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COLORADO, LLC

TECHNICAL MEMORANDUM

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TO:	File
ATTENTION:	Troy Meyer
FROM:	Richard Pearce
DATE:	June 2, 2006
SUBJECT:	Siting Study - Pond Sizing Memorandum
PROJ/PROP NO.	Augusta Resource Corp. – Rosemont Mine / 06.50.0300

1.0 Introduction

The following technical memorandum summarizes the sizing of the lined freshwater and contingency ponds and the unlined stormwater pond for the Rosemont Mine Siting Study. Figure 1 shows the project location and Figure 2 shows the general facility arrangement. The freshwater pond is located above the mill site and will primarily be filled by pipeline, however there is a small contributing basin to the reservoir. The freshwater pond is designed to provide storage for 3 days freshwater requirements for the entire mine site (67 AF) with 5 foot of freeboard. Freshwater requirements are currently estimated to be 5000 gpm by Augusta Resources.

The lined contingency dam is downstream of the mill site is designed to be a multi-use pond. The contingency pond would likely be regulated by the Arizona Department of Environmental Quality (ADEQ) and be classified as a non-storm water pond. The pond is sized to store seven days of tailings slurry (586 AF)\ and the 100-year 24-hour runoff volume (205 AF) with 5 foot of freeboard. It will provide temporary, emergency containment facility for:

1.) Tailings slurry storage in case the filter plant for dewatering the tailings goes down;
2.) Process water overflow storage in case power is lost or process upsets;
3.) Contact surface water storage for runoff from mill site; and
4.) 100-year 24-hour stormwater runoff storage.

The unlined stormwater pond is located at the outlet of the Barrel Canyon drainage basin and downstream of the ultimate footprint of the wasterock/dry tailings disposal area. The purpose of the dam is to provide sediment control for the site, and the reservoir is sized to store the 100-year 24-hour storm event and safely pass the design storm event for the yet to be determined hazard classification. Given the location and size of the dam, the dam likely to be classified as a large, high hazard dam by the Arizona Department of Dam Safety.

2.0 Storm Precipitation

Design storm precipitation was determined based on the Precipitation Frequency Estimates for the Southwest United States (NOAA Atlas 14). The design precipitation is summarized in Table 1.

Table 1: Design Storm Precipitation

Return Period	1-Hour	6-Hour	24-Hour
2-Year	1.4	1.8	2.2
5-Year	1.8	2.3	2.8
10-Year	2.1	2.6	3.2
25-Year	2.5	3.2	3.8
50-Year	2.8	3.6	4.2
100-Year	3.2	4.1	4.7
500-Year	3.9	4.5	5.9

3.0 Basin Characteristics

The drainage basins are outlined in Figure 1, and the characteristics are summarized in Table 2.

Table 2: Basin Characteristcs

	Freshwater Pond	Contingency Pond	Stormwater Pond
Basin Area (mi^2)	0.28	0.82	7.87
Longest Flow Path (ft.)	3,473	9,905	25,698
Basin Slope (ft/ft)	0.28	0.086	0.028
Mean Basin Elevation (ft)	5,550	5,305	4,850

4.0 Rainfall-Runoff Estimates

HEC-1 was used to estimate peak rainfall-runoff and storm volumes for the 2-year through 100-year, 24 hour events. The SCS methodology was used to estimate losses. A 5-minute time step was used with a SCS Type II synthetic rainfall distribution. The soils in the area are classified as a Hydrologic Soil Group D, which is typically described as clay loam, silty clay loam or sandy clay. These soils generally have low infiltration rates and high runoff potential when thoroughly wetted. A curve number of 86 was used for the analysis and is reflective of desert shrub in fair condition. For the siting study it was assumed that the size of the freshwater pond would be minimized, and the design storm flows from that basin would report to the Contingency Pond. The results of the analysis are summarized in Table 3.

Table 3: Rainfall-Runoff Summary

	Contingency Pond	Stormwater Pond
Basin Area (mi^2)	1.10	7.87
Peak Flow (cfs)	2,153	8,247
Time to Peak (hr)	12.08	12.58
Runoff Volume (AF)	204	1,459

5.0 Dam and Reservoir Sizing

Reservoir storage rating curves were developed for each of the pond locations. The Freshwater Pond is sized to store just the freshwater requirements for the plant site. The Contingency and Stormwater Ponds are sized to store the 100-year, 24-hour storm runoff volume and the anticipated sediment yield from the contributing basin area for this storm event. SEDCAD 4 was used to develop an estimate of the sediment yield for the 100-year, 24-hour storm event. The sediment yield assumed near empty reservoirs at the time of the storm and a silty, sand and gravel gradation for the calculations. For feasibility level design, all the dams were sized to store the target storage volume plus 5 feet of freeboard. The storage summary data is presented in Table 4.

Table 4: Pond Storage Volume Summary

	Freshwater Pond	Contingency Pond	Stormwater Pond
Dam Crest Elevation (ft)	5225	4935	4635
Sediment Yield (tons)	NA	15,200	93,650
Target Storage Volume (AF.)	67	220	1,400
Dam Height (ft)	50	45	75

6.0 Dam Hazard Classification/Regulatory Requirements

The Arizona Department of Water Resources classifies dams according to the size of the structure and the hazard potential if the dam were to fail. The classifications are summarized in Tables 5 and 6.

Table 5: Dam Hazard Potential Classification

Classification	Probable Loss of Life	Probable Economic, Lifeline, and Intangible Losses
Very Low	None Expected	Economic and lifeline losses limited to owner's property or the 100-yer floodplain. Very low intangible losses.
Low	None Expected	Low
Significant	None Expected	Low to high
High	Probable – 1 or More	Low to high

Table 6: Dam Size Classification

Category	Storage Capacity (AF)	Height (ft)
Small	50 – 1,000	25 - 40
Intermediate	> 1,000 - < 50,000	> 40 - < 100
Large	>50,000	> 100

The Inflow Design Flood (IDF) is a function of the size classification of the dam. The IDF is the storm event that the dam must be able to store or safely pass through the outlet and/or spillway. The design storms are summarized in Table 7.

Table 7:Inflow Design Storm

Hazard Class	Dam Size Classification	IDF
Very Low	All Sizes	100-Year
Low	All Sizes	0.25 PMF
Significant	Small Intermediate Large	0.25 PMF 0.5 PMF 0.5 PMF
High	All Sizes	Varies 0.5 – 1.0 PMF

7.0 Conclusions

It was assumed for this analysis that all the structures are High Hazard facilities given their proximity to high traffic work areas and the State Highway downstream of the Stormwater Pond. This classification would require spillways capable of safely passing between 0.5 – 1.0 of the PMF. This assumption would have to be reviewed and confirmed with State Dam Safety officials. The classification of Contingency Pond may change over time as the downstream toe is buttressed with wasterock.

Given the size of basins, all the dams would likely require overtopping protection, but because all the structures are rockfill facilities, that should be sufficient to armor the top and downstream face from eroding during the design storm event. If possible, it would be desirable to limit the size and number of jurisdictional dams in order to decrease IDF and the associated spillway requirements. From a permitting and dam safety point of view, it would be beneficial to consider eliminating the freshwater pond and adding additional storage at the Contingency Pond, or downsizing the Freshwater Pond to a non-jurisdictional structure and operate it in conjunction with the Contingency Pond. The tradeoff would be the associated increase in pumping costs if freshwater were taken from below as opposed to above the Mill Site.