adjusted accordingly once the centre line soils and borrow pit data is available. Thicker pavement layers might be required, depending on availability of material.

8. PRELIMINARY MATERIALS ASSESSMENT

8.1 GENERAL

The critical issue most likely to influence various aspects of the Project will be the availability of suitable natural gravel for constructing the pavement layers because it will:

- Determine the construction quality of the road
- Determine quantities and thereby the cost for construction
- Influence the time frame for construction
- Influence the future performance of the pavement during the road's design life.

8.2 GEOLOGY OF THE PROJECT AREA

The project area falls within the Kalahari Group and is characterised by unconsolidated to semi-consolidated sand and gravel with calcrete occuring locally.

8.3 BORROW PITS

A borrow pit investigation will be conducted and the pavement structure will be designed according to the available material.

8.4 AGGREGATES FOR SURFACING AND CONCRETE

Sources of aggregate will be investigated during the detail design stage.

8.5 CONSTRUCTION WATER

Sources of construction water for the area is a challenge and will be investigated during the design stage. It is anticipated that the Namwater scheme in Talismanis and boreholes in the area will be the main source of water for construction.

9. ENVIRONMENTAL CONSIDERATIONS

9.1 AFFECTED PROPERTIES

The proclaimed width for main roads in Namibia is 60m. Where radii of horizontal curves do not comply with the design standards for a 100 km/h design speed, the radii will be increased to ensure compliance with the design standards and these matters shall be discussed with owners of the affected properties.

The purpose of the owner interview is to provide the Roads Authority with the necessary information regarding properties and improvements that are affected by any realignment of the road and borrow pits.

9.2 ENVIRONMENTAL IMPACT

Environmental impacts shall be largely limited to the impact of the wider road reserve on adjacent properties and the utilization of material resources (existing and new borrow pits) with the resultant loss of land.

The EIA report has to be submitted to the Ministry of Environment and Tourism for approval after which a Clearance Certificate will be issued.

After issuance of the Clearance Certificate, the Environmental Management Plan (EMP) will be compiled for inclusion in the Tender documentation.

10. CONCLUSIONS AND RECOMMENDATIONS

10.1 GEOMETRICS

(a) Analysis of the data from the traffic surveys for MR 119 and calculation of the A.A.D.E.V.U. for the year 2025 indicates that the standard cross-section for the four district roads should comprise a 6.3 m wide road formation consisting of two 3.15 m wide lanes with 1.75 m wide adjacent shoulders as per Roads Authority standard drawing no. N2635.

(b) Where the existing horizontal alignments do not comply with the design standards for a 100 km/h design speed, the radii will be increased accordingly.

(c) The roads traverse a very flat terrain, and the vertical alignment will largely follow the ground line, and cross-section requirements, minimum drainage culvert heights and pavement design aspects will influence the final vertical alignment design.

(d) Relocation of certain access points is necessary to ensure compliance with the design standards.

(e) Type A, B or C accesses shall be provided at the numerous private accesses.

10.2 DRAINAGE

A major watercourse run adjacent MR 119 between Helena and Talismanis. At certain sections the watercourse crosses the road.

The Roads Authority had requested that only rectangular (box) culverts be used on the main road and pipe culverts shall only be used along access roads. Box culverts will be provided where necessary and the minimum culvert size of 900mm x 600mm is applicable.

10.3 MATERIALS AND PAVEMENT DESIGN

Material specifications will be based on COTO Standard Specifications for Road and Bridge Works for Southern African Road Authorities. The in-situ material is assumed to be of inferior quality, and we anticipate that the subgrade will have to be improved to conform to G7 requirements. Centreline soil and borrow pit investigations are underway and will dictate the final pavement design.

10.4 RECOMMENDATIONS

We recommend that the findings of this report are approved by the Roads Authority prior to commencement of the detail design phase.

Annexure A:

- **Letter of Appointment**
- **Letter of Acceptance**

Annexure B: Traffic Count Data

Annexure C: Preliminary Pavement Design