Technical Review of Selected Components

Draft Environmental Impact Statement Akyem Project

Prepared by Stuart M. Levit[1]
Center for Science in Public Participation
For EARTHWORKS and Oxfam America
28 July 2008

General Comments

This document is a technical review of selected components of the April 2008 Draft Environmental Impact Statement (DEIS) for the proposed Akyem gold mine in Eastern Ghana.

DEIS Failure to Provide Information

The Introduction states that the DEIS is the basis from which the EPA will decide whether or not to issue an environmental permit. (DEIS at 1-5). However, the DEIS reads more like a general review of mine features and commitment to complete plans, than an actual plan. Because so much of the DEIS is not detailed (or supported by detailed supplements) nor concrete it is difficult to predict the level of impacts the mine will have to human health or the environment.

A significant amount of the data, reports, and Newmont management documents/plans that provide the foundation for the DEIS are not presented in detail in the draft document and appear to be unavailable, or could not be found with due diligence, such as on Newmont's web site or elsewhere on the Internet. All reports and data relied upon or cited in the DEIS, and subsequent documents, should be available to the public, such as by posting them on Newmont's internet site (or other readily accessible site).

In particular, Annex A-3 lists, and very briefly describes, the goals of policies and guidelines referenced in the DEIS, but they are not included as part of the DEIS (which would not be difficult given the ease of electronic and/or Internet distribution.

[1] Stu Levit has a Masters Degree in Land Rehabilitation and is an attorney. He has worked with mining and environmental issues for over 20 years.

For these reasons, the public is limited in its ability to review what is actually proposed and comment on the mine that may be built.

Hazardous Materials

Particularly because of the vast spectrum and quantity of toxic chemicals proposed for mine use or created by mining and related processes, Newmont should commit to disposal of all chemicals to United States' standards (notably Toxic Substances Control Act (TSCA), Resource Conservation Recovery Act (RCRA), Clean Air Act (CAA) and Clean Water Act (CWA)), and all disposal facilities should meet Comprehensive Environmental Response Compensation and Liability Act (CERCLA) disposal requirements. This will ensure that disposal will not cause contamination after the mine is reclaimed.

Mine Pit

Any analysis of the potential to form acid mine drainage should include the pit walls and impacts of fluctuating pit water level - including during the decades when the pit is filling and from the fluctuations to the pit level by season or drought cycles that may follow filling. These sources could be a considerable contributor to acid formation, and thus acid mine drainage, that could alter the predicted chemistry of the flooded pit. This material will have been fractured by blasting so water movement through the fractures could leach/carry contaminants.

While flooding may be the chosen or best mine-closure approach to limit potential contamination from the pit, it is not a foolproof method of preventing mine contamination from above or below the flooded water level.

Water-quality modeling and prediction can yield results that are significantly different from actual final water quality and quantity conditions. This may come from inaccuracies inherent in the data input to the model, assumptions that are made as a part of the modeling, and other factors. As a result, actual water quality must be carefully monitored to compare it with predicted results from the modeling. The modeling predicts that water treatment will not be required. If water quality is worse than modeled or predicted, significant water treatment costs could be required to meet Ghana's standards.

The DEIS estimates that it will take decades for the pit to fill to its predicted flooded elevation. During these decades that the pit is flooding the water level will very likely fluctuate up and down. While complete flooding may control long-term acid generating material that will reside below the flooded level, this fluctuation may impair pit water quality during the decades of flooding. The fluctuating water level will likely promote acid mine drainage where acid may form. If this happens the pit lake could become acidic, thereby leaching more metals from exposed rock.

The fluctuation could increase the potential that the pit lake will be acidic from its earliest flooding stages (it could also become increasingly acidic as the lake continues to flood). This is important not only because bad pit water quality creates a hazard for waterfowl or other wildlife who may use it, but it could impact ground and surface water (because of increased head in the pit as the water level rises and because the outflow structure could discharge poor quality water to nearby surface or ground waters). The mine should model and predict pit water quality for the pit flooding phase and after the pit is flooded. It may be necessary to treat the pit water.

The proposed monitoring could reasonably miss water quality problems that are correlated with either low or high flows. High wet-season flows typically flush out metals salts that may accumulate during the dry seasons. If there is a steady base flow then some streams may show maximum contamination during wet-season flows where dilution is lowest. Biennial monitoring at a minimum is needed, tied to wet-season high flow and dry-season low flow.

Waste Rock

General Comments

The waste rock piles must not degrade human health or the environment. Potential contaminants and the potential for acid mine drainage are present, although Newmont has not adequately characterized the degrees of these hazards. If acid mine drainage does form in the waste rock piles then the current design is inadequate to prevent leaking to and contamination of the environment. Unless the mine demonstrates (using widely accepted industry procedures and standards) that AMD will not occur, then a full underliner, underdrain, and monitoring system is needed. If a further potential for contamination is discovered then the waste rock piles should be top-lined as well.

While the DEIS concludes that the potential for acid mine drainage is very small, it acknowledges that its conclusions are based on analysis of samples from 11 boreholes seeking to represent the entire 146 hectare mine pit. Even if accurate, the company's results still indicate that 15 million metric tons of waste rock could produce AMD. Unless it is clearly demonstrated using industry standards that that material will not form AMD, it should be isolated and handled to ensure that it does not produce AMD, regardless of where/how it is stored, and that if AMD *is* produced there is an effective infrastructure (drains, etc) to capture and treat it.

As with the tailings impoundment (see below), the low-permeability material under the waste rock piles should be defined and be fully impermeable. This includes two factors. The first is the material, which must be sufficiently homogenous and characterized to be of known compactability and resilience. The second is the actual compaction method and efficacy. Newmont is making the assumption that permeability will be 1 x 10-6 cm/sec., but Newmont must be clear about how it will assure that this permeability is achieved.

This should include compaction testing and independent quality assurance to confirm the results.

In addition to creating structures under the waste rock piles, such as French drains, to facilitate flow under the piles, existing streams should be permanently diverted around the piles and reconnected with their existing channels below the piles. If the French drains were to become clogged or inundated by flows, then the waste rock piles could conceivably be undermined, with potentially catastrophic results. Therefore, while there needs to be a mechanism to handle water under the piles, water should also be diverted around the piles to prevent undermining and extend the lifespan of the French drains.

<u>Waste Rock Disposal in the Pit</u>

If acid mine drainage forms in the pit, whether from deposited waste rock or from the pit walls (because of exposed surface area the former is more likely than the latter), it will be nearly impossible to stop (except under constantly flooded conditions) and threatens to leach contaminants from the pit and/or deposited waste rock into groundwater. This underscores the importance of defining the pit hydrology and potential for contaminants to flow out of the pit into surrounding groundwater.

The DEIS defers the decision about depositing waste rock in the pit. Such deposition should not be permitted unless it is clearly demonstrated that backfilling will not increase the potential for acid mine drainage to form in the pit. This decision requires sufficient data using industry standards and methods. This should consider, but not be limited to: the pit and waste rock mineralogy and their potential interactions; potential of the pit/walls and backfilled waste rock to form acid; potential for leaching from the waste rock at a neutral or high pH (these metals, such as selenium, arsenic, antimony and thallium (and sometimes molybdenum and zinc) are difficult to remove from water once they are dissolved); impacts during the decades it will take for the pit water level to reach its predicted maximum height; fluctuating water levels before and after full flooding is achieved; etc.

The pit and waste rock data and any backfill plan should be made available to the public and the public should have the opportunity to comment on the data and plan(s) prior to adoption by the company or government.

Tailings Impoundment

The DEIS states:

> The Tailings Storage Facility would be developed to be state-of-the-practice, using rotational, subareal tailings deposition and would be designed, constructed and operated in accordance with the Company's Standards for Tailings Management and relevant sections of the Minerals and Mining Act (2006), Ghana Minerals and Mining Law (1986) and

> Ghana Mining Environmental Guidelines (1994) which govern design, construction, operation and closure of mining facilities.

DEIS at 2-17. The combination of this description, the "general construction method" that follows, and the description in Annex B4 (which largely repeats the same text as from DEIS Chapter 2) does not sufficiently describe the tailings impoundment design structures to allow the public to fully evaluate their adequacy to meet relevant standards.

Appendix A refers to Newmont's tailings management, stating that:

> Tailing Management (NEM-ENV-S.04 I) - The purpose of this standard is to set the minimum Newmont requirements for the characterization of tailing, protection of wildlife, protection of groundwater, prevention of uncontrolled releases to the environment, management of process fluids, and closure and reclamation of tailing storage facilities.

DEIS Appendix A3-8. What is described and is available to the public is neither specific to the Akyem site nor commits an adequate design to ensure that the facility does not degrade human health or the environment.

The DEIS describes four construction "methods:"

> Initially, the proposed tailings basin would be prepared for construction by salvaging timber, clearing and grubbing the surface of vegetation and then stripping and stockpiling topsoil. Throughout most of the basin, this would typically leave a surface of modest relief composed of saprolite (weathered in-place bedrock consisting predominantly of clay and quartz) that ranges from 5 to 40 metres in thickness. The upper surface of saprolite would be scarified and compacted.
>
> In some parts of the basin, there would be a natural drainage network consisting of fluvial channels underlain by higher permeability alluvial sand and gravel. Throughout the proposed tailings basin, this drainage network of alluvial material would be trenched to a depth of approximately one metre and a system of interconnected slotted drain pipe would be placed in the lined trenches and covered with a filter fabric. The drainage trenches would then be backfilled with sand. This network of pipes would flow to an HDPE-lined collection basin constructed in alluvial sandgravel near the upstream end of the southern tailings embankment.
>
> A low permeability cutoff wall would be constructed immediately downstream of the collection basin to control downstream migration of water through or under the southern embankment from the collection basin or the tailings impoundment. Cutoff trenches would be excavated through alluvial material into the underlying saprolite foundation material beneath the upstream toe of all embankments.
>
> Cutoff walls would be raised with each additional lift of the embankments to ultimate height of the Tailings Storage Facility. The downstream

> collection basin for the under-drain system would have a pump-back tower constructed into the basin to allow solution to be pumped back to the supernatant tailings pond or plant facility. The combination of under-drain piping network, collection basin, and pump-back systems is collectively referred to as the Leachate Collection Recovery System (LCRS). The LCRS collects seepage from below the tailings facility liner system should a leak occur or excess seepage be detected. This system is described in greater detail in Annex 8-4.

DEIS at 2-17. This plan suggests that after removing salvageable or valuable resources the mine proposes to use in-situ saprolite to try to create a "liner" to prevent the tailings/contaminant from seeping or leaching into the ground. Annex B, Figure 4-1 refers to 300mm of compacted clay. It is not clear if this compacted clay is the same as the compacted saprolite described in the narrative, or something else.

The underliner of compacted clay (whether saprolite or something else) should be sufficiently homogenous and characterized to ensure that it is adequately compactable and provides an effective barrier. If there are rocks or other noncompactable materials "contaminating" the liner then it may not function as a liner and its effectiveness would likely be compromised.

The compaction method and efficacy of compaction must be measured by representative testing to demonstrate and maintain at least the permeability of 1 x 10-6 cm/sec. This should be demonstrated by compaction testing and independent quality assurance to confirm the results.

The DEIS' description of the proposed underdrain system is not sufficiently clear to ensure that the results will facilitate flow under the piles and that existing flows into the site will be permanently diverted around the impoundment and reconnected with their existing channels below the piles. If these systems failed, then the tailings impoundment could conceivably be undermined, with potentially catastrophic results. Therefore, while there needs to be a mechanism to handle water under the impoundment, it should include specific components that: divert clean/natural inflow from the impoundment and its foundation; isolate tailings/leakage from the area below; detect and capture leakage that may occur; and insure the isolation and integrity of the tailings impoundment itself.

If the collective LCRS is intended to be a secondary backup to a tailings impoundment that will not leak, then it (the LCRS) plus adequate monitoring may yield a reasonably protective impoundment. If the collective LCRS is intended to be a primary containment feature then it appears that the mine seeks to use the natural environment as a sacrifice zone to act as its liner and containment system. That may be financially advantageous for the company but it is not sufficiently protective and leaves the public to bear the burden of damage and costs.

Because there will be significant levels of cyanide in the tailings pond, even if cyanide destruction is employed (the DEIS does *not* propose it - see below), the impoundment should be designed for the Probable Maximum Flood (PMF). Use of the PMF is standard for no-discharge tailings pond design. This is a separate recommendation from the impoundment's emergency spillways. Adequate storm protection for the pond itself *and* designing to handle the PMF are both needed.

The entire tailings pond should be lined with both compacted clay material and a geosynthetic liner. Lining just the lower portion appears to be a cheap way of construction in an attempt to use the least amount of liner and still underline some of the potential areas of concern. Such construction may attend to the head created by standing water or other factors but is not adequate protection. The entire tailings impoundment should be lined. Lining should not cause a significantly increased incremental cost and will significantly protect water resources. Moreover, if leaking does occur because of inadequate lining, which is probable, the overall cost will be significantly higher than had the pond been lined in the first place.

It is important to ensure that the emergency spillway is designed to ensure that water exiting the emergency spillway will be safely diverted and stored (not simply diluted and released to the environment). During mine operation, this water could contain tailings contaminants, and after mine closure it could contain sediment and depending on reclamation success (or the storm event disturbing tailings) could also contain tailings contaminants. Like the dam itself, the diversions and watercourses below the emergency spillway must be sufficiently designed and constructed to handle the maximum potential water going thru the spillway.

Acid Mine Drainage

The DEIS describes that neither the waste rock nor tailings are expected to generate acid mine drainage. However, the sampling described is not sufficient to characterize the actual potential for acid mine drainage. This is underscored by the difference between what laboratory testing may suggest and what actually happens in the environment.[2] The DEIS proposes to improve this analysis but this should be completed before mining starts to ensure that the mine and reclamation plans can actually deal with any acid drainage that is produced.

The generalized characterization of AMD should not be used to justify the use of specific materials for mine construction. For example, the DEIS states that:

> The roads would be constructed using in-situ material; however, oxide or non-acid generating mine waste rock would be used, as necessary, for construction or routine maintenance.

DEIS at 2-6. In this example, the in-situ material should be sufficiently tested to ensure that acid-generating material is not used (as compared to making that determination based

[2] For example, as discussed below, in spite of laboratory-based predictions to the contrary, in the real world basic (neutralizing) materials may not neutralize adjacent acidic (acid forming) materials because the acid and base products may occur at different times and in different locations (and therefore never actual meet/mix).

on non-specific or non-representative sampling and testing. At the same time, this does not require that testing be burdensome or “overkill”-- just that it be reasonably representative.

The DEIS may mislead some readers to conclude that because there are basic materials present in the waste rock that the basic materials will neutralize any acid that is generated. Acid minerals tend to decompose at different rates than basic/neutralizing minerals, with the acid formation usually taking longer than the basic formation. As a result, even if both minerals (acid-forming and base-forming) are present, acid will still probably form and cause contamination because the naturalizing material will weather first.

Even if the acid is neutralized by the basic materials, the mine rock contains neutral metalloids which will remain in solution in a basic environment, and will contaminate water resources when mobilized.

As a complex iron carbonate, ankerite is not adequately characterized or discussed in the DEIS. The DEIS acknowledges that ankerite could produce acid but the extent is unknown. Additionally, the there could be substantial delayed acid formation, but the company has not yet completed the testing necessary to determine whether this may or may not be a significant problem.

If built, the mine should commit to absolute isolation and protection of potentially acid producing materials to insure water resources are protected. This should include committing to specific testing, handling, treatment, isolation, oversight, and reporting regimens.

The DEIS states that:

> For Akyem Phase I baseline testing, 207 samples were prepared using rock collected from 11 boreholes. Based on the descriptions provided by field geologists, sample intervals representing different rock types were selected based on the above classifications and analyzed for: I) mineralogy and whole-rock chemistry, i.e. metals, using semi-quantitative x-ray fluorescence, and 2) static acid base accounting (ABA) parameters, including acid neutralization potential (ANP), acid generation potential (AGP), and net carbonate value (NCV).

DEIS at C3-1. It goes on to state:

> Based on the Phase I testing of 207 samples, The Company identified 4 major and 12 minor waste rock types present within the mine pit. For Phase 2 of the geochemical testing programme, The Company prepared 16 composite samples (rock mixed together from multiple boreholes and depths) that are representative of each waste rock type to be encountered during mining. The Phase 2 single rock-type composite samples were submitted for ABA analyses, mineralogy and whole-rock metals.

DEIS at C3-5. It further states that:

> While whole-rock concentrations above those found in average crustal rocks does not guarantee that constituents will be released to the environment, it raises the possibility that they could be released in concentrations exceeding water quality standards. The specialized tests performed included Synthetic Precipitation Leachability Procedure (SPLP), Biological Acid Production Potential (BAPP), and Peroxide Acid Generation (PAG) analyses.

DEIS at C3-13. Comparing the mine's abundance of elements with published estimates of average elemental abundance in the earth's crust may be a useful indicator of some things but using it as a guide to potential contamination ignores that if contaminants leach from the mine waste and can exit the waste rock pile they (the contaminants) will degrade human health and/or the environment. This will be the case regardless of their abundance in the earths crust. It is the mine's duty to ensure that mobilization does not occur, such as through AMD, and that mobilized contaminants do not leave the waste rock pile.

SPLP results showed the potential for releases exceeding standards for aluminum (Al), antimony (Sb), arsenic (As), beryllium (Be), cadmium (Cd), lead (Pb), mercury (Hg), manganese (Mn), molybdenum (Mo), nickel (Ni), selenium (Se), and thallium (TI). Those trace metals with exceedances in more than two samples include Al, Sb, and As. DEIS At C3-13. BAPP results showed the potential for release in some samples for Al, Sb, As, Be, boron (B), Cd, chromium (Cr), copper (Cu), iron (Fe), Pb. Mn, Hg, Ni, Se, and zinc (Zn). DEIS C3-13. Final PAG acid generating results indicated that the potential for producing acid mine drainage was low and PAG solutions produced trace metals exceedances, in more than one sample, for Sb, As, Fe, Mn. Pb, Mo, and Se. DEIS at C3-13. The actual concentrations of (at a minimum) these potential contaminants should be more accurately predicted before mine permitting commences.

Other sample analysis was completed on a few handfuls of samples, from the 207 samples from the 11 original boreholes.

> Two tailings samples generated from metallurgical bench-scale work were chemically analyzed to assess the potential for acid generation and trace metal release (Knight Piesold 2002). Analyses included mineralogy, whole-rock chemistry, chemistry of the tailings slurry water, and acid-base accounting. One sample was an oxide tailings sample and the other was a sulfide tailings sample. The mineralogical results were similar to those presented earlier for the various waste rock types. Both pyrite and ankerite were present in trace amounts in the oxide sample and were classified as accessory in the sulfide sample. Both samples were found to have very low potential for acid generation. Both samples were significantly enriched in Sb and Mo above crustal averages. Transition metals and potassium were measured in significant concentrations in the tailings slurry water; cyanide was also present at moderate to high levels.
>
> In summary, Phase I and Phase 2 data indicate that sufficient neutralization capacity exists to prevent acid generation in the waste rock facilities, tailings storage facility, and mine pit area (pit lake). Testing

> also shows the potential for trace metals to be released from various rock types. However, these static test results do not necessarily reflect how the rock will behave in the natural environment over time. The Company will perform additional geochemical testing as part of operations or as needed to address refinements in the mine plan. These tests should provide additional information about the potential for release of trace metals in the natural environment over time.

DEIS at C3-26.

The DEIS acknowledges that these data are not complete and that as mine wastes are produced, further testing will be used to determine whether they pose a threat to cause acid mine drainage or cause environmental degradation.

This may be a reasonable starting point to focus the analysis but it seems substantially under-evaluated to justify a mine design. Whether tested or composited, the entire acid mine drainage analysis is based on 11 boreholes that seek to represent a pit that will be 139 hectares in surface area, almost 500 meters deep, and from which over 500 million metric tons of material will be removed - with almost 400 million tons of that material being waste rock. This is inadequate and should be expanded before permitting or construction.

Finally, the DEIS states that:

> Waste characterization conducted using standard static and kinetic testing protocols indicate there is little if any opportunity for acid generation potential from the waste materials. The bulk of the proposed mine pit shell lies within geologic formations with substantial acid neutralizing potential. Analysis conducted to date indicate that 97% of the waste rock samples tested are non-Potentially Acid Generating (non-PAG) and these samples are expected to represent 384 out of 396 million metric tonnes of total waste rock produced from the facility. Only two samples with small amounts of unoxidized sulphides that have the potential to generate acid were encountered during waste characterization.

DEIS at 2-9. Even if these sampling data are accurate, precise, and complete, there is still a potential to create 15 million metric tons of waste that could produce AMD. This is a substantial amount of material capable of causing significant environmental degradation.

Cyanide Disposal

Cyanide should be destructed when it leaves the process circuit. Most mines have cyanide leaks and often exceed discharge criteria. It is reasonable and prudent, therefore, to keep cyanide from all discharges from active process circuits. No cyanide should be discharged to the tailings pond, supernatant pond, or any other out-of-process disposal or "holding" site.

There is no “cyanide-kill” process proposed for the tailings and the DEIS discusses cyanide discharged at 50 mg/l, which can cause significant impacts to wildlife and the environment. The use of a cyanide-kill process, like the widely applied INCO SO_2 process, to lower the level of cyanide before it enters the tailings pond, is common practice in North America. The cyanide-kill process is used not only to protect wildlife that may inadvertently come in contact with the tailing ponds water, but also to lower the level of residual cyanide in the interstitial water in the tailings themselves. Cyanide will degrade in the tailings pond water near the surface above the tailings, but not in the interstitial tailings water. As a result, seepage to groundwater will contain degrading levels of residual cyanide.

Cyanide-kill is not perfect but is preferable to not employing this process as the level of cyanide entering the environment is lower. However, it is worth noting that even though most mines in the U.S. destruct cyanide, cyanide levels vary significantly in their discharges/ponds. The reason for this is not entirely clear, but many, if not most, mines employing cyanide still have leaked or otherwise released cyanide into the environment. Photo-degradation may treat cyanide in the tailings or other holding ponds but it only is effective at or near the surface of the pond, and therefore does not degrade buried or interstitial cyanide that is in the tails once the tails are deposited.

Reclamation

The Provisional Land Rehabilitation Plan states that:

> The Company proposes to develop a more refined land rehabilitation plan within six months of commencement of operations (i.e., mining and producing gold) as a means to engage stakeholders in a process that could influence Project design and realize other benefits.

DEIS at G1-1. It seems that stakeholders should be engaged in the process to influence Project design and realize other benefits ***before*** mining is commenced and gold is being produced. That may be years after governmental permitting and actual site disturbances begin and ignores the substantial impacts (good and bad) to and potential input from stakeholders. The reclamation plan not only impacts the mine operations and design but mine economics - and therefore is too integral a component of the mine plan to postpone until so late in the process. It is proposed that at least a completed draft reclamation plan is appropriate before mine permitting.

Soils/Growth Media

The EA assesses the suitability of soils for agriculture and reclamation. DEIS at 3-55. All non-contaminated surface materials should be salvaged for reclamation. Materials that are particularly high quality may be stored separately but there is no reason to not salvage all materials.

In the DEIS, suitability determination is ultimately postponed to be completed in conjunction with development of the reclamation plan. DEIS at 3-55. This is unacceptable. The reclamation plan should be completed *before* the mine is permitted. This is to ensure that the whole mine is adequately assessed and evaluated. If data or other information available only during mining suggest that changes are appropriate, then those changes should be considered, but at a minimum, it is impossible to post an adequate surety/bond without having a fully developed mine operation *and* reclamation plan.

The DEIS states:

> As the mine, haul and access roads, stockpiles, waste rock disposal and tailings storage facilities are being constructed; the Company would recover available topsoil from these sites for future use in reclaiming disturbed areas. Topsoil profiles vary considerably across the Project Area. Recovery depths would be determined through an analysis of soil data collected during baseline studies of the Project Area as verified by on-the-ground reclamation specialists during salvage operations. <u>The overall intent is to obtain only the growth medium (topsoil and subsoil) necessary to achieve the objectives of the Closure and Decommissioning Plan</u>.

DEIS at 8-4 [Emphasis added]. It is unclear from the description whether this description means that the company proposes to salvage only as much material as is necessary[3] or it proposes to salvage only the topsoil and subsoil, which are necessary for growth. The plan should require salvaging all topsoil and subsoil from areas disturbed by mining activities - regardless of location or volume. Post-mine plant growth and establishment benefit substantially from maximizing plant growth media (soils), particularly where agriculture is a proposed post-mine land use. The more soil, the better the post-mine revegetation success, particularly in the first five years.

The best reclamation model would be for the company to salvage soil materials in two lifts - the first being A and B horizons, presumably the "topsoil" described in the DEIS, and the second being lower soil series. Without the referenced Geomatrix and SRI 2008 report it is difficult to know exactly what the salvageable soils look like, but based on the information in the soil descriptions at 3-53 and Table 3-19, salvaging some of the deep soils in two lifts would maintain the DEIS's goal of salvaging topsoil, but would also provide additional material from below the topsoil layer (notably, C horizons) that are not necessarily suitable for plant growth but are more weathered and fractured than bedrock or undeveloped rock.[4] These lower horizons would then be placed as the first step of replacing cover material, upon which the topsoil (A and B horizons) would be placed. The net effect is more cover material that will better support plants and more quickly further develop soils than just the A and B horizons placed on top of sand, waste rock, liners, etc. Given the DEIS' strong emphasis on the importance of post-mine agricultural

---

[3] This amount could be calculated in many ways, such as based on specific replacement amounts/depths determined to be necessary, overall depth desired multiplied by total area to be reclaimed, etc.

[4] This should include only C horizons and not clays.

use and productivity, ensuring the good growth environment provided by maximum salvage and replacement is essential.

The topsoil salvage piles will stand unused for years. As a result, as the DEIS acknowledges the soils quality will degrade during mine operations and the soil value will be reduced from when it was salvaged compared to when it is replaced. To preserve soil integrity (including organic materials, microbes such as mychrrhizae, promote aeration, reduce weed introduction, and reduce erosion, the mine should commit to establishing nurse crops on the topsoil salvage piles. These plants should be consistent with, and not compete, with the planned postmine revegetation, especially agricultural seeding/planting.

Revegetation

The DEIS states:

> Prior to initiating the proposed reclamation vegetation plan, the Company would evaluate topsoil replacement depths for various exposures to arrive at a design that accounts for soil replacement depths that may vary according to location and soil type. The variety of replacement depths would provide different vegetation mosaics on reclaimed areas. The regraded surface would be ripped where necessary prior to placement of topsoil. Ripping would reduce compaction, maximize infiltration, provide a uniform seed bed and establish a bond between subsoil and topsoil. The Company's revegetation programme goals would be to stabilize reclaimed areas, ensure public safety and establish a productive vegetative cover based on applicable land use plans and designated post-mining land uses.

DEIS at 8-4. Because the reclamation plan is little more than a generic goal statement and general list, it is premature to evaluate it. However, given the post-mine agricultural emphasis, the revegetation plan should probably focus more on that goal. Where agriculture is a goal it is probable that the mosaics would be less desirable than for, for instance, wildlife habitat. Ripping should be employed prior to soil placement in all locations where any substantial compaction has occurred, including natural settling which can happen over years or on slopes or uneven ground where subsoil surfaces may not hold replaced soils from slipping/wasting.

The DEIS describes the importance of agriculture as a critical post-mine land[5] but does not commit to steps or measurements (benchmarks, goals) that will ensure that agriculture is a significant post-mining land use and how this use will be achieved. Many inhabitants rely on small agricultural farms for subsistence. From the perspective of environmental availability or logistical facilitation, the DEIS fails to fully commit to ensuring that after mining the inhabitants will be able to resume agricultural practices. Agricultural suitability as a post mining land use should at a minimum be considered based on current use, not the theoretical potential for productivity, and plan reclamation to achieve that goal.

---

[5] To the point that the mine proposes increasing agricultural acreage as an emphasis for backfilling waste rock into the pit.

Further, the mine should commit to characterizing stored topsoil resources (in year or two prior to starting reclamation) to identify basic physical and chemical characteristic. These results can then be used to determine what, if any, amendments are necessary and appropriate to enhance and ensure revegetation success. Criteria should include material size fractions, nutrients, pH, and organic content. Sampling should be done at the surface and deep in the piles. This will ensure that the replaced soil and subsoil materials/horizons are best able to support post-mine agricultural goals. By sampling and evaluating the materials before they are disturbed, the mine can mix-in organics and other amendments that may be necessary to ensure they are fully integrated into the replaced soils (as compared to simply added as top-dressing).

The DEIS should also commit to establishing specific revegetation criteria for success. There are no measurable benchmarks or goals. For agricultural lands this would include crop type and plant establishment and/or productivity goals and expectations. For wildlife or other uses it should include percent plant ground cover, percent plant aerial cover, plant species alpha diversity, plant species beta diversity, and years during which measurement shall be made to define success. These goals are important to simply determining what reclamation success means as it is to determining when it is appropriate to release the mines surety/guarantee bond(s).

Weed Management

The DEIS does not establish a detailed weed control plan, but weeds could significantly threaten the post-mine land uses given the invasive species present in the area. Weed problems can begin during the first stages of mining, particularly during topsoil salvage operations and establishing nurse crops, when weeds can begin to take hold. Therefore, a weed-prevention program should be developed and implemented. At a minimum, this plan should include:

- Certification of weed-free seed;
- Processes to prevent weed introduction (such as washing vehicles if there is a specified potential to distribute weeds, such as off-site equipment that will be brought on-site to hydroseed or otherwise cover a lot of ground on the site and could thereby distribute weed seeds across a large area);
- Weed-response plan identifying how weeds will be controlled if they do come to the site.

Erosion Control

The DEIS does not elaborate on erosion control plans, but one should be required and it should not rely on vegetation alone. *Established* vegetation may prevent or control erosion. However, on newly-treated surfaces (such as mine lands that have just been recontoured, seeded, planted, etc. - but are not yet fully vegetated) and sometimes for years after revegetation starts, there is no erosion control because there is only limited vegetation. Further, the reclamation activities themselves can increase potential erosion, such as by water collecting and traveling in ruts from reclamation vehicles, vehicle tracks that do not follow contours, etc.

Contouring and micro-contouring (equipment operators creating small ridges and troughs along the contours) can help control erosion - because less steep slopes tend to slow water's travel. However, water *will* travel *somewhere* whenever it is not infiltrating the ground or pooling on the surface. Steeper slopes tend to be the biggest concern for erosion but erosion should be considered anywhere that water will fall/travel.
The mine should be required to prepare a specific erosion control program. This should include final surface contouring protocols, such as ensuring that machinery travels along contour lines wherever technically possible; micro-contours are created to promote water retention and decrease water travel, dozer basins and other water holding measures are promoted where woody planting will occur, etc. Erosion control mat should be required to protect overburden/water quality on all slopes greater than 4% or 20^o.

Erosion sediment control structures, such as hay bales, erosion fence, or similarly effective tools, should be used along streams/waterbodies below active and recent reclamation construction where erosion could wash sediment into waterbodies and degrade fish habitat.

The erosion control plan should include specific erosion control events (types of erosion, such as rills or erosion greater than 5 cm wide and 3 cm deep, piping wider than 3 cm, etc) that will trigger the mine taking action to prevent further erosion and re-reclaim the erosion damage.

Bonding-Surety

The DEIS states that:

> The Company would accrue adequate funds to complete final closure and reclamation of the Project and post any necessary bonds in accordance with the Final Reclamation and Closure Plan, to be approved by the EPA.

DEIS at 8-10. During the 18 months while the Provisional Management Plan is in effect, the company should be required to post a bond sufficient to reclaim and restore lands from all mine disturbances that occur over the life of the mine and after closure. This bond should be based on the actual costs to reclaim what has been disturbed - as compared to being tied-to or based on actual gold or other production figures. The bond amount should include a 30% to 50% multiplier to account for the additional costs required of a third-party, such as the government, to implement the reclamation plan.

<u>Considerations for Future Bond Calculation</u>

Mines incur much/most of their reclamation liability in the first years after opening the mine (pit, tailings pond and dam, and waste rock piles - but before they may produce substantial or any income) and if the mine closes or goes bankrupt before mining and reclamation is complete then there probably won't be enough money to close/reclaim the mine. Similarly, if the mine temporarily suspends activities there would need to be funds to maintain operations and activities that protect human health and the environment, such as pumpback operations, water treatment, monitoring, etc.

The need to protect human health and the environment separate from the mine's operators, combined with the high costs to maintain or reclaim the mine, support requiring a bond or similar financial surety so that if Newmont or its subsidiaries is not available or willing to complete adequate reclamation then another entity has funds to do the necessary work.

Further, the cost to an agency to perform reclamation at a mine site is usually 30-50 percent higher than the cost to the original operator. This is because of costs for mobilization, overhead (regulators issuing contracts), contractor profit, etc.

Monitoring

It is important that the public be able to participate in all phases of mine permitting, operations, closure, and post-closure activities. To support this need, monitoring and discharge reports, including reporting on contamination of surface and ground water, should be made publicly available in a timely manner. The mine should immediately notify the public of leaks, contamination, etc, and develop a system for such timely notification in a way that is broadly accessible to all affected parties. This is essential for trust and to develop a working relationship with the public, especially affected communities. Adequate monitoring is the only way to determine spills and their impacts. Unknown leaks, or leaks that employees fail to report or attempt to hide will remain undiscovered and their contamination will continue or disperse unless monitoring is in place to detect them. Adequate monitoring before, during, and following mining also protects the company, because it allows all involved to determine what is caused by the mine versus other sources/causes.

Actual monitoring points for all monitoring should be clearly identified in terms of location and times of sampling. Moreover, monitoring points should be representative and be close to the discharge, to prevent long mixing zones that may become essentially sacrifice zones.

Contaminant release and incident reporting structures (such as Newmont's 5-Star reporting program) should require that the company provide environmental data and reports to the public. There should be full transparency and Newmont should commit to informing the public and government about any unplanned or unpermitted releases as soon as it becomes known - not just during the regular document/reporting cycle. Annual or even quarterly reports do not adequately address the public's right to know about problems at the mine. This promotes good operating procedures and public trust.