Mitigation Measures for the Acid Mine Drainage Emanating from the Sabie Goldfield: Case Study of the Nestor Mine

R. Lusunzi, F. Waanders, E. Fosso-Kankeu, K.T.R. Netshitungulwana

West Virginia Mine Drainage Task Force Symposium & 15th International Mine Water Association Congress, Morgantown, WV, USA

23 April 2024

NWU®
NORTH-WEST UNIVERSITY
NOORDWES-UNIVERSITEIT
UNIBESITI YA BOKONE-BOPHIRIMA

Council for Geoscience

Disclaimer

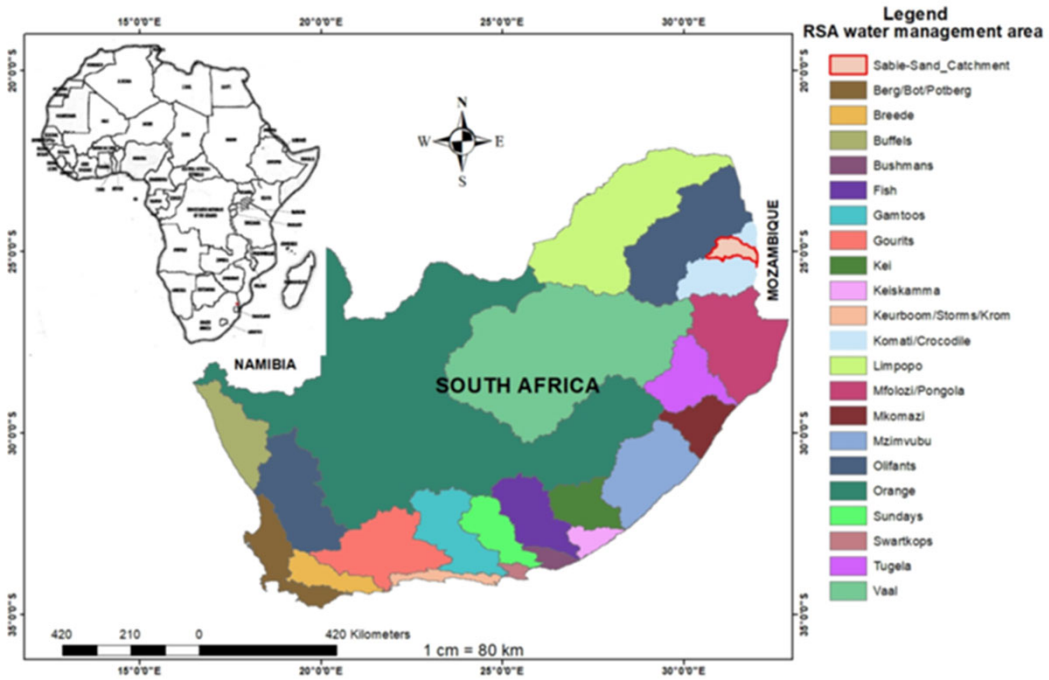
Outline

- Introduction
- Objectives
- Methodology
- Results
- Conclusions

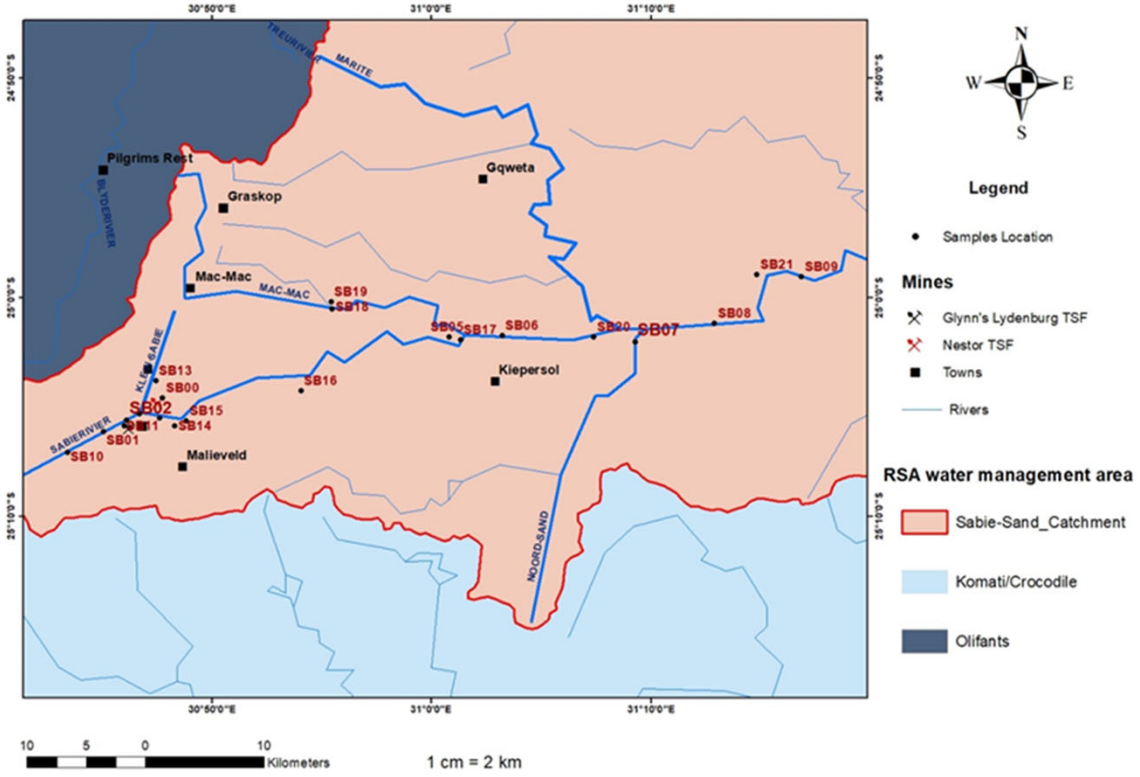
Introduction

- The increased accumulation of trace elements in soils due to anthropogenic activities poses a risk to the health of humans and the ecosystem: for
  - Biological diversity
  - Water resources
- Metals accumulate in sediments from both natural and anthropogenic sources
- Geochemical studies have been conducted on the Sabie Goldfields mine tailings storage facilities (MTSF) (Lusunzi et al., 2017, 2018, & 2019).
- This study aimed at developing mitigation measures for the AMD emanating from the Nestor MTSF.

Sabie-Sand Catchment



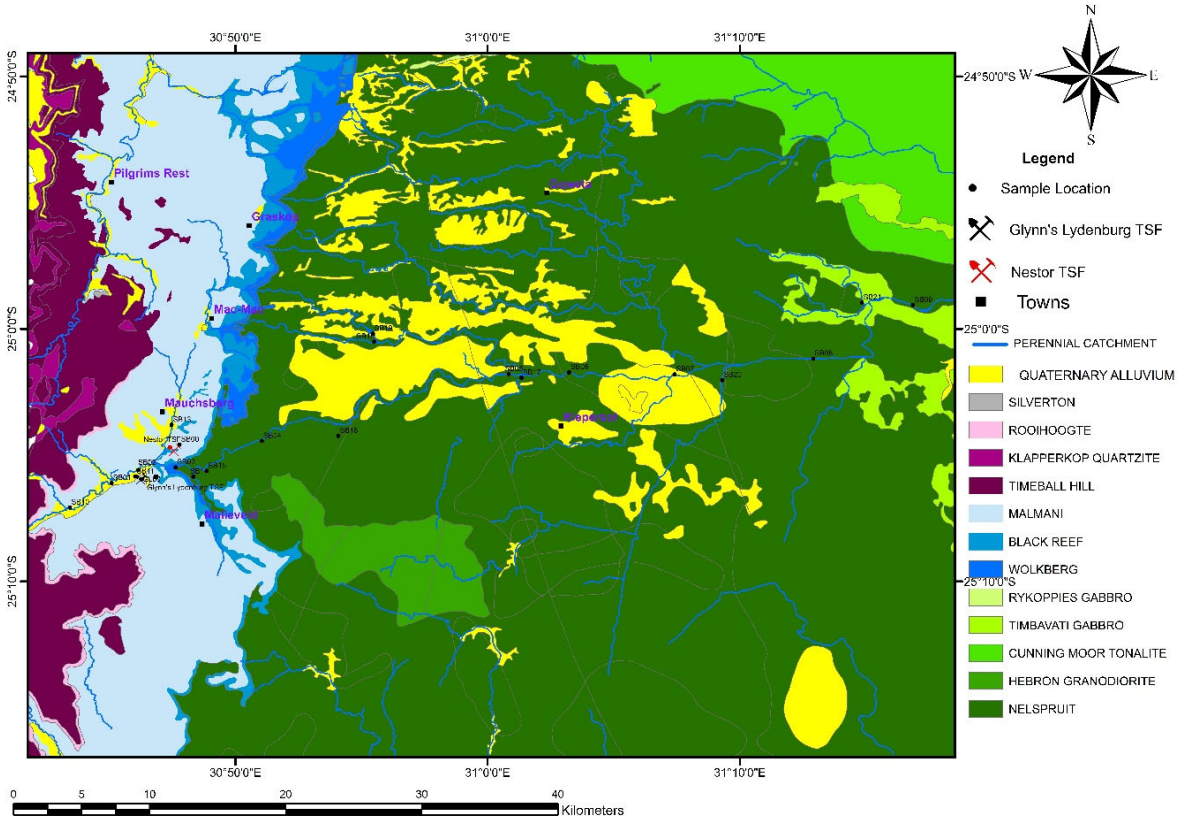
Location of the Sabie River Catchment



Nestor MTSF in the Sabie Area

Glynns Lydenburg MTSF in the Sabie Goldfield

Geological Setting of the Sabie River System



Objectives

- **Developing mitigation measures for the AMD emanating from the Nestor MTSF using materials from the Glynns Lydenburg MTSF**

- *To provide extensive data sets for future initiatives such as mathematical modelling of AMD*

Methodology

- ***Sampling***

- Tailings from the Nestor and Glynns Lydenburg MTSFs
- Top 0-5 cm layer using a plastic scoop (20 kg)

- ***Analyses***

- Acid-base accounting: acid-production potential and acid-consumption potential of tailings
- X-Ray Diffraction: mineralogical composition

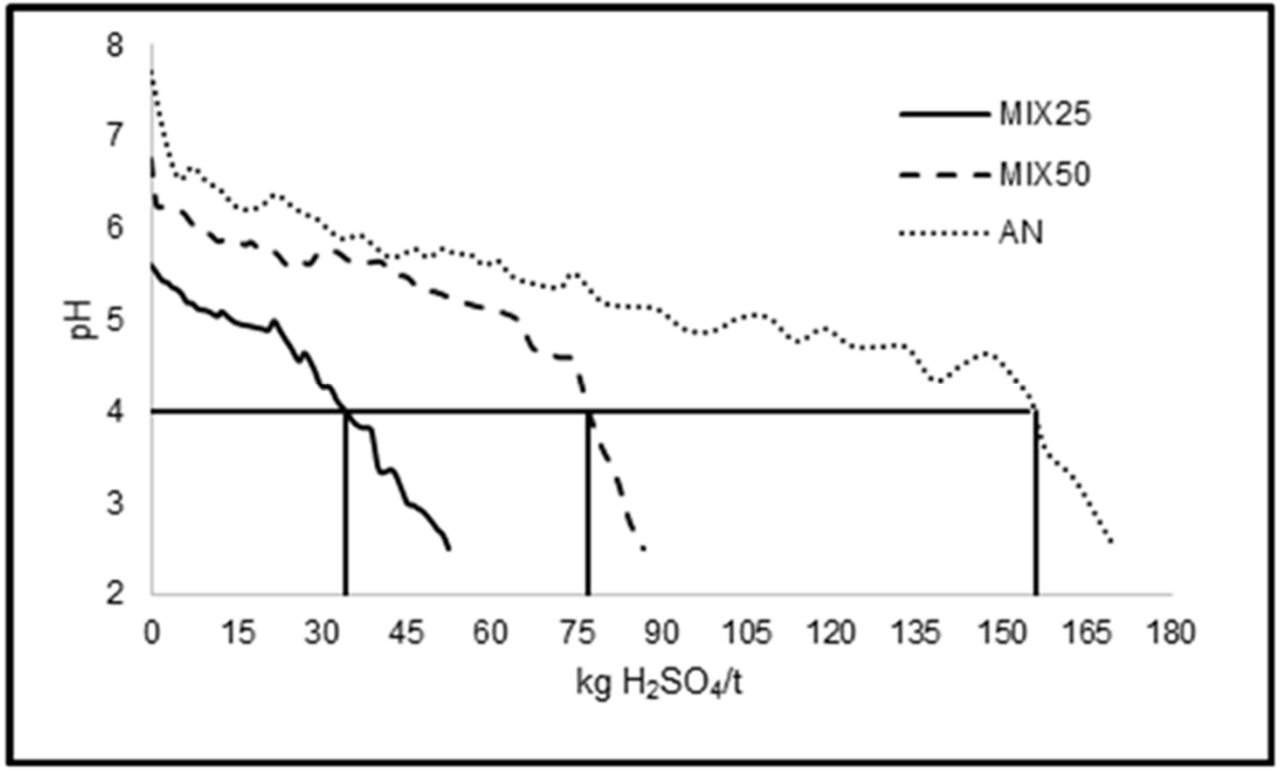
Geochemical Results

Sample ID	Paste pH	ANC (kgH_2SO_4/t)	Sulfur (Total)	MPA (kgH_2SO_4/t)	NAPP (kgH_2SO_4/t)	$Ratio_{ANC/MPA}$
NTS	2.5	0	0.43	13	13	0
GTS	7.7	184	0.07	2	-182	92
COM25	5.1	56	0.34	10	-46	6
COM50	6.1	96	0.25	8	-88	12

Acid Base Accounting Results

Sample ID	Paste pH	ANC (kgH_2SO_4/ton)	Sulfur (Total)	MPA (kgH_2SO_4/ton)	NAPP (kgH_2SO_4/ton)	R (ANC/MPA)
NTS	2.5	0	0.43	13	13	0
GTS	7.7	184	0.07	02	-182	92
COM25	5.1	56	0.34	10	-46	06
COM50	6.1	96	0.25	08	-88	12

Acid Buffering Characteristic Curve (ABBC)



Acid Base Accounting Results…

Sample ID	ANC (ABA) (kgH_2SO_4/ton)	ANC (ABBC $_{pH=2.5}$) (kgH_2SO_4/ton)	ANC (ABCC $_{pH=4}$) (kgH_2SO_4/ton)
COM25	56	53	35
COM50	96	87	77
GTS	184	170	155

Acid Base Accounting Results…

Sample	NAPP (kgH_2SO_4/ton)	NAG-pH	Classification
NTS	13	2.7	PAF
COM25	-46	4.9	NAF
COM50	-89	5.0	NAF
GTS	-182	5.9	NAF

Mineralogical composition

Sample ID	Quartz	Mica	Dolomite	Pyrite	Goethite
NTS	80.5	17.9	ND	0.1	1.5
GTS	59.7	8.0	29.4	ND	2.9

Conclusions

- Rehabilitating the Nestor MTSF should be the top priority.
- Location and geochemistry: Glynns Lydenburg MTSF tailings could be used as a cover for potential vegetation growth in the Nestor MTSF.
- Benefits: cost-effective and local community empowerment.
- Limitations: gold assay was not performed.

NWU®
NORTH-WEST UNIVERSITY
NOORDWES-UNIVERSITEIT
UNIBESITI YA BOKONE-BOPHIRIMA

THANK YOU

Council for Geoscience