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RESPONSE TO PROF. MIKE MULLER'S STATEMENT REGARDING THE RISKS OF ACID MINE DRAINAGE (AMD) IN BUSINESS DAY, 1st JULY, 2010

I refer to the viewpoint expressed by Prof. Mike Muller in the Business Day, dated the 1st of July, 2010 whereby it was stated:

"Mike Muller, a registered engineer and professor of public and development management, warns that the focus on AMD risks distracting the country from dealing with water pollution from inadequately maintained sewage works, which he says pose an immediate risk to downstream users.

He says media coverage of the issue is heavily influenced by interests in the mining and water treatment industries, which, he says, stand to profit by exaggerating the problem.

Pumping and treating polluted water represents a substantial cost to the mining industry, and these companies are naturally interested in either reducing these costs or lobbying for government subsidies, he says.

Other companies are interested in selling equipment and technology to treat this water, he says."

Permit me, please to take the liberty to respectfully expostulate with Prof. Muller on this matter, which, in the present circumstances I apprehend to be not only justice to the Federation for a Sustainable Environment (FSE), but, on the whole justice to downstream water users, the public and a mute environment. I shall state, as concisely as possible, the reasons which have led me to the conclusion at which I have arrived.

The FSE and I do not have commercial interests in the mining and water treatment industries. My response is therefore not actuated by narrow self- or commercial interests, but by the physical (real) evidence of irreversible ecological degradation, documentary evidence of the enormous ramifications of AMD[1], and by the alarming water values within the Tweelopiespruit.

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[1] Waste from gold mines constitutes the largest single source of waste and pollution in South Africa and there is wide acceptance that AMD is responsible for the most costly environmental and socio-economic impacts. Production of AMD may continue for hundreds of years after mines are closed and tailings dams decommissioned.

Releases of AMD have low pH, high electrical conductivity, elevated concentrations of iron, aluminium, uranium and manganese and raised concentrations of toxic heavy metals. The acid produced dissolves salts and mobilizes heavy metals from mine workings. Dark, reddish-brown water and pH values as low as 2.5 persist at the site. AMD is not only associated with surface and groundwater pollution, but is also responsible for the degradation of soil quality, for harming aquatic sediments and fauna, and for allowing heavy metals to seep into the environment. Long-term exposure to AMD polluted drinking water may lead to increased rates of cancer, decreased cognitive function and appearance of skin lesions. Studies on the exposure of pregnant woman to relatively low concentrations of heavy metals and other industrial chemicals in drinking water revealed that the neural development of the fetus could be compromised which can result in mental retardation.

If indeed the extent of "… ***problems related to mining waste may be rated as second only to global warming and stratospheric ozone depletion in terms of ecological risk"*** **(EEB, 2000), then the Witwatersrand gold mining area of South Africa is at serious risk.**

The three mining basins in Gauteng, i.e. the Eastern, Central Rand and West Rand basin are partially flooded or flooded with AMD. This has already happened in the Krugersdorp–Randfontein area where water has started to decant from a number of shafts into the Tweelopiespruit catchment. This inflow is having serious impacts upon the ecology and water quality. To exemplify: The combination of pH- and redox-driven reactions resulted in the National Nuclear Regulator NNR declaring the Robinson Lake a radiation area, with uranium levels exceeding natural levels by four orders of magnitude (factor 40 000). The Tweelopiespruit is a Class V River, that is, a river that is highly and acutely toxic.

(Interpolation: Prof. Mike Muller was Director-General (DG) of the Department of Water Affairs and Forestry (DWAF) (1997-2005) where he led the development and implementation of legislation, policies and strategies in water resources and water services as well as Government's water supply and sanitation (WS&S) programme. Prof. Muller was therefore the DG of the DWAF when the decant of the first mining basin, namely the West Rand Basin occurred in August, 2002. From 2002 to 2005 the AMD was allowed to flow untreated into the Tweelopiespruit and the Wonderfonteinspruit Catchment Areas, with devastating consequences.

It is to be taken for granted that Prof. Muller was therefore well acquainted with the foreseeable flooding of mine voids, the impacts and the risks of AMD. Prof. Muller undoubtedly had access to *inter alia* the findings and recommendations of:

1. The Chamber of Mines' Research Organisation "*Report on an Investigation into Mine Effluents*" by M. Frost (1957);

2. the Final Report of the *Interdepartmental Committee on Dolomitic Mine Water: Far West Rand,* submitted to the Minister of Water Affairs by the Director of Water Affairs (J.M. Jordaan), November, 1960;

3. the "*Commentary On The Final Report Of The Interim Departmental Committee Regarding Dolomitic Mine Water: Far West Rand"* (Dr. G.J. Stander), 1964;

4. "*An Integrated Strategic Water Management Plan for the Gauteng Gold Mines,"* 1996;

5. "*Report on the Radioactivity Monitoring Programme in the Mooi River (Wonderfonteinspruit) Catchment*". Institute for Water Quality Studies. Department of Water Affairs and Forestry. April 1999;

6. "*An Economic and Technical Evaluation of Regional Treatment Options for Point Source Gold Mine Effluents entering the Vaal Barrage Catchment."* R. Pilson. WRC Report No 800/1/00;

7. *Publication of the "Radioactivity Study on sediments in a dam on the Wonderfonteinspruit Catchment*." Conducted by the Council for Geoscience and commissioned by the DWAF. Wade et al. (2002) (WRC);

8. "*Tier 1 Risk Assessment of Selected Radionuclides in Sediments of the Mooi River Catchment."* Project Leader: Peter Wade. Water Research Commission Report 1095/1/02;

9. *"Uranium and heavy metals in sediments in a dam on the farm Blaauwbank".* Coetzee et al. (2002) (Council for Geoscience).

It is respectfully submitted that for a former Director General to acknowledge that there are currently significant AMD risks because of the flooding of the mining basins in the Witwatersrand Gold Fields would in fact be a confession that he or she has failed in his or her statutory duty of care during his or her term in office to put proactive water management measures in place.)

In order to ripen the readers' judgment whether Prof. Muller's minimization or trivialization of the risks posed by AMD is an accurate portrayal of the matter, I now, by analogous reasoning, refer to the written response of Mr. Mike Muller, the then Director General of the Department of Water Affairs and Forestry, to my oral and written submissions to the Department of Water Affairs on alleged pollution and ecological degradation of the Wonderfonteinspruit by gold mining activities. The letter is dated the 7th of October, 2004. With reference to radioactivity, please see the anomaly between the response of Mr. Muller and the findings of a few of the thousands of official public domain and peer reviewed academic Reports.

Submissions by Mr. Mike Muller, Director General, DWAF. **7 October, 2004.**	**Findings of the Water Research Commission (WRC) Report No 1214/1/06** ***"An assessment of sources, pathways, mechanisms and risks of current and potential future pollution of water and sediments in gold-mining areas of the Wonderfonteinspruit catchment".*** **2004.**	**1.Findings of the National Nuclear Regulator's (NNR) Report No TR-RRD-07-0006 entitled** ***"Radiological Impacts of the Mining Activities to the Public within the Wonderfonteinspruit Catchment Area".*** **July 2007.** **2. The National Nuclear Regulator's (NNR)** ***"Status Report on the Actions Arising from the Study of Radiological Contamination of the***	**1.*"Threats and opportunities for post-closure development in dolomitic gold-mining areas of the West Rand and Far West Rand (South Africa) – a hydraulic view."* 2010.** **2.*"Uranium Pollution of Water resources in Mined-Out and Active Goldfields of South Africa – A Case Study in the Wonderfonteinspruit Catchment on Extent and Sources of U- Contamination and Associated Health Risks."* 2009.**	**Findings of the Department of Mineral Resources'** ***"Draft Regional Mine Closure Strategy for the Far West Rand Gold Fields".*** **2009.**

		***Wonderfonteinspruit Catchment Area (WCA)".* 29 October 2007.**	**Prof. Dr. Frank Winde, North West University.**	
"The finding of the Mooi River (Wonderfonteinspruit) Study of this Department was that Potchefstroom is NOT at risk and that the radioactivity level complied with the most stringent criteria for low radioactivity levels."	*"Studies by the Department of Water Affairs and Forestry have indicated elevated levels of radioactivity in rivers draining the gold-mining areas of the Witwatersrand. A detailed study of the Mooi River system (including the Wonderfonteinspruit) showed radioactivity levels in this system to be elevated, although doses to the public from formal drinking water sources were found to be within acceptable limits at most sites.* ***Following this study, Wade et al. (2002) showed that the river sediments act as a sink, holding radionuclides, often at concentrations considerably higher than those found in the sources (gold/uranium ores and mine tailings). Wade has further demonstrated that the uranium in these sediments may be***	*"This study showed that past and present discharges of radionuclides into the Wonderfontein Spruit catchment as a consequence of mining activities can lead to considerable radiological impacts to the public via various exposure pathways, exceeding significantly the natural level and also the dose limit for the public of 1 mSv per annum, at numerous sites."* (Regional Mine Closure Strategy for the Far West Rand Gold Field. Department of Mineral Resources.) *"For approximately 50% of the 47 sampling sites, the calculated incremental doses of the respective critical group are above 1 mSv per annum up to 100 mSv pa…"* *"The radioactive contamination of surface water bodies in the*	*"Potential threats associated with uncontrolled flooding of the mine voids include an initial, **severe water shortage** in the WFS lasting between 15 and 60 years, during which almost no water would be available for maintaining aquatic ecosystems, farming activities, diluting municipal wastewaters and, last but not least, recharging the Boskop-Turffontein Compartment as sole supply of drinking water to approximately 300 000 inhabitants of the Potchefstroom municipal area. In a worst-case scenario this period of filling the mine void and the de-watered dolomitic compartments could be followed by **highly polluted, radioactive mine-water decanting**, via a number of yet unknown points including existing springs that currently supply potable water to the Mooi River system, accompanied by large-scale reactivation of sinkholes in densely populated*	*"Status of radioactivity in the Far West Rand (FWR)* *"The ores of the Witwatersrand contain appreciable concentrations of uranium, …* *"In addition to the uranium, its radioactive daughter nuclides are likely to be present, and pose a risk to downstream water users, to people directly exposed to radioactive materials, to windblown radioactive dust and radon gas.* *"An airborne radiometric survey of the FWR was done for DWAF (CGS)). Interpretation of the data show many of the residential areas (Carletonville, Westonarea, Khutsong) fall within areas of **high risk of radioactivity contamination**. Furthermore contamination around surface discard facilities shows a distinct plume towards*

	obilized by changes in water chemistry." (Emphasis added.) *"The mean values for the Wonderfonteinspruit samples were found to significantly exceed not only natural background concentrations*, but also levels of regulatory concern for cobalt, zinc, arsenic, cadmium and uranium, with uranium and cadmium exhibiting the highest risk coefficients".* *(The analytical results were compared with a compilation of regulatory limits, exclusion limits and guidelines for contaminant levels in sediments, as well as the global mean values for similar sediments in the geological record.) *"The contaminants of greatest concern are therefore uranium, cadmium, zinc and cobalt, with the median value for uranium concentrations measured in this sampling phase 720 times the local background and for cadmium, 700 times the local background".*	*Wonderfonteinspruit catchment area caused by the long-lasting mine water discharges and diffuse emissions of seepage and runoff from slimes dams poses radiological risks to the public resulting from the usage of polluted environmental media."* *"The pathway sediment→SPM →cattle→milk/meat→person ("SeCa") can cause radioactive contamination of livestock products (milk, meat) resulting in effective doses of the public in some orders of magnitude above those resulting via the pathway "WaCa."* *"It was found that at 6 of the 10 investigated sites the U-238 activity concentration exceeded 0.2 Bq/g, with the highest values measured in sediments from the Tudor Dam and Coetzee Dam, and that uranium might be remobilized from the sediments by changes of pH, redox potential or TDS in the water column."* (DMR's Regional Mine Closure Strategies for the	*areas. It is argued that such a scenario must be avoided through a combination of building up adequate rehabilitation funds by the mining industry, governmental control and improved scientific understanding."* (Emphasis added.) *"Results indicate that U-levels in water resources of the whole catchment increased markedly since 1997 even though U-loads emitted by some large gold mines in the Far West Rand were reduced. This apparent contradiction is explained by the contribution of highly polluted water decanting from the flooded mine void in the West Rand.* *"…800kg of U per year flowing into Boskop Dam as Potchefstroom's main water reservoir…"* ***"Of particular concern is the fact that U-levels in the WFS are comparable to those detected in the Northern Cape which had been geostatistically linked to abonormal haematological values related***	*surface streams.* *"The most important considerations relating to the concerns about water contamination in post mining times are the fact that the surface water entering the FWR is already contaminated before entering the area. Water polluted by leachate from mine dumps (AMD) shows characteristically high sulphate concentration. This will form the greatest threat to groundwater quality after closure. Surface and groundwater interactions suggest that poor quality surface waters are impacting on the dolomitic aquifer. The receiving environment of contaminated water from the FWR is the Boskop Dam, and downstream users in the Mooi River including* ***Potchefstroom****. Conditions exist for uranium to be transported in solution in these waters. It is possible that radiogenic material may migrate, dissolved in groundwater, to be consumed at some other point where radioactive*

	"What about the end users? Direct analyses and long-term integration methods indicate possible pollution of downstream water resources" *"Potchefstroom is located downstream of the Wonderfonteinspruit, from which more than 400 000 people derive their drinking water via the Boskop Dam."* *"The results of this study indicate that uranium poses a hazard to water users in the catchment because of its chemical toxicity. A full radiological risk assessment, looking at both dissolved radionuclides in water and radionuclides bound to sediment, is required to determine current and future risks due to radioactivity."* *"The measured uranium content of many of the fluvial sediments in the Wonderfonteinspruit, including those off mine properties and therefore outside the boundaries of licensed sites, exceeds the exclusion limit for*	Far West Rand. 2009.) *"Preliminary results of analyses conducted on produce grown in the area have indicated that the dose levels are of radiological concern to the regulator."* (NNR's Status Report. 2007.)	***to increased incidences of leukaemia observed in residents of the area".*** (Emphasis added.)	*contamination may not be* expected." (Emphasis added.) "*There are a number of boreholes (roughly 200) in the entire West Rand dolomitic compartments, where water level measurements are taken at regular intervals by the Potchefstroom DWAF Hydrology office. .. The Department undertakes no groundwater quality monitoring at this stage".*

	regulation by the National Nuclear Regulator. A decision is therefore necessary by the NNR, regarding a regulatory response to this problem."			

From the aforesaid we infer that Mr. Muller's statement "*The finding of the Mooi River (Wonderfonteinspruit) Study of this Department was that Potchefstroom is NOT at risk and that the radioactivity level complied with the most stringent criteria for low radioactivity levels"* is a minimization or trivialization of the actual and documented status of radioactivity within the Wonderfonteinspruit Catchment Area. We trust that it was an innocent misrepresentation of facts.

With reference to the management of AMD:

We respectfully, but firmly dissent from the viewpoint of Prof. Mike Muller that the risks of AMD to our surface- and groundwater resources are "*exaggerated*." We concur, however, with the recommendations of the Department of Mineral Resources' Regional Mine Closure Strategies for the West-, Far West, East and Central Rand Gold Fields, namely: The least desirable option for the long term is natural decant. This option will allow contamination of the dolomite aquifer, changing the ecology of the rivers systems, causing the corrosion of infrastructure and result in sinkholes and seismicity.

Detailed mine water management interventions must be put in place within prescribed time frames in order to prevent uncontrolled decant of AMD charged with toxic metals and extremely high sulphate content to surface environments. The recommended option is pumping and treatment. The polluter pays principle and the precautionary principle must be applied, and the authorities must apportion clear accountability. The matter is urgent.

Submitted by: Mariette Liefferink
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