1.0 Introduction
In March 2005, Augusta Resource Corporation (Augusta) commissioned Vector Arizona LLC (Vector) to conduct an initial site selection study for a tailings impoundment at the proposed Rosemont Mine in Arizona. The evaluation consists of an analysis of alternative sites based on defined design and selection criteria as well as estimated development costs to identify the preferred tailings impoundment locations and disposal methods.

1.1 Background
The Rosemont project site lies in a high, sparsely populated intermountain area approximately 35 miles southeast of Tucson, Arizona (Figure 1) on the east slope of the Santa Rita Mountains. Access to the site is via Highway 83 which connects Interstate 10 with the town of Sonoita. Augusta controls a large portion of the site including the Hidden Valley Ranch and Rosemont Ranch. The Coronado National Forrest is custodian of much of the slopes of the Santa Rita Mountains.

1.2 Site Visit
Troy Meyer, P.E. of Vector visited the Rosemont property March 8 through 9, 2006 to perform site reconnaissance and familiarize Vector with the proposed facility locations, site features, surficial geology and soils. Photographs taken during this site visit are presented in Attachment A.

1.3 Previous Studies
A pre-planning study was conducted by the University of Arizona (The Mines Project Group 1980) for a previous owner of the property (Anamax Mining Company). The study involved an evaluation of potential waste rock and tailings sites for the proposed
Helvetia/Rosemont Mine and was focused on economic feasibility, socio-economic factors such as visual impact and possible closure methods and landforms. The study identified Sycamore Canyon as the preferred tailings impoundment site for conventional tailings disposal.

1.4 Objectives

This report is intended to provide a basis for decisions regarding future tailings impoundment facilities and disposal methods. The study considered both conventional (slurry) and dry stack tailings disposal methods and a comparative analysis was performed to the extent possible. The primary tasks performed for the study included:

- Regional Screening;
- Identification of Sites;
- Analysis of Fatal Flaws;
- Investigation of Remaining Sites;
- Qualitative Evaluation and Ranking;
- Semi-quantitative Evaluation and Ranking;
- Cost Analysis; and
- Selection of Alternatives for Detailed Investigation.

This study attempts to provide a clear, transparent and communicable evaluation methodology and selection of the preferred tailings disposal site and method for the Rosemont project. Much of the site evaluations at this stage of the study are based on judgment and experience with similar projects rather than deterministic analysis due to the difficulty of quantifying the various potential impacts of a tailings impoundment, particularly environmental and socio-economic impacts. This report is based on information provided by Washington Group International (WGI) regarding the suitability of the tailings to the proposed filtering technology to produce “dry” tailings and the associated costs and does not attempt to verify WGI’s data or conclusions.

The next phase of the study will involve a detailed evaluation and investigation of the preferred sites and disposal methods including the following primary tasks:

- Detailed Site Investigation of Preferred Sites;
- Conceptual Designs for the Sites;
- Evaluation of Costs and Pollution Risks;
- Evaluation of Alternative Tailings Disposal Methods;
- Ranking of Sites/Methods and Selection of Prime Site/Method; and
- Preparation of Reports and Documentation.
2.0 Design Considerations

2.1 Design Objectives

Vector has developed a list of design objectives and design criteria to be followed in the evaluation of alternative tailings sites and disposal methods. The design criteria generally follow the Arizona BADCT Mining Guidance Manual (ADEQ, 2005). These criteria will be further refined during the design phase.

The overall general design objective is to provide safe, cost-effective, and environmentally responsible management of the tailings produced by the proposed Rosemont Mine. Detailed design criteria and objectives include:

- Provision of secure long-term storage of 440 million tons (mt) of tailings, which is sufficient for the ore to be mined and processed during about 16 years of project life at a projected rate of 75,000 tons per day (tpd) with potential expansion to 500 mt storage capacity.

- Location within the immediate general area of the mine (approximately 5 mile radius from the proposed mine pit).

- Design of the tailings impoundment so that tailings water seepage into the groundwater system will be reduced to the maximum extent reasonably achievable by basin sliming or geologic containment (for conventional deposition), provision of surface water runoff and seepage collection, and other measures as required.

- Prevention of airborne release of tailings solids to the environment by provision of dust suppression measures.

- Compliance with all applicable regulations including Arizona BADCT standards.

- Creation of a site-specific design that accounts for local factors including climate, geology, hydrogeology, seismicity, and vegetation.

- Establishment of an effective and efficient reclamation program, preferably concurrent reclamation.
2.2 Design Criteria

Table 2.1 presents a summary of the conceptual design criteria for the Rosemont tailings impoundment design.

Table 2.1: Summary of Conceptual Design Criteria

<table>
<thead>
<tr>
<th>1.0 Basic Data</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 Tailings design capacity requirement = 440 million tons</td>
<td></td>
</tr>
<tr>
<td>1.2 Ultimate tailings capacity requirement = 500 million tons</td>
<td></td>
</tr>
<tr>
<td>1.3 Tailings produced at 75,000 tons per day</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>3.0 Embankment Stability</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 Static</td>
<td></td>
</tr>
<tr>
<td>2.1.1 Minimum factor of safety (FOS) of 1.5 under normal operating conditions</td>
<td></td>
</tr>
<tr>
<td>2.1.2 Minimum FOS of 1.3 during construction (non-critical slopes)</td>
<td></td>
</tr>
<tr>
<td>2.2 Dynamic (earthquake)</td>
<td></td>
</tr>
<tr>
<td>2.2.1 Crest deformation &lt;3 ft under design basis earthquake loading</td>
<td></td>
</tr>
<tr>
<td>2.2.2 Minimum FOS of 1.1 for post-earthquake assessment</td>
<td></td>
</tr>
<tr>
<td>2.2.3 Assume tailings fully liquefy under earthquake conditions</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3.0 Hydrology and Water Management</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1 Assume 100 yr / 24 hour storm event for all hydraulic structures</td>
<td></td>
</tr>
<tr>
<td>3.2 Probable Maximum Flood (PMF), in addition to the maximum operating level under normal conditions</td>
<td></td>
</tr>
<tr>
<td>3.3 Use average monthly conditions to evaluate monthly fluid levels throughout the life of the tailings impoundment for alternatives analysis</td>
<td></td>
</tr>
<tr>
<td>3.4 Assume 100% water reclaim to mill</td>
<td></td>
</tr>
<tr>
<td>3.5 Design tailings facility and seepage control systems (e.g. liners, barriers, pumpback systems) such that the downstream flow immediately below the dam, in terms of quantity and quality (pH and metals) does not exceed applicable regulatory limits, over the active life of the facility</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4.0 Conventional Tailings Disposal Method</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1 Conventional subareal deposition technique</td>
<td></td>
</tr>
<tr>
<td>4.2 Assume tailings in-place density of 100pcf based upon published data</td>
<td></td>
</tr>
<tr>
<td>4.3 Assume 50% solids content by weight for tailings slurry</td>
<td></td>
</tr>
<tr>
<td>4.4 Tailings solids specific gravity = 2.70</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5.0 Dry Tailings Disposal Method</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1 Dry stack within waste rock dump</td>
<td></td>
</tr>
<tr>
<td>5.2 Assume tailings in-place density of 110pcf</td>
<td></td>
</tr>
<tr>
<td>5.3 Assume 15% moisture content by weight for in-place dry tailings</td>
<td></td>
</tr>
<tr>
<td>5.4 Tailings solids specific gravity = 2.70</td>
<td></td>
</tr>
</tbody>
</table>
2.3 Tailings Production and Storage Requirements

Mine and milling estimates indicate a tailings stream of approximately 75,000 tons per day (tpd) to the tailings impoundment for 16 years for a total of 440 mt of tailings capacity required with an expansion capacity for up to 500 mt. Based on a tailings in-place dry density of 100 pounds per cubic foot (pcf) for conventional tailings and 110 pcf for dry tailings, the total volume of tailings requiring impoundment is approximately 370 million cubic yards (cy) and 337 million cy for conventional and dry tailings, respectively.

2.4 Water Management

Current engineering practice for conventional tailings facilities dictates that the probable maximum flood (PMF) is accommodated by providing excess tailings impoundment capacity during operations and by providing a permanent spillway at closure designed to discharge the peak flow during the PMF event. Water management for dry stack tailings would involve routing basin runoff away from the active stack area and providing armoured channels on the stack perimeter and downstream sediment controls.

2.5 Geologic and Geotechnical Considerations

Geotechnical considerations for design of conventional tailings facilities include engineering characteristics of the tailings with regard to permeability, consolidation, strength, liquefaction potential, seepage control, and methods of drainage; engineering characteristics of the near surface geology with regards to permeability, strength, bearing capacity, collapse potential, liquefaction potential, suitability to embankment and liner construction and seepage control; and engineering characteristics of deeper geology with regard to permeability, seepage flow paths, groundwater depth and recharge, and attenuation potential. Considerations for dry stack tailings facilities include many of the above mentioned factors as well as waste rock characterization. These data have not yet been collected; therefore these evaluations rely on assumptions based on published “typical” parameters and previous experience.

The evaluations presented in this report do not consider quantified geologic or geotechnical site characteristics or factors. This study assumes natural geologic containment can be achieved at the considered tailing impoundment sites by “slimming” the basin with fine tailings prior to normal deposition and by providing seepage control measures (cutoff trench, slurry wall, grout curtain, etc). Due to the large impoundment areas and difficult terrain, use of geomembrane impoundment liners is not considered the preferred containment method for conventional tailings disposal. Current
experience with geomembrane liners is that they can be very effective used under certain field and installation conditions for smaller impoundments, but their application to large impoundments and for long-term effectiveness is questionable. Geotechnical site investigations are necessary to provide data for future design evaluations. Section 5.0 of this report discusses recommended additional work related to detailed geotechnical investigation of preferred sites for conceptual and pre-feasibility level designs.

2.6 Dry Tailings

The dry stack concept developed for this study involves dewatering the tailings using filtering technology and delivering the “dry” tailings to a disposal site using conveyors. The tailings will have a moisture content of approximately 15%. The tailings will be placed within the proposed waste rock dump to provide erosion protection and allow for covering with waste rock for dust control and progressive reclamation similar to landfill operations. This study does not consider mixing or “co-mingling” of tailings and waste rock however future evaluations may find this method suitable.

2.7 Reclamation

Upon the end of the tailings facility operational life, the conventional tailings impoundment must be closed and reclaimed so as to retain physical and chemical stability, and to protect human health and environment. The reclamation concept assumed for this study involves dewatering the final surface of the impoundment and constructing a graded cover to provide positive drainage to a final closure spillway. The cover surface would then be vegetated to limit wind and water erosion and water infiltration through the tailings mass.

Dry tailings provide an opportunity for a more straight-forward closure design due the lack of a free water pool, more consolidated and dryer tailings mass, low seepage potential, and high degree of structural integrity. The dry stack can be constructed to provide a suitable final closure configuration. A reclamation cover similar to that described above would then be placed over the final surface and permanent armored drainage channels would be constructed.
3.0 Site Selection Evaluation for Conventional Facilities

3.1 General

Four potential impoundment sites were identified for conventional tailings disposal utilizing 10ft contour interval topographic mapping provided by Augusta. Figure 2 presents the general locations of each potential impoundment site.

Embankment and impoundment volumetrics were performed for each site to identify embankment alignments and sizes that will provide up to 500 mt of tailings storage. Embankment sideslopes of 2:1 (horizontal: vertical) and downstream construction methods were assumed for the study based on use of mine waste for embankment construction. Multiple embankment locations were considered in the larger drainages in order to evaluate the most efficient alignment.

Embankment fill volume, impoundment storage capacity, drainage basin area, and impounded tailings area was estimated for each site. The facility life was calculated based on a tailings disposal rate of 75,000 tpd and an average in-place tailings density of 100 pcf.

3.2 Fatal Flaw Screening Criteria

The potential tailings sites identified were initially screened based on two fatal flaw criteria. Sites providing less than the required 500 mt of ultimate storage capacity were eliminated. Sites not considered viable due to costs associated with displacement of waste rock were also eliminated. The sites located in the Barrel drainage were eliminated based on these criteria. The “Barrel A” site (embankment alignment A in upper Barrel drainage) was eliminated due to lack of capacity and the “Barrel B” site (embankment alignment B in lower Barrel drainage) was eliminated due its location in the designated waste rock disposal area. Figures 3 and 4 present the evaluated tailings impoundment layouts. Table 3.1 presents the site volumetrics for the remaining sites as well as storage capacity versus embankment fill volume ratios. This ratio is an indication of the cost per ton for tailings storage.
Table 3.1 – Summary of Tailings Site Volumetrics

<table>
<thead>
<tr>
<th>Site</th>
<th>Crest Elev. (ft)</th>
<th>Emb. Height (ft)</th>
<th>Emb. Fill Volume (cy)</th>
<th>Storage Capacity * (cy)</th>
<th>Storage vs. Fill Volume Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schofield A</td>
<td>4760</td>
<td>285</td>
<td>12,236,691</td>
<td>38,367,840</td>
<td>3.1</td>
</tr>
<tr>
<td></td>
<td>5,080</td>
<td>605</td>
<td>143,512,669</td>
<td>383,667,035</td>
<td>2.7</td>
</tr>
<tr>
<td>Schofield B</td>
<td>4,650</td>
<td>250</td>
<td>9,402,720</td>
<td>41,792,797</td>
<td>4.4</td>
</tr>
<tr>
<td></td>
<td>4,940</td>
<td>540</td>
<td>136,862,802</td>
<td>379,013,604</td>
<td>2.8</td>
</tr>
<tr>
<td>Sycamore A</td>
<td>4,680</td>
<td>410</td>
<td>13,039,807</td>
<td>38,931,708</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>5,030</td>
<td>760</td>
<td>135,269,587</td>
<td>374,624,861</td>
<td>2.8</td>
</tr>
<tr>
<td>Sycamore B</td>
<td>4,520</td>
<td>350</td>
<td>7,170,599</td>
<td>39,743,046</td>
<td>5.5</td>
</tr>
<tr>
<td></td>
<td>4,800</td>
<td>630</td>
<td>64,877,056</td>
<td>383,227,357</td>
<td>5.9</td>
</tr>
<tr>
<td>Empire</td>
<td>4,450</td>
<td>185</td>
<td>3,506,908</td>
<td>57,478,054</td>
<td>16.4</td>
</tr>
<tr>
<td></td>
<td>4,600</td>
<td>335</td>
<td>21,604,721</td>
<td>412,803,391</td>
<td>19.1</td>
</tr>
</tbody>
</table>

* Based on 100pcf in-place dry density for tailings.

3.3 Evaluation Parameters

The siting studies were divided into four major categories (primary evaluation parameters), with overall weighting factors as shown in Table 3.2. In selecting a tailings impoundment site, it was important to Augusta that all sites analyzed were reviewed in a manner that accounts for all substantive impacts of concern by stakeholders. Using the techniques described in “A Multiple Accounts Analysis for Tailings Site Selection” (Robertson & Shaw) and other published papers (Caldwell 1983, Robertson 1982), Vector was able to analyze the potential sites through a series of these fundamental parameters.
Table 3.2 – Primary Evaluation Parameters and Weighting Factors

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Weighting Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Review</td>
<td>4</td>
</tr>
<tr>
<td>Socio-Economic Review</td>
<td>3</td>
</tr>
<tr>
<td>Technical Requirements</td>
<td>2</td>
</tr>
<tr>
<td>Project Economics</td>
<td>1</td>
</tr>
</tbody>
</table>

Under each primary evaluation parameter, a number of sub-parameters were defined. This list was then scrutinized to identify the sub-parameters which are either similar for all alternatives or not materially influential in the selection process. The remaining sub-parameters are considered the fundamental parameters for the Rosemont tailings impoundment siting study. The fundamental parameters were then weighted and each site was ranked on the fundamental parameters from one to nine, nine being the most appropriate and all other locations ranking equal or less. The weights and rankings were then multiplied together, resulting in a normalized sum (merit rating score) for each primary parameter. In this way, the most appropriate site based on a ranking is determined when ranked against another site for that particular parameter. The merit scores for each site were then compiled and multiplied by the weighing factors in Table 3.2 to provide a final score. Table 3.3 presents list of fundamental parameters and weightings for the Rosemont tailings impoundment siting study.

3.4 Environmental Review

The environmental fundamental parameters included eleven different factors. If the fundamental parameter did not distinguish one site from another, that particular parameter was dropped from the ranking system. All environmental fundamental parameters are listed below and the rational for inclusion or exclusion are included.

3.4.1 Climate

Climate was a parameter determined to have no impact on the siting study. All potential sites are located within one general area and the climate does not vary enough from site to site to make this a determining fundamental parameter.
3.4.2 Air Quality

In order to evaluate air quality, indicators were chosen. Those indicators included visible emissions from stacks (which will not be an indicator for tailings facilities), visible fugitives, noxious odors (not an indicator for tailings facilities), and total exposed area and elevation (which gives an indication of wind exposure).

When ranked against the other fundamental parameters in this section, air quality was ranked as high importance and was set at seven (7). Comparable rankings among each of the sites were then completed using elevation and location as affected by the prevailing winds. In this case, the higher locations on the southern side of the slope received the most unfavorable, i.e. lowest, ranking. The dry tailings option was considered the most favorable due to the opportunity for concurrent covering of the dry stack with waste rock limiting the exposed tailings surface.

Measures were also reviewed to determine if mitigation could change the ranking. In this case, dust control measures, emissions controls from processes, and maintaining road conditions did not affect the overall ranking.

3.4.3 Hydrology and Water Management

In order to evaluate hydrology and water management, the fundamental parameter of maximizing water conservation was used. Indicators for this fundamental parameter were water reuse based on tailings rate of rise, sufficient storage to capitalize on stormwater capture from upstream catchment areas, and potential pond sizes and their effect on evaporation.

When ranked against the other fundamental parameters in this section, hydrology and water management was ranked fairly high and was set at eight (8). Comparative rankings among each of the sites were then completed using rate of rise, natural containment, and potential evaporation. In this case, the larger tailings impoundments ranked lowest, i.e. most unfavorable conditions for this parameter. The dry tailings option was considered the most favorable since this method allows a higher fraction of the water to be removed from the tailings.

Measures were also reviewed to determine if mitigation could change the ranking analysis. In this case, process controls would affect each tailings impoundment equally. Therefore, mitigation did not affect the overall ranking.
3.4.4 Water Quality

Indicators were selected in order to evaluate water quality, specifically groundwater quality. Those indicators included preservation of ambient conditions at point of compliance (POC) wells. POC wells are installed and monitored to verify that geologic containment of the various sites are maintained.

When ranked against the other fundamental parameters in this section, water quality was ranked the highest and was set at nine (9). Comparative rankings among each of the sites were then completed using potential geologic containment. In this case, the smaller impoundments with better geologic containment ranked highest, or most favorable. The dry tailings option was considered the most favorable since this method limits potential seepage to a very low level.

Mitigating factors such as liners were discussed. However because the terrain in all locations at the property is either steep or hilly, placement of liner system would be difficult and long-term integrity hard to predict. If liners were used for the tailings facility, water quality issues may be mitigated but the overall site ranking would be offset by technical issues.

3.4.5 Aquatic Ecology

In order to evaluate aquatic ecology, it was determined that the fundamental parameter would be to minimize or eliminate downstream impacts. The indicators chosen for this evaluation included sedimentation and erosion potential in downstream watersheds which could cause an impact to Cienega Creek.

When ranked against the other fundamental parameters in this section, aquatic ecology was ranked in the mid-range and was set at five (5). This determination was made because there is no aquatic ecology located at the site so there is the potential for mitigation. Comparative rankings among each of the sites were then completed using the sedimentation and erosion potential from stormwater diversions. In this case, the channel outfall locations that were most isolated from natural drainages were ranked the highest, or most favorable to this parameter.

Measures were also reviewed to determine is mitigation could change the ranking analysis. Mitigation would be equally available at all sites and no change was made to the overall ranking.
3.4.6 Acid Rock Drainage (ARD) Control

In order to evaluate ARD control, indicators were chosen. Those indicators included water quality in stormwater runoff and POC wells. Both of these indicators are directly related to the rock types being mined and the controls which are put in place. Further investigation of the ARD potential of the final tailings material may change or eliminate this ranking.

When ranked against the other fundamental parameters in this section, ARD control was ranked in the mid-range and was set at five (5). Comparative rankings among each of the sites were then completed using geologic containment and runoff potential. In this case, the more compact locations ranked highest, or most favorable for this parameter.

Measures were also reviewed to determine if mitigation could change the analysis. Once the actual ARD potential is known for the tailings, ranking among the various sites could change.

3.4.7 Fish Habitat

In order to evaluate fish habitat, indicators were chosen. Those indicators included downstream water quality effects based on potential impacts to the Cienaga Creek drainage and local riparian habitats. Mapping and reports from the Sonoran Desert Conservation Plan (SDCP) were used to help make this determination.

When ranked against the other fundamental parameters in this section, fish habitat was ranked fairly low and was set at four (4). Comparative rankings among each of the sites were then completed using the potential for downstream effects based on size and location of the drainage.

Mitigating factors were also reviewed to determine if they would change the analysis. For this category, controls did not affect the overall ranking.

3.4.8 Terrain and Soils

In order to evaluate terrain and soils, indicators were chosen related to minimizing off-site impacts. The indicators chosen for this parameter included the potential for blowing dust and unnecessary roadways. Decision criteria were based primarily on exposed tailings, wind exposure, and haul and access road lengths.

When ranked against the other fundamental parameters in this section, terrain and soils was ranked fairly low and was set at four (4). Comparative rankings among each of the
sites were then completed using elevation and location as affected by the prevailing winds. In this case, the higher locations on the southern side of the slope received the lowest, or most unfavorable, ranking. The dry tailings option was considered the most favorable due to the opportunity for concurrent covering of the dry stack with waste rock limiting the exposed tailings surface and due to limitation of roadways.

Measures were also reviewed to determine if mitigation would change the analysis. In this case, dust control measures, emissions controls from processes, and maintaining road conditions did not affect the overall ranking.

### 3.4.9 Vegetation

In order to evaluate vegetation, indicator parameters were chosen. These indicators included the vegetation conservation and invasive weed restriction. The Sonoran Desert Conservation Plan (SDCP) was used to map vegetative species in the area.

When ranked against the other fundamental parameters in this section, vegetation was ranked in the mid-range and set at six (6). Comparative rankings among each of the sites were then completed using the SDCP species mapping and the area impacted by the facility. Facilities with a larger footprint or with more species were ranked lower, or more unfavorable. The dry tailings option was considered the most favorable due limiting the disturbed footprint to that similar to the required area for waste rock disposal. This area would be disturbed regardless of tailings considerations.

Measures were also reviewed to determine if mitigation would change the analysis. In this case, removing vegetation prior to disturbance, including monitoring invasive species, did not affect the overall ranking.

### 3.4.10 Wildlife

In order to evaluate wildlife, indicators were chosen related to minimizing disturbance or displacement of wildlife habitat. The indicators chosen for this parameter included the actual site usage by species and facility footprints mapped over the habitat from the SDCP.

When ranked against the other fundamental parameters in this section, wildlife ranked mid-range and was set at six (6). Comparative rankings among each of the sites were then completed using the number of species mapped in an area versus the facility footprint. The dry tailings option was considered the most favorable due limiting the disturbed footprint to that similar to the required area for waste rock disposal. This area would be disturbed regardless of tailings considerations.
Measures were also reviewed to determine if mitigation would change the analysis. In this case, exclusion of species from an area did not affect the overall ranking.

### 3.4.11 Special Status Species

In order to evaluate endangered species, indicators were chosen related to minimizing disturbance to critical habitat or to known populations of special status species. The indicators chosen for this parameter included the actual site usage by species and facility footprints mapped over the habitat from the US Fish and Wildlife Service, the Forest Service, and the SDCP.

When ranked against the other fundamental parameters in this section, special status species ranked mid-range and was set at six (6). Comparative rankings among each of the sites were then completed using the number of species mapped in an area versus the facility footprint.

Measures were also reviewed to determine if mitigation would change the analysis. Because the areas that would be mitigated are closely situated and the measures would be similar, the existence of a particular species from an area did not affect the overall ranking.

### 3.5 Socio-Economic Review

The socio-economic fundamental parameters included seventeen different factors. If the fundamental parameter did not distinguish one site from another, that particular parameter was dropped from the ranking study. All fundamental parameters are listed below and the rational for inclusion or exclusion are included.

#### 3.5.1 Income

Income generation was a parameter determined to have no impact on the siting study. Because all potential sites are located within one general area, income generation is not directly affected by location. Therefore, this factor is not a determining fundamental parameter. Income generation would only be a factor if the selected site limited production capacity or the overall mine life.

#### 3.5.2 Taxes

Tax generation was a parameter determined to have no impact on the siting study. Because all potential sites are located within one general area, tax generation is not directly affected by location. Therefore, this factor is not a determining fundamental
parameter. Tax generation would only be a factor if the selected site limited production capacity or the overall mine life.

3.5.3 Regional Government Development

Since the regional governments are already established, it was determined that this parameter had no impact on the siting study.

3.5.4 Labor Market Analysis

An analysis of the labor market was determined to have no impact on the siting study. Because all of the sites are located within one general area, labor requirements are not directly affected by location. Therefore, this factor is not a determining fundamental parameter. The labor market would only be a factor if the selected site limited production, and therefore manpower needs in a tight labor market.

3.5.5 Population

Population was a parameter determined to have no impact on the siting study. Because all of the sites are located within one general area, equally remote from habitated areas, population issues are not directly affected by location. Therefore, this factor is not a determining fundamental parameter.

3.5.6 Housing

The housing review was a parameter determined to have no impact on the siting study. Because the site is located within one general area, the actual housing situation is not directly affected by location. Therefore it will not vary enough from site to site to make this a determining fundamental parameter.

3.5.7 Transportation and Traffic

Housing was a parameter determined to have no impact on the siting study. Because all of the sites are located within one general area, equidistant from urban or rural areas, housing issues are not directly affected by location. Therefore, this factor is not a determining fundamental parameter.

3.5.8 Navigable Waters (Recreational)

There are no delineated navigable waters at the facility that are used for recreation. Therefore, this parameter was determined to have no impact on the siting study.
3.5.9 Health and Safety

In order to evaluate health and safety, indicators were chosen. Those indicators included worker safety based on injury and accident rates.

When ranked against the other fundamental parameters in this section, health and safety was ranked high and set at eight (8). Comparative rankings of each of the sites were then completed using the proximity of tailings facilities to the rest of the operation and the terrain between the tailings facilities and the plant. In this case, tailings impoundments further away or over tougher terrain ranked lowest, or more unfavorable. In the case of dry stack tailings, the additional operational equipment (filters, conveyors, stackers, compactors) were considered an opportunity for worker accidents.

Mitigating factors were also reviewed to determine if mitigation would change the analysis. In this case, hazard communications and training were determined not to affect the overall ranking.

3.5.10 Land Tenure

The sites considered are within land controlled by Augusta. Therefore, this parameter was determined to have no impact on the siting study.

3.5.11 Fishing

There is no historic fishing at any of the sites being evaluated. Therefore, this parameter was determined to have no impact on the siting study.

3.5.12 Outdoor Recreation and Tourism

In order to evaluate outdoor recreation and tourism, indicators were chosen related to minimizing impacts to current uses. The indicators chosen for this parameter included current recreational uses on the site, hiking trails intersecting the property, visibility of the operations from recreational areas, and the perceived “remoteness” of the current recreational area.

When ranked against the other fundamental parameters in this section, outdoor recreation and tourism was ranked high and set at nine (9). Comparative rankings among each of the sites were then completed using the size of the facilities, current uses, and existing impacts such as roadways and developed recreation. In this case, the largest area of impact ranked lowest, or most unfavorable. The dry tailings option was considered the most favorable due limiting the disturbed footprint to that similar to
the required area for waste rock disposal. This area would be disturbed regardless of tailings considerations.

Measures were also reviewed to determine if mitigation would change the analysis. In this case, mitigation did not affect the overall ranking.

3.5.13 Visual Quality

In order to evaluate visual quality, indicators were chosen. Those indicators included determining which operating facilities would be visible from roadways and trails, and determining which views would be obstructed by those facilities. In addition, a viewshed analysis was completed to determine the long-range visual impact of the facilities. Figures 12 through 14 present the results of the viewshed analyses.

When ranked against the other fundamental parameters in this section, visual quality was ranked high and set at eight (8). Comparative rankings among each of the sites were then completed using the viewshed analysis. In this case, tailings impoundments with the lowest ultimate elevations that were furthest from existing roadways had the highest, or most favorable, score.

Measures were also reviewed to determine if mitigation would change the analysis. In this case, mitigation did not affect the overall ranking.

3.5.14 Archaeological Resources

In order to evaluate archaeological resources, indicators were chosen. Those indicators included a review of potential archaeological resources in the area and the overall impact of each facility on those resources.

When ranked against the other fundamental parameters in this section, archaeological resources were ranked mid-range and was set at six (6). Comparative rankings among each of the sites were then completed using information available in the SDCP, studies performed by the University of Arizona for a previous land exchange, and other studies. In this case, it was determined sites in canyons or valleys not associated with steep terrain have more of a potential to have archaeological resources and are therefore ranked lower than those with steeper terrain or that are located outside of the canyons or valleys. The dry tailings option was considered the most favorable due limiting the disturbed footprint to that similar to the required area for waste rock disposal. This area would be disturbed regardless of tailings considerations.
3.5.15 Historical Sites

In order to evaluate historical sites, indicators were chosen. Those indicators included a review of potential historical sites in the area and the overall impact of each facility on those sites.

When ranked against the other fundamental parameters in this section, historical sites were ranked mid-range and set at six (6). Comparative rankings of each site were then completed using information available in the SDCP and other studies. In this case, it was determined that sites located in areas of high archaeological concern would be the most impacted and receive the lowest, or most unfavorable, ranking. The dry tailings option was considered the most favorable due limiting the disturbed footprint to that similar to the required area for waste rock disposal. This area would be disturbed regardless of tailings considerations.

Measures were also reviewed to determine if mitigation would change the analysis. In this case, mitigation did not affect the overall ranking.

3.5.16 Post-Mining Land Use

In order to evaluate post-mining land use, fundamental parameters of self-sustaining reclamation and appropriate uses were considered. The indicators associated with this fundamental parameter included restoration to historical use based on landscape surveys in the SDCP.

When ranked against the other fundamental parameters in this section, post-mining land use was ranked mid-range and set at six (6). Comparative rankings among each of the sites were then completed using the overall historic land use and the potential to restore the area to that use. In this case, tailings impoundments with a higher potential to be restored to historical use such as grazing scored higher, or more favorable. The dry tailings option was considered the most favorable due limiting the disturbed footprint to that similar to the required area for waste rock disposal. This area would be disturbed regardless of tailings considerations.

Measures were also reviewed to determine if mitigation would change the analysis. In this case, mitigation did not affect the overall ranking.
3.5.17 Infrastructure Improvement

Infrastructure improvement was a parameter determined to have no impact on the siting study. Because all of the sites are located within one general area, infrastructure improvements are not directly affected by location. Therefore this factor is not a determining fundamental parameter. Site access and utility corridors would be required regardless of site selection.

3.6 Project Economics

The project economics fundamental parameter included five different factors. Because four of the five different fundamental parameters are included in a net present value analysis, they were grouped together as one category.

3.6.1 Net Present Value Analysis

Table 3.4 presents the net present value (NPV) analysis for the evaluated tailings sites. The analysis used a discount rate of six percent and evaluated capital and operating costs for 16 years of tailings production at 75,000 tpd which represents the Phase 6 mine pit plan. Capital and operating costs were estimated for the following items:

- Embankment earthwork – a unit cost of $1.50/cy was used for construction of the starter embankment which assumes the use of a contractor. Costs were based on earthwork volumes estimated for a starter embankment providing approximately 2.5 years of tailings storage. A haulage unit cost of $0.10 per ton-mile was used for construction of the embankment downstream raises plus a placement cost of $0.75 per cy assuming a dozer working at the embankment and compaction of waste rock by haul traffic. This costs also assumes engineered “transition zones” will be constructed on the upstream portions of the embankments to provide filtering and bedding for a geomembrane liner. Depending on embankment design, transition zone materials may be derived from crushed or screened local materials.

- The dry tailings options assumes placement of waste rock buttress at 20% of the tailings placement volume and assumes an incremental 2 mile haul over the “normal” waste rock haul to route haul traffic to the waste rock buttress with a waste rock placement cost of $0.05 per cy (assumed no compaction required). A cost of $0.05 per cy was also assumed for tailings placement and assumes a dozer will provide the necessary compaction for a trafficable surface and acceptable settlement.

- Tailings slurry and water reclaim pipelines – costs were estimated for construction of the slurry line from the proposed mill location to each evaluated tailings dam location. Each
pipeline routing was evaluated to include length of pipe under gravity flow versus pressure flow. It was assumed that high density polyethylene (HDPE) pipe would be utilized for gravity flow portions of the pipeline and steel pipe would be required for the pressure flow portions. Unit costs of $100 per lineal foot (lf) and $150 per lf were assumed for gravity and high pressure HDPE pipe, respectively. Nominal pipe diameters of 30 inches and 22 inches were estimated for gravity and pressure pipelines, respectively.

Tailings pumping requirements – capital costs for required slurry and water reclaim pumps were estimated for each pipeline by calculating the bank horsepower (BHP) requirements. A unit cost of $300 per installed BHP was assumed for pump capital costs. Pump operating costs were estimated by converting BHP into kilowatt-hour requirements. A unit cost of $0.055 per kilowatt-hour was assumed.

Containment system costs – a unit cost of $3,000 per lf of embankment was assumed for installation of a containment system for conventional tailings impoundments. The conceptual containment system assumes geologic containment can be adequately achieved by “slimming” the basin with fine-grained tailings to form a seepage barrier to achieve groundwater protection goals. This approach would also involve some type of seepage cutoff and collection system at the embankment (e.g. cutoff trench, slurry wall, grout curtain, etc.) and a geomembrane liner on the upstream face of the dam.

Water costs – a unit cost of $500 per acre-ft of water was used based on input from Augusta. Makeup water requirements were estimated for each site based on water balance calculations. A separate Vector memo titled “Preliminary Rosemont Water Balance” and dated May 4, 2006 presents the detailed water balance calculations for the conventional tailings sites considered. Dry tailings makeup water assumed 15% water loss by weight.

Reclamation costs – a unit cost of $15,000 per acre was assumed for reclamation of the tailings impoundment surface at closure based on experience with similar projects. Reclamation costs for dry tailings stack was assumed to be covered by waste rock reclamation program.

Dry tailings equipment – capital and operating costs for the dry tailings equipment (filtration system, conveyors, stackers, etc) were provided by WGI. Vector did not attempt to verify these data.
The cost screening identified the most cost effective sites based on net present value (NPV) at a discount rate of 6 percent. The estimated costs for each facility were applied to the facility life cycle as follows: (1) starter embankment and liner system construction costs, slurry and reclaim water pipeline and pump capital costs, and dry tailings equipment costs were applied to the Year 0 (pre-mining construction), (2) the remaining embankment and liner system construction costs were spread evenly across Years 1 through end of facility life (Year 16), (3) slurry and reclaim water pumping costs and dry tailing operational costs were spread evenly across the facility life, and (4) closure costs were applied to Year 17. Table 3.4 presents the NPV analysis and Table 3.5 presents a summary of NPV values and tailings disposal costs expressed in $/ton of tailings. The technical viability of the proposed facilities and construction methods must be verified in the design phase to substantiate these costs; however the results of the analysis provide some guidance for tailings related decision making.

Table 3.5 – Summary of NPV Analysis Results

<table>
<thead>
<tr>
<th>Site</th>
<th>Starter Capital (Million $)</th>
<th>Operating Cost (Million $)</th>
<th>Operating Costs ($/ton)</th>
<th>6.0% NPV (Million $)</th>
<th>Disposal Costs ($/ton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sycamore A</td>
<td>42</td>
<td>224</td>
<td>0.44</td>
<td>153</td>
<td>0.31</td>
</tr>
<tr>
<td>Sycamore B</td>
<td>30</td>
<td>192</td>
<td>0.37</td>
<td>124</td>
<td>0.25</td>
</tr>
<tr>
<td>Schofield A</td>
<td>41</td>
<td>269</td>
<td>0.52</td>
<td>175</td>
<td>0.35</td>
</tr>
<tr>
<td>Schofield B</td>
<td>46</td>
<td>300</td>
<td>0.59</td>
<td>196</td>
<td>0.39</td>
</tr>
<tr>
<td>Empire</td>
<td>38</td>
<td>205</td>
<td>0.40</td>
<td>134</td>
<td>0.27</td>
</tr>
<tr>
<td>Dry Tailings</td>
<td>39</td>
<td>202</td>
<td>0.40</td>
<td>141</td>
<td>0.28</td>
</tr>
</tbody>
</table>

* Operating costs for life of mine after startup; disposal costs based on NPV.

From a project economics perspective, the Empire site provides the most efficient storage capacity resulting in relatively low capital and ongoing dam construction costs. However due to the large tailings surface area and resulting high evaporation rate and makeup water costs estimated for the Empire site, the NPV is relatively high. The dry tailings option compares favorably to the conventional disposal costs based on the costs provided by WGI and the assumptions presented herein and is primarily due to the cost savings related to water conservation. However it should be noted that comparison of costs between conventional and dry stack tailings is somewhat difficult at this stage of study due to the lack of design data and difficulty in estimating construction and closure costs, as well as potential overlap of dry stack work force with other duties.

### 3.6.2 Economic Risk

In order to evaluate economic risk, indicators were chosen including the relative ease of permitting and receiving a plan of operations.
When ranked against the other fundamental parameters in this section, economic risk was ranked high and set at seven (7). Comparative rankings of each of the sites were then completed using perceived impacts to the environment and the potential economic impact, such as the risk of permit delays or forced cessation of activities. In this case, sites potentially impacting major drainages or groundwater regimes ranked the lowest, i.e. most unfavorable. The dry tailings option was considered the most favorable due limiting the total disturbed footprint for tailings and waste rock to a single drainage.

In addition, areas seen as having a potential economic risk of losing investment or delayed investment elsewhere would also be ranked lower. The sites would have similar economic risk associated with investment so this criterion was not used in the ranking.

Measures were also reviewed to determine if mitigation would change the analysis. In this case, mitigation factors did not affect the overall ranking.

3.7 Technical Issues

The technical issues fundamental parameters included six different factors. If the fundamental parameter did not distinguish one site from another, that particular parameter was dropped for this siting study. In this review, all fundamental parameters are listed below and the rationale for inclusion or exclusion is included.

3.7.1 Impoundments

In order to evaluate impoundments, a fundamental parameter of constructability was considered. The indicators for this parameter included the geology and site topography as well as embankment height.

When ranked against the other fundamental parameters in this section, impoundments were ranked high and set at eight (8). Comparative rankings of each of the sites were then completed using geologic containment and topography. In this case, areas that resulted in high tailings impoundment structures ranked the lowest, or most unfavorable. The dry tailings option was considered the most favorable due to the lack of engineered embankment and co-disposal with waste rock.

Measures were also reviewed to determine if mitigation would change the analysis. In this case, mitigation factors would not affect the overall ranking.
3.7.2 Containment

In order to evaluate containment, a fundamental parameter of minimizing containment seepage and ensuring process containment were considered. The indicators for this parameter included using the best available demonstrated control technology (BADCT) standards, and providing allowances for emergency structures in sensitive areas.

When ranked against the other fundamental parameters in this section, containment was ranked fairly high and set at seven (7). Comparative rankings among each of the sites were then completed evaluating the actual physical location of the facility and distance from the operating facilities. In this case, sites with shorter dam lengths in more confined valley sites ranked the highest due to an implied relative ease of achieving geologic containment. Also, areas furthest from the plant site ranked the lowest, or most unfavorable, because these locations provide a larger overall facility footprint. The dry tailings option was considered the most favorable due to the very low anticipated seepage and lack of engineered containment system.

Measures were also reviewed to determine if mitigation would change the analysis. In this case, mitigation factors did not affect the overall ranking.

3.7.3 Diversions

The diversions review was a parameter determined to have no impact on the siting study. Because all of the sites have similar containment or diversion requirements, this is not directly affected by location. Therefore, diversions are not a determining fundamental parameter.

3.7.4 Covers

In order to evaluate covers, a fundamental parameter of a self sustaining cover system was reviewed. The indicators for this parameter included the surface area, the ability to regrade or place materials and higher slope angles, and the ultimate elevation of tailings at closure.

When ranked against the other fundamental parameters in this section, covers was ranked high and set at seven (7). Comparative rankings among each of the sites were then completed using final elevations and impoundment size. The areas with the lower elevations and flatter slopes were ranked the highest, or most favorable. The dry tailings option was considered the most favorable due to the opportunity for concurrent reclamation and ability to construct the dry stack to facilitate final reclamation.
Measures were also reviewed to determine if mitigation would change the analysis. In this case, mitigation factors did not affect the comparative ranking.

3.7.5 Access Road

In order to evaluate access roadways, a fundamental parameter of minimizing dust and the number of required roadways was considered. The indicator for this parameter included distance from the operating facilities.

When ranked against the other fundamental parameters in this section, access roads were ranked mid-range and set at five (5). Comparative rankings among each of the sites were then completed using an actual location and distance from the operating facilities. In this case, areas furthest from the plant site ranked the lowest, or most unfavorable. The dry tailings option was considered the most favorable due the dry stack location in proximity to the pit and plant site.

Measures were also reviewed to determine if mitigation would change the analysis. In this case, mitigation factors would not affect the overall ranking.

3.7.6 Pipeline

In order to evaluate pipelines, fundamental parameters of ease of inspection and maintenance, and allowances for cleanout and spill control were used. The prime indicator for this parameter included the distance from operating facilities.

When ranked against the other fundamental parameters in this section, pipelines were ranked mid-range and set at five (5). Comparative rankings among each of the sites were then completed using actual location and distance from the operating facilities. In this case, areas furthest from the plant site ranked the lowest, or most unfavorable. The dry tailings option was considered the most favorable due the dry stack location in proximity to the pit and plant site.

Measures were also reviewed to determine if mitigation would change the analysis. In this case, mitigation factors did not affect the ranking.

3.8 Summary of Evaluation Results

In general, this study developed information that is fairly intuitive. The more compact the site footprint, the less impact they will have on the surrounding area. Grouping tailings facilities with the rest of the operating facilities and impacting a fewer number of drainage areas or watershed boundaries will be more favorable than those facilities that are more spread out. From a project economics perspective, several less economic
sites scored favorably overall due to environmental and socio-economic considerations. Table 3.3 presents the merit ratings for each fundamental parameter and Table 3.6 presents the final merit scoring results.

Table 3.6 – Merit Scoring Results

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Schofield A</th>
<th>Schofield B</th>
<th>Sycamore A</th>
<th>Sycamore B</th>
<th>Empire</th>
<th>Dry Tailings</th>
<th>Weight (W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0 Environmental</td>
<td>5.4</td>
<td>5.5</td>
<td>6.2</td>
<td>6.3</td>
<td>4.5</td>
<td>8.5</td>
<td>4</td>
</tr>
<tr>
<td>2.0 Socio-Economic</td>
<td>6.5</td>
<td>6.2</td>
<td>5.5</td>
<td>5.5</td>
<td>3.8</td>
<td>7.2</td>
<td>3</td>
</tr>
<tr>
<td>3.0 Project Economics</td>
<td>6.2</td>
<td>5.8</td>
<td>5.9</td>
<td>6.8</td>
<td>5.1</td>
<td>9.0</td>
<td>1</td>
</tr>
<tr>
<td>4.0 Technical</td>
<td>5.0</td>
<td>5.2</td>
<td>4.6</td>
<td>4.7</td>
<td>3.4</td>
<td>9.0</td>
<td>2</td>
</tr>
</tbody>
</table>

| Merit Score \(\frac{R \times W}{\sum W}\) | 5.7 | 5.7 | 5.6 | 5.8 | 4.1 | 8.2 |

The dry tailings option scored the most favorable in all categories due to a number of factors including:

- Eliminates need for engineered embankment and seepage containment system
- Maximizes water conservation and minimizes water makeup requirements
- Results in a very compact site limiting disturbance to a single drainage
- Allows opportunities for concurrent reclamation and covering for dust control

Section 4 provides a more detailed description of the dry tailings concept.
4.0 Site Descriptions

4.1 General

This section provides a brief description of each of the preferred sites identified in the evaluation. Refer to Figures 5 through 9 for depictions of each embankment footprint, impounded tailings area, drainage basin area, and possible pipeline and haul road routings.

4.2 Physiography

The proposed Rosemont mine site is contained within the southwestern portion of the Mexican Highlands section of the Basin and Range physiographic province within the Santa Rita mountain range. The Mexican Highlands is a transitional terrain with varied topographic relief separating the Sonoran Desert to the southwest and the Colorado Plateau to the north. The Santa Rita mountain range, locally, defines the contact between the Sonoran Desert and the Mexican Highlands sections. A significant portion of the site is characterized by rolling grasslands interrupted by densely vegetated washes. Other portions of the site are characterized by relatively steep mountain valleys.

The proposed Rosemont mine can be further located within the Mexican Highlands, specifically, to the northern portion of the Santa Rita Mountain range, bounded on the west by the subdued topography of the Sonoran Desert and the Santa Cruz River drainage basin. This western boundary is coincident with the Quaternary-active Santa Rita fault zone. The Santa Rita Mountain range extends from the Pantano Wash, in the north, approximately 40 km southwest to the Sonoita Creek about 20 km north of the Mexican border.

4.3 Geology

The proposed Rosemont mine site lies in the southwestern region of North America, specifically, in the Basin and Range physiographic province. The Basin and Range is characterized by relatively evenly spaced, subparallel mountain ranges separated by broad, thick alluviated basins the boundaries of which are defined by high-angle extensional faults. This irregularly shaped region encompasses an area greater than 1,500 km in length and up to 1,000 km in width extending from the southern portions of Idaho and Oregon through the majority of Nevada, parts of western Utah, eastern California, western and southern Arizona, southwestern Arizona and northern Mexico.
The Santa Rita Mountains comprise a relatively small horst consisting of primarily Mesozoic-age rocks (deposited between 248 and 65 mybp) bounded on the east by the Davidson Canyon graben and a small uplifted range known as the Empire Mountains.

A detailed discussion of regional and site geology and seismicity is presented in a separate Vector memo titled “Geology and Seismotectonic Review for the Rosemont Mine Siting Study” and dated April 20, 2006.

4.4 Rosemont Open Pit

The open pit mining activity will be located along the eastern slope of the Santa Rita Mountain range at the upper reaches of Wasp Canyon. The identified ore-body is contained within a Paleozoic sedimentary sequence of quartzites, siltstones and carbonate rocks, namely the: Devonian Martin Formation; Mississippian Escabrosa Limestone; Pennsylvanian Horquilla Limestone; Pennsylvanian-Permian Earp Formation; and Permian Epitaph Formation, from oldest to youngest.

From a geotechnical standpoint, waste rock materials and those materials stripped as overburden will consist primarily of hard carbonate rocks, fine- to coarse-grained sandstones and conglomerates. Although no geotechnical site investigations have been completed, Vector believes these materials will provide sound construction materials. Some of the materials produced as waste from the open pit may be rich in chert. Chert is a poor aggregate material for concrete.

4.5 Schofield Site

The Schofield site is underlain by the Late Cretaceous Salero Formation and unconsolidated alluvium of Quaternary age. The upper Salero Formation consists of interbedded conglomerate, coarse sedimentary breccia, coarse-grained arkosic sandstone and lesser rhyolite flows. The Quaternary age alluvium is composed of gravel and sand common to washes and stream beds in the arid southwest with accumulations of material from sand size to boulders. These materials should be capable of supporting a large earthfill/rockfill embankment and may provide suitable construction materials using large excavation equipment. Based on review of available geologic mapping, there are no clay borrow sources available within the Scholefield Canyon area.

There are several high-angle normal faults underlying the Scholefield Canyon embankment site and impoundment that displace Late Cretaceous-age deposits. However, there is no indication that these faults are active in the current geologic setting.
and, therefore, pose a low risk of surface rupture and attendant hazards to a tailings storage facility.

Figure 10 presents a conception section of the proposed convention tailings dam for the Rosemont project.

4.6 Sycamore Site

The Sycamore site is underlain by rocks of the: Permian Epitaph and Scherer formations; Early Cretaceous Willow Canyon and Apache Canyon formations; and Larmide-age Helvetia Intrusions, in ascending stratigraphic order. These formations consist of limestones, siltstones, mudstones, marls, quartzites, sandstones, and conglomerates. Although, no geotechnical investigations were completed as a part of these siting studies, the foundation materials should be capable of supporting a large earthfill/rockfill embankment and may prove to be suitable construction materials using large excavation equipment. Based on review of available geologic mapping, there are no clay borrow sources available within the Sycamore Canyon area.

There are several high-angle normal faults underlying the Sycamore Canyon – B-Option embankment site and impoundment that juxtapose Permian and Cretaceous bedrock units. Additionally, the northern side of Sycamore Canyon at the Option B site is underlain by a series of southeast plunging anticlines and synclines. However, there is no indication that these faults or folds are associated with active tectonics in the current geologic setting and, therefore, pose a low risk of surface rupture and attendant hazards to a tailings storage facility.

4.7 Dry Tailings Stack

The concept developed for this study involves dewatering the tailings and placing the “dry” tailings within the proposed waste rock dump. The concept developed for this study involves placement of waste rock in the lower portion of the waste rock dump area to provide a dry tailings buttress. Dry tailings would be delivered by conveyor and placed with a radial stacker similar to that used for heap leach operations. This evaluation assumes a dozer would be used to spread the dry tailings and provide sufficient compaction for trafficability of the conveyor and stacker and to limit settlement to that similar to the waste rock buttress. The active stacking area would be limited to allow dust and erosion control. Contact water would be captured in a sediment pond located downstream of the waste rock dump. Figure 11 presents a conceptual dry stack for the Rosemont project. A separate memo presents the surface water hydrology and pond sizing calculations.
5.0 Summary and Recommendations

This report presents an evaluation of site alternatives for tailings facilities for the proposed Rosemont Mine. This evaluation provides a basis for decisions regarding future tailings impoundment facilities utilizing both conventional and dry stack tailings disposal methods.

This evaluation does not consider quantified geologic or geotechnical site characteristics or factors. Geotechnical and geological site investigations are necessary to provide data for additional studies and would consist of geologic mapping and test pit investigations to characterize the near surface geology and identify possible borrow materials for embankment construction, and geotechnical drilling to characterize deep geology and embankment foundation conditions to determine whether or not these potential sites are fatally flawed.

The evaluation consisted of an analysis of alternative sites based on defined design criteria and evaluation parameters including estimated development costs to identify the preferred tailings impoundment location and disposal method. Initially 4 sites were identified as possible impoundment locations for conventional disposal. Several embankment alignments were developed for 3 of these sites for a total of 7 impoundments for consideration. The initial fatal-flaw screening consisted of eliminating the sites with insufficient storage capacity to contain 500 mt of tailings and site that displaced efficient waste rock storage areas resulting in elimination of 2 impoundment sites. The remaining sites along with the dry tailings option were further evaluated using a multiple accounts analysis. The evaluation considered 4 primary evaluation parameters: environmental impacts, socio-economic impacts, technical review, and project economics. Fundamental sub-parameters in each category were developed and weighted to allow evaluation of relative site merit.

In general, this study developed information that is fairly intuitive, the more compact sites, closer to the operating facilities that impact a fewer number of drainage areas or watershed boundaries will be more favorable than those facilities that are more spread out. The results indicate the dry tailings option as the most favorable disposal method based on the assumptions presented in this report. Dry tailings stack eliminates the need for engineered embankments and seepage containment systems, maximizes water conservation and minimizes water makeup requirements, results in a very compact site limiting disturbance to a single drainage, and allows opportunities for concurrent reclamation and covering for dust control.
The evaluation indicates Shoffield (Embankment Alignment A) and Sycamore (Embankment Alignment B) as the preferred sites for conventional tailings disposal. Project economic ratings for Sycamore (Embankment Alignment B) and the dry tailings option are essentially equal when economic risk is considered.

Based on the evaluations presented in this report, we recommend that detailed site investigations and laboratory testing be initiated for the dry tailings option to support additional evaluations and conceptual design of dry tailings stack. These investigations should consist of the following:

- Geologic mapping of the proposed dry stack area;
- Geotechnical drilling and seismic surveys along the proposed waste rock buttress alignment to characterize foundation conditions;
- Laboratory testing on tailings and waste rock to provide engineering parameters for design.
6.0 References


Caldwell, Jack A. and Robertson, Andrew MacG., Selection of Tailings Impoundment Sites, Die Siviele Ingenieur in Sud-Afrika, October 1983.


Robertson, Andrew MacG. and Shaw, S.C. , A Multiple Accounts Analysis for Tailings Site Selection, Robertson GeoConsultants, Inc., Vancouver, BC, V6C 3B6, Canada.


APPENDIX A

SITE PHOTOS
Sycamore Canyon – Top of basin looking north

Sycamore Canyon – Top of basin looking north
Schofield Canyon – Just west of Hwy 83 looking west

Schofield Canyon – Top of upper south reach looking east
Schofield Canyon – North reach basin area looking south (buildings are Hidden Valley Ranch)

Barrel Canyon Basin– near top of basin looking north
Arcosic near surface soils in Barrel basin

Typical rocky ground surface at Rosemont site