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DEVELOPMENT OF THE HOG RANCH MINE WASHOE COUNTY, NEVADA

Presented at the Northern Nevada Section of AIME April Meeting, 1987

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INTRODUCTION

History

The Hog Ranch Mine is located 50 miles north of Gerlach in Washoe County, Nevada. A portion of the property was initially staked in 1979 as a uranium target by Noranda Exploration which, at that time, was the operator and minority interest holder of a Uranium Joint Venture funded by Geomex, a Canadian-based venture group.

The initial gold mineralization was first drilled in 1981 at the South Deposit, which is generally undeveloped. Ferret Exploration Company, as manager of Geomex's U.S. operations, elected to assume operatorship of the Joint Venture at the end of 1981. The first discovery at the site of the initial mine, the Krista Pit location, was made in 1982 about three miles north of the South Deposit.

Development capital was obtained through a public stock offering of Western Goldfields, Inc., and a joint venture with Orenevada and Mantagu Mining Investments. The mine is operated by Western Hog Ranch Company, a joint venture of Western Goldfields, Geomex and Royal Resources, who recently purchased Montagu's interest.

The decision to proceed with development of a 4,000 ton per day heap leach operation was made in late February 1986. Kappes, Cassiday & Associates were appointed engineers/construction managers and Gilbert Western, Inc., were given the contract to mine, crush and stack the ore.

Funding sufficient to begin activities was obtained through private financing in April, but the public stock offering was not completed until August 1986, two days before leaching began and one month before first gold pour.

Ground-breaking took place on 28 April 1986, leaching began 15 weeks later on 15 August, and the first pour, over 700 ounces, occurred on 14 September.

The Hog Ranch property has proven or indicated reserves in excess of five million tons, about 0.06 ounces gold per ton. Reserve evaluations are continuing. Ongoing exploration is expected to add reserves that could extend the mine life several years.

The Hog Ranch property consists of 733 contiguous lode claims comprising some 14,000 acres.

Laboratory Test Work

The Hog Ranch ore body can be described as silicified and argillized volcanic rocks intermixed with soft clay. Gold occurs as fine free particles in both types of material.

Test work indicated that material crushed to minus 1 ½ inches and agglomerated had recoveries of 75% for the hard silica and 90% for the clayey type ore.

Metallurgical evaluation of the deposit was very simple. The total laboratory program cost less than $80,000, plus an additional $30,000 for two bulk field samples taken from shallow pits.

Laboratory testing on the deposit consisted of bottle roll and column leach tests on rotary drill hole cuttings and column leach tests on two bulk samples. On the two bulk samples, the program consisted of six small-column leach tests with approximately 200 pounds of ore in each test and two large column tests of approximately 25 tonnes.

The laboratory program was kept simple because:

- Mineralogical and geological review indicated that the initial target ore body was relatively shallow and had uniform metallurgical characteristics.

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- Preliminary studies indicated that recoveries with heap leaching would be very good and that the overall ore grade was high enough such that economic viability did not require extremely accurate determination of percent gold recovery.

Project Economics

A project feasibility study was completed by Kappes, Cassiday & Associates in December 1985. The feasibility predicted a capital investment of approximately seven million dollars with an operating cost of around ten dollars per ton. Capital payback was predicted within twelve months.

Project review for stock market approval was conducted by Irv Parrish of Derry, Michener, Booth and Wall located in Toronto.

Construction

Preliminary site clearing began on 3 April and extensive site work began on 28 April 1986.

Kappes, Cassiday and Associates acted as general contractor and construction managers. Several major subcontractors were employed during construction and are listed below.

Buildings	Sierra Building Systems Sparks, NV
Pad & Pond Liners	Watersaver Company, Inc. Denver, CO
Water Pipeline	Hadfield Irrigation Lehi, UT
Civil Work	Kennedy, Jenks, Chilton Sparks, NV
Earth Works	GilbertWestern Corporation Salt Lake City, UT

Table 1 - Capital Investment

G&A and Utilities	$1,500,000
Design & Const. Management	$500,000
Misc. Subcontractor Cost	$200,000
Pad, Ponds, & Solution Collection	$2,300,000
Recovery Plant	$1,300,000
Pump System	$100,000
Reagent Handling	$100,000
Lab/Bucking Room & Warehouse	$200,000
Miscellaneous	$300,000
TOTAL	**$6,500,000**

Capital Investment

The capital required at Hog Ranch was less than $7,000,000 (excluding operating capital). The cost can be roughly broken down as shown in Table 1.

SITE INSTALLATIONS

Pad Installation

Hog Ranch installed 1.8 million square feet of 40-mil PVC to receive the first year's production. The ground was very rocky and extensive preparation was necessary to provide a suitable base for the material. The entire surface was raked by hand to remove small rocks and roots before compaction. The PVC was installed by Gaston Containment Systems, Inc. (for Watersaver Co.). The pad was installed at a cost of $0.51 per square foot including all costs for surface preparation, geotextile cover and drainage pipes.

Pond Installation

Three 2.5 million gallon ponds were installed at Hog Ranch. The ponds had to be blasted out of almost solid rock. The rough surface was then plated with fine soil and fine-graded. Each pond measured 325 feet by 125 feet. The ponds were 12 feet deep with 2.5 to 1 side slopes. The ponds were lined with 36-mil reinforced Hypalon. The cost of liner installation, exclusive of excavation, was $0.70 per square foot of liner. Because of the steep topography at the pond location and the need to speed up the pond permitting process, ponds were almost totally incised below the pre-existing ground surface. Pond excavation costs exceeded $300,000.

Process and Potable Water

Water is received into a 30,000 gallon storage tank via a pipeline from a well located 15,000 feet horizontally, and 1000 feet vertically from the mine.

Power

Separate diesel-fired generators are located at the process plant (450 kW), the well (250kW), the office/camp location (75kW), and the crushers/mine site (450 kW).

Support Facilities

In addition to the recovery plant, a laboratory, reagent handling building, warehouse/shop, offices, and campsite were installed.

RECOVERY SYSTEM

Gold is recovered by carbon adsorption, then stripped from the carbon using an alcohol strip method and electroplated. Six closed-top carbon columns, each containing two tonnes of carbon, are used. Adsorption, desorption, and acid washing take place in sequence in

the same columns, and carbon is not normally removed from the columns.

Two columns (4 tons) of carbon are stripped at a time, using a strip solution flowrate of 50 gpm, and solution containing 1% each of sodium hydroxide and sodium carbonate and 20% ethanol. Strip pressure is atmospheric and strip temperature is 83 degrees Celsius. Strip solution heating and carbon pre-heating is done by direct steam injection with the solution electroplated at normal strip temperatures so that heat exchangers are not required.

The stripping section of the plant is capable of recovering gold at over twice the design rate of gold production, thus optimization of the system is not required. The normal strip cycles exceed 30 hours, but preliminary data indicates that cycles of less than 16 hours can be achieved.

The key surprise noted during operation has been that the presence of mercury in the ore prevents the electrolytic cells from plating gold during the first several hours of the strip cycle. Once mercury levels are reduced sufficiently, gold plating becomes efficient and the strip cycle can be rapidly completed.

Key features of the recovery system include:

- Permanent residence of the carbon in the same columns during adsorption and desorption cycles.
- Alcohol stripping with a unique alcohol recovery/recycle system.
- A flexible system of tanks and piping so that various types of stripping including single-pass stripping (once through the carbon with separate electrolytic system recycle), and the AARL pre-soak process – widely used overseas but not in the U.S. – can be evaluated. The only strip process utilized to date has been the conventional system of a continuous solution recycle loop through the carbon and electrolytic cell system.

Support facilities in the pant include:

- Gas-fired mercury retort
- Gas-fired crucible furnace for producing doré
- Gas-fired rotary kiln for periodic re-activation of the carbon
- Lime silo with agitated slurry tank (because cement is used in agglomerating the actual use of lime will be minimal or non-existent)
- Agitated mix tank for processing cyanide received in 3,000 pound flo-bins

The recovery plant costs can be broken down as shown in Table 2.

Table 2 - Recovery Plant Costs

Site Excavation	$200,000
Plant Building	$300,000
Adsorption/Desorption	$500,000
Alcohol Recovery	$100,000
Acid Wash/Regeneration	$100,000
Retort/Smelting	$100,000
TOTAL	**$1,300,000**

OPERATING PARAMETERS

Ore Production & Leaching Rate

The production at Hog Ranch is designed for 4,000 tons per day processed with an average yearly production of one million tons.

Ore Treatment

Hog Ranch Mine employs two stage crushing to -1.5 inches and agglomerating in a rotary agglomerating drum.

Ore Placement

Ore is placed in one 25 foot high lift by radial stacker fed by sectional conveyors operating on the pad. Some run-of-mine low grade material is direct truck stacked.

Leach Cycles

The agglomerated ore is processed in a two-stage countercurrent leach with 30 to 45 days of leaching in each cycle.

"Dump" Leach of Low Grade

Low grade material is leached at run-of-mine size. The initial two pad sections have been loaded directly with this material. In the future, this run-of-mine material will be placed as a second lift on top of previously leached heaps.

Heap Flowrate

Leach solution is sprinkled onto the heaps at a rate of 0.005 gpm/ft^2. Total flow onto both heap cycles exceeds 1300 gpm. Additionally, up to 200 gpm of barren solution is used in the agglomerating system.

The average solution flow through the recovery plant is 600 gpm.

Reagent Consumption

Predicted reagent consumptions at hog Ranch are listed on the next page.

NaCN	0.5 lb/ton
$Ca(OH)_2$	1.0 lb/ton
Cement	6.0 lb/ton

Solution Flow Monitoring

Shedding vortex flowmeters with totalizers are located on each of the process solution lines going to the heaps and on the carbon column input line. Solutions from the heaps are directed through one of three pipes into Parshall flumes with continuous recording flowmeters. Solutions at all locations are regularly sampled.

PRODUCTION STATISTICS

Production

To date, 492,000 tons of crushed and agglomerated ore has been placed, from which approximately 22,000 ounces of gold have been recovered.

Also, 260,000 tons of run-of-mine material has been placed, from which approximately 4,000 ounces of gold have been recovered.

While it is difficult in the early stages of heap leach operation to correctly monitor recoveries, they appear to be on target. Based on a 60-day leach cycle and recovery rates as predicted from the laboratory tests, recovery through the end of 1986 was 97% of the predicted recoveries.

As a guide to projecting initial working capital requirements, it is interesting to note that of the total recoverable ounces placed into the heaps during 1986, only 75% had been recovered by the end of 1986. Since overall recovery is projected at 75% of contained fire-assayed gold, the total recovery through the end of 1986 was only about 50%.

The delay in recoveries is largely due to the fact that stacking of the ore began in August but design tonnage was only approached in December. Other production activities such as working out pipe placement methods for good heap coverage also took a few months to optimize.

Operating Cost

During 1986, gold was produced for approximately $220 per ounce. The cost is expected to drop for future operations.

Contract Mining Costs

Contract mining costs were approximately $4.40 per ton during 1986.

Recovery Costs

Processing, general, and administrative costs totaled approximately $5.00 per ton during 1986.

KEY DEVELOPMENT PERSONNEL

Dan W. Martin, President, Western Goldfields, Inc.

Dan has been a member of the mining community in Nevada for many years. He was a prominent member of Tenneco Minerals before accepting the position of president of WGC.

Ralph Barnard, Ferret Exploration

Ralph was responsible for early identification of the potential deposit and for positioning Ferret Exploration to retain the dominant management role during project conception.

Naseem Mian, General Manager; Western Hog Ranch Company

Naseem has an M.S. in Mining Engineering from the Royal School of Mines, London. He has worked in Africa, Europe and the Middle East; he has been in the U.S. since 1980, and has worked with Western Goldfields for one year.

Siegfried Holso, Project Geologist

Sieg has been working on the Hog Ranch deposit since the early development stages and is presently working to expand the reserves and define new areas.

Larry Martin, Process Geologist

Larry is also working to expand the reserves and define the Hog Ranch geology.

Kim Drossulis, Mine Superintendent

Kim joined the project at an early point and coordinated all of the mining plan and subsequent mining activities.

Daniel W. Kappes, President, Kappes, Cassiday & Associates

Dan Kappes has been a well-known heap leaching consultant for many years. KCA has developed several mines in the US and oversees. Dan served as a project manager on the Hog Ranch Project.

Geoff Allard, Project Manager

Geoff acted as principal design engineer and field construction manager on the project.