State of Utah
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Department of
Environmental Quality

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DIVISION OF RADIATION CONTROL
Rusty Lundberg
Director

February 6, 2012

CERTIFIED MAIL
(Return Receipt Requested)

Billy M. Ray
Manager Closure Execution
Ambrosia Lake Site Manager
Reclamation & Closed Mines
BHP Billiton
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Tucson, AZ 85704 USA

Subject: DRC review of the Rio Algom Mining, LLC (RAML) work plan, prepared by Montgomery & Associates (M&A), entitled "Supplemental Site Assessment to Address Out-of-Compliance Status at Trend Wells RL-1 and EF-8, Lisbon Facility," dated December 13, 2011: **Request for Information**

Dear Mr. Ray:

Utah Division of Radiation Control (DRC) has reviewed the December 13, 2011 Rio Algom Mining, LLC (RAML) Work Plan, prepared by Montgomery & Associates (M&A), entitled "Supplemental Site Assessment to Address Out-of-Compliance Status at Trend Wells RL-1 and EF-8." This Request for Information (RFI) is a summary of DRC review of the RAML Work Plan. A full technical review of the work plan is found in the attached Technical Memorandum.

The DRC identified a number of apparent discrepancies of fact or interpretation found in the initial work plan text and graphics. These apparent discrepancies are described in detail in the memorandum.

The following is a brief synopsis of the apparent discrepancies, discussed in detail in the memorandum:

(1) Assumption that the Burro Canyon Formation "is currently unsaturated along the crest of the LVA."
(2) Assumption that the "unsaturated zone separates the BCA into two separate aquifer areas: the North Aquifer and the South Aquifer."
(3) Assumption that "the South Aquifer is bounded on the southwest by the LF and on the northeast by the unsaturated zone of the BCA."
(4) Discussions of hydraulic conductivity values previously assumed for the Burro Canyon Formation (field and modeling values previously reported are inconsistent and should not be used in future modeling – please see the discussion in the memo).
(5) Statement that "a representative horizontal hydraulic conductivity value for the BBA is on the order of 0.01 ft/d has been reported"; note that values as high as 0.96 ft/day have been reported, nearly two orders of magnitude higher.
(6) Assumption that "horizontal groundwater velocities may vary from a few feet per year (ft/y) in unfractured rock (primarily North Aquifer) to over 100 ft/y for extensively fractured rock (Lewis Water Consultants, 2001)"; while Lewis Water Consultants does make such a statement, the memorandum shows, using values from field data, that these results do not hold for the large uranium plume northeast of the so-called dry zone.
(7) Assumption that "the current direction of groundwater flow is generally from the southeast to northwest."
(8) Maps of lines of equal head that do not account for saturation and refraction in the Brushy Basin Member, and other mapping discrepancies.
(9) Non-representative groundwater sampling from wells at which aquifer water levels are several tens of feet to over a hundred feet above screened intervals of the wells.
(10) Lack of information concerning vertical components of hydraulic gradient.
(11) Limited number of items in a list of key uncertainties, which list ignores many other key uncertainties.

In addition to these apparent discrepancies, there is a large list of uncertainties that need addressing within the work plan. Most of these require additional field work. In addition to those uncertainties already mentioned in the work plan, here are some additional ones that need attention:

- Boundaries of wet (i.e., saturated at and near the base of the formation) and dry portions of the Burro Canyon Formation located in or near the crest of the LVA
- Places of hydraulic connection between the so-called "North Aquifer" and "South Aquifer"
- Groundwater flow directions for all areas of the site potentially contaminated
- Nature, extent and magnitude of uranium distributed in groundwater in areas near the currently identified NW tip of the NW-trending uranium plume along the eastern flank of the LVA; this would include areas west and south of Wells RL-1 and RL-3
- Nature, extent and magnitude of uranium distributed in shallow (water-table depth) groundwater in the Burro Canyon Formation in the vicinity of Wells EF-3a and EF-

8, where only deeper groundwater in the formation appears to have been sampled and analyzed in recent years

- Nature, extent and magnitude of uranium distributed in both shallower and deeper groundwater of the Burro Canyon Formation in areas located to the west, WSW and WNW of Wells EF-3a and EF-8
- Nature, extent and magnitude of uranium distributed in the vadose zone located in the vicinity of disposed tailings in the former upper and lower impoundments and surrounding areas
- Nature, extent and magnitude of uranium distributed in shallow and deeper groundwater located in or near fault zones located parallel to the LF
- Potential for westward, WSW and/or WNW flow and transport in various areas of the site, particularly between the LVA and the LF
- Location and characteristics of subsidiary faulting in one or more fault zones located proximate to and/or east of the identified primary LF
- Vertical components of hydraulic gradient in the Burro Canyon Formation at several representative locations across the site
- Vertical components of hydraulic gradient in the Brushy Basin Member (if vertical components of hydraulic gradient are found to be significant in the Burro Canyon Formation)
- Distribution of head, leading to accurate mapping of lines of equal head, for all groundwater present at the site, including that in saturated porous media of either the Burro Canyon Formation or the Brushy Basin Member, as well as determination of appropriate refraction at hydrostratigraphic boundaries
- Hydraulic head as well as groundwater quality at and near the water table in the Burro Canyon Formation as determined through installation and monitoring of one or more shallow monitoring wells close to Well EF-3a

Almost all of these uncertainties can be addressed through a carefully thought-out program of well drilling and completion, coring, hydraulic testing, and water-level monitoring. Most of these uncertainties, can, in fact, be addressed by pursuing this course at about ten locations. The table at the end of this document (Table 1) summarizes possible locations for drilling and completing a number of wells at the Rio Algom Lisbon site and for coring rock in the source area. This table is created to correspond with the much longer, accompanying January 31, 2011 memorandum describing in detail the DRC review of the RAML work plan (RAML, December 13, 2011). References, denoted as "Refs" in the table, refer to relevant sections of the memorandum.

Some additional drilling and coring may be necessary to more fully evaluate saturated and unsaturated conditions at the LVA crest in a number of areas.

In addition to the type of work as illustrated in the table, there are several other things that the DRC requires (please see details in the memorandum):

(1) Evaluate vertical hydraulic conductivity as proposed in the original work plan
(2) Re-do mapping of lines of equal head at the water table (irrespective of formation containing the water table)
(3) Revise sampling plans for wells southwest of the LVA where water levels are much higher than the top of screen elevations, where low-flow sampling is not appropriate
(4) Investigate the vadose zone in the source area and specifically describe the approach
(5) Pursue initial probabilistic modeling to help identify any other data gaps prior to doing field work
(6) Explain time interval for modeling and number of modeling runs to be done
(7) Proceed with proposed geophysical tests
(8) Prepare geologic logs and well completion diagrams as described in detail in the memorandum
(9) Perform hydraulic testing as described in detail in the memorandum
(10) Plan to develop wells and leave them to stabilize for a suitable lag time (often exceeding one week) prior to sampling and monitoring
(10) Conduct field testing as agreed upon with the DRC
(11) Complete Phase II probabilistic modeling to account for findings in the field

If you have any questions concerning this letter, please contact David Edwards at 801-536-4259.

Sincerely,

Rusty Lundberg

Rusty Lundberg, Director
Division of Radiation Control

RL/DE/de

TABLE 1

#	Location of Newly Installed Well*	Screened Interval	GW Sampling	Hor. K value	Vert. dh/dz value	Refs
1	~500' W of RL-1	(1) BCF or (2) 30' of BBM**	Y	Y		4C,D,F,G,P,R
2	~3000' W of RL-1	BCF water table	Y	Y		4C
3	~1000' SW of RL-1	(1) BCF or (2) 30' of BBM**	Y	Y		4C,D,F,G,P,R
4	In fractures near LF, 1500' SSE of RL-6	BCF water table	Y	Y	Y	4C,E,W
5	In fractures near LF, 1500' SSE of RL-6	base of BCF	Y	Y	Y	4C,E,W
6	In fractures near LF, ~1000' W of EF-6	BCF water table	Y	Y		4C,E
7	Shallow well just next to EF-3A	BCF water table	Y	Y	Y	4C,S,T,U,W
8	Shallow well ~900' W of EF-3A	BCF water table	Y	Y		4C,E
9	~1000 NE of EF-3A	(1) BCF or (2) 30' of BBM**	Y	Y		4C,G
10	In source area	core unsaturated zone				4Y

* or, for #10, core from borehole in source-area vadose zone

** only if the BCF has no saturated thickness at this location

W = west, SW = southwest, SSE = south southeast, NE = northeast, BCF = Burro Canyon Formation, BBM = Brushy Basin Member, Vert. dh/dz value = vertical component of hydraulic gradient calculated from measurement of heads in two wells with screens having basically the same x,y points but different z coordinates.