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"Technical Support for Grassroots Public Interest Groups"

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Re: Comments on: The Environmental Impact Assessment Report and Environmental Management Programme for the Proposed Platreef Underground Mine, prepared for Platreef Resources (PTY) Ltd, by Digby Wells Environmental, January, 2014

The Center for Science in Public Participation provides technical advice to public interest groups, non-governmental organizations, regulatory agencies, mining companies, and indigenous communities on the environmental impacts of mining. CSP2 specializes in hard rock mining, especially with those issues related to water quality impacts and reclamation bonding.

Dr. David Chambers has 37 years of experience in mineral exploration and development – 15 years of technical and management experience in the mineral exploration industry, and for the past 22 years he has served as an advisor on the environmental effects of mining projects both nationally and internationally. He has Professional Engineering Degree in Physics from the Colorado School of Mines, a Master of Science Degree in Engineering from the University of California at Berkeley, a Ph.D. in Environmental Planning from Berkeley, and is a registered professional geophysicist in California (# GP 972).

SECTION-SPECIFIC COMMENTS

2.1.10 Soils
2.1.10.8.1 TSF Site 2
2.1.10.8.2 TSF Site 3

It is recommended that both TSF 2 & 3 sites be avoided from a soils perspective (EIA, p 55). The wording is virtually identical for both TSF 2 and TSF 3:

> *"The soils occupying TSF site 3 (and TSF site 2) will be difficult to manage due to their sandy nature. Stripping stockpiling and rehabilitation will be difficult to manage the prevention of erosion, due to the sandy nature of the soil and the high rainfall intensity present in the area.* ***It is recommended that the location of TSF 3 (and TSF 2) should be avoided from a soils point of view for use as a TSF****. " (EIA, p 55,* ***emphasis added****)*

In spite of this pointed cautions, TSF 2 is the preferred location for the tailings site (*3.7.4.2 Preferred (TSF) Location*). There is no discussion of why TSF 1 was eliminated from consideration.

Recommendation: The reason for choosing a site where there is a warning NOT to use a site for a tailings facility needs to be justified in the EIA. In addition, a discussion of the reason(s) for eliminating TSF 1 from consideration should be included in the EIA.

There are means to manage the issues with stripping, stockpiling and rehabilitation, but these are not discussed in the EIA. In addition, the sandy substrate would also provide a conduit for seepage to leave the tailings impoundment and go under, through, or around the tailings dam. No matter how many designed engineering barriers to seepage are incorporated, there will be some seepage that migrates past the tailings dam.

It is becoming standard procedure in the United States to have lined impoundments for platinum and other metal mines that have Potentially Acid Generating/Metals Leaching (PAG/ML) tailings. There is no discussion in the EIA or the Appendices of the PAG/ML potential of the tailings, which are likely to be potentially acid generating. This is a serious shortcoming in the EIA, because the geochemical nature of the tailings has bearing on the design of the tailings impoundment.

If the tailings are PAG/ML, then the best solution is to have a lined tailings impoundment, especially at TSF 2 and TSF 3, where the substrate would only assist in the migration of seepage from the impoundment into groundwater.

The upstream design of the proposed tailings dam (*3.7.4.2 Preferred (TSF) Location*) would not lend itself to the installation of a liner. To install a liner the design of the tailings dam would need to be switched to (preferably) a downstream-type dam, which would be a much safer dam seismically, and would accommodate the incorporation of a liner for the impoundment.

It should also be noted that the discussion of the long term seismic stability of the tailings dam in not clearly annunciated in the EIA.

Recommendation: A discussion of the PAG/ML potential of the tailings, and its implications on the design of the tailings impoundment must be included in the EIA.

2.1.2.1.1 Surface Subsidence

Subsidence (caving at the surface due to the collapse of underground mine workings) is not predicted to be an issue at Platreef:

> *"The planned Platreef underground mining will have no effect on the ground surface, due to the depth and mining method. Platreef is limiting the dimensions of individual stopes to ensure stability and they will be backfilled prior to mining adjacent to them." (EIA, p 4)*

Yet there is a bit more caution presented in Appendix Q - Conceptual Rehabilitation Plan:

> *"It is important to note that when pillar extraction "robbing" is undertaken that there is a potential risk for subsidence to occur. This is as a result of the back areas being left unsupported and are allowed to collapse." (Appendix Q - Conceptual Rehabilitation Plan, p 38)*

Platreef should have conducted a rigorous analysis of potential subsidence, and presented the results in Appendix O - Geotechnical Report, especially since some of the mine workings are near or under habited areas. There is no information on subsidence in Appendix O - Geotechnical Report, so in the EIA the conclusion that there will be "no effect" from subsidence appears to be purely circumstantial.

Recommendation: Platreef should conduct a rigorous analysis of potential subsidence, and presented the result in Appendix O - Geotechnical Report.

3.7.4 Tailing Storage Facility

In Table 3-3: The TSF Design Criteria and Assumptions, it is noted that the "Side Slope Factor of Safety" is 1.3 for the "*Temporary slopes*" and 1.0 for "*Permanent slopes*" (EIA, p 142), and that the "*Seismicity*" is "*Low Seismicity Zone*."

A Factor of Safety (FOS) for a static slope failure of 1.3 is appropriate, but that FOS should be maintained after closure. A FOS for a dynamic (seismic) failure of 1.0 is appropriate, but there is no indication that this modeling has been done. For a tailings facility, a dynamic model should be run to insure seismic safety over the millennia that the dam must stand. The most rigorous method is to use finite element or finite difference programs such as TARA (Finn et al 1986), FLAC (Itasca Group 2002), or PLAXIS (PlaxisBV 2002) in which dynamic response, pore-pressure development, and deformations can be fully coupled.[1]

A pseudostatic model, even in an area of low seismicity, is not appropriate for upstream dam construction. A pseudostatic analysis (sometimes called seismic coefficient analysis) should only be considered as an index of the seismic resistance available in a structure not subject to build-up of pore pressure from shaking. It is not possible to predict failure by pseudostatic analysis, and other types of analysis are generally required to provide a more reliable basis for evaluating field performance.[2] The upstream dam proposed for the tailings facility, which depends on the stability of the tailings on which it is constructed, is susceptible to a build-up of pore pressure from seismic shaking.

Recommendation: The results of dynamic modeling for a potential seismic-related failure should be performed and the results disclosed in the EIA. The methodology used to determine the horizontal acceleration that is used for the modelling should also be documented.

4.2.6 Cumulative Impacts on Local Groundwater Resources

> *"In terms of the tailings storage facility on the farm Rietfontein 2KS, hydrogeological studies confirms a non-permeable basement consisting of* ***solid/highly weathered clayey rock*** *which will contain any leachate generated by vertical drainage and "In terms of the tailings storage facility on the farm Rietfontein 2KS, hydrogeological studies confirms a non-permeable basement consisting of solid/highly weathered clayey rock which will contain any leachate generated by vertical drainage and* ***secured by an engineered liner system****."." (EIA, p 165,* ***emphasis added****)*

Although the statement above is not in direct conflict with the statements made about the soils present at TSF 2 on EIA page 55 (discussed in the previous section), it is not totally consistent with them either. It is not possible to key a tailings dam into bedrock to a point where there seepage will be completely eliminated, so complementary measures to containing seepage need to be employed.

The statement on EIA page 165 interestingly enough mentions that leachate will be *"... secured by an engineered liner system."* This most probably refers to liner system on the face of the starter dam, but it is not practicable to extend this liner to the subsequent upstream dam raises. The *"…solid/highly weathered clayey rock …"* referenced on EIA page 165 is also problematic in that if it is indeed "solid" it is also likely to contain fractures which would allow some seepage to pass, and if it is "highly weathered clayey rock" it could form a slippage plane that could lead to a Los Frailes-type dam failure. You really can't have both.

It is also noted in Appendix J - Hydrogeology Impact Assessment Report:

> *"The surface infrastructure of the mine area consists of several features that may pose a potential pollution threat to the local groundwater system. The baseline study has revealed that the shallow aquifer system is vulnerable to surface pollution due to the relatively shallow water table and as evidenced by the elevated nitrate (NO3-N) concentrations observed in the surrounding areas*

[1] Federal Guidelines for Dam Safety Earthquake Analyses and Design of Dams, Federal Energy Regulatory Commission, May 2005, p. 32.
[2] Ibid., p. 35.

> *originating from anthropogenic activities.* ***Suitable mitigation will be included in the design of the TSFs, waste rock dump and ore stockpile to minimize the risk of poor quality seepage impacting on the groundwater and surface water of the area****." (Appendix J - Hydrogeology Impact Assessment Report, Nov13, Executive Summary, p 5,* ***emphasis added****)*

Suitable mitigation to protect for potentially acid generating and/or metals leaching tailings would be a lined tailings impoundment.

Suitable mitigation for PAG/ML waste rock would be selectively backfilling the PAG waste back into the mine, or placing it in the tailings impoundment.

It was also recommended in this appendix that:

> *"Platreef Resources should consider establishing a local water resources monitoring committee where issues around water uses, potential impacts and water quality trends can be discussed and resolved." (Appendix J - Hydrogeology Impact Assessment Report, Nov13, section 10.0 Recommendations, p 94)*

This is an excellent recommendation.

Recommendation: There needs to be more analysis/discussion of why a totally lined tailings impoundment is not necessary or practicable for Platreef.

4.3 Risk of Acid Mine Drainage or Potential Groundwater Contamination Associated With the Mineral to Be Mined

The discussion of acid mine drainage and its potential to affect groundwater takes less than one page. 68 waste rock samples have undergone Acid Base Accounting (ABA), and kinetic tests are underway nominally for a 20 week duration (EIA, p 168).

There is no appendix listing the ABA results and sampling locations for the 68 waste rock samples.

It is also noted in this section:

> *"It has been assumed that the PAG and Non-PAG waste rock material cannot be separated at the source and therefore a blend of PAG and Non-PAG waste rock material will report to the Waste Rock Berm (WRB)." (EIA, p 168)*

If there is an active sampling program as mining proceeds there is no reason ABA samples can't be taken as drilling for blasting is underway, with the results used to segregate PAG and Non-PAG waste rock. This statement also leads one to surmise that the number of samples of waste rock may not be sufficient to define each geologic horizon that will be encountered in the mine. Defining the geologic horizons might be as simple as sampling hanging wall and foot wall rocks, but it is probably more complicated than this. There is no discussion of this issue in the EIA or Appendices.

There is also no mention of ABA information on the tailings. As discussed previously, information on whether the tailings will be PAG/ML is extremely important in driving the design of the tailings impoundment. One can only assume from the tailings dam design proposals in the EIA that the tailings are Non-PAG and do not have any metals leaching potential. This would be rather unusual for a deposit of this type.

Recommendation: A thorough understanding the acid generation/metals leaching capability of both the tailings and the different geologic horizons of the waste rock must be presented in the EIA in order to guide the design of the tailings impoundment and the reclamation of the waste rock.

23 Financial Provision in Relation to the Execution of the Environmental Management Programme
23.2 Annual Forecasted Financial Provision Calculation.

The figures in Table 23-1: Closure Liability Cost Breakdown, appear to have been developed in a rigorous manner. However, the cost calculation information should be presented in much more detail, probably in Appendix Q - Conceptual Rehabilitation Plan. A summary presentation is appropriate for the body of the EIA, but when million are stake, more detail on the calculation is warranted.

For example, in the "Calculation of the Quantum," on EIA page 318, what is typically referred to as "indirect costs" are listed under the categories of "Preliminary and General (12%)," "Contingency (10%)," and "Contingency (again) (14%)." The total for indirect cost is ~36%.

The "direct" costs of rehabilitation generally include: regrading, revegetation, building removal, water treatment, and monitoring & long term maintenance. The "indirect" costs of rehabilitation include: mobilization/demobilization; engineering redesign; engineering procurement & construction management; contractor overhead; contractor profit; agency administration; annual inflation; and a general contingency.

There are probably as many ways to break down these cost categories as there are authors on the subject, but a general test of all the approaches is to look at the total percentage of indirect costs compared to direct costs. The following table presents two approaches to calculating indirect costs:

INDIRECT COST GUIDELINES

	CSP2* Recommended *Percentage of contract costs*		USFS** Recommended *Percentage of contract costs* Minimum	Maximum
Contingency	10%	Contingencies:		
		POO Scope Contingency	4%	30%
		Bid Contingency	10%	20%
Mobilization/Demobilization	10%	Mobilization/Demobilization	0%	10%
Engineering Redesign	3%	Engineering Redesign	2%	10%
Engineering, Procurement & Construction Management	5%			
Contractor Overhead	15%	Contractor's Costs:		
(including Performance Bond cost)		Performance & Payment Bonds	3%	3%
		Estimated State Sales Tax on direct costs:	0%	5%
Contractor Profit	10%	Profit & Overhead:	15%	30%
Agency Administration	10%	Agency Project & Contract Management	4%	14%
Annual Inflation	3%	Inflation	1%	6%
	======		======	======
TOTAL	66%		39%	128%

References:

* Hardrock Reclamation Bonding Practices in the Western United States, James R. Kuipers, PE, Center for Science in Public Participation, February 2000.

** Training Guide for Reclamation Bond Estimation and Administration, For Mineral Plans of Operation Authorized and Administered Under 36 CFR 228A, USDA Forest Service, Minerals and Geology Management, April 2004.

On the left is a suggested approach from CSP2, a non-profit. On the right is a suggested approach from the US Forest Service, a government agency. The range of the ratio of indirect to direct costs varies from 39% to 128%, both from the USFS.

Again, the ratio of indirect to direct costs for Platreef is 36% - which is slightly lower than all of the recommended ranges in the table. However, since there is no amplifying information presented on how these costs were apportioned, it is not possible to rationalize the Platreef calculations. It is only possible to say the indirect cost estimates are probably low.

Recommendation: More detailed information on cost calculations and reclamation procedures should be presented in Appendix Q - Conceptual Rehabilitation Plan.

If you have any questions about these comments, please contact me.

Sincerely:

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