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Technical Memorandum

Arroyo del Puerto Embankment/Channel

Additional Information, Revision 1

John M. McBee

To:	Thomas McLaughlin	**From:**	John M. McBee, P.E.
Company:	Nuclear Regulatory Commission	**Date:**	May 21, 2008
Re:	Arroyo del Puerto Embankment/Channel Additional Information	**Project #:**	1155690067
CC:	Terry Fletcher, Rio Algom Mining LLC		

The purpose of this memorandum is to provide additional information concerning construction of a diversion embankment and channel, and an interior drainage channel as described in *Site Erosion Protection Measures from Surface Water Flow in the Arroyo Del Puerto, Ambrosia Lake Mill, Ambrosia Lake, New Mexico,* Rio Algom Mining LLC, Revision 1, January 2008 and Amendment 1 to Revision 1, March 2008. Specifically, more information is provided to address three potential concerns: 1) potential impacts to groundwater monitoring wells from construction; 2) potential residual contamination in soils within the diversion channel footprint; and 3) potential recharge to the Alluvial Aquifer (which the Alternate Concentration Limits application for groundwater compliance has been approved) from infiltration due to surface water flows in the Arroyo del Puerto channel. Each potential area of concern is addressed as follows:

Potential Concern 1: Potential impacts from construction were reviewed with respect to the approved Alternate Concentration Limit (ACL) Application for Alluvial Groundwater for the facility. To assure continued monitoring of the wells as listed in the ACL, monitoring wells that could potentially be impacted by construction were assessed. No wells are going to be abandoned or replaced as the result of construction of the diversion embankment/channel. However, there are five wells within the area of construction (30-48, 32-69, 32-41, 32-42, and 32-45KD) that will have changes in their final surface elevations due to the construction. These wells will be flagged and maintained during construction. At the completion of construction, depending on specific final elevation requirements at each well, new surface casing will be installed and erosion protection rock placed if necessary to assure continued access for monitoring of the wells as required in the license. There are six additional wells that will be in the vicinity of the construction that will not need changes in their surface completion elevations (30-47, 30-04, AW-1, 31-05, 32-02, and 32-43N). However, they too will be flagged and maintained during construction activities.

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Potential Concern 2: The largest possible footprints of Ponds 4, 5, and 6 are shown in the construction drawings (Sheet 3 attached). Prior to design of the diversion channel in the vicinity of the northeast corner of Pond 4, aerial photographs of the facility taken during milling operations were reviewed to assess the actual limit of tailings ponding in the Pond 4. No ponding of tailings effluent was seen in any of the aerial photos in the extreme northeast portion of Pond 4. The height of the berms used to construct Ponds 4, 5, and 6, were approximately four feet and based on the slope of the topography, ponding over the entire footprint shown would have required a higher embankment.

In the northeast portion of the area shown as Pond 4 (an approximate 2-acre area – see Sheet 3, attached) that will be in the diversion channel, soils were sampled to the calculated potential scour depth to either: 1) confirm that no impacted subsurface soils were present; or 2) locate potentially impacted soils that would require excavation and relocation to the Pond 2 disposal cell. The results of the soil samples from 10 borings did not indicate tailings ponding in this area. Sample analyses included radium-226, uranium, or thorium-230 and only one soil sample (taken at 0' to 2') had an elevated reading (55 pCi/g for thorium-230) above the soil cleanup standards (14 pCi/g for thorium) per the *Soil Decommissioning Plan* (Komex, 2006). This area was re-sampled with soil samples taken from 0' to 1' (on 6" increments) at three locations approximately 10' away from the boring. Results of all six samples, which ranged from 0.3 to 1.8 pCi/g, were well below the cleanup standards for thorium-230, so no further action was warranted.

The interior channel will be constructed adjacent to the southwest sides of Ponds 4, 5, and 6 and will not be excavated into potentially impounded areas of the former ponds. The side rock apron of the channel will tie to the erosion protection rock to be placed over the entire conservatively estimated footprints of Ponds 4, 5, and 6. The alignment of the original Arroyo del Puerto will be straightened by construction of the interior channel and the channel will be lined with erosion protection rock to prevent scour from a probable maxim flood (PMF) event.

Potential Concern 3: Construction of the Arroyo del Puerto diversion embankment and channel will significantly decrease the potential for groundwater recharge to the Alluvial system from surface water flow in the arroyo at the Rio Algom site. The diversion structure will divert offsite flows from a drainage area of approximately 57 square miles above the Rio Algom site around areas of the impoundment. Prior to mining activities, surface water from "significant" events from this large drainage area would have gone down the Arroyo del Puerto channel. The Geomorphic Evaluation of Arroyo del Puerto Drainage, Ambrosia Lake Area (Appendix E-1, January 2008 submittal), discusses infiltration as it relates to geomorphic processes, soils, and landforms controlling flood events. The high infiltration rates and capacities of the soils discussed relate to individual storm events primarily in drainage areas leading to Arroyo del Puerto that would mitigate high surface water flows from a significant precipitation event (probable maximal precipitation). A description of the soils in the vicinity of the Arroyo del Puerto at Rio Algom facility is included in the text of the submittal (page 49) and Appendix E-1 (page 6). The soils have been described as over 30 feet of fine sandy silt to silty fine sand. Attached are additional grain-size distributions of soils sampled in the site area. While these soils would accept significant infiltration from a storm event, their fine-grained composition (51 to 67 percent silt-sized particles or smaller) would also cause them to retain the moisture. This retention due to the relatively low permeability of the soils would allow for evapotranspiration processes to remove the soil moisture prior to deep infiltration. For the Ambrosia Lake area, the evaporation rate (54 inches per year – in/yr)[1] is six times the annual precipitation (8.83 in/yr)[2].

After construction of the diversion structure, only 440 acres within the site boundary will contribute to surface water flow within the former Arroyo del Puerto channel adjacent to the former tailings ponds. The interior channel will be constructed to provide an outlet for any surface water flows from "significant" precipitation events in the immediate area of the Ambrosia Lake Tailings Impoundments comprising an approximate total surface area of 440 acres and consisting of the following areas:

- North and east sideslopes of former Pond 1,
- Northern half of Pond 2,
- Pond 3,
- Pond 4, 5, and 6 areas, and
- Other portions of the permanent withdrawal area "inside" of the diversion channel and embankment.

Significant recharge to aquifers in arid regions of the United States occurs only where there is a relatively sustained duration of surface water flowing in stream channels. This typically occurs at the base of mountains with a melting snow pack or large drainages at higher elevations, and not where there are only ephemeral storm events in the lower portions of the drainage basins. In *Regional Analysis of Ground-Water Recharge* (USGS professional Pager 1703)[3], studies of two basins in New Mexico showed that annual ground-water recharge was less than 0.3 percent of average annual precipitation (page 57). For the Ambrosia Lake area (8.83 in/yr)[2] this would result in a recharge to the alluvial groundwater system of less than 0.03 inches per year (basin wide). It should also be noted that the report states (also on page 57) "that runoff is an important component (in addition to in-place recharge) to the available ground-water supply in the basins corresponding to the eight recharge-study sites". Since potential surface water flows from the 57-square-mile drainage to the Arroyo del Puerto will be diverted around the former tailings ponds, this component of recharge in the arroyo at Rio Algom will be effectively eliminated. The 440 acres within the site boundary is approximately 1 percent of this upland drainage area.

Although it has been less than three years since water discharge into the Bypass Channel (which was adjacent to the north and east boundaries of Ponds 4, 5. and 6) was discontinued per approval of the ACL Application for Alluvial groundwater compliance, there have been measured decreases in groundwater elevations in the monitoring wells in the vicinity of these former ponds (also discussed in the Geomorphic Evaluation of Arroyo del Puerto, previously cited). This shows that the previous surface water discharge to the Bypass Channel was the primary recharge source to the alluvial system in this area.

References:

1: National Oceanic and Atmospheric Administration, "Climatic Atlas of the United States", U.S. Department of Commerce, 1979.

2: U.S. Department of Commerce, San Mateo, New Mexico, 1939-1974.

3: U.S. Geological Society Professional Paper 1703 – Ground-Water Recharge in the Arid and Semiarid Southwestern United States – Chapter B, 2007.

CONSTRUCTION NOTES:

1) Location of Diversion Embankment/Channel alignment and grade based on 2006 Aerial Survey provided by Rio Algom Mining LLC.
2) Adjustments to the Diversion Embankment/Channel alignment and grade will be necessary to fit actual topography.
3) All fill areas adjacent to the Diversion Embankment/Channel shall be graded to have positive drainage.
4) Disturbances to the area shall be kept to a minimum during construction. Temporary erosion control measures shall be taken where necessary.
5) Topsoil shall be removed within existing vegetated areas and shall be stockpiled for later use where needed as directed by owner. Topsoil removal shall be limited to construction limits. Care shall be taken to prevent damage to vegetated areas outside construction limits.
6) All existing drainages along and near the Diversion Embankment/Channel shall remain in place and undisturbed.
7) The Northern corner of Tailings Pond 4 to be checked to a depth of 10 feet below final grade by Rio Algom Mining LLC for remaining tailings contamination. If exists, contamination on the Northeast side of the embankment shall be removed and replaced with clean fill. The work is to be accomplished by others.
8) The locale of the Arroyo del Puerto that is adjacent and southeast of Tailings Pond 9 is presently being used as a fill material borrow source. The final configuration of the channel within this area ia shown much wider than the existing alignment.

Sta. 86+75 Section 19
Sta. 83+81 Section 18
Sta. 80+00 Section 17
Sta. 75+00 Section 16
Sta. 70+00 Section 15
Sta. 65+00 Section 14
Sta. 60+00 Section 13
Sta. 55+00 Section 12
Sta. 50+00 Section 11
Sta. 45+00 Section 10
Section 9
Sta. 40+00
Sta. 35+00 Section 8
Sta. 30+00 Section 7
Sta. 25+00 Section 6
Sta. 20+00 Section 5
Sta. 15+00 Section 4
Sta. 10+00 Section 3
Sta. 5+00 Section 2
Sta. 0+00 Section 1
Sta. -5+00 Section -1
Station -2+00
Sta. 91+75 Section 20
Sta. 96+75 Section 21

L
L'
(Sheet 4)
K
K'
(Sheet 4)

Detail 2 (Sheet 7)
Detail 6 (Sheet 5)
Detail 1 (Sheet 6)

Northeast corner of Tailings Pond 4 (Note 7)

Upstream end of Work Package
Downstream end of Work Package

Fill Existing Channel (Note 3)

Tailings Pond 4
Tailings Pond 5
Tailings Pond 6

Existing Diversion Channel
Existing Discharge Channel
Interior Drainage Channel (Not included in this Work Package)
Diversion Embankment/Channel Work Package Area

Existing State Highway 509

Channel Configuration (Note 8)

POND 3

D_{50} = 1" Rock
D_{50} = 3.2" Rock
D_{50} = 7.8" Rock
D_{50} = 12.0" Rock

0 Feet 600

CONSTRUCTION STATIONING & RIPRAP PLACEMENT
ARROYO DEL PUERTO
DIVERSION EMBANKMENT/CHANNEL
AMBROSIA LAKE MILL
RIO ALGOM MINING LLC
GRANTS, NEW MEXICO

TETRA TECH

PROJECT No. 5690067
FILE NAME: Channel Plan_Sheet 3.DWG
DRAWING BY: EJS 04/8/08
REVIEWED BY: MJB

SHEET 3

Size	Percent Passing			
	SE of Pond 6	Sec. 32 - No. 1	Sec. 32 - No. 2	Interceptor Trench Area
No. 4				100
No. 10				99
No. 16				99
No. 30	100			99
No. 40	99	100	100	98
No. 50	98	98	98	98
No. 100	86	76	80	81
No. 200	67	54	51	65

Section 32 is east of the former Ponds 3 through 6.
Interceptor Trench Area would be adjacent to the northeast side of Pond 3.