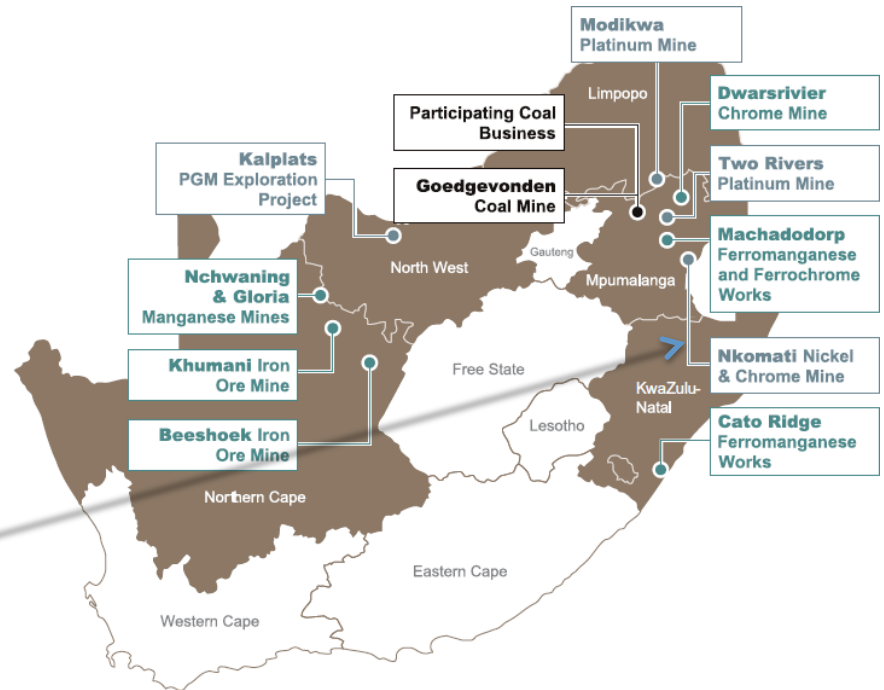




# African Rainbow Minerals

Nkomati Mine





Located in the Machadodorp area of the Mpumalanga province, 300 kilometres east of Johannesburg. African Rainbow Minerals (ARM) is a leading South African diversified mining and minerals company with long-life, low unit cost operations and significant growth opportunities.

Nkomati represents one of the largest nickel reserve in South Africa having estimated reserves of 408.6 million tonnes of ore grading 0.33% nickel. The 408.6 million tonnes of ore contains 1.35 million tonnes of nickel metal. Nickel mining takes place by means of an underground shaft as well as by open-pit mining. Oxidised chromitite is also mined as part of the pre-strip of the future open pits.

ARM mines and beneficiates iron ore, manganese ore and alloys, chrome ore and alloys, platinum group metals, copper, nickel and coal. ARM also has an investment in gold through its shareholding in Harmony.





## HAUL ROAD STABILIZATION

January, 2010, Norilsk Nickel Africa (Pty) Ltd contracted Polymer Pavements to stabilize the haul roads on the open cast mining section.

### STABILIZATION – SOILTECH MK. III POLYMER

The existing haul road was ripped to a depth of 150mm. SoilTech Mk. III polymer stabilizer, supplied by Polymer Pavements was applied at a ratio 1.5 liters per m<sup>2</sup>.

SoilTech Mk. III was diluted with water and sprayed over the ripped area. Further water was added to the soil and once the material was brought to optimum moisture content, the road was profiled

Once OMC was reached the stabilized base-layer was compacted with a 12 tonne vibrating roller to 98% MOD.

The road was opened to traffic 24 hours later

After 3 days of curing, a diluted concentration of ClearTech polymer was sprayed over the top, using a water bowser. ClearTech assists in keeping the surface of the base-layer in a stable condition

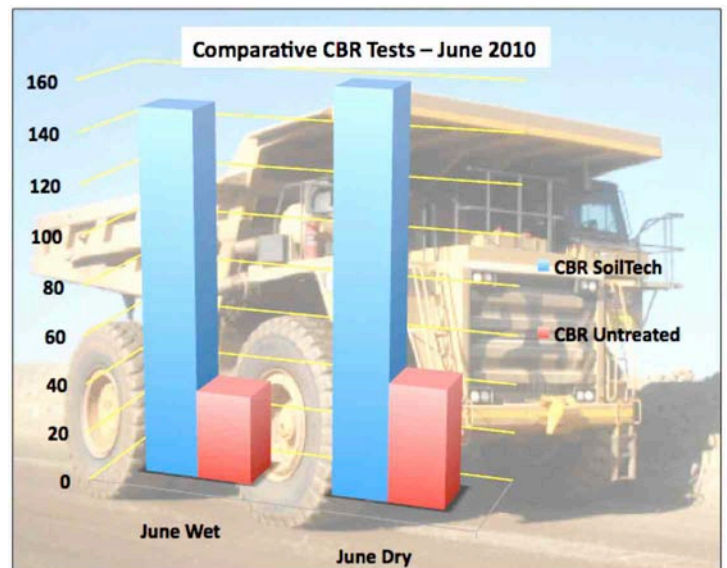


**NKOMATI MINE - HAUL ROADS**

**DYNAMIC CONE PENETROMETER TEST RESULTS**

<b>Dry Test (June 2010)</b>	<b>Wet Test (soaked for 40 mins)</b>
Average Reading on Treated Dry Road CBR 160% UCS 1308 kPa E-Modulus 509 MPa	Average Reading on Treated Wet Road CBR 148% UCS 1217 kPa E-Modulus 475 MPa
<b>Average Reading on Untreated Dry Slag Road</b> CBR 48% UCS 453kPa E-Modulus 187 MPa	<b>Average Reading on Untreated Wet Slag Road</b> CBR 36% UCS 352 kPa E-Modulus 147 MPa
<b>Dry Test (9 March 2010)</b>	<b>Wet Test (soaked for 2 hours)</b>
Average Reading on Treated Dry Road CBR 135% UCS 1121 kPa E-Modulus 440 MPa	Average Reading on Treated Wet Road CBR 102% UCS 875 kPa E-Modulus 347 MPa

Table 1.







*"The section with Polymer stabilizer has shown a significant improvement in the functional performance in that dust has been minimized"*

#### Professor Alex Visser

Professor Visser recently retired as the South African Roads Board Professor in Transportation Engineering in the Department of Civil Engineering at the University of Pretoria, South Africa.

His fields of research interest are primarily low-volume road design and maintenance, roads for ultra-heavy applications, and road management systems. He is an elected Fellow of the prestigious South African Academy of Engineering. He is a Fellow and Past President of the South African Institution of Civil Engineering (SAICE). In 1998 he was awarded the SAICE award for Meritorious Research for his contributions to low-volume road technologies.

In 2004 he received the Chairman's Award from the Transportation Division for contributions to transportation engineering. He was awarded emeritus membership of the USA Transportation Research Board Low-Volume Roads Committee in 2006 for lifelong service.

Prof Visser's qualifications include:

PrEng, B Comm (SA), BSc (Eng) (Cape Town), MSc (Eng) (Wits), PhD (Texas), FSAICE, AMAcad

Prof. Alex Visser was asked to provide comment on the DCP tests at Nkomati Mine:

*"The results obtained on the haul roads are shown in Table 1. Note that two sets of results were taken. The first, in March 2010 only provided results on the stabilized sections, and no comparison with the untreated road.*

*The repeated test in June 2010 provided results on both sections. Firstly, it is interesting to note that on the untreated slag road the DCP CBR is 48% dry and 36% wet, although only soaked for 40 minutes because of constraints.*

*The soaked CBR **should be more than 60%**, and the untreated road does not fulfill this criterion, and this low value also explains the deformation shown in Figure 1.*

*The **stabilized section** had a dry DCP CBR of 135% in March and 160% in June 2010. This shows that there was strength gain in the intervening period. Furthermore, the soaked DCP CBR was 102% in March (after 2 hours soaking) and 148% in June after 40 minutes soaking. These results show that the bearing capacity improved by stabilizing, and the bearing capacity is better than the minimum required.*

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Nkomati haul roads before stabilization, after rains



After Stabilization with SoilTech Polymer