NEW PROVING GROUND

TRAFFIC IMPACT ASSESSMENT

.

OCTOBER 2015

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TRAFFIC IMPACT ASSESSMENT

Mercedes-Benz SA Ltd

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PRODUCTION TEAM

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TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

1 INTRODUCTION

1.1 PURPOSE

WSP Group Africa has been appointed by the General Planner IngenAix GmbH on behalf of Mercedes-Benz South Africa Limited to conduct a Traffic Impact Assessment for the proposed new proving ground near Upington in the Northern Cape.

The purpose of this report is to present the findings, conclusions and recommendations of the traffic study.

1.2 LOCALITY

The site is located on Steenkamps Pan Farm No. 419 Portion 6 approximately 38 km north-east of Upington town as shown on Figure 1 in Appendix A.

1.3 SCOPE

This report discusses the following aspects related to the traffic and transportation related to the aforementioned development.

- Land use;
- Roads and access;
- Trip generation and distribution; and
- Conclusions and recommendations.

2 LAND USE

2.1 EXISTING LAND USE

The proposed project site, Portion 6 of Farm No. 419 Steenkamps Pan is ± 3 750 ha and currently used for agricultural purposes, i.e. cattle.

2.2 FUTURE DEVELOPMENT

The proposed development is a light vehicle testing and proving ground for heat-related vehicle tests and will be operational throughout the year, with the peak period between October and April. Farming on the entire property will continue to take place in parallel to the testing activities.

The preliminary master layout of the proving ground is shown on Figure 2 in Appendix A and will include the following main components:

- High-speed oval ± 17km long with 4 lay-by areas;
- Handling track ± 5.5km long;
- Multifunctional area ± 140m x 400m with an acceleration lane of 25m x 600m;
- Gravelled “bad roads” ±10km long; and
- Building area, as shown on Figure 3 below.

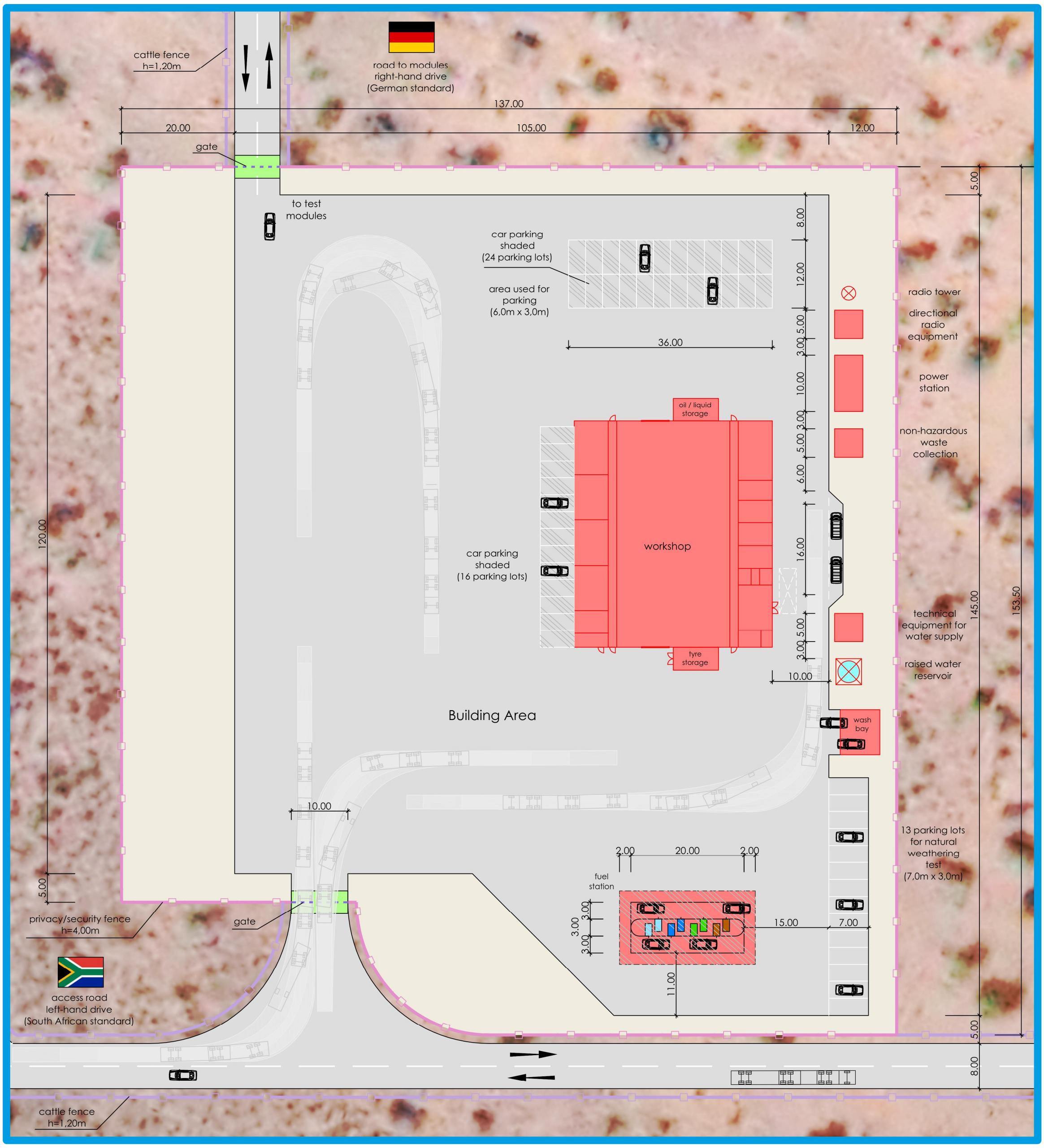


Figure 3: Building Area

3 ROADS AND TRAFFIC ENVIRONMENT

3.1 SITE INVESTIGATION

The traffic engineer conducted an investigation of the roads and traffic environment in the vicinity of the project site on Friday, 17 July 2015. The findings of the investigation are discussed below. The photographs are included in Appendix B.

3.2 EXISTING ROADS

The N10 national road provides access to Upington from the north, but veers off to the west ± 1km south of the Upington airport access to form a T-junction as shown in Photograph 1. The western approach of the T-junction is stop-controlled. From this T-junction a provincial road (DR3322) continues to the north to provide access to the airport.

The N10 is a two-lane undivided road with 3.4m lane widths and good surface condition, as shown in Photograph 3. The general speed limit on the N10 between the airport and Upington is 80km/h (Photograph 4) and 40km/h for heavy vehicles (Photograph 5).

The DR3322 falls under the jurisdiction of the Northern Cape Department of Roads and Public Transport and is surfaced up to the airport access. From this point it has been paved with block paving (Photograph 6) for ± 5.5km between the airport access and the Department of Agriculture's State Vetenarian and Karakul Research Station facility to the north (Photograph 7). To the north of the aforementioned access the DR3322 is a gravel road and the W325 warning sign indicating the change in road surface has been posted – see Photographs 8 and 9. The posted speed limit on the block-paved section is 80km/h, as shown in Photograph 10.

The gravel provincial road (DR3322) was measured to have an average width of 7.2 m and bends to the north east towards the proving ground site.

3.3 TRAFFIC

The observed traffic volumes on the N10 and provincial road to the north (DR3322) were very light and no existing traffic operational/capacity issues were identified.

3.4 ACCESS

Access to the proving ground will be obtained off the DR3322, approximately 38 km from the airport access. The proposed access location to the proving ground is ± 140m to the north-east of the existing farm access, which will be replaced by the new access to the proving ground. The existing farm access gate is shown in Photograph 11. There is another access gate on the opposite side of the DR3322, providing access to the north (Photograph 12).

In terms of the South African Road Classification and Access Management Manual[4] (TRH26) the DR3322 can be classified as a class 4 collector road and property access from this class of road is allowed. The manual[4] does not provide a guideline for access spacing off a rural class 4 road.

Photographs 13 and 14 were taken from the position of an exiting vehicle at the proposed proving ground access location to demonstrate the available shoulder sight distance.

Shoulder sight distance is the distance that the driver of a vehicle that is stationary at the stop line of a minor road can see along the major road, to be able to enter or cross the major road before an approaching vehicle reaches the intersection. It is therefore a function of speed of vehicles traveling on the major road, the width of the major road and the type of vehicles that are trying to cross.

Considering the posted speed limit of the paved section of the DR3322, i.e. 80km/h, and the fact that the maximum speed limit on a class 4 rural road is 100km/h, the latter was used for a worst case scenario. However, it should be noted that the current riding quality of the gravel road was perceived not to be conducive to such high travel speeds.

In terms of the manual for Geometric Design of Rural Roads(5) (TRH17) the required shoulder sight distance onto a 7.5 m wide road with 100km/h design speed ranges between 200m and 380m for a passenger car and a single unit truck and trailer respectively.

Photograph 13 shows that the sight distance to the south were observed to be adequate. Photograph 14 shows a slight rise in the vertical road alignment to the north-east. The travel distance between the aforementioned vertical crest and the future access location was measured to be ±360m and is considered to be acceptable, but it is advised that the SARTSM(6) compliant W107 and W108 warning signs (shown in Figures 4 and 5 below) should be implemented on the DR3322 at positions 320m in advance of the proving ground access (assuming a gravel road with a speed limit of 100km/h).

Figure 4: Side-road junction warning sign in north-eastern direction

Figure 5: Side-road junction warning sign in south-western direction

3.5 ROAD SURFACE

During the site investigation it was perceived that the road surface conditions of the gravel provincial road (DR3322) may pose a potential safety hazard, especially to heavy vehicles transporting test cars to and from the proving ground.

The current surface of the gravel section of the DR3322 has a significant amount of loose material. This material is located in windrows next to the trafficked portion of the road, between the wheel-tracks, and rutting in the wheel path is evident, as shown in Photographs 13, 15 and 16. This problem is typically a symptom of inadequate or inefficient grader maintenance and/or the general properties of the gravel wearing course and may hamper a driver's ability to control a vehicle on the road.

The main cause of rutting in Southern Africa is the ravelling of low-cohesion material under traffic movement. Ruts pose potential problems as they tend to retain rain water which softens the wearing course and allows deformation under traffic. Routine blading of unpaved roads replaces gravel in the ruts and simultaneously compensates for any subgrade deformation which may have occurred.

Regular maintenance of the DR3322 should be undertaken by the Department of Roads and it is therefore recommended that the Department is approached and the maintenance plan of the road be discussed with the Department in order to reduce the potential safety risk that may exist.

It is further recommended that the drivers of the vehicles utilising the gravel road, as part of the operations of the proving ground, be advised as to the potential safety hazards that may exist.

4 TRAFFIC IMPACT ASSESSMENT

4.1 CONSTRUCTION PERIOD

The proving ground construction works will comprise the following:

- ± 40km of gravelled and asphalted roads for the proving ground;
- ± 50km single-lane maintenance/farm roads;
- ± 2 500m^2 gravelled and ± 5 000m paved parking areas;
- Multifunctional area (± 75 000m^2 paved);
- Bridge over the high speed oval;
- Guard house at main access;
- Security and agricultural fencing; and
- Building area of ± 16 000m^2 (see Figure 3) consisting of:
  - A workshop of ± 1 400m^2;
  - Car wash area with concrete paving;
  - Buildings for electrical infrastructure; water supply; and waste storage;
  - Underground sewerage storage/septic tank;
  - 40 covered parking bays;
  - Roofed fuel station with concrete paving;
  - Security fencing;
  - Radio tower and directional radio equipment;
  - Asphalt paved area around buildings designed for trucks up to a maximum of 56 tons and maximum axle loading in accordance with the National Road Traffic Act 93 of 1996.

It is envisioned that the construction of the main components will be phased as follows:

- **Phase 1** (14 months): The oval; lay-bys; building area; bridge; grades (slope hill); access roads outside the oval; and the "bad" roads.
- **Phase 2** (8 months): The handling track; multifunctional area; and access roads inside the oval.

The total construction period of the proving ground infrastructure is therefore approximately 22 months, which is relatively short and is not expected to have a long term impact on the public road pavements.

The road construction materials (G7 – G10 bulk fill; G3 – G5 for base and subbase; and aggregate for asphalt) are planned to be sourced from the project site and will therefore not be transported on public roads.

The majority of construction plant will remain on site for the duration of the construction and taking the above scope of the works into account it is not expected that the construction of the proving ground will have a significant traffic impact.

The rules and conditions for the transportation of abnormal loads and vehicles on public roads are defined in the TRH11 Manual (*Draft guidelines for granting of exemption permits for the conveyance of abnormal loads and for other events on public roads*, 7th Ed. March 2000) and should be consulted if any abnormal loads will be transported to the site. The detailed procedures for applying for exemption permits are also covered in the aforementioned document. In terms of these guidelines an abnormal load is defined as a material object which, due to its dimensions and/or mass, cannot be transported on a vehicle(s) without exceeding the limitations of either dimensions or mass contained in Chapter III, Parts 3 and 4 of the Road Traffic Regulations.

4.2 NORMAL OPERATIONS

The proving ground will be operational for the full duration of the year, but the summer months (October to April) will be the peak period. Nine different test teams will be working on the site for two to three weeks per team. Each team will have its own set of test cars and workshop equipment that will be flown from Germany to Upington. The expected heavy and light vehicle trip generation during the operational phase of the proving ground is discussed separately below. This study considered the peak period trip generation for a worst-case scenario.

4.2.1 Heavy Vehicle Transport

4.2.1.1 Car Carriers

Each test team will have approximately ten cars, which will be transported to and from the proving ground by means of trucks. External car carrier service providers will be used for this purpose, i.e. for every loaded truck/car carrier to the site, one empty will return shortly thereafter. Car carrier trucks can typically transport between five and nine cars at a time. For a worst-case scenario it could therefore be assumed that two carriers would be used per test team upon their arrival and departure.

4.2.1.2 Testing Equipment

The testing equipment for each test team will be transported by truck from the airport. External transport service providers will also be used for this purpose, but the number and frequency of these heavy vehicles are considered to be low. The office and kitchen equipment, furniture and core IT-equipment will remain on the site permanently.

4.2.1.3 Fuel Tankers

The proving ground will make use of eight on-site mobile fuel tanks (3m^3 each) which will be fuelled up every two weeks. Taking the maximum storage capacity of 24m^3 into account, it is estimated that one fuel tanker will be sufficient to supply the full two-weekly requirement.

The diesel tanks for generators will have a capacity of 20 to 40m^3, which will be refuelled every two to three weeks. A maximum of two diesel tankers could therefore be expected every two to three weeks.

4.2.1.4 Waste

(i) *Non-hazardous* waste will include paper, foils and residual waste and will be collected in ordinary refuse containers and stored in the waste building. The total estimated 2.7m^3 waste per month will be disposed in Upington and one garbage removal truck will be sufficient for this purpose.

(ii) *Sewerage* water from the proving ground will be collected in a central, underground facility (tank) with a capacity of 70m³. The sewerage tank will be emptied by a local service provider from Upington and sewerage water will be disposed in a registered treatment plant. The sewage tank will need to be emptied every 10 to 14 days, resulting in approximately 7 trips to and from the site at a time. A maximum of 21 bi-directional trips per month could therefore be expected for sewerage collection and disposal.

(iii) *Hazardous waste* will include the following estimated monthly quantities and will be discarded at a suitable facility in Upington once a month:

- 50ℓ cooling liquid;
- 50ℓ used oil;
- 1kg freezing agent;
- 50ℓ emulsions;
- 10kg cleaner spray cans; and
- 0.1m³ used cleaning towels.

(iii) *Used tyres* will be stored on site and flown back to Germany. A maximum of 96 tyres could be stored temporarily on site in the 32m² storage area attached to the main building in the building area.

4.2.1.5 Total Heavy Vehicles Trip Generation

Considering the above heavy vehicle trip generation characteristics, and allowing for two to four additional trucks per month for various technical service providers, the maximum monthly heavy vehicles trips generation is summarised in Table 1 below:

Table 1: Monthly Heavy Vehicle Trips

Description	To Proving Ground	From Proving Ground
Car Carriers	4	4
Trucks for testing equipment	2	2
Fuel/diesel tankers	6	6
Non-hazardous waste trucks	1	1
Sewerage disposal	21	21
Hazardous waste trucks	1	1
Trucks for transporting used tyres	1	1
Technical service providers	4	4
Total	**40**	**40**

From the above it can be seen that the number of heavy vehicles expected to be generated by the proving ground will be low and is expected to have an insignificant impact on the traffic operating conditions on the surrounding public road network.

4.2.2 Employee Transport

4.2.2.1 Local Staff

The security and cleaning staff are expected to be local residents of Upington and will consist of approximately two cleaners and six security guards. Two to four security guards will be on duty at a time and will work rotating shifts to ensure 24-hour security at the proving ground.

4.2.2.2 Test Teams

Each test team will comprise 10 to 20 foreigners, who will stay in Upington for the duration of their work at the proving ground. These skilled employees will work normal working hours at the proving ground from 8am to 5pm on a Monday to Saturday.

An overlap of test teams may occur at times, but it is not expected that more than two test teams (30 to 40 employees) would work on site simultaneously.

Employees will stay at hotels and accommodation in Upington and will use test vehicles to travel to and from the proving ground. It could be assumed that two to three employees will travel together per vehicle.

4.2.2.3 Total Employee Trip Generation

From the above, the maximum peak hour employee trip generation of the proving ground is summarised in Table 2 below:

Table 2: Maximum Employee Trip Generation

Description	To Proving Ground		From Proving Ground	
	AM	PM	AM	PM
Mini-bus Taxi (local staff)	1	1	1	1
Test Cars	20	0	0	20
Total	**21**	**1**	**1**	**21**

Other light vehicle trips (± 5 – 8 trips per day) from various service providers will be generated by the proving ground throughout the day, but is not expected to be generated during the peak hours and were therefore not included in Table 2.

The South African manuals for traffic impact studies (TMH16[(2)] and RR 93/635[(3)]) only requires traffic impact studies to be conducted for development generating 50 or more peak hour trips, which is more than double the expected trip generation of the proving ground. It could therefore be concluded that the traffic impact of proving ground trips on the peak hour traffic conditions will be negligible.

4.3 TRAFFIC IMPACT ON ROAD DR3322

The expected maximum daily traffic on the DR3322 will remain below the threshold to make it economically viable to surface the road with a bituminous seal, in accordance with the TRH20[(7)] guidelines.

The gravel wearing course of the road consists mainly of calcrete, which is in abundance in the region. Material tests performed on the proving ground site have been used to represent the possible conditions of the material used for Road DR3322. At this stage, a concept design/

calculation has been done in accordance with TRH20, however, testing of the material in the road structure will be require for a more accurate and detailed design. The concept calculations show that the calcrete material falls within Zone B where the material ravels and corrugates for a gravel wearing course. Only low plasticity materials corrugate significantly, especially those with a high sand and fine-gravel fraction. However, many roads with gravels having plasticity indices of up to 9 have produced corrugations. These form when the material is continually spread from the sides of the road back onto the road during grader maintenance. This material is usually deficient in binder (most of it having been blown away with time as dust) and the material forming the corrugations is non-plastic. Corrugations seldom form to any significant extent during the wet season, as the material is slightly "cohesive" in its wet state through capillary suction and is not adequately mobile to form corrugations. Roads susceptible to the formation of corrugations should be inspected regularly in order to programme the necessary maintenance required to avoid the loose corrugations becoming fixed.

The total estimated gravel loss calculated over the 2-year construction period equates to roughly 16mm per year. It is therefore recommended that a depth of 40mm to 50mm should be imported and constructed in addition to the existing gravel wearing course to accommodate the traffic's impact induced during the construction phase (by the Roads Department). The construction phase wearing course concept design is included in Appendix C.

Similarly, the total estimated gravel loss calculated over a 5-year operational period is roughly 8mm per year. It is therefore recommended that a depth of 50mm to 60mm should be imported and constructed in addition to the existing gravel wearing course (by the Roads Department). Refer to Appendix C for the operational phase wearing course concept design.

The following should be addressed in the detail design phase should it be considered that the road be upgraded or rehabilitated:

- Geometric design and drainage;
- Detail materials design and borrow pit investigation in conjunction with the Department of Roads; and/or
- Maintenance in accordance with TRH20[7].

5 REFERENCES

1. Mercedes Benz South Africa – New Proving Ground South Africa Preliminary Design Specification Book. Ingen|aix GmbH, 14 July 2015.

2. South African Traffic Impact and Site Traffic Assessment Manual (TMH16) Volume 1, Version 1.0, August 2012. Committee of Transport Officials, South Africa.

3. Manual for Traffic Impact Studies (RR 93/635). BKS (Pty) Ltd for Department of Transport, October 1995.

4. South African Road Classification and Access Management Manual (TRH26), Version 1, August 2012. Committee of Transport Officials, South Africa.

5. Geometric Design for Rural Roads (TRH17). CSIR, Pretoria, 1988

6. Southern African Development Community Road Traffic Signs Manual, Volume 1 – Uniform Traffic Control Devices, Part 1. De Leuw Cather (North) Pty Ltd for the Department of Transport, November 1997, South Africa.

7. The Structural Design, Construction and Maintenance of Unpaved Roads (TRH20). Department of Transport, Pretoria, 1990.

6 CONCLUSIONS & RECOMMENDATIONS

6.1 CONCLUSIONS

From the site investigation and evaluation the following may be concluded:

(i) The proving ground will not generate significant volumes of heavy and light vehicle traffic.

(ii) The heavy vehicles generated by the proving ground during construction and normal operations will not have a significant impact on the road pavements of the affected public roads.

(iii) The peak hour trip generation of the proving ground will not have a significant impact on the traffic operating conditions of the affected public road network.

(iv) The north-eastern shoulder sight distance at the proposed access location is slightly sub-standard, but considered to be acceptable subject to the implementation of appropriate warning signs.

6.2 RECOMMENDATIONS

Taking the above conclusions into account, the proving ground can be supported from a traffic point of view subject to the following recommendations:

(i) The access to the proving ground should have at least one inbound and one outbound lane of 3.5m each.

(ii) SARTSM[(6)] compliant warning signs W107 and W108 should be implemented in advance of the proving ground access.

Should the client wish to engage with the Department of Roads regarding the maintenance of the DR3322; it is recommended that the gravel loss due to the traffic impact during the construction and operational phases (Section 4.3) as well as the safety hazard of the road surface condition (Section 3.5) be discussed.

7 APPENDICES

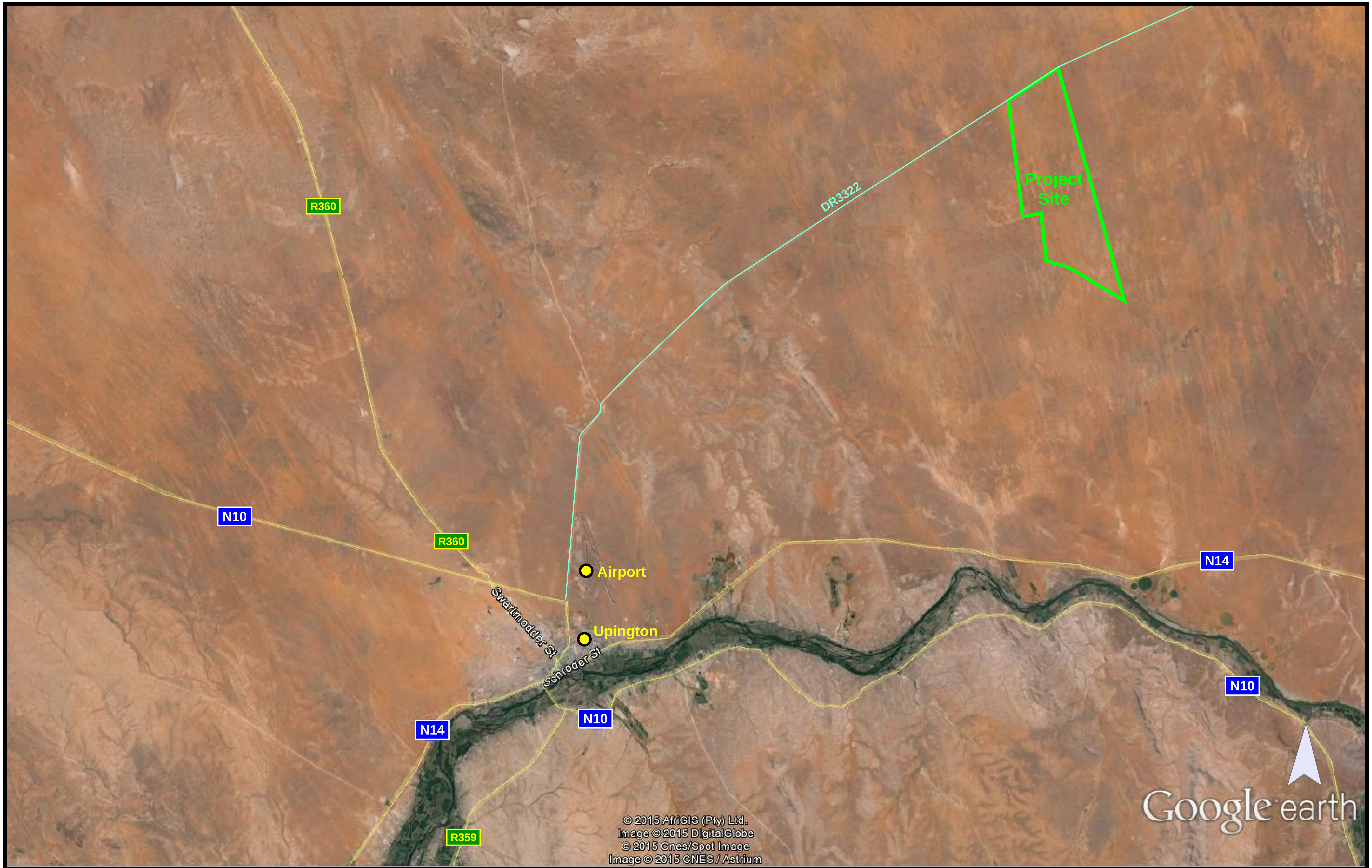
Appendix A Figures

Appendix B Photographs

Appendix C Wearing Course Design

Appendix A

FIGURES



Locality Plan - New Proving Ground Site

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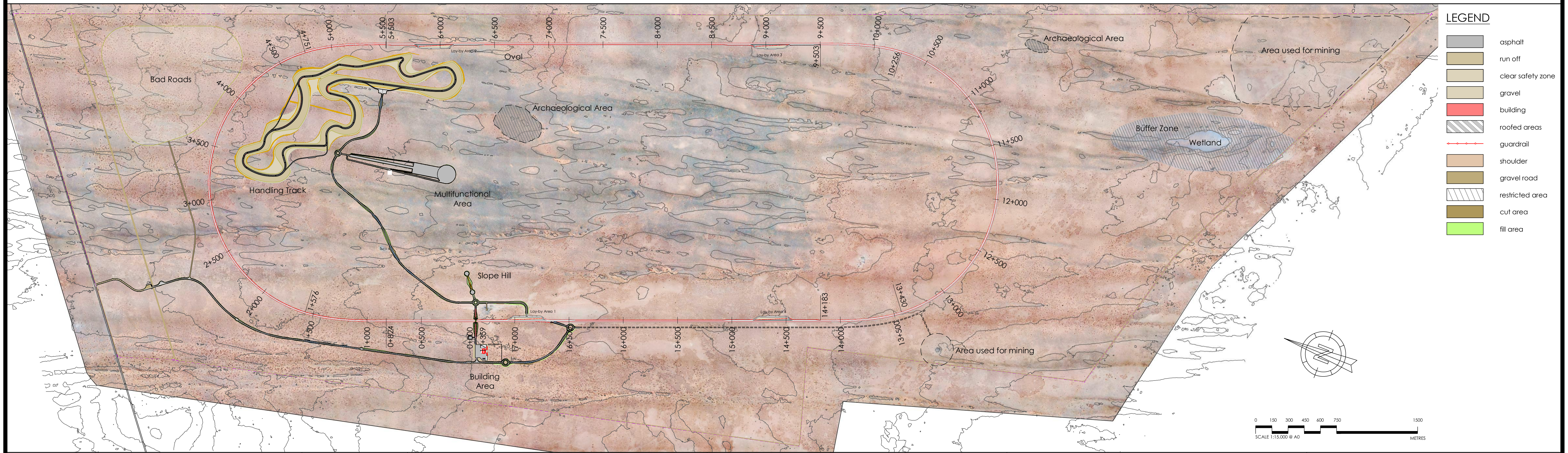
Figure 1



Proving Ground Master Layout

Figure 2

Appendix B

PHOTOGRAPHS

Photograph 1: T-junction of the N10 and access road to the north-east (from western approach)

Photograph 2: T-junction of the N10 and access road to the north-east (from southern approach)

Photograph 3: N10 road surface

Photograph 4: 80km/h general speed limit on the N10

Photograph 5: 40km/h truck speed limit on the N10 towards Upington

Photograph 6: Block paved road between the airport and State Vetenarian facilities

Photograph 7: Access to State Vetenarian and Karakul Research Station

Photograph 8: Road sign to warn of transition from block paving to gravel road

Photograph 9: Transition from block paving to gravel on the DR3322

Photograph 10: 80km/h speed limit in advance of block-paved section of the DR3322 (southbound)

Photograph 11: Existing farm access to the south of the DR3322

Photograph 12: Existing farm access to the north of the DR3322

Photograph 13: South-westward sight distance from proposed access location

Photograph 14: North-eastward sight distance from proposed access location

Photograph 15: Loose material on the DR3322 provincial road

Photograph 16: Loose material on the DR3322 provincial road

Appendix C

WEARING COURSE DESIGN

Road DR3322- Main Road from Airport to Site

Thickness Design of Imported Gravel Wearing Course
CONSTRUCTION PHASE

Design parameter	Value	Comments
Traffic volume (AADT)	100	Assumed value
Percentage heavy vehicles	10	Assumed value
Minimum formation thickness in mm	150	Material used for formation must have a field CBR value of more than 5%
Minimum thickness required for subgrade protection (t) in mm	0	Subgrade CBR predominantly more than 5% over road length
Traffic induced compaction (Ct) in %	20	Assumed potential loss of gravel thickness during construction: Average value obtained from TRH20 (p 17): Value can be up to 30%.
Weinert N-value	5	Assumed to be moderate to dry area
Percentage of material passing the 26.5 mm sieve (P26)	56 - 70	From laboratory test results
Plastic limit (PL)	NP	From laboratory test results
Percentage of material passing the 0.075 mm sieve (P75)	3.1 - 7.5	From laboratory test results
Product of plastic limit and percentage passing 0.075 mm sieve (PF)	31 - 75	Calculated
Design life (Ld) of road or regravelling frequency (in years)	2	Assumed value
Predicted annual gravel loss (GLp) in mm	16.2 - 17	According to Paige-Green formula in TRH20
Design thickness recommended for wearing course (T in mm)	**40 - 50**	According to design thickness equation in TRH20

Road DR3322- Main Road from Airport to Site

Thickness Design of Imported Gravel Wearing Course
OPERATIONAL PHASE

Design parameter	Value	Comments
Traffic volume (AADT)	30	Assumed value
Percentage heavy vehicles	10	Assumed value
Minimum formation thickness in mm	150	Material used for formation must have a field CBR value of more than 5%
Minimum thickness required for subgrade protection (t) in mm	0	Subgrade CBR predominantly more than 5% over road length
Traffic induced compaction (Ct) in %	20	Assumed potential loss of gravel thickness during construction: Average value obtained from TRH20 (p 17): Value can be up to 30%.
Weinert N-value	5	Assumed to be moderate to dry area
Percentage of material passing the 26.5 mm sieve (P26)	56 - 70	From laboratory test results
Plastic limit (PL)	NP	From laboratory test results
Percentage of material passing the 0.075 mm sieve (P75)	3.1 - 7.5	From laboratory test results
Product of plastic limit and percentage passing 0.075 mm sieve (PF)	31 - 75	Calculated
Design life (Ld) of road or regravelling frequency (in years)	5	Assumed value
Predicted annual gravel loss (GLp) in mm	7 - 8.4	According to Paige-Green formula in TRH20
Design thickness recommended for wearing course (T in mm)	**50 - 60**	According to design thickness equation in TRH20