

**SOME POTENTIAL RISK ASSOCIATED WITH HEAP LEACH PADS**

<b>RISK NUMBER &amp; TITLE</b>	<b>RISK DESCRIPTION</b>	<b>PROBABILITY OF OCCURRENCE</b>	<b>CONSEQUENCES OF OCCURRENCE</b>	<b>MITIGATION APPROACH</b>
<b>1.0 SURFACE WATER CONTROL</b>				
<b>1.1 RUNON CONTROL</b>	Precipitation runoff flows to toe of heap leach pad and infiltrates the heap leach pad	<i>[Insert here your assessment of the probability of occurrence of this risk. The metric may be as simple as: low; medium; or high.</i>	Ponding of water at toe of heap leach pad. Rise of water table in heap leach pad affects rock slope stability. Infiltration of ponding water to heap leach pad impacts leaching efficiency.	Construct berms, dikes, swales, and channels to collect and/or divert runoff.
<b>1.2 LEACHATE PONDING</b>	Precipitation ponds on flat surfaces of heap leach pad. Low infiltration.	<i>It may be as complicated as the percentage probability of occurrence.</i>	Leachate evaporates instead of seeping into heap leach pad. Low infiltration rates affect leaching efficacy.	Scarify top surfaces to break up hard-crust layers. Control spray rate to limit pond build-up.
<b>1.3 BENCH OVERTOPPING</b>	Precipitation ponds on bench surfaces and overtops bench perimeter dikes	<i>And if you can, put some text in along with the probability to explain why you assign the metric you do.]</i>	Loss of control of surface water. Loss of leachate. Development of erosion surface and gullies on sideslope of heap leach pad.	Scarify bench surfaces to breakup hard-crust layer. Control spray rate. Maintain bench perimeter dikes.
<b>1.4 EROSION</b>	Water flowing down the outer face of heap leach pad induces gully erosion.		Soil and rock washed down the slope to build up sediment on benches. Gullies contribute to surficial slope instability.	Control bench ponding (as above) and clear bench sediment build-up.

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<b>2.0 LEACHING</b>				
<b>2.1 CHANNELIZED FLOW</b>	Infiltration (leachate) flows preferentially through higher permeability zones in a rat-hole or funnel-like pattern.		Only partial leaching of the heap leach pad as "dry" zones do not contribute to metal recovery.	Inject water in boreholes.
<b>2.2 BENCH SEEPAGE</b>	Leachate emerges at toe of slopes on upper benches as a result of perched flow on low-permeability zones in heap leach pad..		Only partial leaching of the heap leach pad as material below low-permeability zone not subjected to leaching.	Inject water in boreholes.
<b>2.3 POOLING</b>	Leachate collects and "pools" at or near base of heap leach pad as a result of localized topographic depressions or zones with impeded outflow.		Impeded leaching. Potential for pooled zones to affect overall heap leach pad stability.	Recover "pooled" seepage by pumping using recovery bores screened at base of heap leach pad.

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<b>3.0 HEAP LEACH PAD INTEGRITY</b>				
<b>3.1 PIPING</b>	The passage of leachate through the heap leach pad materials results in "piping" of fines, i.e., internal erosion.		Excessive solids in collected leachate. Potential development of zones of collapsible material in heap leach pad.	Avoid leaching susceptible zones. Place filters over areas of leachate emergence.
<b>3.2 SLOPE INSTABILITY</b>	Surficial and/or deep-seated slope instability resulting from pore-pressure build-up and/or material weathering.		Surficial downslope movement of affected heap leach pad materials. Development of slip zones and material movement onto benches.	Prevent build-up of potentially detrimental pore pressures. Monitor incipient and actual slope deformation.
<b>3.3 EXCESSIVE SETTLEMENT</b>	Piping, collapse, or weathering induces excessive heap leach pad material consolidation and hence observed surficial settlement		Observed surface cracking of materials. Observed irregular surface topography potentially contributing to surficial ponding.	Regrade affected areas. Limit infiltration in affected areas.

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<b>4.0 GROUNDWATER IMPACT</b>				
<b>4.1 SEEPAGE THROUGH LINER AND DRAINS</b>	Leachate seeps down through imperfections in basal liner and drains.		Loss of leachate and potential groundwater impact	Install double liners, drain systems, and leak monitoring layers
<b>4.2 GROUNDWATER IMPACT</b>	Leachate seeps to groundwater and impacts same.		As above	As above