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the federation for a sustainable environment

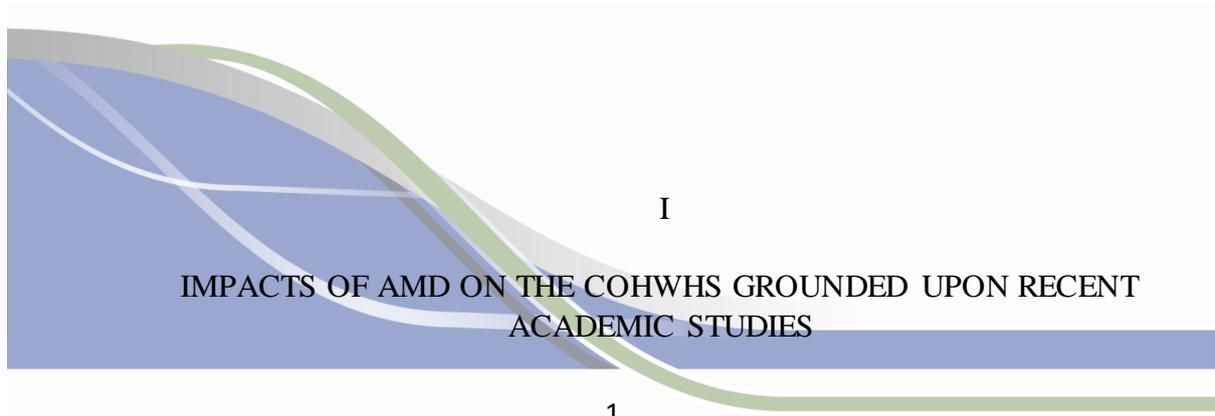
## Comments on the Cradle of Humankind World Heritage Site (COHWHS)

### Integrated Management Plan

The following comments are submitted on behalf of the Federation for Sustainable Environment (FSE). The FSE is a federation of community based civil society organisations committed to the realisation of the constitutional right to an environment that is not harmful to health or well-being, and to having the environment sustainably managed and protected for future generations. Their mission is specifically focussed on addressing the adverse impacts of mining and industrial activities on the lives and livelihoods of vulnerable and disadvantaged communities who live and work near South Africa's mines and industries

In anticipation of the release of the draft Integrated Management Plan for the COHWHS by the end of May 2018, allow us please to submit the following preliminary comments on:

- I. The impacts of Acid Mine Drainage (AMD) on the COHWHS grounded upon recent academic studies;
- II. The current treatment of AMD and the potential impacts upon the COHWHS; and
- III. The current Mining Applications within the Magaliesburg Area and the potential impacts upon the COHWHS' unique sense of place





The relatively proximity of the COHWHS to:

1. the West Rand Acid Mine Drainage (AMD) source (10km upstream from the COHWHS),
2. the receptor rivulets (Tweelopiespruit, Bloubankspruit, lower Rietspruit), rivers (Crocodile West), pits (West Wits Pit) and dams (Hippo Dam, Aviary Dam, etc.) and the wetlands downstream of the discharge point of approximately 40 million liters per day of neutralised but highly saline AMD from the high density sludge Western Basin Water Treatment plant

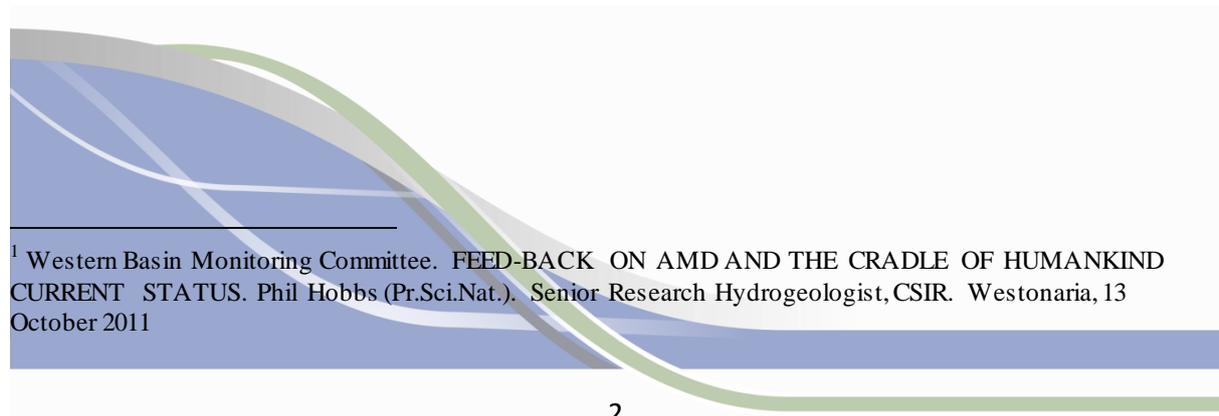
places this region at a moderate to high risk for groundwater and surface water contamination. Untreated AMD has been allowed to discharge continuously into the environment of the COHWHS for ten years following the flooding of the Western Basin in 2002.

We now refer to the findings of a number of peer reviewed academic reports.

1.

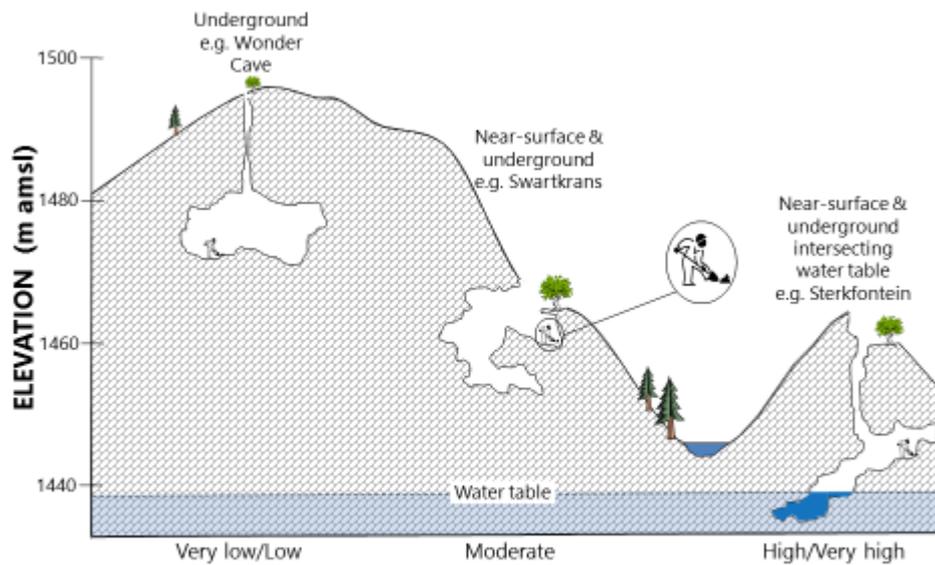
Western Basin Monitoring Committee. FEED-BACK ON AMD AND THE CRADLE OF HUMANKIND CURRENT STATUS. Phil Hobbs (Pr.Sci.Nat.). Senior Research Hydrogeologist, CSIR. Westonaria, 13 October 2011

Bolt's Farm and the Sterkfontein Caves were identified in 2011 as posing high and very high hydrovulnerability risks<sup>1</sup>. See subjoined graphs.

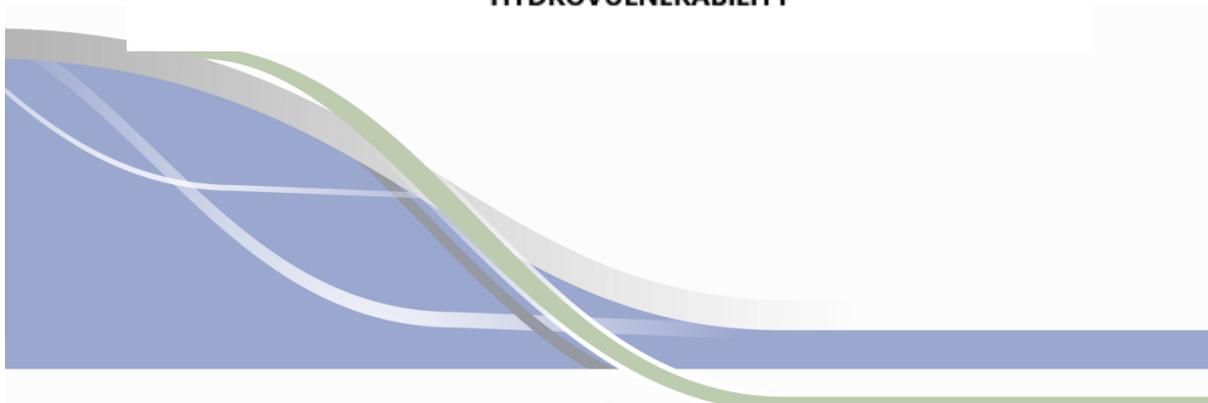


FOSSIL SITE	SURFACE ELEVATION (m amsl)	CAVE BASE ELEVATION (m amsl)	GROUNDWATER ELEVATION (m amsl)	SEPARATION DISTANCE (m)	HYDRO-VULNERABILITY
BOLT'S FARM	>1480	<1448	~1448	0	VERY HIGH
SWARTKRANS	>1470	<1465	~1440	<25	MODERATE
STERKFONTEIN	>1470	<1437	~1437	0	HIGH
COOPERS	>1465	~1460	~1435	<30	LOW
KROMDRAAI	>1470	~1465	~1432	<35	LOW
MINNAARS	>1455	<1450	~1437	<20	MODERATE
PLOVER'S LAKE	>1430	<1425	~1420	<5	MODERATE
WONDER CAVE	>1500	~1440	~1422	>20	LOW
DRIMOLEN	>1545	~1540	~1490	~50	VERY LOW
GLADYSVALE	>1415	~1370	~1362	~10	LOW
MOTSETSE	>1495	~1490	~1415	>80	VERY LOW
HAASGAT	>1470	~1465	~1420	~45	VERY LOW
GONDOLIN	>1385	~1380	~1340	~40	VERY LOW
MALAPA	>1435	~1430	~1375	~55	VERY LOW

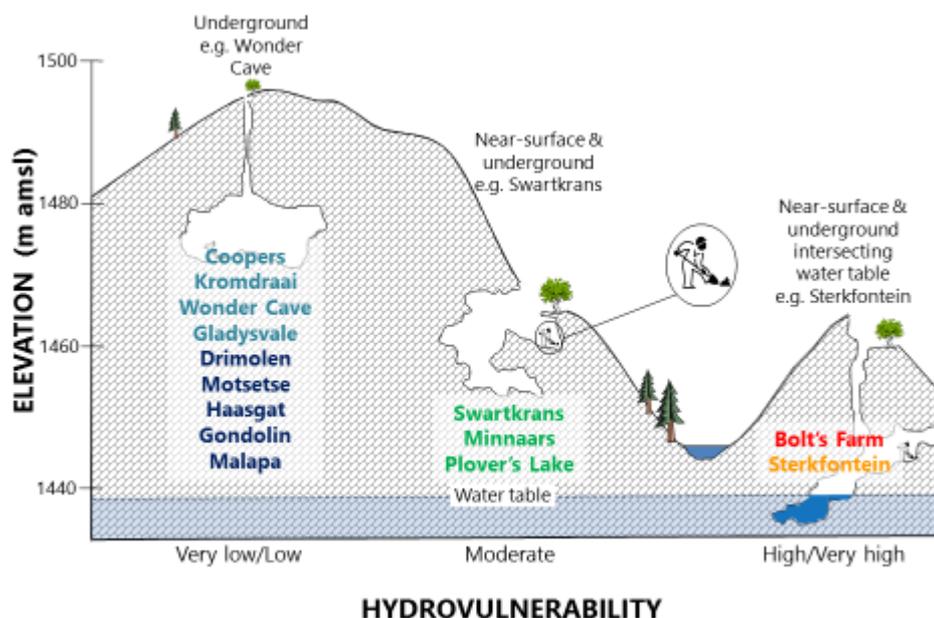
### SYNOPTIC CAVE MORPHOLOGY



### HYDROVULNERABILITY



### SYNOPTIC CAVE MORPHOLOGY



2.

Findings of the 2018 Report titled “Hydrochemical assessment of mine water discharging into the surface and groundwater systems that flow through the Cradle of Humankind World Heritage Site, South Africa”

The extent of the mine drainage signature was assessed in 2011-2012 by Chazanne A Long in a recent (2018) Report titled “Hydrochemical assessment of mine water discharging into the surface and groundwater systems that flow through the Cradle of Humankind World Heritage Site, South Africa”.

The study found that the mine water discharging from the point source in the West Rand is shown to be the only mine water that drains northwards from the West Rand goldfield. The extent of the mine drainage signature was found to flow through the southern portion of the COHWHS and into the Crocodile River up to 54.2km downstream of the point source from the Harmony Gold (now Sibanye Stillwater) property in the West Rand. In addition to the surficial contamination, there is evidence of groundwater-surface water interactions within the karstic terrain of the COHWHS.

The 2011-2012 study found that the AMD signature changed to a Neutral Mine Discharge and Saline Discharge signature 12.6 km from source according to the Global Acid Rock Drainage Guide SO<sub>4</sub> and TDS classification systems, respectively, and is described as high-acid, high-metal drainage for the length of the Krugersdorp Reserve whereas at one sampling point (identified in the Study as “CA19”) within the COHWHS the surface water is defined



as high-metal, high-acid drainage and at another sampling point (identified in the study as “CA07”) as near neutral, low metal drainage.

The study found that this is a significant finding as there are large changes in the hydrochemistry within a very short distance after entering into the COHWHS. Hydrochemical modelling indicated that the contribution of the AMD from the West Rand at one point within the COHWHS (CA19) is between 75% and 80% and high precipitation masses are being deposited between these sampling points. The report found that 16.8 tons per day of  $\text{SO}_4^{2-}$  entered the COHWHS derived from the AMD from the West Rand and 1 to 8 tons per day were deposited into the COHWHS traversed by the Bloubank Spuit, which translates into 93% (14.9 tons per day from the West Rand’s AMD) of  $\text{SO}_4^{2-}$  entering the COHWHS was deposited within the first 2.2 km.

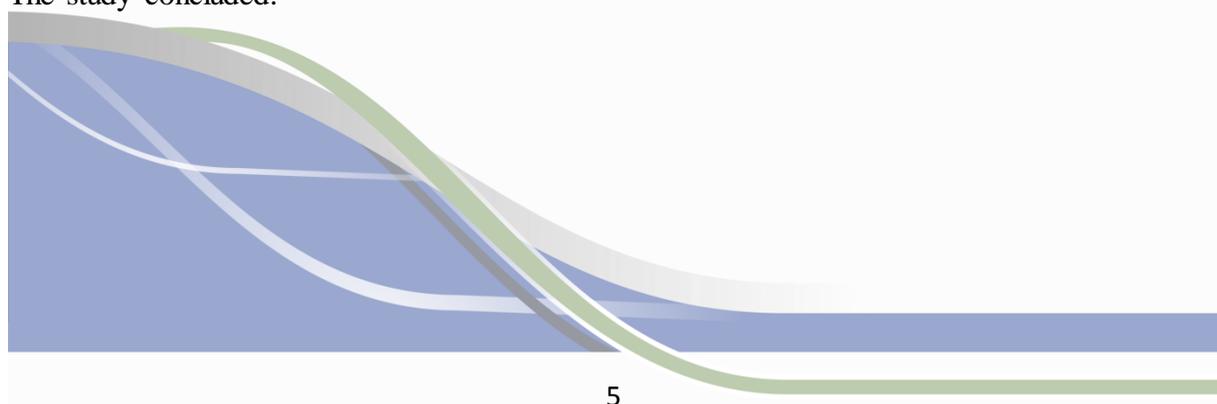
The study alerted us to the fact that groundwater is a non-renewable resource owing to the length of time required to recharge an aquifer, while surface water is generally accepted to be renewable. As water consumption demands continue to increase, all water is becoming a non-renewable resource since it cannot be replenished by natural processes at a rate equal to or greater than consumption. Water security is a basic human need, and the right is entrenched in the legal framework of South Africa as a basic human right, to provide the social and health requirements recognised as being necessary to function. Moreover, water security and water quality issues in the Gauteng and North West Provinces because of poorly managed water resources could place the future economic certainty of these regions at risk.

The study concluded that while much academic research has been undertaken on the environmental impacts and social science studies of the effects of mining on communities that no investigations into the chemistry have been followed through with medical findings. The study recommends that epidemiological studies to be carried out across areas affected by mining activities.

### 3.

The 2016 Study by Dr Francois Durand titled “Die Impak van Suur mynwater op die ekologie van die Wieg van die Mensdom en die Krugersdorp-Wildreservaat aan die Wes-Rand (Suid-Afrikaanse Tydskrif vir Natuurwetenskap en Tegnologie ISSNOnline 2222-4173, Print 0254-3486

The study concluded:



Die Tweelopiespruit was oorspronklik een van die belangrikste lewensare aan die Wes-Rand. Die watergehalte het oor die laaste dekade sodanig afgeneem dat dit ondrinkbaar is en ook nie meer vir besproeiing gebruik kan word nie. Die akwatiese makro-invertebrate is grootliks afwesig in die Tweelopiespruit en die Rietspruit waarvan die suurgehalte vanaf 2011 tussen pH 2.4 en 4.6 wissel. Die afwesigheid van makro-invertebrae in die rivierstelsel het 'n groot impak op die res van die ekologie. Werveldiere soos visse, amfibieë of watervoëls, wat nog in 2007 in die gebied voorgekom het, is nou afwesig, veral in die Tweelopiespruit en Rietspruit. Die oorspronklike oewerbos langs die geaffekteerde riviere is grootliks deur die soutbestande riet *Phragmites* verplaas. Die Bloubankspruit vloei deur die suidelike deel van die Wieg van die Mensdom verby verskeie fossielvindplekke soos Bolt's Farm, Rising Star (Dinaledi), Swartkrans, Sterkfontein, Minnaars, Coopers, Kromdraai en Plovers Lake. Die agteruitgang van die watergesondheid van

die rivierstelsel wat deur die Wieg van die Mensdom Wêrelderfenisgebied vloei, is kommerwekkend t.o.v. die effek daarvan op die akwatiese organismes, oewerbosse van die rivier en die gesondheid van mense en diere wat van die water afhanklik is, veral in hierdie gebied waar daar geen munisipale watervoorsiening is nie. Die agteruitgang van die ekologie in die gebied sal ook 'n negatiewe uitwerking op die gebied as een van die belangrikste toerisme-aantrekkings in Gauteng hê.

#### 4.

The 2012 study by J.F. Durand titled "*The impact of gold mining on the Witwatersrand on the rivers and karst system of Gauteng and North West Province, South Africa*" also have relevance. It found e.g. that:

*"The decimation of plant life around water bodies that contain high levels of sulphate is obvious in places such as Robinson Lake and Randfontein on the West Rand. The rocks, soil and plants on the river banks affected by mine effluent are often encrusted with sulphate slats. The water in the Swartkrans dolomitic compartment [which hosts the COHWHS] contains sulphate concentrations of over 150mg/l due to the AMD pollution emanating from Harmony Gold's Randfontein Operations."*

The study furthermore found that the levels of aluminium, cobalt and nickel in the Tweelopiespruit/Rietspruit/Bloubankspruit system are far higher than those accepted in water quality regulations. The levels of zinc in the Tweelopiespruit and Rietspruit were found to exceed the accepted maximum levels of zinc at 0-3mg/l. According to the 2012 Study "*high*



*levels of calcium, magnesium and iron have also been measured in the Tweelopiespruit/Rietspruit/Bloubankspruit system. The amount of calcium, magnesium and sulphates which are released into the rivers and groundwater indicates the rate of dissolution of the dolomites by AMD containing sulphuric acid.”*

The study found that:

- certain rivers due to the mine effluent are devoid of macroscopic organisms;
- the riparian vegetation has suffered a loss of biodiversity in affected areas;
- the aquatic life in the water bodies was decimated;
- the iron hydroxide that settles on the river bed turned it into a crust which is impenetrable to the invertebrates that have to live in the sediment, which also included bottom feeders like certain fish and water birds; and
- the rivers affected by AMD on the West Rand are virtually devoid of vertebrate life as well.

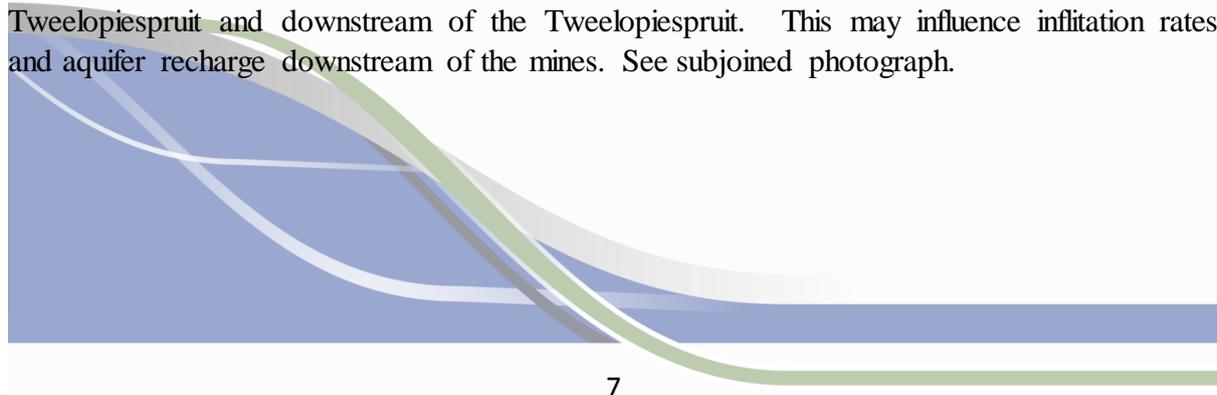
While it is acknowledged that the situation has improved with the short term treatment of AMD, which was implemented since 2012, the Tweelopiespruit, the wetlands downstream of the Tweelopiespruit and the receptor dams remain unrehabilitated and the neutralised AMD remains unfit for any use as a result of its high salinity.

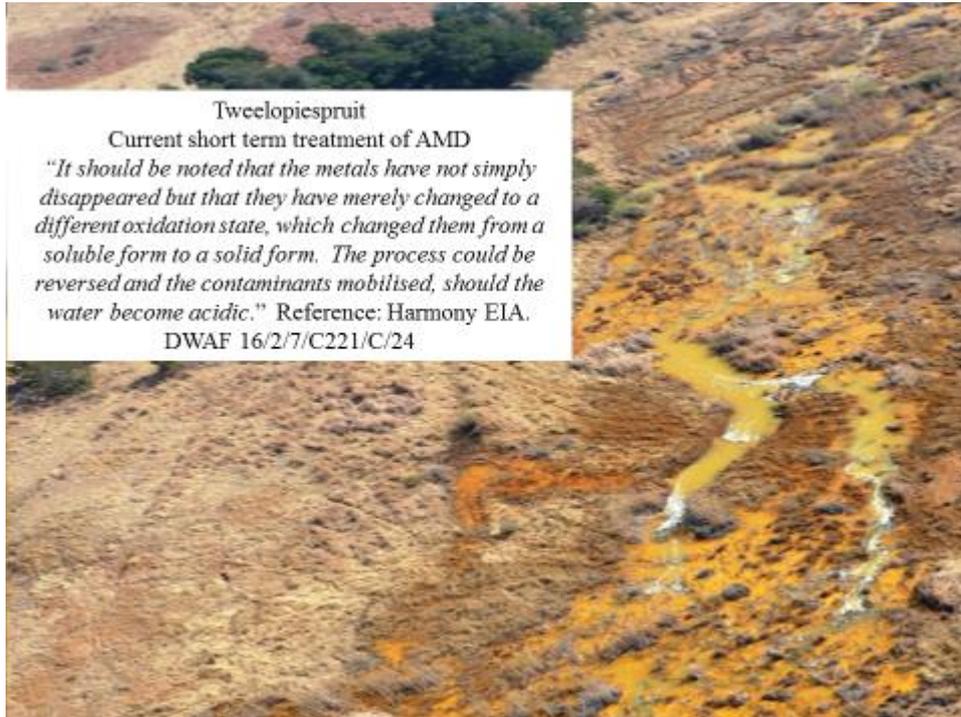
## II

### CURRENT TREATMENT OF AMD AND POSSIBLE IMPACTS ON THE COHWHS

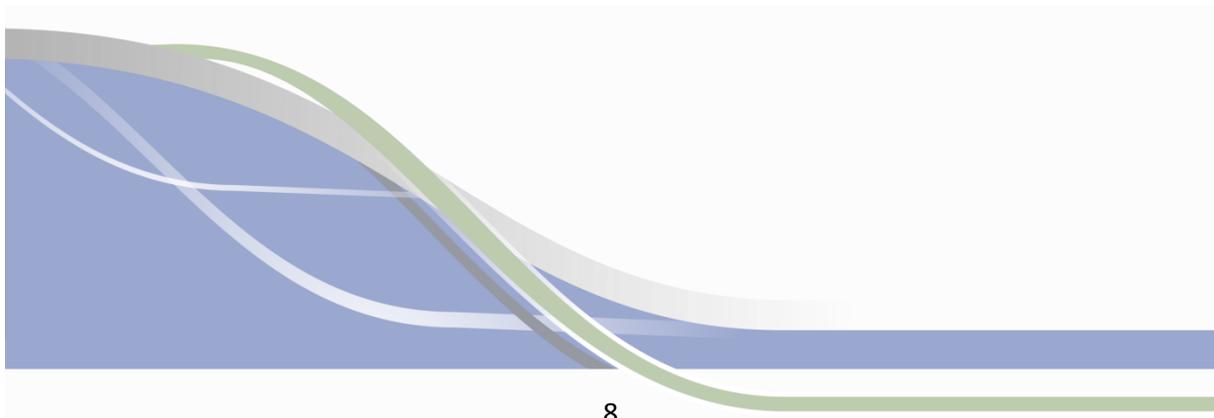
The current (immediate and short term) treatment of AMD is by means of neutralisation or a pH adjustment. In most cases, metals will precipitate out of solution if the pH is adjusted upwards i.e. the water is made more alkaline. It should be noted that the metals do not simply disappear but change to a different oxidation state, which changes them from a soluble form to a solid form. The metals are still there, in the area where the precipitation has occurred in the first place. The process can be reversed and the contaminants mobilised, should the water become acidic.

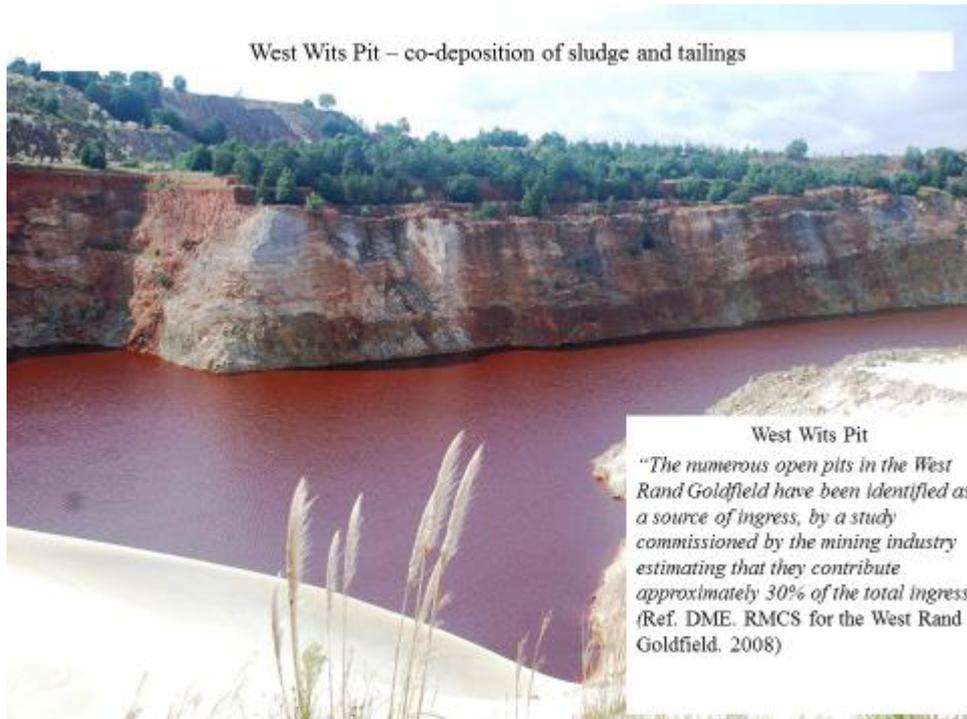
River bed armouring from the precipitation of ‘yellow boy’ can be observed in the Tweelopiespruit and downstream of the Tweelopiespruit. This may influence infiltration rates and aquifer recharge downstream of the mines. See subjoined photograph.





The high density metal sludge is discharged into the unlined West Wits Pit after the neutralisation of AMD within the West Rand. There has been no impact assessment conducted to assess the impacts of the disposal of the metal sludge into the West Wits Pit on groundwater or downstream water uses although the numerous open pits in the West Rand Goldfield have been identified as a source of ingress of AMD into the West Rand Basin, by a study commissioned by the mining industry estimating that they contribute approximately 30% of the total ingress.





Results which the FSE obtained in terms of the provisions of the Promotion of Access to Information Act (PAIA) (2 of 2000) from the Department of Water and Sanitation for January to June 2016 of the Western Basin's neutralised AMD discharge to the Tweelopiespruit show pH values of 9, conductivity of 375 mS/m, manganese of 2.21 mg/l and sulphate values of 2 660mg/L.

The high concentrations of sulphate exert predominantly acute health effects (diarrhoea). Sulphate concentrations of 600mg/l and more cause diarrhoea in most individuals and adaptation may not occur. Usually individuals exposed to elevated sulphate concentrations in their drinking water for long periods become adapted and cease to experience acute health effects (diarrhoea). The numerical limit for sulphate in terms of the Resource Quality Objectives (RQOs) for the Upper Vaal is between 200 and 500mg/l depending on the water use.

In livestock watering, it was found that sulphate levels above 250 mg/l suppress copper and selenium which result in poor fertility and condition<sup>2</sup>.

Elevated sulphate concentrations increase the corrosion rate of metal fittings in water distribution systems.

<sup>2</sup> Jan Myburgh, Faculty of Veterinary Science University of Pretoria, Onderstepoort. Conservation Medicine: Toxicology. "Is there a connection between acid mine drainage, acid rain, trace element nutrition of livestock and HIV / AIDS in humans on the eastern Transvaal Highveld?"



- Elevated sulphate concentrations increase the corrosion rate of metal fittings in water distribution systems.
- When there are metals dissolved in the water in excessive concentrations, the corrosion and scaling effects would be increased.

Harmony Environmental Impact Document titled "Impact of the discharge of Treated Mine Water, via the Tweelopies Spruit, on the receiving Water body Crocodile River System, Mogale City, Gauteng Province" (DWAF 16/2/7/C221/C/24) (3 December 2006)

### III.

#### CURRENT MINING APPLICATIONS

The mining industry enjoys an elevated or even preferential status in public and official opinion based on the perceived benefits mining brings relative to its costs. However, the outstanding universal value of the COHWHS<sup>3</sup> ought to supersede the value of mining, which by its very definition is unsustainable.

We are of the considered opinion that the authorisation of the recent applications for prospecting and mining within the Magaliesburg area, adjacent to the COHWHS:

1. will not support the best practicable environmental option (BPEO) in terms of the National Environmental Management Act (NEMA) (107 of 1998) for the area,
2. will compromise the conservation and protection of the special character, ambience and tranquillity associated with the COHWHS ("sense of place"), and
3. will fail to give effect to Section 24 of the Constitution of the Republic of South Africa, that is to:
  - a) Prevent pollution and ecological degradation;
  - b) Promote conservation; and

<sup>3</sup> In terms of the Integrated Management Plan Introductory Session presentation by the Management Agency (9 and 12<sup>th</sup> May, 2018) "these sites have produced abundant scientific information on the origin and evolution of human beings over the past 3.5 million years, their way of life, and the animals with which they lived and on which they fed."



- c) Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development

SUBMITTED BY:

A handwritten signature in black ink, which appears to read 'M. Liefferink'.

Mariette Liefferink.

CEO: FEDERATION FOR A SUSTAINABLE ENVIRONMENT

26 May 2018.

