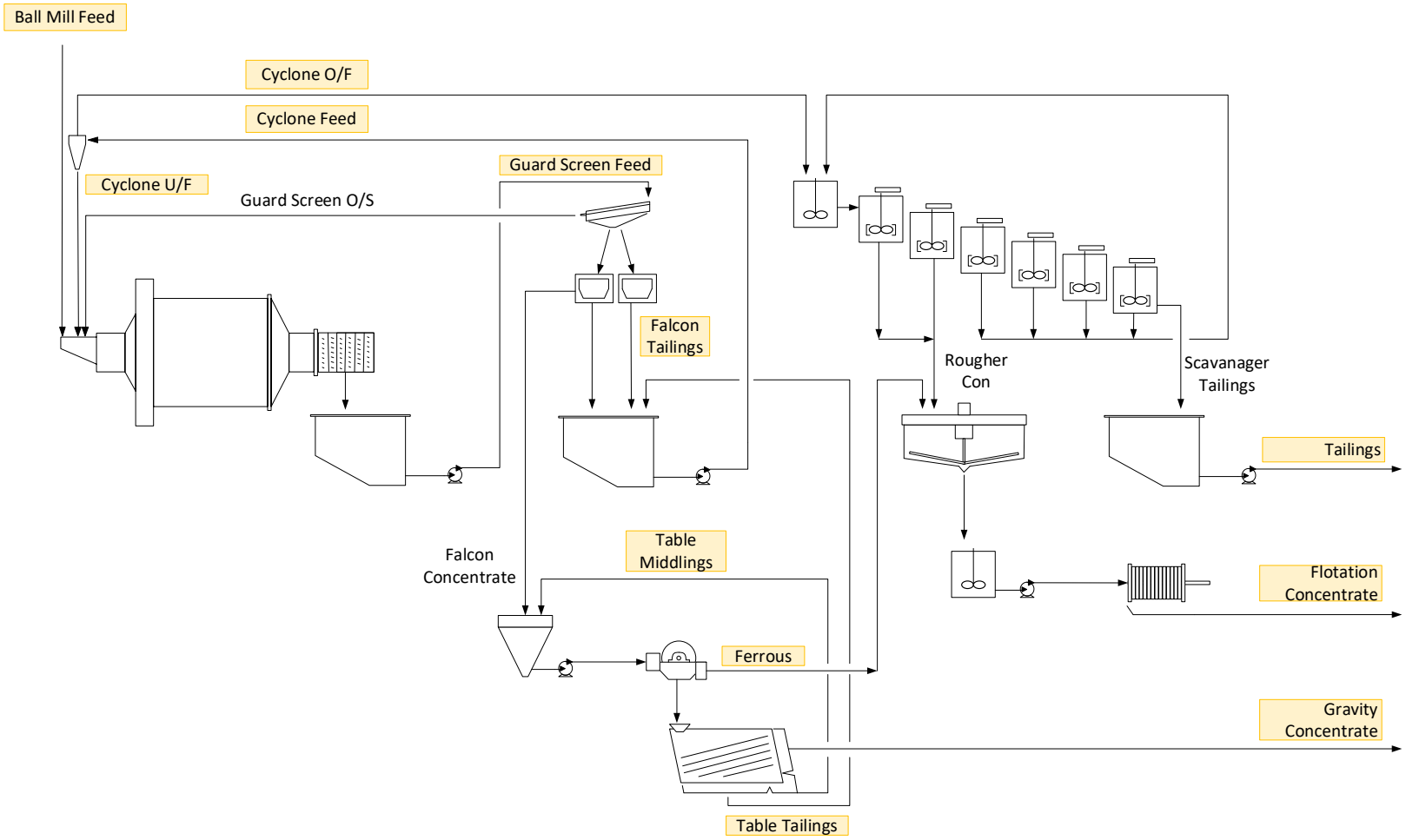
A Gravity Audit at Harte Gold's Sugar Zone Mill in Northern Ontario

Conference of Metallurgists - COM 2021

SUGAR ZONE MINE

- Located north of Lake Superior, Ontario, Canada
- Orogenic, greenstone hosted gold deposit
- Underground longhole stoping operation
- 50,000 – 55,000 oz expected production in 2021
- Entered Commercial Production: 2019
  Expected Mine Life: 13 years

SUGAR ZONE MILL - FLOWSHEET



Conventional Gravity-Flotation Flowsheet

Gravity

- 100% of mill discharge over guard screen (2mm square mesh), then 2x Falcon SB concentrators prior to hydrocyclone
- Falcon concentrate to gold room
- Table Concentrate to bullion

Flotation

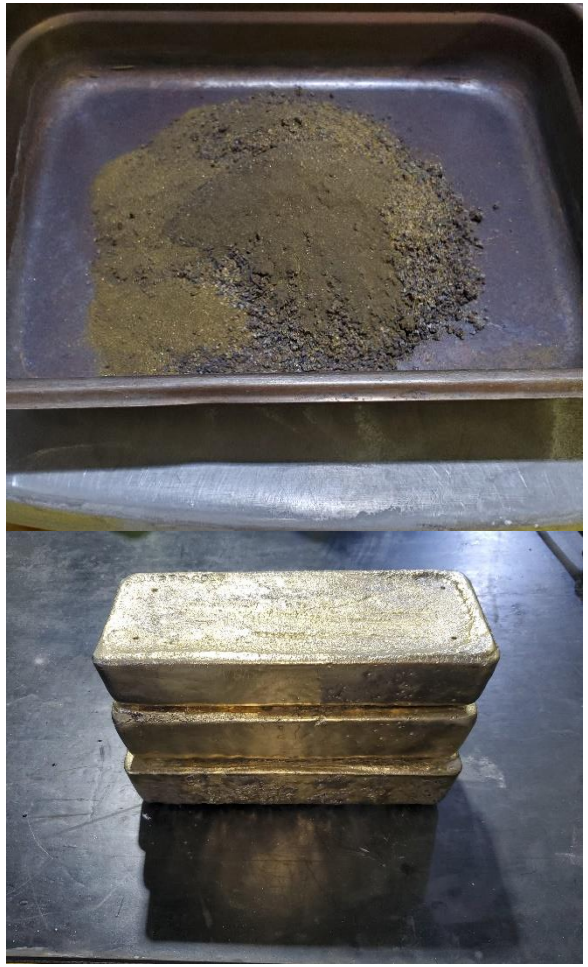
- Cyclone O/F to rougher/scavenger flotation
- Rougher concentrate to smelter

GRINDING / GRAVITY CIRCUIT

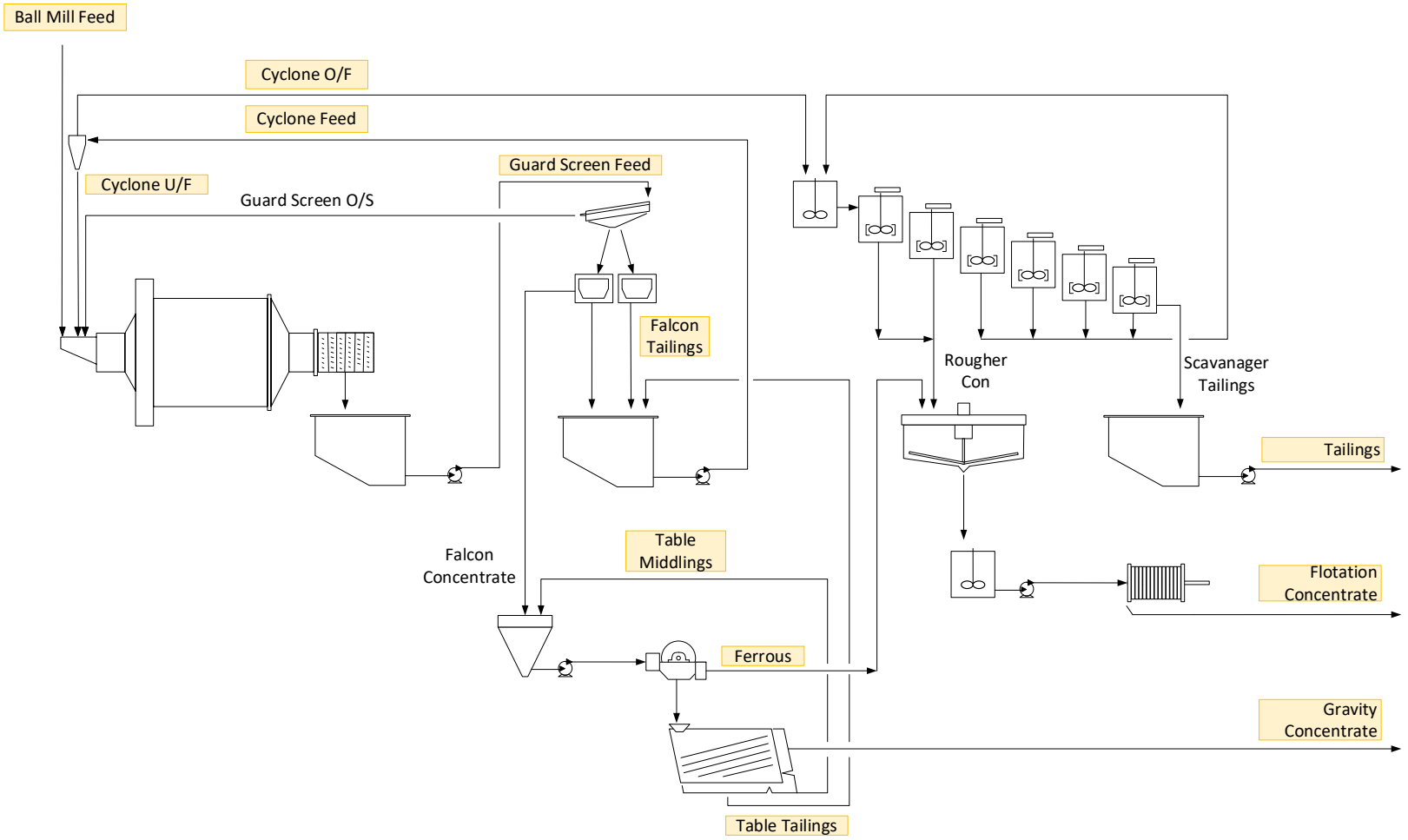
- Feasibility study testwork on samples collected between 2010 and 2018 suggested 50-90% GRG content of ore, therefore much attention was given to the design of the gravity circuit
- 100% of circulating load treated by gravity for maximum GRG recovery
- Gravity concentrate processed by shaking table to avoid the need to use cyanide

GOLD ROOM

- LIMS magnet removes steel prior to tabling
- 2-3 passes over shaking table required to produce final concentrate (operator skill dependent)
- 70-75% Au grade concentrate for smelting
- Gold bullion produced on site assays ~ 80% Au

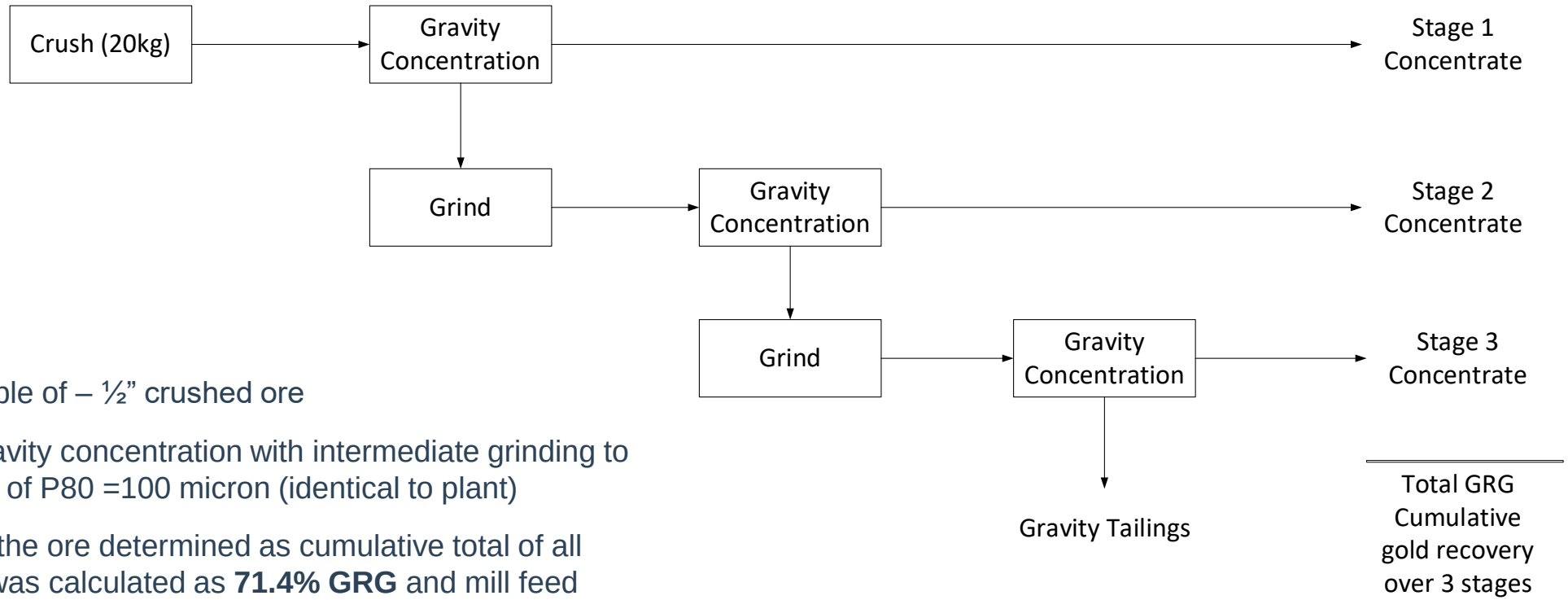


GRAVITY AUDIT – SAMPLING CAMPAIGN



- Design of three day sampling campaign in cooperation between Harte Gold and Sepro
- Composite samples drawn from points highlighted in yellow
- Completion of size fraction assays (SFA) and detailed gravity recoverable gold (GRG) tests for gold deportment study
- Mathematical modelling of the gravity circuit and benchmarking of plant performance
- Identification of avenues to maximize gravity recovery and economical implications

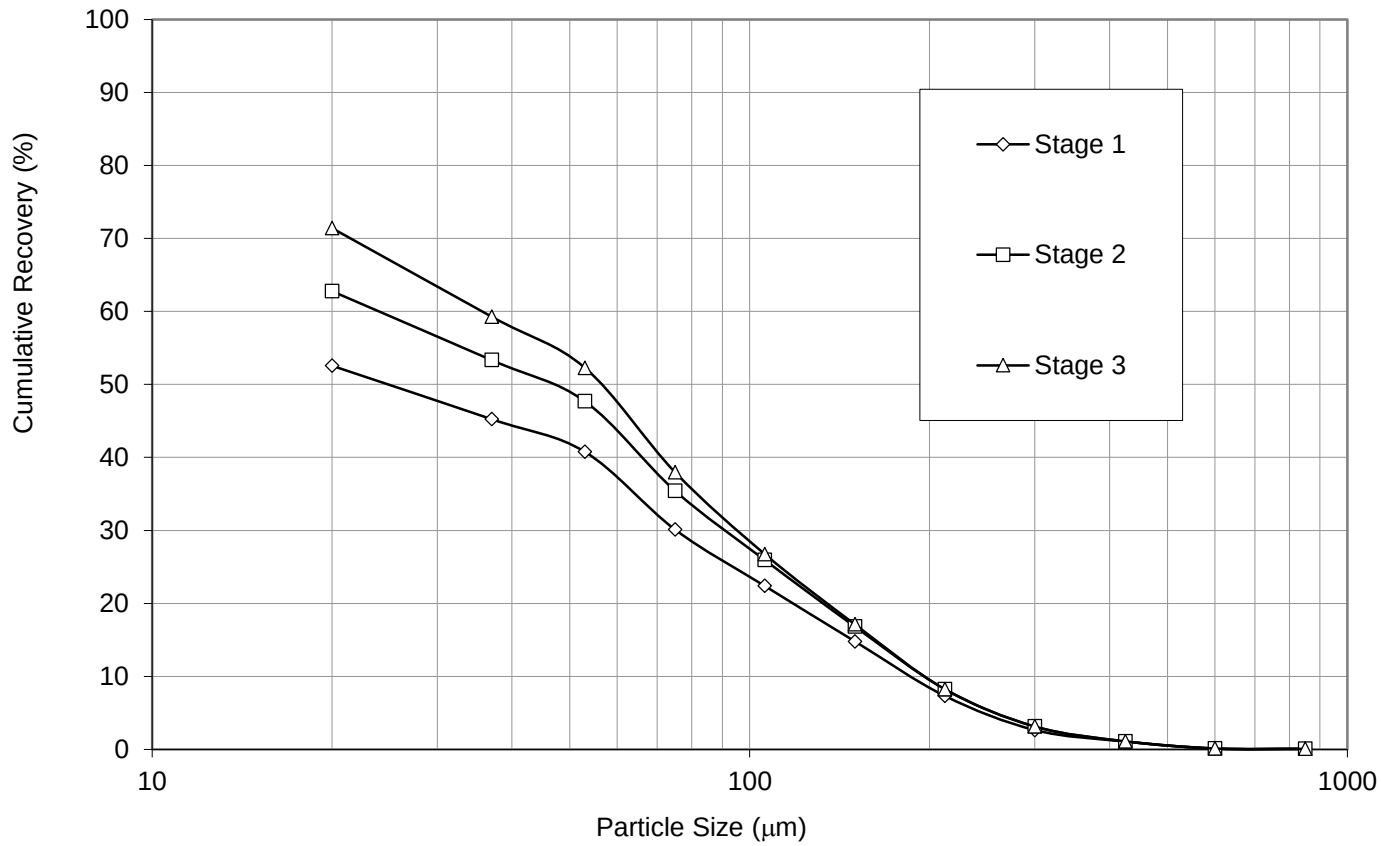
GRG TEST



- Mill Feed sample of – ½" crushed ore
- 3-stages of gravity concentration with intermediate grinding to final grind size of P80 =100 micron (identical to plant)
- GRG value of the ore determined as cumulative total of all three passes was calculated as **71.4% GRG** and mill feed grade of 5.64 g/t

GRG TEST RESULT

- Particle size distribution curves from three passes representative of **moderately coarse GRG**
- 52% recovered in 1st pass (crush)
  + 10% recovered in 2nd pass (200 micron)
  + 9% recovered in 3rd pass (100 micron)
- 29% is coarser than 100 micron

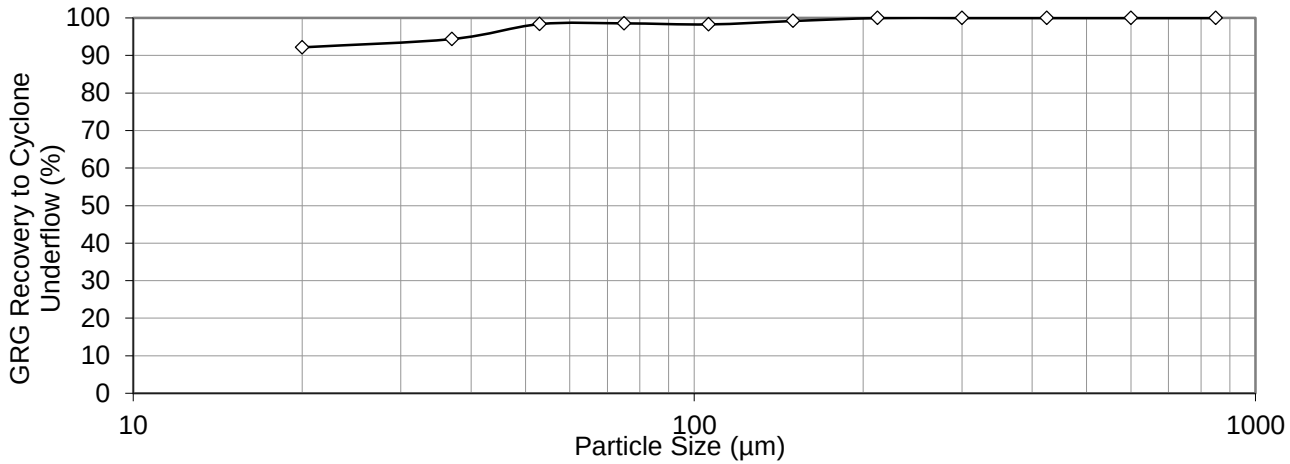


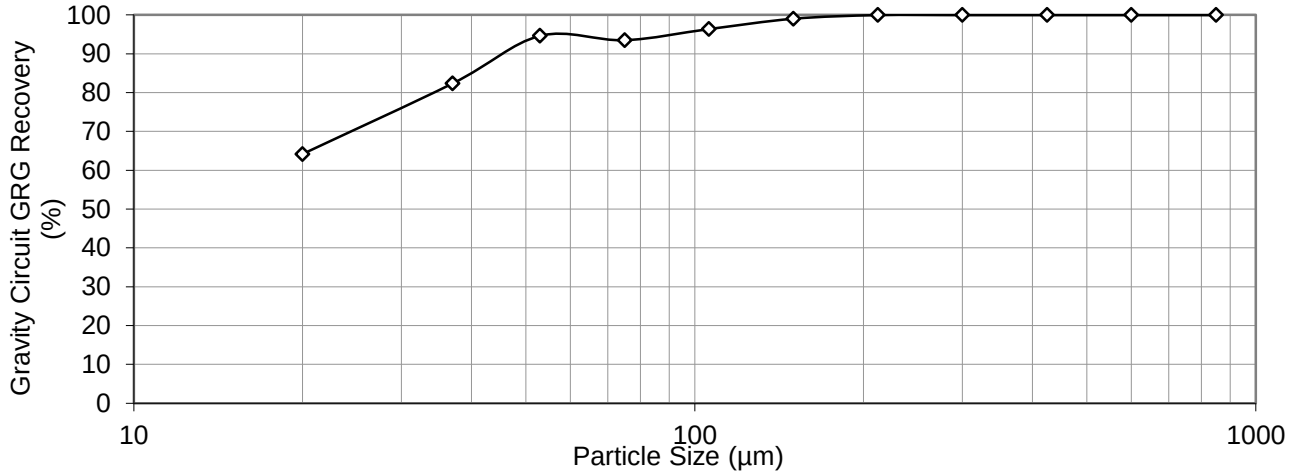
GRG RECOVERY BY HYDROCYCLONE

- Hydrocyclone classification: Overflow P80 = 100 micron
- Cut size for gold is finer due to high density, more gets returned to the U/F
- **Hydrocyclone GRG recovery to cyclone U/F = 93.7%**

…. relatively low
… efficient cyclone
expected 95-99% GRG recovery to U/F

- Gravity circuit GRG recovery is highly dependent on hydrocyclone to retain GRG within the grinding circuit – effectively a multiple pass environment





PLANT MASS BALANCE

- Plant outputs are accounted for as

1. Gravity Concentrate (Table Con / Bullion)
2. Flotation Concentrate + Ferrous
3. Tailings

	Tonnage	Grade		Distribution	
	(t/h)	Total Au (g/t)	GRG (g/t)	Total Au (%)	GRG (%)
Gravity Con	**0.17 kg/h**	**75%**	**75%**	**70.3**	**87.7**
Ferrous	4 kg/h	1,195	1,195	2.7	3.4
Flotation Concentrate	0.57	68.6	20.3	22.0	8.1
Flotation Con + Ferrous	0.57	76.5	28.5	24.7	11.5
Final Tailings	31.0	0.29	0.04	5.0	0.8
Calc Ball Mill Feed	31.6	5.64	4.5	100.0	100.0

GRG MODEL

Sepro Mineral Systems' advanced mathematical model, based on fundamental research by Dr. André Laplante of McGill University in Canada, can predict gold recovery for new installations or assist in trouble shooting existing operations.

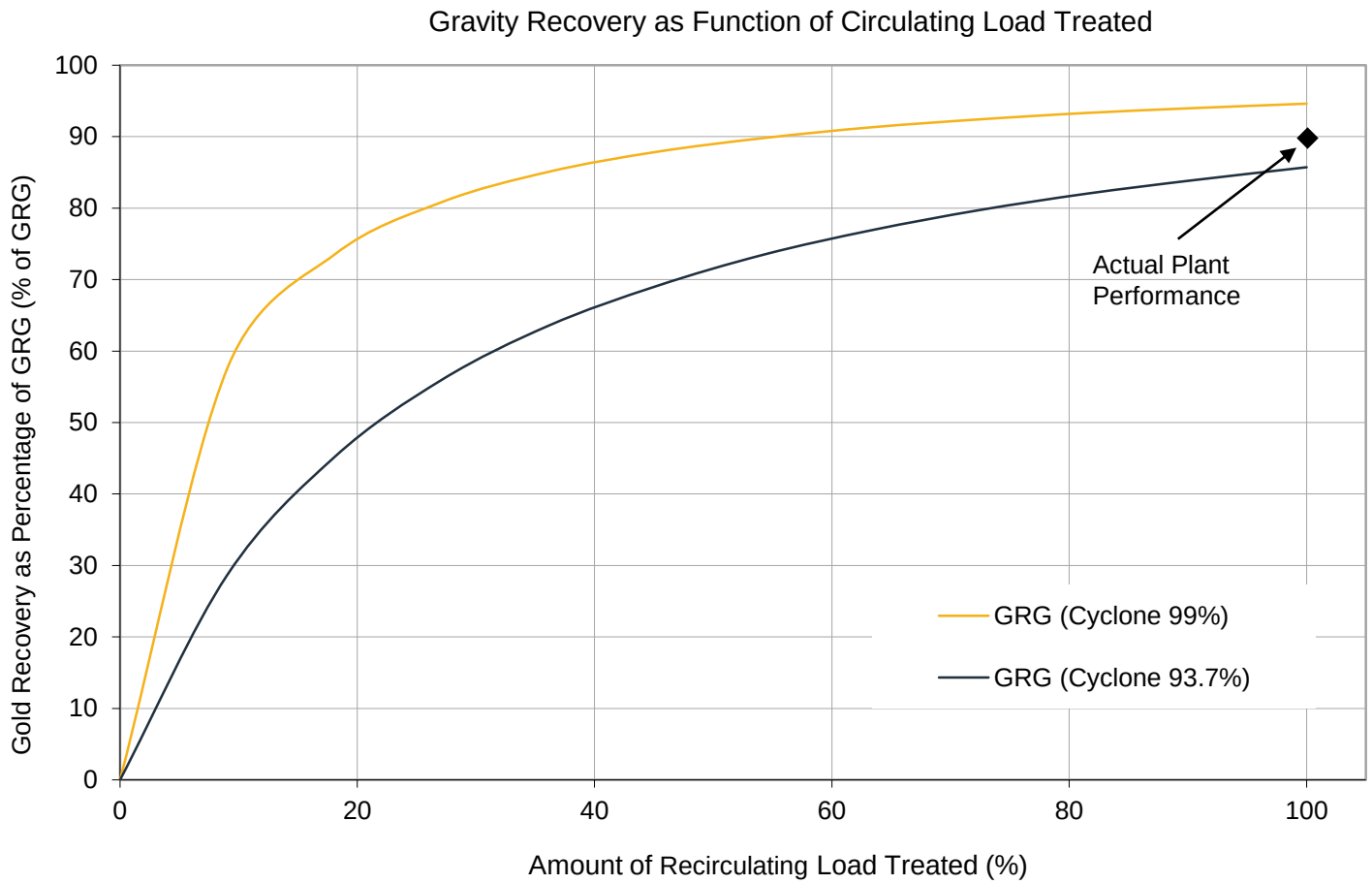
The key factors impacting gravity recovery from within grinding circuits :

- Gravity-recoverable-gold (GRG) content of the ore
- Size distribution of the GRG
- Sulfide content of the ore (Sugar Zone = 1% - 3% Sulfides)
- Recovery efficiency of the gravity circuit including gold room
- Cyclone efficiency (as defined by the partition curve of GRG)
- Fraction of the circulating load treated by the gravity concentrator
- Amount of GRG converted to non-GRG in the grinding mill (grinding behaviour of the gold)
- Gravity circuit availability

GRG MODEL (CONTINUED)

Modelling results:

- X Axis: 100% of circulating load treated with 2x Falcon SB1350 concentrators (by design)
- Y Axis: Model suggests **85.7% - 94.6% GRG Recovery** depending on efficiency of the hydrocyclone at retaining GRG within the grinding circuit
- Actual plant performance **87.7% GRG Recovery** aligns with model

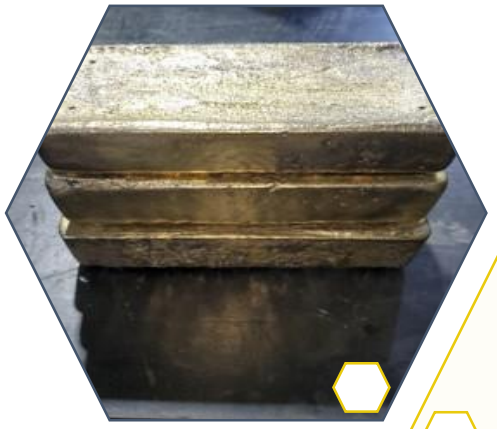


REVENUE MODEL

Payment terms differ between gravity bullion and bulk flotation concentrate:

- Transportation cost
- Treatment charge
- Refining + assay charge
- Moisture penalty
- Payable terms

At a gold price of $ 1,700 USD per troy ounce and flotation concentrate grade of 76 g/t:



$ 1,694 /oz
for bullion

$ 1,501 / oz
for bulk flotation concentrate

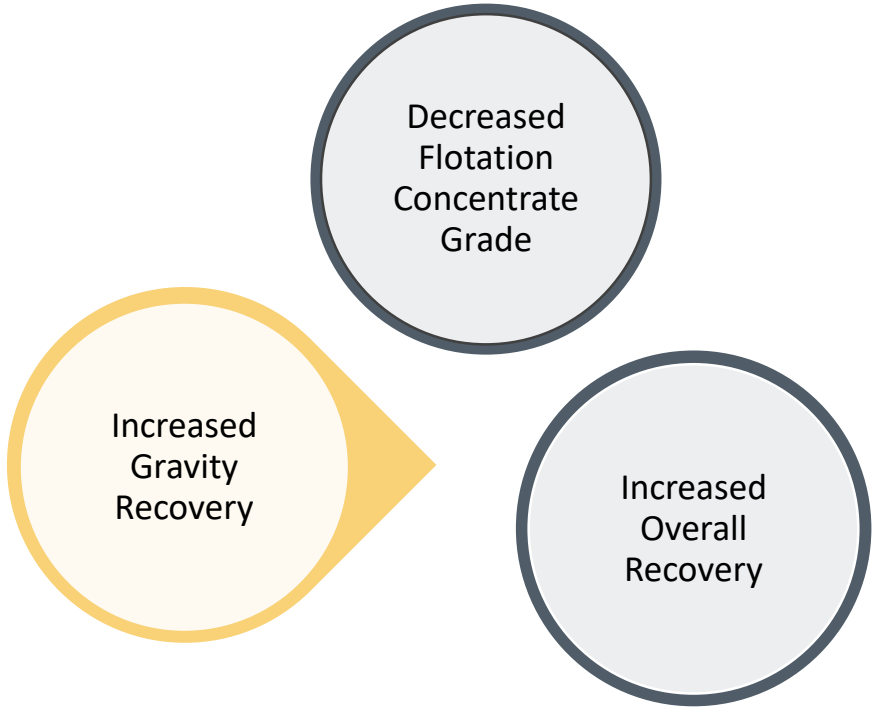
REVENUE MODEL (CONTINUED)

Comparison between payment terms are favorable for bullion over concentrate;

However it becomes more complex considering the interactions:

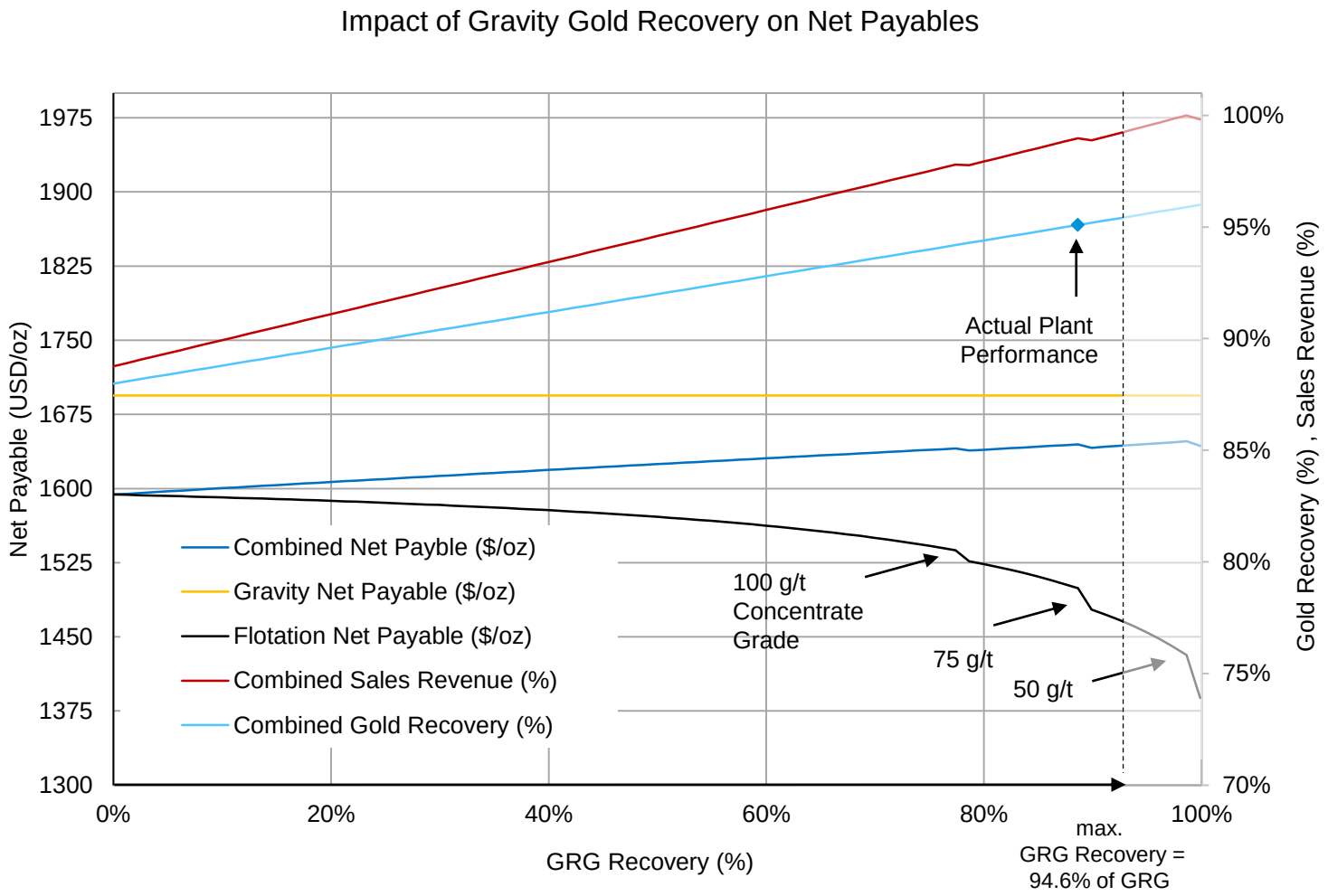
- Payment terms for flotation concentrate are grade dependent
  Shifting gold from flotation concentrate to gravity results in an inevitable reduction in flotation concentrate grade since mass yield is primarily governed by sulfide content and not gold content

- Effects of Gravity Recovery on Overall Plant Recovery:
  Assumption: 1% Overall Recovery Increase per 10% Gravity Recovery



REVENUE MODEL (CONTINUED)

- Modelling provides understanding of correlation between gravity and flotation recovery
- Contractual payable terms steps at 100 g/t, 75 g/t and 50 g/t
- Advantage in payable terms for gravity gold outweighs penalties for low flotation concentrate grade
- Combined revenues are optimized through continued gravity recovery improvements and while maintaining the flotation concentrate grade above 75 g/t or 100 g/t depending on mill feed grade



Thank you.

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