SAPPI NGODWANA MILL

PRELIMINARY ASSESSMENT OF HAUL ROADS FOR SAPPI, NGODWANA DAM REHABILITATION

PROJECT 20828

AUGUST 2020

SAPPI SOUTHERN AFRICA (PTY) LTD
PRIVATE BAG X 1001
NGODWANA
1200

DMV NELSPRUIT INCORPORATED
P.O. BOX 5142
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1. INTRODUCTION

DMV Consultants Nelspruit Inc. was approached by D.J. Hagen & Associates in July 2020 to assist them with the Preliminary Assessment of haul roads associated with the Ngodwana Dam Upgrading project. This assessment includes the following: -

- Consultation with Mr. Carel van der Merwe of SAPPI to compile a list of temporary and permanent upgrades required;
- Inspection of the site and advice on the necessary surveys, analysis, tests, etc.;
- Investigation of site conditions;
- Incorporate clients detailed requirements into the design proposals;
- Complete a preliminary assessment with layout drawings and cost estimates of required upgrades;
- Produce a report with assessment recommendations, cost estimate and drawing.

2. SUMMARY AND RECOMMENDATION

Proposed haul route requirements received from D.J. Hagen & Associates (DJH&A) were evaluated with the SAPPI inputs, inspections of the routes, investigations of site conditions, environmental inputs, discussions of detailed requirements made by SAPPI, inputs by TRAC and adjustment of weights of sourced materials. A preliminary assessment was done, based on these inputs. From this assessment the proposed haul routes and stockpile areas are technically feasible. From the detailed cost estimate in paragraph six the total cost of the establishment and maintenance of the routes is estimated at R15,629,133.56. In this regard some alternatives may be considered, and these alternatives are discussed in this report.

3. METHODOLOGY

The following methodology was pursued in conducting the Preliminary Assessment of the haul roads: -

- Evaluation of input from the Dam Rehabilitation Design, Water Use and Environmental Authorisation Requirements;
- Evaluation of SAPPI input;
- Report on required upgrades in terms of sizing of elements, based on agreed standards;
- Prepare a drawing which indicates positions and size of proposed upgrades;
- Quantify required upgrades in terms of standard specifications;
- Estimate construction costs of upgrades based on our database of rates for similar upgrades.

3.1 Dam Rehabilitation Design, Water Use and Environmental Authorisation Requirements

The dam rehabilitation design requirements included a drawing, nr: DJH059-100-LS-01 received from DJH&A. This drawing gives details of the layout of the proposed rehabilitation areas as well as sections indicating the levels of fill required for the rehabilitation process.

An aerial photograph with the layout of the catchment area, proposed haul routes, construction areas, possible stockpile areas, conflicting infrastructure and proposed new infrastructure was also provided by DJH&A. Volumes of materials to be hauled from sources were initially allocated to the construction areas in the following ratios: -

- 30,000m³ of material for the rock toe berm on the main embankment will be sourced commercially from suppliers in the Nelspruit area that can meet the specification.
- 11,000m³ of material for the right flank area where the embankment will be raised with material from the SAPPI stockpiles at the dumpsite areas.

This ratio was subsequently altered to make provision for approximately 7,500m³ of the main embankment berm material to come from the SAPPI stockpiles at the dumpsite.

The Water Use and Environmental Authorisation process requires inputs from this investigation regarding physical aspects including size, scope, volumes etc. This report will assist to provide answers in this regard.

3.2 Evaluation of SAPPI Input

A site inspection was done on 27 July 2020. Mr. Carel vd Merwe from SAPPI accompanied Mr. Paul Nicholson and Steyn de Wet to indicate haul routes and to give input on SAPPI's requirements regarding the haul routes. The haul routes that were identified are indicated in Figure 1 attached as "Annexure A".

It is proposed to complete the rehabilitation work on the Ngodwana dam on the Farms Roodewal 470 JT and Grootgeluk 477 JT, directly South of the N4, West of Nelspruit. This facility is regarded as a water reservoir facility which has a primary function of the storage of water for SAPPI's Ngodwana factory, requiring no additional land-use approvals.

The proposed rehabilitation process will require approximately 41,000m³ of material. It will be upgraded with a raised right flank to the North of the dam spillway and a rock toe berm on the main section South of the spillway, which includes the left flank of the dam.

The material for the haul road upgrading and right flank (± 29,000m³) will be hauled from the stockpiles at the SAPPI dumpsite area to the South-West of SAPPI (Route 1) and the rock toe material (22,500m³) will come from commercial sources to the East of Ngodwana (Route 2). The balance of material (7,500m³) for this section will also come from SAPPI stockpiles at the dumpsite area and is included in the figures above.

The input on the haul routes, which includes temporary and permanent upgrades as well as the possible extensions of roads, passing lanes, flattening of road vertical alignments, barricades to protect SAPPI bulk water supply pipelines, access to the spillway retaining wall on the North side and a footbridge downstream of the dam spillway, was discussed.

Route 1:

This route *(indicated in green arrows on Figure 1)* starts at the SAPPI dumpsite stockpile area and continues to the N4. Access to the N4 for the material hauled for the upgrading of the haul roads and raised right flank (± 29,000m³) will be obtained at the existing intersection at the weigh bridge (± km 3.0 W) which provides access to SAPPI's dumpsite and material stockpiles *(Route 1, Road 1 indicated in red on Figure 1)* with a right turn movement onto the N4. This material will then be hauled Eastward along the N4 in 18m³ tip trucks (normal road haulers and not ADT's) up to the Kaapsehoop intersection (± km 6.2 W), where trucks will turn right onto the Kaapsehoop road (D799), travel for ± 200m along this road and turn right towards the Ngodwana Dam onto the existing fishing club access which is a surfaced access road. A material stockpile area located approximately 600m along this road is the destination of this material. Trucks returning will turn left onto Kaapsehoop road (D799), left at the Kaapsehoop N4 intersection (± km 6.2 W) and left again at the dumpsite access (± km 3.0 W), at the weighbridge intersection.

Material from the stockpile will be hauled to the point of placement on the North flank along the abovementioned fishing club road and a newly created gravel access is to be constructed *(road indicated in black on Figure 1).* An access route to the contractors site office turns off from the route to the stockpile towards the spillway area *(road indicated in yellow on Figure 1).* This access route will also serve as a haul road for the ± 7,500m³ material from the SAPPI stockpiles reserved for the main section of the embankment, as well as the ± 10,200m³ material required for the upgrading of haul roads. A link from this road to the Northern spillway retaining wall is required for the clearing of trees along this retaining wall.

Route 2:

The material for the rock toe berm (± 22,500m³) will be hauled from commercial sources situated at Alkmaar or Karino via the N4 in tipper trucks (normal road haulers). These trucks will pass through the Kaapsehoop intersection (± km 6.2 W) and turn left opposite the existing light vehicle turn-off to SAPPI's administration area (± km 5.8 W), on an existing gravel road. This road provides access to SAPPI's Water Treatment Works (WTW). Material will be stockpiled on a stockpile area opposite the WTW. Trucks returning will turn right at the gravel access onto the N4 (± km 5.8 W), drive through the Kaapsehoop intersection (± km 6.2 W) and leave towards Nelspruit. If a stream crossing is constructed this movement can be replaced by directing returning trucks across the Ngodwana River onto Route 1 via Road D799 (Kaapsehoop) and back to Nelspruit on the N4.

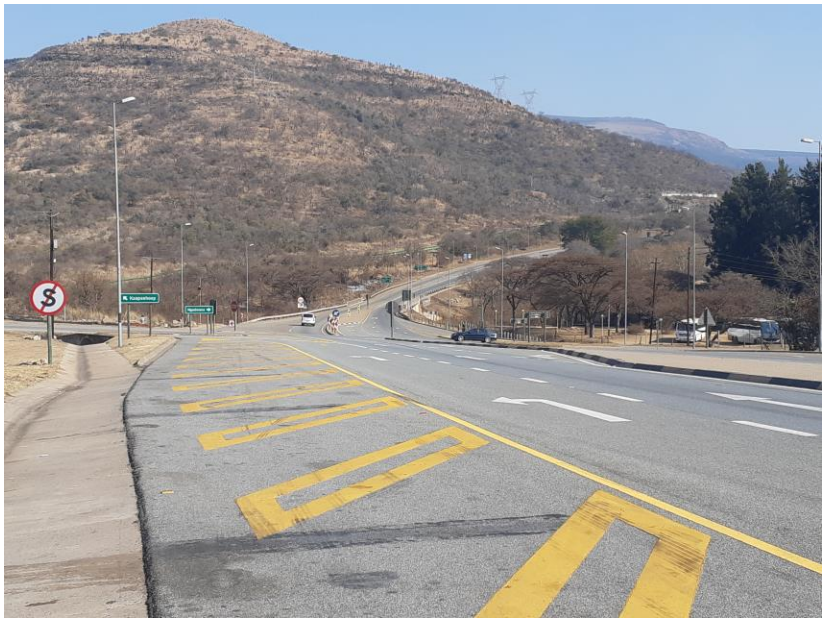
Material will be hauled from the WTW stockpile area to the rock toe berm on the main section of the dam on an existing route. It runs along the SAPPI bulk water supply line to the West of the Ngodwana River to the embankment of the central section *(road indicated in green on Figure 1).* A new route *(road indicated in blue on Figure 1)* up the embankment up to the point of placement of the rock toe berm on the main section of the dam will be required due to material delivery requirements and restricted space between the toe and the bulk water pipeline. A foot bridge below the spillway will link the site office area with the contractor's laydown area.

From the haul route description for both routes, sections of the N4 are to be used as haul routes. A traffic assessment was done for the affected sections of the N4 and was discussed in a separate report to investigate the traffic conditions of this facility. The N4 falls under the jurisdiction of SANRAL as roads authority and TRAC, the concessionaire operating this route as a toll road concession. In general, the N4 was therefore not discussed in any detail by SAPPI except to highlight the requirement for a traffic assessment. It is however important to point out that this is a high order road which meets all the requirements as a haul route with, very high geometrical and pavement standards which ensures a high degree of reliability and safety for all users.

SAPPI's input focussed primarily on the other sections of the haul roads, which make up the haul routes as defined above.

For Route 1 the first section is the existing SAPPI dumpsite access road. This road has a surfaced section of approximately 150m and a gravel section of approximately 1150m. It is generally in a good condition and will require limited upgrading to serve as a haul road. It is however a fact that this section will require some rehabilitation after the haulage due to the expected deterioration of the wearing course during the haul process. The picture below is an indication of the condition of this road: -

The second section of the route is the N4 section which is serviced by an at-grade intersection of a high standard which provides safe access to and from the dump site access. This 3.2km section stretches to the Kaapsehoop intersection which is also an at-grade intersection of a high standard which provides access to the Kaapsehoop section of this route. The picture below gives a view of this intersection: -



A third section of this route runs along the Kaapsehoop road (D799) for about 200m. This is also a high standard surfaced road, as clearly depicted in the picture below: -

From here the fourth section of the route turns in onto the Ngodwana Dam Access Road at an existing intersection which requires no upgrading. This route is surfaced and provides an all-weather access to the dam. Reservations were expressed by SAPPI if this road will be able to withstand the haulage without any damage and this is therefore assessed in this report. Section four runs up to the access gate at the fishing club, past the proposed stockpile area; approximately 600m along this road. The pictures above and below also show the access: -

The fifth section of this haul route is the last section up to the construction area of the right flank of the dam. It was pointed out by SAPPI that careful alignment of this section is required to prevent excessive damage to the vegetation and the bulk water supply pipeline in this vicinity, as detailed on the picture below: -

An existing gravel access road, which turns off from section four of this route opposite the stockpile area, (Route 1, Road 6) is earmarked for the access to the contractors' site office area on the North side of the dam spillway. This route crosses the river pipeline at an existing structure which may require a safety upgrade. This is also a haul road. It will be deliberated / discussed for upgrading and is linked to Section 4 of Route 2. Detail of the pipeline crossings can be seen in the picture below: -

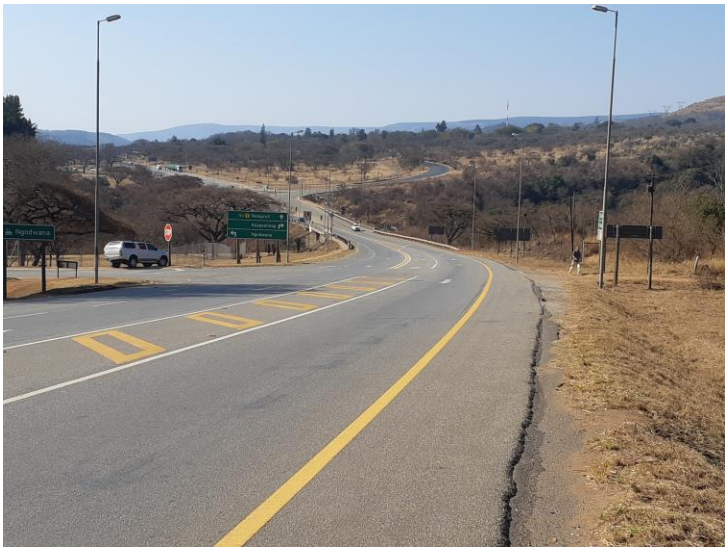
The site office area will be prepared by clearing away alien vegetation to allow for the offices and appurtenant, temporary buildings required for the construction process.

Road 7 on Route 1 will link Road 6 with the Northern spillway retaining wall as access.

A pedestrian walkway and pedestrian bridge below the spillway will provide access to the construction site from here. This must be done in a way to conserve the area and to serve as an eco-recreation area after construction. A pedestrian bridge can be located at the spot indicated in the picture below: -

For Route 2 the first section is again the N4 which was discussed previously.

The second section runs from the N4 turn-off to the SAPPI Water Treatment Works up to the stockpiling area at the Water Treatment Works. The access from the N4 to this section will require some upgrading to ensure capacity for queuing of vehicles turning East onto the N4. This required upgrading is discussed in this report. A picture of the access shows the current layout: -



A third section of this route runs from the stockpile area on the N4, along the steel pipeline from the dam which supplies water to the Water Treatment Works, to the proposed new rock toe berm along the main embankment of the dam. This existing section is very narrow with poor horizontal and vertical alignment. It will require some adjustment in this regard and passing bays will have to be established along the route to facilitate passing of construction traffic and to protect the pipeline from construction traffic. From the picture below it is clear how close the pipeline is to the existing road: -

The fourth and last section of this route turns away towards the left flank of the dam in order to reach the final fill level of the rock toe berm where a road along the embankment continues to the laydown area for construction plant and equipment. This area is to be created below the spillway area. Some clearing of alien vegetation will be required for this purpose. A picture of the deviation point: -

3.3 Upgrades Required

On completion of our site visit, with the benefit of inputs received from SAPPI and our long term involvement on projects in the area, a desk-top study was done to gather as much geotechnical, survey, existing roads geometry, aerial photography and as-built information as possible to do a preliminary assessment of the haul road and associated infrastructure required for these dam rehabilitation processes.

It soon became clear that in some cases very restricted access exists and therefore a thorough and accurate survey will be required of the haul routes (excluding the N4) to pinpoint obstacles, infrastructure like pipelines, culverts, manholes, swamp areas (wetlands), passing areas and protected vegetation. The existing aerial surveys are not accurate enough for this purpose.

This area is not only known for its poor-quality subgrades but also for the unavailability of good quality gravels for road construction. It is proposed that a centre line investigation be conducted on the haul routes (excluding the N4) to determine the bearing capacity of these roads. The roads will experience heavy vehicle traffic with abnormal loads in areas with poor sub-grades where surface water is visible. Further to this it is proposed that material specialists be tasked to source suitable gravel to be used as fill and wearing course material on gravel roads. This should include testing of the existing stockpiled material at the Waste Dump Stockpile.

3.3.1 Route 1

Section 1 of Route 1 is an existing haul road for the haulage of waste at the dumpsite. It is a well-maintained road which is regularly sprayed with lignosulphate for dust control purposes. The gravel section of this road will require normal gravel road maintenance in order to achieve a level 5 serviceability with maximum roughness of 80, dustiness of less than 3 and exclusive possibility as defined in TRH 20 technical guidelines.

The required maintenance will include:

- Roadside maintenance which is mainly restricted to vegetation control;
- Drainage maintenance;
- Surface maintenance;
- Safety aspects;
- Provision of a budget for such maintenance.

Sections 2 and 3 fall under the control of the National and Provincial Roads Authorities and is maintained regularly to a high standard. The horizontal and vertical alignment of the N4 allows acceptable sight distances at the proposed location of access onto the N4 (i.e. in excess of 300m). Good lighting exists along this section of road, which enhances safety during night-time hauling. Proper interaction with these authorities is recommended. Liaison with the authorities before expected peak traffic conditions occur, for instance, long weekends and the start and end of school holidays will ensure optimal and safe utilisation of these facilities. Coordinated planning and temporary suspension of haulage on these routes during these periods will provide a productive and safe environment for all road users.

Section 4 will in all probability suffer some damage during the haul operations. Although no as-built information is available, this road was never designed for heavy construction traffic and as such the following damage can be expected: -

- Damage to surfacing where turning movement onto and off this section occurs;
- Development of potholes due to the structural design of the road, aged condition of the existing surfacing and the effect of surface water during the haul process;

It is proposed that maintenance be done on this section of road during the construction period by repairing defects in order to maintain trafficability and then to reassess the condition after the dam rehabilitation is completed.

Final repairs can then be affected and re-surfacing of the road can be done to reinstate it to its former condition.

Section 5 will be a temporary 3.9m wide access to the right flank of the construction area, with passing bays and a turnaround area. This section will require a new geometric design, structural design and drainage design with alignment through indigenous vegetation and away from the section of steel pipeline which is located above ground in this area. Once alignment and clearing and grubbing of vegetation and topsoil have been completed, this section will require drainage features like mitre banks and possibly a pipe culvert. Subgrade preparation will include ripping and re-compaction within these alignment parameters. A gravel wearing course of 150mm thickness, which meets the requirements of TRH 20, will be imported from a suitable source and placed on top of the subgrade to abovementioned width and processed to the required geometric standards before being compacted to the density required to provide adequate bearing capacity for the anticipated traffic. It is recommended that the same material from the dumpsite stockpile be blended with ash plant material to be used as wearing course material. This is based on laboratory results which is included in “Annexure B”. Some more testing of the available material will however be required.

Section 6, the access to the contractors' laydown area and haul road will require upgrades in terms of a widened pipe crossing as well as minor fills around these areas. Some blading of this 3.9m wide route with subgrade preparation along the existing alignment with a new 150mm thick gravel wearing course will be adequate to create an all-weather route for vehicles to reach the parking areas, offices and other temporary facilities required by the contractor and to link up with Route 2, Section 4.

Section 7, the access to the Northern spillway retaining wall, will require bush clearing, a 3.9m wide route with subgrade preparation along the new alignment.

Preparation of the site office area will require some clearing of vegetation around and under the indigenous trees in order to erect temporary structures to maintain this area in a proper manner and to facilitate overland/drainage.

A 2m wide walkway from this area to the pedestrian bridge below the spillway will require clearing of vegetation under the trees and some subgrade compaction as well as an all-weather surface to ensure safe walking conditions, with timber handrailing in steep sections. A pedestrian bridge, with a span of approximately 20m which can become a permanent feature, will be constructed below the spillway to provide safe access over the Ngodwana river to the construction site. This bridge should be of steel or timber construction to ensure off-site manufacture and quick erection to facilitate a fast establishment process.

3.3.2 Route 2

Section 1 of this route is part of the N4 and the same approach discussed in paragraph 3.3.1 applies here.

Section 2 access from the N4 requires upgrading of this access from the N4. A proper designed access which meets the requirements of SANRAL as roads authority and TRAC as its concessionaire will be required here. Such access will have to meet the following standards: -

- A T-type junction with maximum of 30° deflection and N4 through alignment;
- Surfaced 7m wide roadway 100m long for queuing and paint markings with kerbing to guide vehicles and a 1.8m gravel shoulder;
- Stop control at point of entrance at 6.25m from N4 edge of road;
- A line of sight from 5m back from the edge of the N4 of at least 300m in both directions;
- A right turn radius of at least 15m;
- Lane width of at least 6.5m at bell mouth;
- Kerb radii of 15m;
- Tapers of 60m to a full lane width of 3.7m wide;
- Drainage by culverts of N4 side drains;

This section up to the Water Treatment Works stockpile area will require re-alignment of horizontal and vertical geometry to meet the abovementioned standards. Clearing and grubbing of this re-aligned section will be required with drainage features such as like side drains and stormwater crossings. The sub-grade preparation of the re-aligned roadway will require ripping and re-compaction. A gravel wearing course of 3.9m width, with gravel shoulders will be constructed with imported gravel material as discussed in paragraph 3.3.1. As mentioned, additional testing of available material will be required to evaluate suitability.

Section 3 follows the route from the stockpile area to the rock toe of the embankment. The existing route from the Water Treatment Works has a limited geometrical alignment which falls outside the safety and geometrical design standards required for a haul road. Although it is not economical to construct deep cuts, high fills or large horizontal curves and obstructions such as the water pipeline and its protection as well as the streambeds are limiting factors it is still recommended that, where possible, 7m wide sections be contemplated for passing purposes and 3.9m wide sections elsewhere. Spacing will be determined by sight distance. It is proposed that a 30km/h geometric design standard be followed and that the construction vehicles expected on this route determine the horizontal alignment minimum standards. In this regard a 25m curve in the roadway should be achieved with 15m as the absolute minimum for low-bed equipment delivery. On the vertical alignment the crest and sag k-values 2 and 5 respectively should be maintained.

Protection of services such as the pipeline will be facilitated with extended culverts at pipeline crossings, berms, barriers and bollards. Drainage will consist of extended culverts and concrete causeways with roadway crossfall as well as mitre banks and berms. Sub-soil drainage may be required on wet sections. This section will require cut to fill operations, rockfill in some areas, sub-grade preparation of re-aligned sections. Imported gravel material of 150mm thickness will be processed into a wearing course along the route. Dump truck manoeuvring areas will be accommodated in the bypass areas.

Section 4 will require a 3.9m wide section with a completely new alignment in order to reach the points of placement of the material along the rock toe berm. Restricted space at the bottom of this structure between the pipeline and the toe limits the space available to less than 2m, which is not wide enough for trucks to pass. The final level of material placement is also much higher up the embankment and a new road is required to this point. This new haul road is indicated in blue as Route 2, Section 4 on the layout on Figure 1. It follows the route up the groin of the dam and turns onto the embankment at the existing berm, runs along this berm line along the face of the embankment and then drops down to the plant and equipment laydown area. This route will cross the pipeline at the newly constructed culvert before running uphill to the groin area. Fills will be used to create this route. Once past the equipment laydown area this road will cross the Ngodwana river below the spillway area at a stream crossing before linking with Route 1, Section 6. Geotechnical conditions will determine if the stream

crossing will be a causeway or pipe culverts with a fill across the stream. Examples of these type of stream crossings are attached as "Annexure D". This link with Route 1, Section 6 across the Ngodwana river will ensure access to haul material from the SAPPI stockpiles at the dumpsite.

The equipment laydown area will be cleared of vegetation under trees and vehicle parking areas will require sub-grade preparation and graveling for wearing course purposes as described above.

4. POST CONSTRUCTION REMEDIAL WORK

4.1 Route 1

Section 1 of Route 1 may require maintenance as described in paragraph 3.2.1. This section should be re-assessed in terms of these guidelines' completion of haul activities and rehabilitated and reinstated according to these guidelines.

Sections 2 and 3 will be dealt with by the relevant road authorities.

Section 4 will require rehabilitation which may include evaluation of the road condition with recommendations on repair of potholes, patching of surfacing, base rehabilitation and resurfacing of the roadway.

Section 5 can be ripped and shaped to facilitate drainage before this is re-vegetated by seeding and watering of indigenous grass cultivars which match the surrounding grass types.

Section 6 is the access to the contractors' offices and parking facilities and is an existing access and should be maintained as access to the spillway. On removal of site establishment, the office areas can also be ripped, shaped and vegetated as described above to become an eco-recreation area. The footbridge will remain in place for future access.

Section 7 is the access to the Northern spillway retaining wall. This should be maintained as access to the spillway.

4.2 Route 2

Section 1 of Route 2 falls under the N4 roads authority. This process is discussed in paragraph 4.1.

Section 2 will remain as the access to the Water Treatment Works and will be maintained as a normal gravel access road.

Section 3 will remain as the access to the toe of the embankment and spillway area and will be maintained as such. Temporary barriers for pipe protection will be removed.

Section 4 will be provided with berms to control stormwater run-off. It should be ripped and re-vegetated as discussed in 4.1 and the stream crossing should be rehabilitated.

The contractor's laydown area will be ripped and shaped after removal of site establishment and re-grassed as discussed in the previous paragraph.

5. DESIGN LAYOUT

A design layout for these routes with proposed upgrades, details of stockpile areas, road extensions, and geometrical layout is attached as "Annexure C".

Where road alignment was revised or new road sections developed, appropriate chainages were provided to ensure orientation on these sections.

The geometrical design standards on horizontal and vertical alignment standards discussed earlier were followed to achieve this layout. Deviation from existing routes were based on this to achieve functionality for purpose within the constraints of the topography. For this purpose, a Digital Terrain Model (DTM) was sourced and new preliminary models of road sections were created in order to produce preliminary designs to quantify.

This layout forms the basis of the quantities used in combination with the estimated rates to produce estimated costs for the proposed infrastructure.

6. COST ESTIMATE

A detailed cost estimate was prepared for the various sections described above and this estimate is summarised below: -

Route 1 Section 1	R	153,986.86
Route 1 Section 4	R	466,619.38
Route 1 Section 5	R	305,629.34
Route 1 Section 6	R	1,473,962.44
Route 1 Section 7	R	401,144.10
Footbridge	R	689,865.00
Route 2 Section 2	R	2,235,078.82
Route 2 Section 3	R	2,183,983.24
Route 2 Section 4	R	5,115,158.14
Stockpile & Laydown Areas	R	565,123.61
Sub - Total	R	13,590,550.92
Vat (15%)	R	2,038,582.24
TOTAL	**R**	**15,629,133.56**

This cost estimate is base on cost of construction of similar activities and may vary due to escalation and detail design requirements. This estimate includes preliminary and general costs as well as professional fees and disbursements.

7. REFERENCES

The following references were used in this report: -

1. TRH 20: Unpaved Road Design;
2. TRH 14: Road Material;
3. Mbombela Aerial Survey;

This report was compiled by:

PAUL NICHOLSON PR. ENG.

ANNEXURE A

HAUL ROUTES

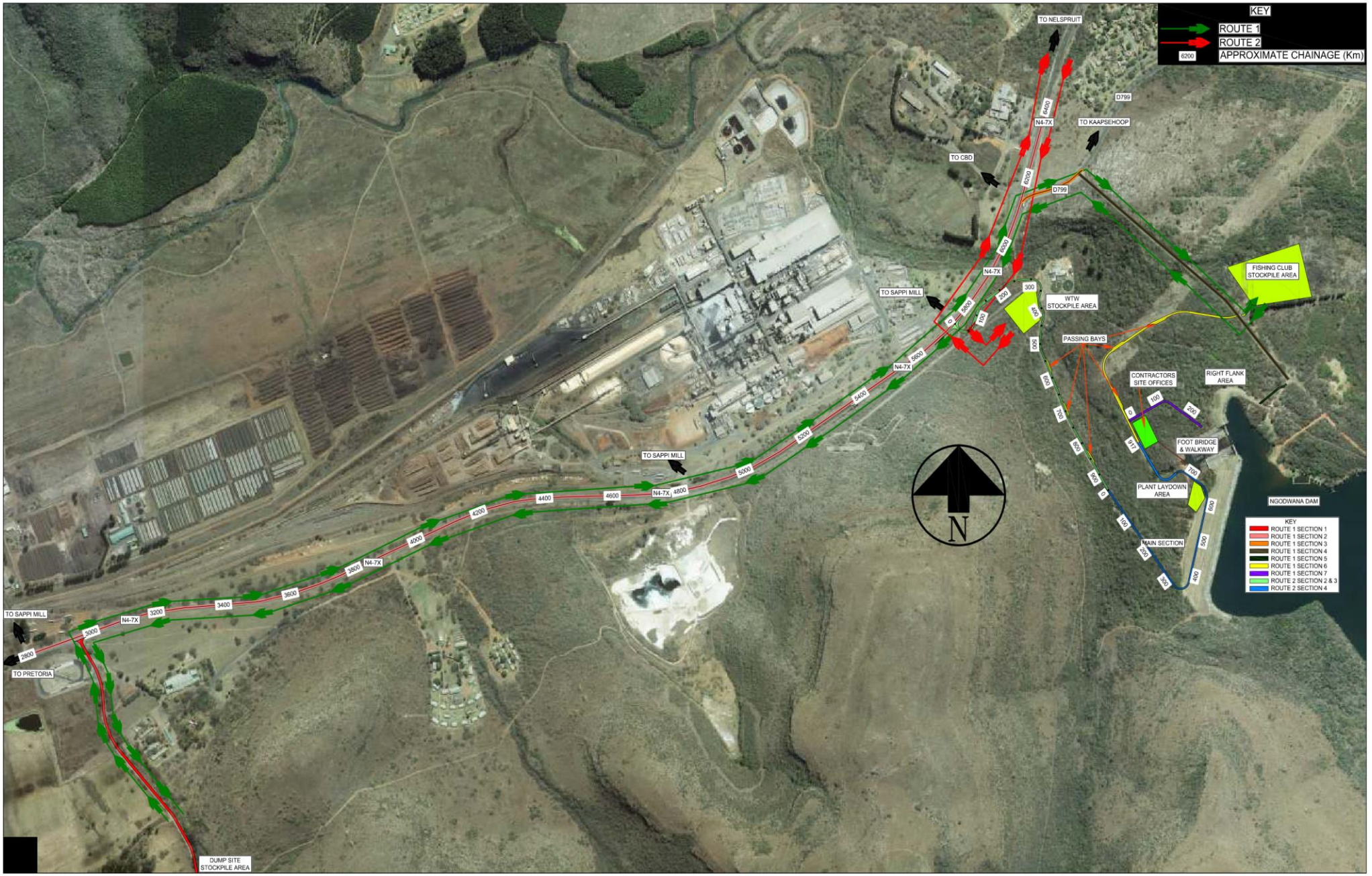

KEY
ROUTE 1
ROUTE 2
6200
APPROXIMATE CHAINAGE (Km)
TO NELSPRUIT
D799
N4-7X
TO KAAPSEHOOP
TO CBD
FISHING CLUB STOCKPILE AREA
WTW STOCKPILE AREA
TO SAPPI MILL
PASSING BAYS
CONTRACTORS SITE OFFICES
RIGHT FLANK AREA
FOOT BRIDGE & WALKWAY
PLANT LAYDOWN AREA
NGODWANA DAM
MAIN SECTION
TO PRETORIA
DUMP SITE STOCKPILE AREA
N
KEY
ROUTE 1 SECTION 1
ROUTE 1 SECTION 2
ROUTE 1 SECTION 3
ROUTE 1 SECTION 4
ROUTE 1 SECTION 5
ROUTE 1 SECTION 6
ROUTE 1 SECTION 7
ROUTE 2 SECTION 2 & 3
ROUTE 2 SECTION 4

FIGURE 1

ANNEXURE B

LABORATORY RESULTS

LETABA LAB (Pty) Ltd

24 Kragbron Street,
Nelspruit, 1200
P.O Box 739,
White River, 1240

T0549

CIVIL ENGINEERING MATERIALS LABORATORY

Tel. No: 087 285 0816 **e-mail :** letaba@letabalab.co.za www.letabalab.co.za

GRAVEL, SOIL AND SAND TEST REPORT

SANS 3001 Methods GR1, GR5, GR10, GR20, GR30 & GR40

Client : **DMV Consulting Engineers** | Doc No: 26717/1(i) | Date Sampled : **21-Jan-20**

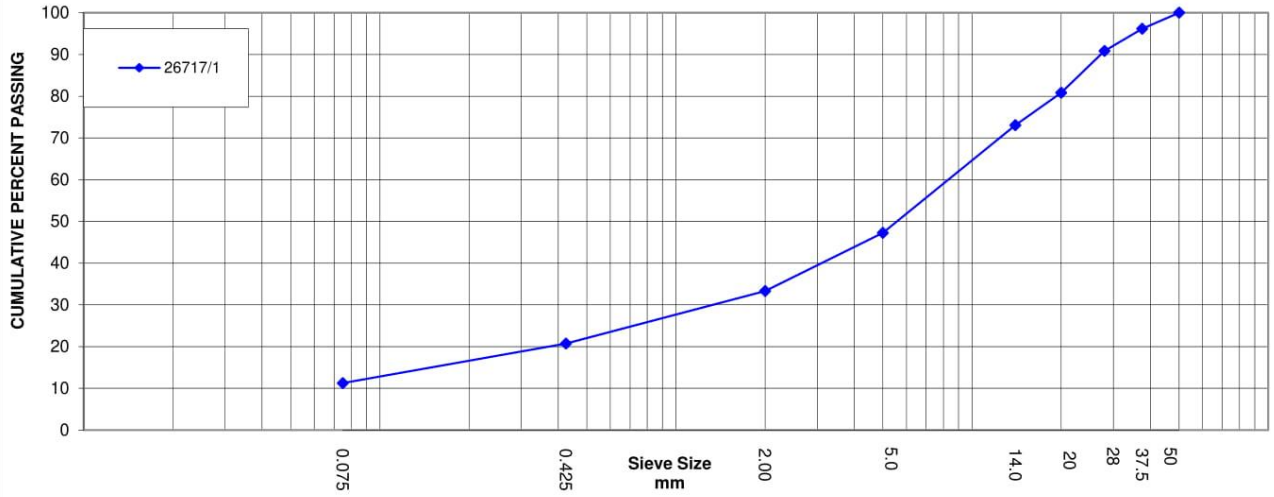
Address: P.O. Box 5142, Nelspruit, 1200 | Date Recieved: **21-Jan-20**

Contract : **Sappi Ngodwana** | Date Tested : **31-Jan-20**

Description : **Material sampled from Stockpile at Ash Plant sampled by lab**

Depth (m)	Sample No	Description * (Unified Soil Classification)	Sieve Analysis Cumulative percentage passing 50.0	37.5	28	20.0	14.0	5.0	2.00	0.425	0.075	Grading Modulus	Atterberg Limits (%) Liquid Limit	Plasticity Index	Linear Shrinkage	Classification * Unified Soil	COLTO : 1998	US. Highway	Group Index
-	26717/1	drk GreyPoorly graded gravel with silt and sand	100	96	91	81	73	47	33	21	11	2.3		NP	0.0	GP/GM	G6	A-1-a	0

GRADING ANALYSIS



GENERAL *

Effective size (mm):	**<0.075**
Uniformity co-eff. :	**8308**
Curvature co-eff. :	**212.7**
Oversize Index :	**0**
Shrinkage Product :	**0**
Grading co-eff. :	**27.2**

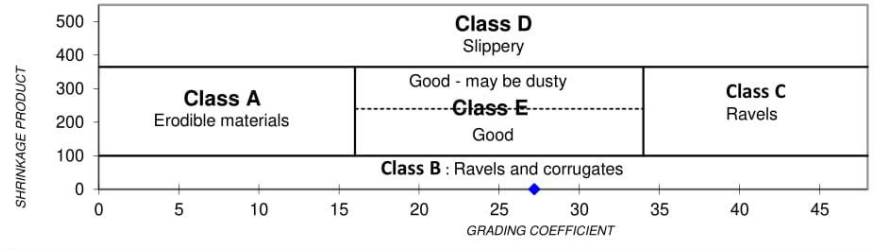
CBR RESULTS (%) :

@ 100% comp. :	**75**
@ 98% comp. :	**56**
@ 97% comp. :	**48**
@ 95% comp. :	**36**
@ 93% comp. :	**27**
@ 90% comp. :	**18**

Soil Mortar Analysis : SANS 3001-PR5 *

Coarse Sand (<2.0>0.425mm):	**37.9%**
Fine Sand (<0.425>0.075mm):	**28.3%**
Silt & Clay (<0.075mm):	**33.8%**

PERFORMANCE AS GRAVEL WEARING COURSE *



*** tests done at Mbombela (Nelspruit) branch*

REMARKS

All items marked * fall outside our scope of our quality document

This sample was sampled using Method MB1 of TMH5 : 1981 and prepared for compaction by using the Crushing method

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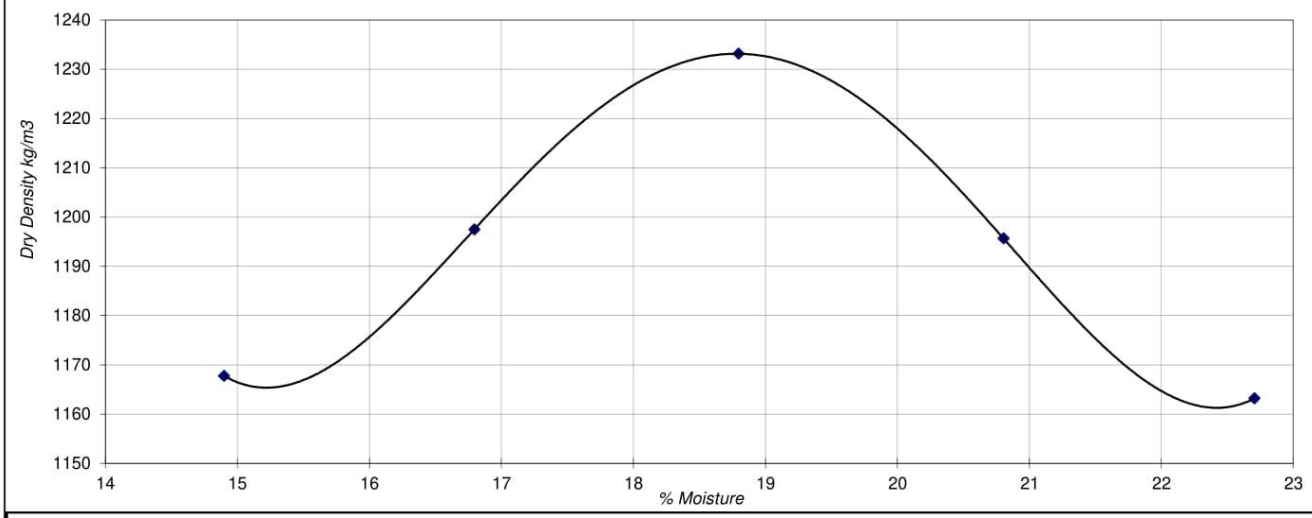
LETABA LAB

CBR and Maximum Dry Density test report

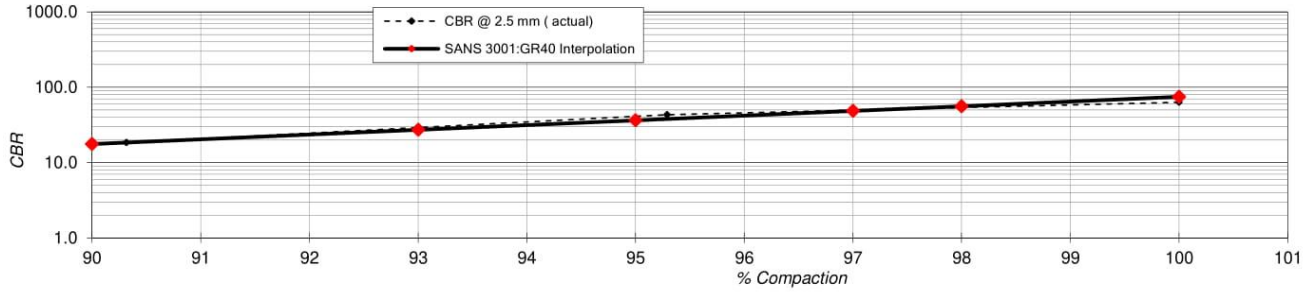
SANS 3001 Methods GR1, GR5, GR10, GR20, GR30 & GR40

Client:	**DMV Consulting Engineers**	Date tested:	**31-Jan-20**
Contract :	**Sappi Ngodwana**	Date Recieved:	**21-Jan-20**
Description:	**Material sampled from Stockpile at Ash Plant sampled by lab**	Sample no:	**26717/1**
		Doc no:	26717/1(ii)

Maximum Dry Density =	**1233**	**kg/m³**
Optimum moisture content =	**18.8**	**%**



California Bearing Ratio



% Compaction	100	98	97	95	93	90
CBR of 13.3 kN	75	56	48	36	27	18

** tests done at Mbombela (Nelspruit) branch

REMARKS

Briquette Information			
% Compaction of MDD:	100.1%	95.4%	90.4%
Dry Density (kg/m³):	1234	1176	1115
Compaction Moisture (%):	18.7	18.7	18.6
% Swell:	0.0	0.1	0.1

This sample was sampled using Method MB1 of TMH5 : 1981 and prepared for compaction by using the Crushing method

Please note that test results are only relevant to the sample tested, and were sampled in accordance with TMH5 : 1991, Method MB1 : Stockpiles, by the lab at positions and frequencies stipulated by client. Any results may only be reproduced in their entirety with the written consent of LETABA LAB (Pty) Ltd, and any opinions and interpretations expressed fall outside the scope of our Quality Document.

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GRAVEL, SOIL AND SAND TEST REPORT

SANS 3001 Methods GR1, GR5, GR10, GR20, GR30 & GR40

Client : **DMV Consulting Engineers** | Doc No: 26717/2(i) | Date Sampled : **21-Jan-20**

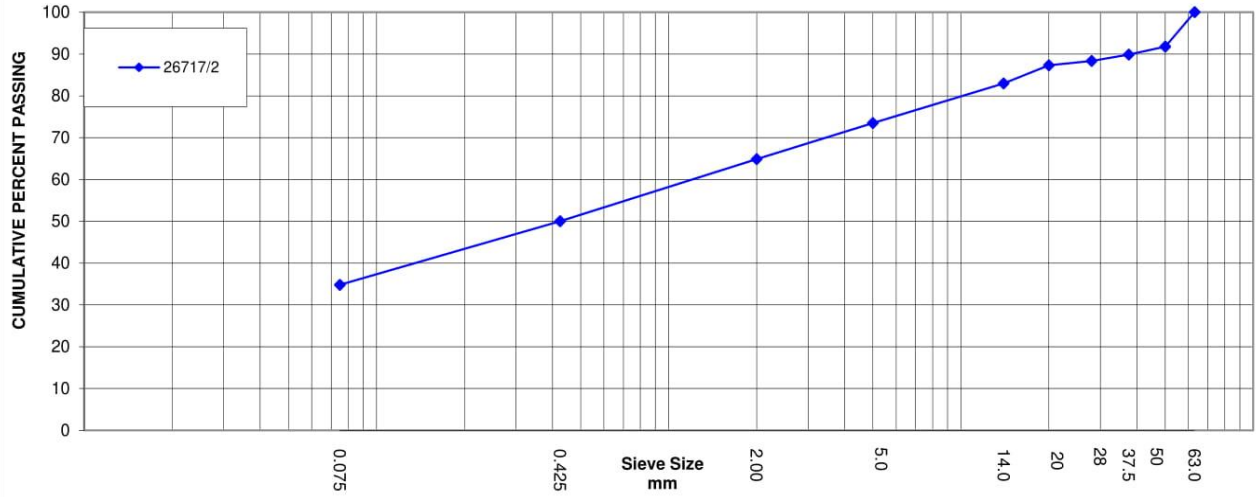
Address: P.O. Box 5142, Nelspruit, 1200 | Date Recieved: **21-Jan-20**

Contract : **Sappi Ngodwana** | Date Tested : **31-Jan-20**

Description : **Material sampled from Stockpile at Dump Site sampled by lab**

Depth (m)	Sample No	Description * (Unified Soil Classification)	Sieve Analysis Cumulative percentage passing 50.0	37.5	28	20.0	14.0	5.0	2.00	0.425	0.075	Grading Modulus	Atterberg Limits (%) Liquid Limit	Plasticity Index	Linear Shrinkage	Classification * Unified Soil	COLTO : 1998	US. Highway	Group Index
-	26717/2	drk Red Clayey sand	92	90	88	87	83	73	65	50	35	1.5	31	16	7.7	SC	<G9	A-2-6	1

GRADING ANALYSIS



GENERAL *

Effective size (mm):	**<0.075**
Uniformity co-eff. :	**1202**
Curvature co-eff. :	**0.1**
Oversize Index :	**16**
Shrinkage Product :	**385**
Grading co-eff. :	**17.2**

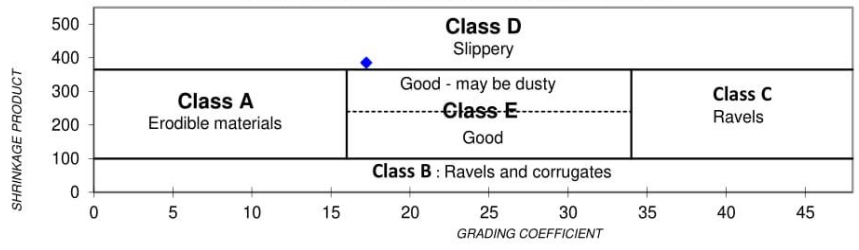
CBR RESULTS (%) :

@ 100% comp. :	**9**
@ 98% comp. :	**5**
@ 97% comp. :	**4**
@ 95% comp. :	**3**
@ 93% comp. :	**2**
@ 90% comp. :	**1**

Soil Mortar Analysis : SANS 3001-PR5 *

Coarse Sand (<2.0>0.425mm):	**22.9%**
Fine Sand (<0.425>0.075mm):	**23.4%**
Silt & Clay (<0.075mm):	**53.6%**

PERFORMANCE AS GRAVEL WEARING COURSE *



*** tests done at Mbombela (Nelspruit) branch*

REMARKS

All items marked * fall outside our scope of our quality document

This sample was sampled using Method MB1 of TMH5 : 1981 and prepared for compaction by using the Crushing method

Please note that test results are only relevant to the sample tested, and were sampled in accordance with TMH5 : 1991, Method MB1 : Stockpiles, by the lab at positions and frequencies stipulated by client. Any results may only be reproduced in their entirety with the written consent of LETABA LAB (Pty) Ltd, and any opinions and interpretations expressed fall outside the scope of our Quality Document.

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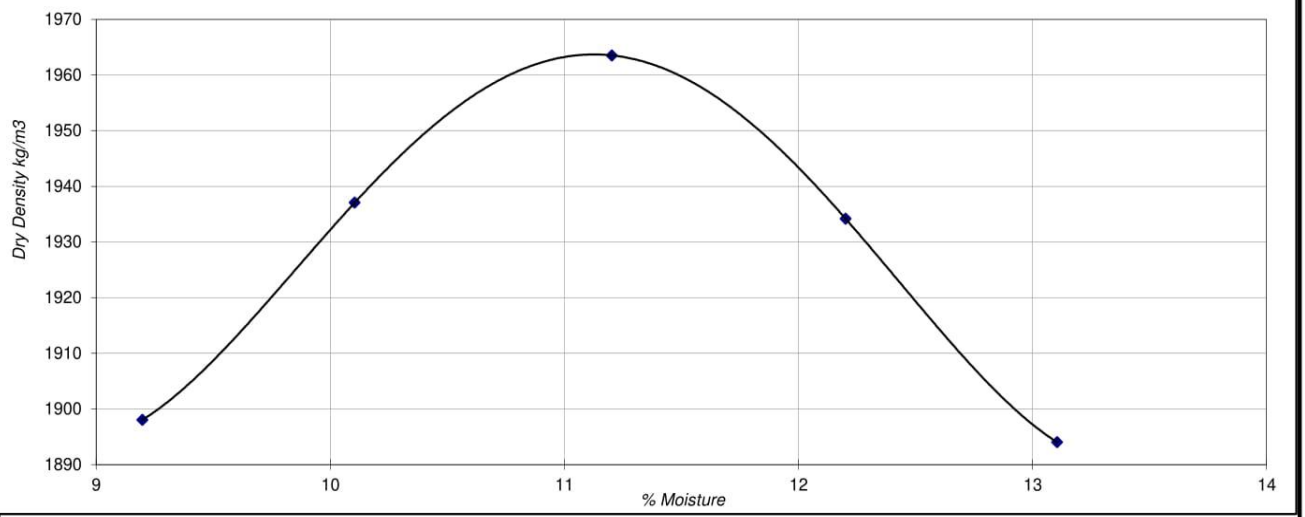
LETABA LAB

CBR and Maximum Dry Density test report

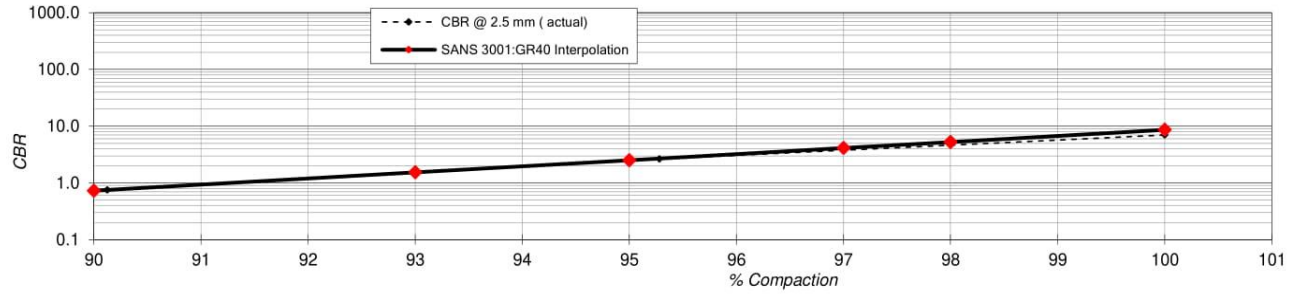
SANS 3001 Methods GR1, GR5, GR10, GR20, GR30 & GR40

Client:	***DMV Consulting Engineers***	*Date tested:*	**31-Jan-20**
Contract :	***Sappi Ngodwana***	*Date Recieved:*	**21-Jan-20**
Description:	***Material sampled from Stockpile at Dump Site sampled by lab***	*Sample no:*	**26717/2**
		Doc no:	26717/2(ii)

Maximum Dry Density =	**1964**	**kg/m³**
Optimum moisture content =	**11.1**	**%**



California Bearing Ratio



% Compaction	**100**	**98**	**97**	**95**	**93**	**90**
CBR of 13.3 kN	**9**	**5**	**4**	**3**	**2**	**1**

** tests done at Mbombela (Nelspruit) branch

REMARKS

Briquette Information			
% Compaction of MDD:	**100.1%**	**95.3%**	**90.2%**
Dry Density (kg/m³):	**1965**	**1872**	**1771**
Compaction Moisture (%):	**11.2**	**11.1**	**11.3**
% Swell:	**0.3**	**0.7**	**1.2**

This sample was sampled using Method MB1 of TMH5 : 1981 and prepared for compaction by using the Crushing method

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GRAVEL, SOIL AND SAND TEST REPORT

SANS 3001 Methods GR1, GR5, GR10, GR20, GR30 & GR40

Client : **DMV Consulting Engineers** | Doc No: 26717/3(i) | Date Sampled : **21-Jan-20**

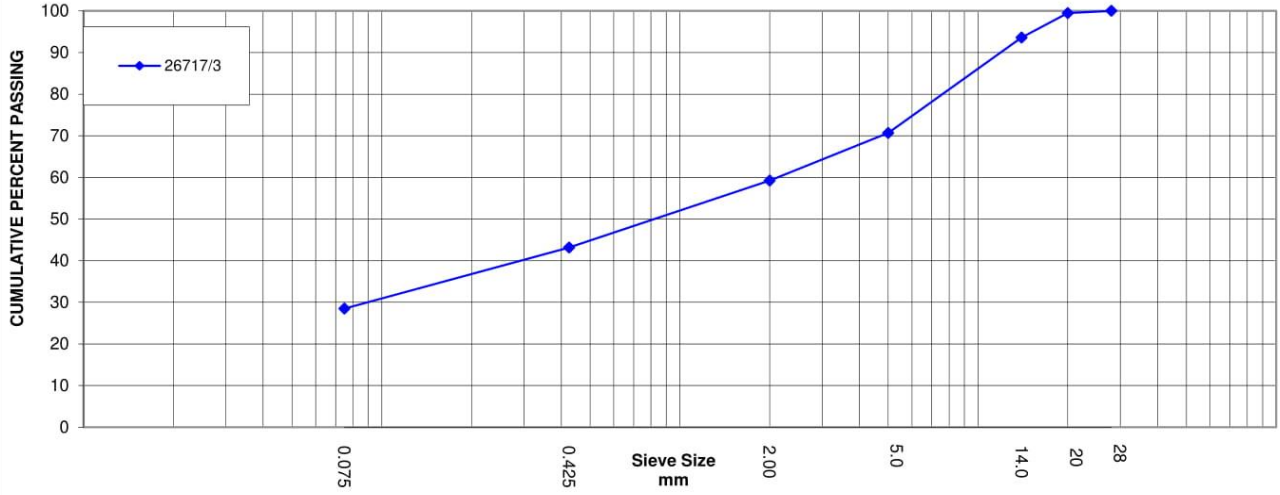
Address: P.O. Box 5142, Nelspruit, 1200 | Date Recieved: **21-Jan-20**

Contract : **Sappi Ngodwana** | Date Tested : **4-Feb-20**

Description : **Blended sample - 50% Ash Plant material & 50% Dump site material sampled by lab**

Depth (m)	Sample No	Description * (Unified Soil Classification)	Sieve Analysis Cumulative percentage passing 50.0	37.5	28	20.0	14.0	5.0	2.00	0.425	0.075	Grading Modulus	Atterberg Limits (%) Liquid Limit	Plasticity Index	Linear Shrinkage	Classification * Unified Soil	COLTO : 1998	US. Highway	Group Index
-	26717/3	lt GreySilty/clayey sand			100	99	94	71	59	43	28	1.7	28	4	1.7	sm/sc	G7	A-2-4	0

GRADING ANALYSIS



GENERAL *

Effective size (mm):	**<0.075**
Uniformity co-eff. :	**2124**
Curvature co-eff. :	**3.8**
Oversize Index :	**0**
Shrinkage Product :	**73**
Grading co-eff. :	**28.8**

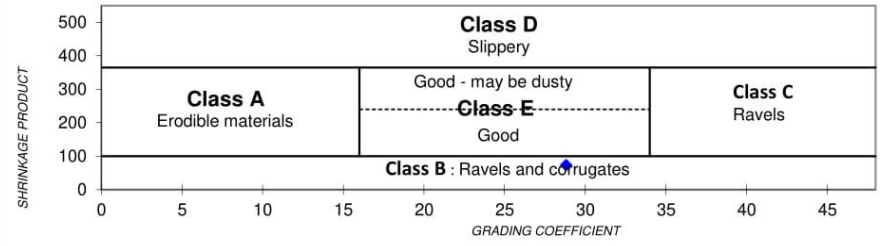
CBR RESULTS (%) :

@ 100% comp. :	**34**
@ 98% comp. :	**29**
@ 97% comp. :	**27**
@ 95% comp. :	**22**
@ 93% comp. :	**19**
@ 90% comp. :	**15**

Soil Mortar Analysis : SANS 3001-PR5 *

Coarse Sand (<2.0>0.425mm):	**27.1%**
Fine Sand (<0.425>0.075mm):	**24.8%**
Silt & Clay (<0.075mm):	**48.1%**

PERFORMANCE AS GRAVEL WEARING COURSE *



*** tests done at Mbombela (Nelspruit) branch*

REMARKS

All items marked * fall outside our scope of our quality document

This sample was sampled using Method MB1 of TMH5 : 1981 and prepared for compaction by using the Scalping method

Please note that test results are only relevant to the sample tested, and were sampled in accordance with TMH5 : 1991, Method MB1 : Stockpiles, by the lab at positions determined by lab, and test frequency stipulated by the client. Any results may only be reproduced in their entirety with the written consent of LETABA LAB (Pty) Ltd, and any opinions and interpretations expressed fall outside the scope of our Quality Document.

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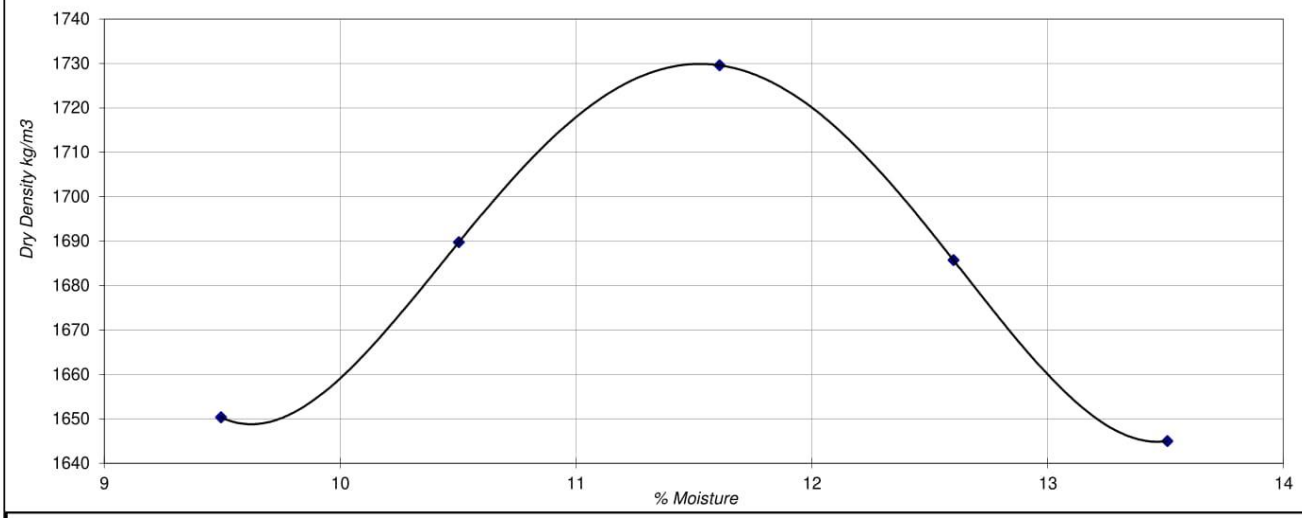
CBR and Maximum Dry Density test report

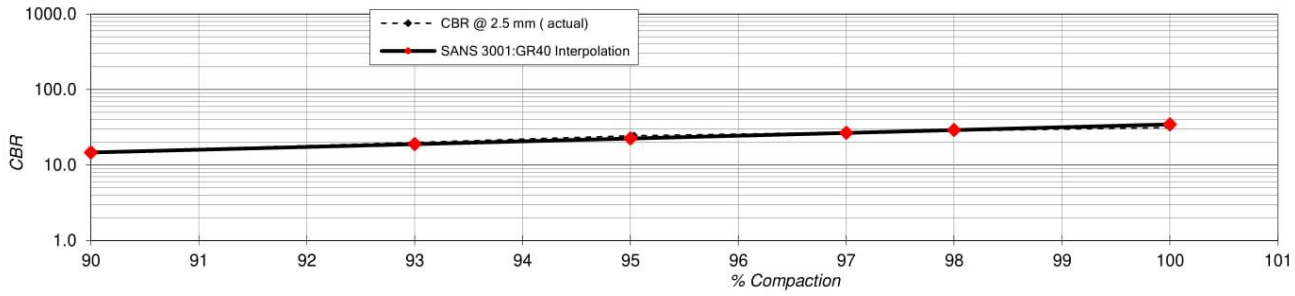
SANS 3001 Methods GR1, GR5, GR10, GR20, GR30 & GR40

Client:	***DMV Consulting Engineers***	*Date tested:*	**4-Feb-20**
Contract :	***Sappi Ngodwana***	*Date Recieved:*	**21-Jan-20**
Description:	***Blended sample - 50% Ash Plant material & 50% Dump site material sampled by lab***	*Sample no:*	**26717/3**
		Doc no:	26717/3(ii)

Maximum Dry Density =	**1730**	**kg/m³**
Optimum moisture content =	**11.5**	**%**



California Bearing Ratio



% Compaction	**100**	**98**	**97**	**95**	**93**	**90**
CBR of 13.3 kN	**34**	**29**	**27**	**22**	**19**	**15**

** tests done at Mbombela (Nelspruit) branch

REMARKS

Briquette Information			
% Compaction of MDD:	**100.1%**	**95.1%**	**90.0%**
Dry Density (kg/m³):	**1732**	**1646**	**1556**
Compaction Moisture (%):	**11.6**	**11.6**	**11.6**
% Swell:	**0.0**	**0.1**	**0.2**

This sample was sampled using Method MB1 of TMH5 : 1981 and prepared for compaction by using the Scalping method

Please note that test results are only relevant to the sample tested, and were sampled in accordance with TMH5 : 1991, Method MB1 : Stockpiles, by the lab at positions determined by lab, and test frequency stipulated by the client. Any results may only be reproduced in their entirety with the written consent of LETABA LAB (Pty) Ltd, and any opinions and interpretations expressed fall outside the scope of our Quality Document.

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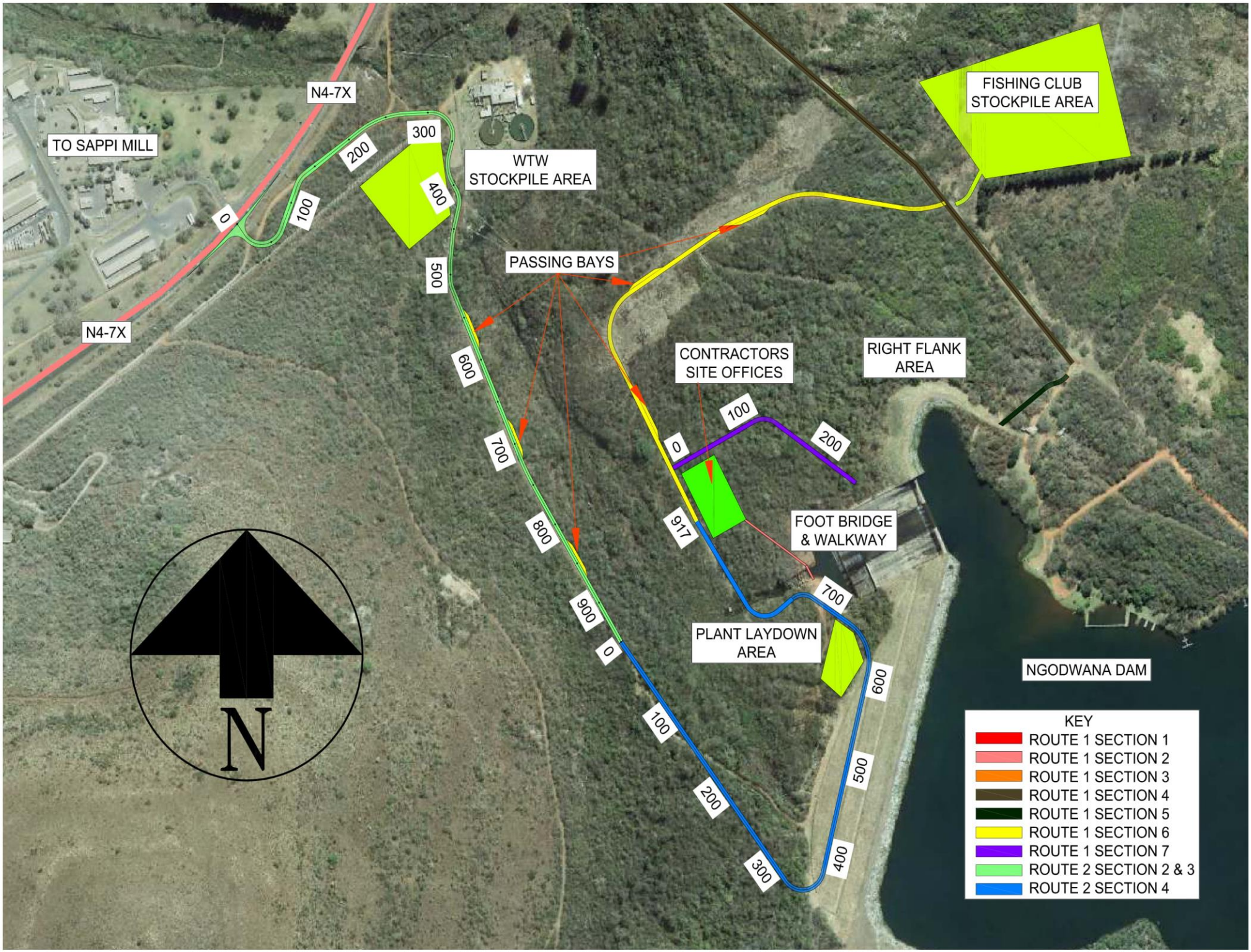
ANNEXURE C

DESIGN LAYOUT


N4-7X
TO SAPPI MILL
N4-7X
0
100
200
300
400
WTW
STOCKPILE AREA
FISHING CLUB
STOCKPILE AREA
PASSING BAYS
500
600
700
800
900
0
100
200
300
400
500
600
700
CONTRACTORS
SITE OFFICES
RIGHT FLANK
AREA
0
100
200
917
FOOT BRIDGE
& WALKWAY
PLANT LAYDOWN
AREA
NGODWANA DAM
N
KEY
ROUTE 1 SECTION 1
ROUTE 1 SECTION 2
ROUTE 1 SECTION 3
ROUTE 1 SECTION 4
ROUTE 1 SECTION 5
ROUTE 1 SECTION 6
ROUTE 1 SECTION 7
ROUTE 2 SECTION 2 & 3
ROUTE 2 SECTION 4

ANNEXURE D

TYPICAL STREAM CROSSINGS

A TYPICAL CULVERT CROSSING

A TYPICAL CAUSEWAY PIPE CULVERT COMBINATION

A CONCRETE CAUSEWAY ON IMPORTED ROCKFILL

CAUSEWAY WITH PIPE CULVERTS