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SMALL AND LARGE HEAP LEACHES
DIFFERENCES IN APPROACH

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Historically, heap leaching has had a reputation as a bit of an underdog – a low-cost, low-technology approach to properties that couldn't be treated any other way. In recent years the spate of very large heap leaches, however, has served to dispel that concept.

For example, the Mesquite operation of Consolidated Goldfields in Southern California is a $70 million dollar investment with a production rate of 12,500 tons per day.

The reasons to use heap leaching instead of conventional milling are illustrated by two recent installations in Nevada – Paradise Peak in central Nevada (FMC) and Hog Ranch in the northwest corner of Nevada (Western Goldfields/Ferret Exploration).

As Table 1 shows, the capital costs of a conventional mill are very significant. Paradise Peak costs $20,000 per daily ton of capacity, whereas Hog Ranch, a low-key heap leach installation, costs less than $2,500 per daily ton.

At a gold price of $400 per ounce and an 11% cost of capital, an ore body with a gold content of 0.08 ounces per ton would have to show a very high recovery differential, about 40%, to justify the mill. This assumes that milling and heap leaching operating costs are identical; however, mill operating costs are generally significantly higher than those of heap leaching.

In the case of Paradise Peak, the mill could be justified because the ore is high grade and contains a large amount silver, which is not readily leachable. However, for many large ore bodies, heap leaching is the best choice from a financial standpoint. Thus, the choice of treatment – conventional mill or heap leach – is between two equally valid methods that have both "come of age."

Table 1 - Capital Cost Comparisons - Mill & Heap Leach

	PARADISE PEAK	HOG RANCH
Daily Ore Tonnage	4000	4000
Type of Mining	OPEN PIT	OPEN PIT
Type of Processing	CYANIDE MILL	HEAP LEACH
Capital Cost	$ 80 MILLION	< $10 MILLION
Capital + Finance Cost/Ton	$15.00	$1.90
Capital Cost, oz Gold/Ton	0.0375	0.0050
Percent Added Recovery Needed to Justify The Mill - Ore Grade 0.08 oz Gold/Ton		41%

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Table 2 - Capital Cost Comparisons - Large & Small Heap Leaches

	MESQUITE	HOG RANCH	LITTLE BALD MOUNTAIN
Daily Tonnage	12,500	4,000	400
Capital Cost - (Installations)	$ 50 MILLION	$ 7 MILLION	$ 0.5 MILLION
(TOTAL)	$ 70 MILLION	$ 10 MILLION	$ 1 MILLION
Installations, $/Daily Ton	$ 80 MILLION		< $10 MILLION
Capital + Finance Cost/Ton	$4,000.00	$1,700.00	$1,000.00

Heap leach technology can be compared to the U.S. auto industry; as the technology has matured, it has become larger and developed a lot of complications. For example, the Ford Model T truck had its heyday in the early auto market, but modern drivers enjoy the luxury of a Cadillac.

Has heap leaching grown out of its original role as a "Model T" method for treating small deposits? The answer should be "no" – large and small deposits require technically different approaches, but each should be valid in the appropriate situation.

Why is it that properties show this reverse economy of scale? Specifically, why do they get more expensive per ton of throughput as they get larger? There are at least three reasons:

1. Small operations are more closely controlled by people who care – sophistication in design can easily give way to personal "hands-on" involvement in daily operations.

   For instance, Little Bald Mountain in northeastern Nevada, near Placer's Bald Mountain operation, was able to successfully run a conveyor stacking system directly on leach pads because the managers were there to supervise each conveyor movement; Hog Ranch requires an 18 inch gravel cover.

2. Small operations can afford to be more labor intensive – they generally have a shorter life and are higher grade than the large ones.

3. It's easier to modify a small operation to correct or work around initial design difficulties. LBM avoided any agglomeration in the first year even though the ore had relatively high clay content by selective mining and careful stacking with minor production losses. Agglomeration was installed in year two so that it would not affect the initial capital requirement.

Another example of "reverse economics" of size involves the amount of money spent initially on ore body development prior to the decision to proceed with production.

At what point should a company suspend exploration drilling and begin operations? Should it design operations only for proven tonnage or for "expected"

Table 3 - Approach to Ore Reserve Development

Large Company Goal: Create Long-Tem Stability (Drill for Planning Purposes)

Small Company Goal: Decrease Cost of Future Capital (Drill Only Enough to Justify Development)

RECOVERABLE GOLD CONTENT (OZ/TON)	TYPICAL HEAP GRADE (OZ/TON)	BREAK-EVEN TONNAGE	20% DCFROI TONNAGE
0.03	0.045	3,000,000	5,000,000
0.05	0.077	1,000,000	2,000,000
0.06	0.092	460,000	800,000
0.08	0.120	100,000	160,000
0.10	0.150	50,000	85,000
0.15	0.230	20,000	35,000

GOLD PRICE US $ 400/oz

tonnage?

The small company might stop when it has enough tonnage to break-even, particularly if it has good chances for developing additional tonnage later on. Usually, the sources of capital available to the small company are very expensive – stock offerings may appear to provide "free" money, but in terms of management time and future flexibility this is very costly capital. Generally, the sooner a small company can begin developing cash flow, the better.

The large company, on the other hand, has more resources available to it, especially in the critical area of management talent needed to develop or "massage" investment capital; and thus its cost of capital is lower. At the same time, it generally places more importance on long-term stability and on financial measures of performance (i.e. return on investment becomes more important in relation to promotional value).

To accomplish its goals the large company will need to show a decent return on investment and a decent life. To do this, it will have to prove up at least one and a half times the amount needed for simple recovery of investment. In fact, to meet long-term stability goals, it may be found desirable to develop two or three times as much reserves as it needs.

The goals of a company do and should change. We (KCA) have dealt with companies that, correctly, placed very small properties into production. Within a year or so, their minimum target for new properties often becomes much larger because the first property was quite successful in return on investment and allowed the company to out-grow it.

CONCLUSIONS

Ore bodies aren't usually flexible. The small ore bodies need the small-company approach. This aspect of the business is generally acknowledged though not always appreciated. If both approaches are valid, can they both be done by the same company? Probably not.

The concept of a small company is not very well understood in business. A "small company approach" is not created merely by lowering the financial goals of the big company. Small companies have more personal involvement by the managers. For a big company to get small successfully, it has to find a way to shift personal involvement from upper management to lower management.

A recent article in one business magazine made the point that companies, fortunately, aren't biological organisms. They don't merely grow up, grow old, or wither away and die. Good companies may go through many cycles of being large or small, but it is probably difficult to be both sizes at once.

In conclusion, it should be said that most companies which have built expensive "Cadillac" operations – the Mesquite heap leach, the Paradise Peak mill - seem to have made valid decisions. These companies have relatively low costs of capital and very long-term goals of maintaining corporate stability.

The other end of the spectrum – low-cost, rapid development – is equally valid and important. It can be the road to success for small companies with big future plans.