Water Treatment Challenges in the Philippines: The King-king Copper/Gold Project

Mine Design, Operations & Closure Conference

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Presentation Outline

1. The King-king Mine
2. Anticipated treatment challenges
3. Original prefeasibility findings
4. Latest water quality & quantity information
5. Potential water treatment

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Location

- About 35 km east-northeast of Davao City (1.5 M people) by air
- 92 km from Davao City by paved road
- 13 ports in the Davao Region
- Owner is St. Augustine Gold & Copper (Spokane, WA)
- Client is MDC America, Inc.

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Mining in the Philippines

- 35 operating metallic mines
- One operating copper smelter and one nickel processing plant
- Over 250,000 Filipinos employed

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King-king Project

- Measured & indicated reserves
  - 10.3 M oz Au (0.334 g/t)
  - 5.4 B lbs Cu (0.254%)
- Resource value of $41 B (Sept. 2011)
- 100,000 tpd ore delivery
- Mine life of 20+ years
- Projected annual production for 1st five years of full plant operation:
  - 395,000 oz Au @ 0.597 g/t
  - 267 M lbs Cu @ 0.397%

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Key Milestones

- Feb. 2012: EIS submittal
- May 2012: Declaration of mine project feasibility
- Q4 2012: Preliminary feasibility technical report
- Q3 2013: Bankable feasibility study
- Currently in permitting phase

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Anticipated Treatment Challenges

- Lots of water!
- Many water sources, some with potentially poor quality
- Several sets of regulatory requirements
- Very large site
- Remote location from most water treatment equipment suppliers

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ORIGINAL PREFEASIBILITY FINDINGS

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Waters to Treat

- Valueless rock management area (VRMA) runoff
- Tailings storage facility (TSF) runoff
- Pit groundwater
- Pit runoff
- Heap leach spent ore (HLSO) runoff
- Drinking water supply
- Wastewater

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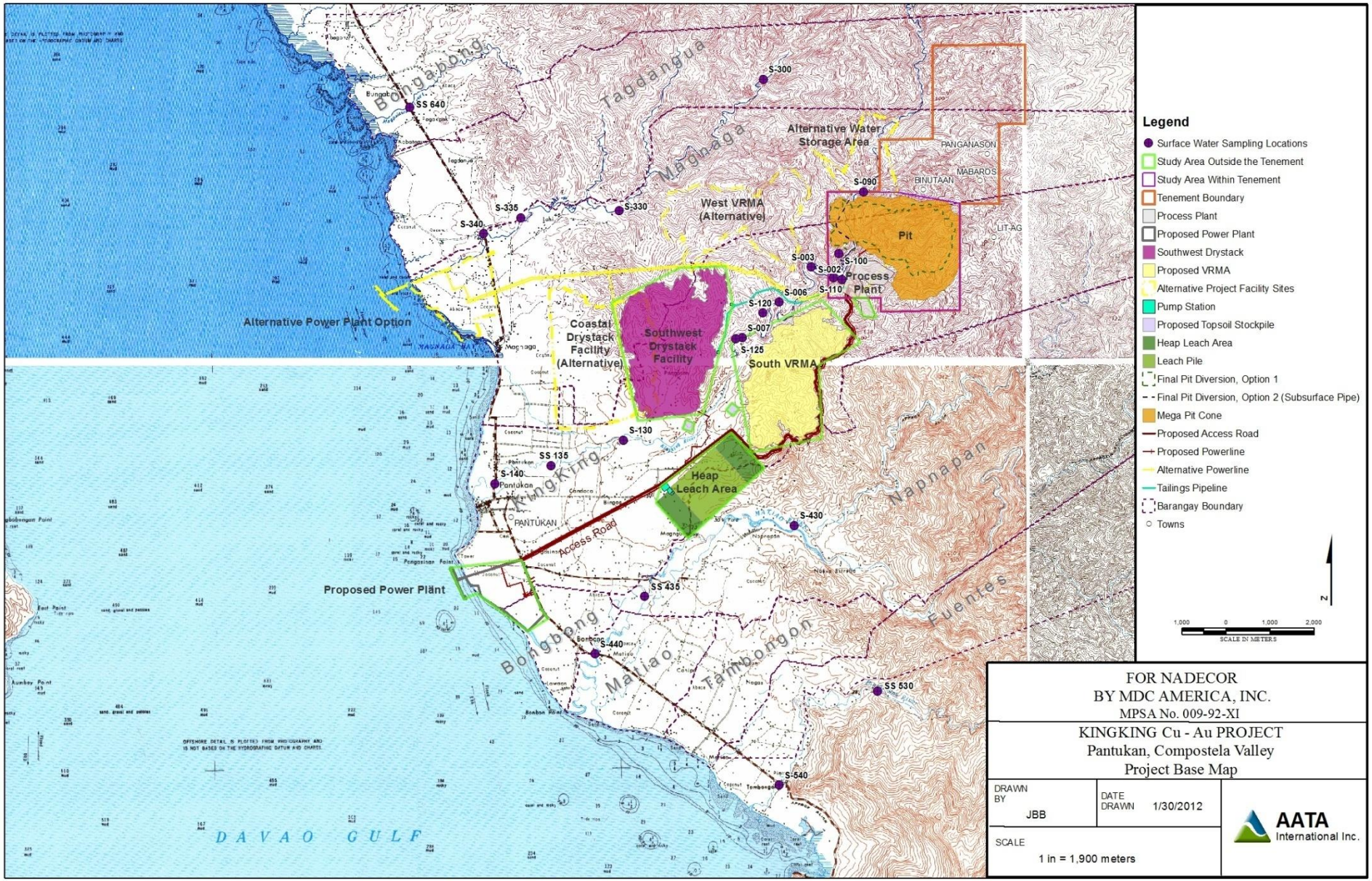

FOR NADECOR
BY MDC AMERICA, INC.
MPSA No. 009-92-XI

KINGKING Cu - Au PROJECT
Pantukan, Compostela Valley
Project Base Map

DRAWN BY	DATE DRAWN
JBB	1/30/2012

SCALE
1 in = 1,900 meters

AATA International Inc.

Flow Rates

	Max. Flow Rate (gpm)	
Source	**Year 1**	**Year 18**
VRMA runoff	185	2,424
TSF runoff	810	5,786
Pit GW	3,199	3,089
Pit runoff	189	7,242
HLSO runoff	898	0

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Contaminants of Potential Concern

- pH
- Total and dissolved metals (esp. copper)
- TSS
- Sulfate
- TDS
- Nitrate?

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Regulatory Compliance Standards

- International Finance Corporation (IFC) guidelines for mining operations
- Philippine drinking water standards
- Philippines draft 2008 inland or marine standards for metals and sulfate treatment
- Philippines draft 2008 inland or marine standards for metals only

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Analysis of Standards

- IFC discharge limits are generally less stringent than others
- For categories with metals limits, most of the limits are similar
- Wide range of limits for TDS and TDS constituents such as sodium, chloride and sulfate

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Anticipated Water Treatment

- Need to treat at least one water source for the following contaminants
- Probable:
  - Cd, Cu, Fe, Mn, Ni, Zn, pH, F, SO_4
- Possible:
  - Al, Sb, As, B, Cr, Pb, Hg, Se, TDS, TSS

Examined many different treatment combinations and scenarios

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Drinking Water and Wastewater

- 4,000 people initially (construction phase)
- 2,000 people later (mine operations)
- Could have central treatment, or two or more locations
- For drinking water, select best available water as feed to DWTP
- Probably packaged plants

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LATEST WATER QUALITY & QUANTITY INFORMATION

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New Findings

- Less acid generation than previously predicted (higher pH, lower metals)
  - VRMA metals conc. reduced by $\geq$ 10x
  - HLSO metals conc. are higher
- Projected flows have generally decreased, especially early in mine life
- New water balance from AMEC

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VRMA Water Quality

- Encapsulation strategy
  - Assumed that one lift of material would be max. volume of rock contacting stormwater
- Used barrel test results to predict water quality

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VRMA Composition

Alteration Type	Tons	Percent
Advanced Agrillic Zone	2,328,213	0.35%
Sericite-Clay-Chlorite	9,262,386	1.4%
Propylitic-Chlorite sub-zone	1,961,663	0.3%
Other rock types	642,542,956	97.9%

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HLSO Water Quality

- Now assuming different WQ from TSF
  - Complete encapsulation
  - 10% of HLSO volume would be filled each year for 10 years
  - 1% of rock contains moisture from leach operations (dissolved contaminants)
  - One year after placement, HLSO contribution decreases to 50%
  - Two years after placement, HLSO contribution decreases to 0%

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Flow Rates

	Max. Flow Rate (gpm)	
Source	**Year 1**	**Year 18**
VRMA runoff	960	2,550
TSF runoff	760	2,700
Pit GW	650	3,700
Pit runoff	88	3,370
HLSO runoff	420	0

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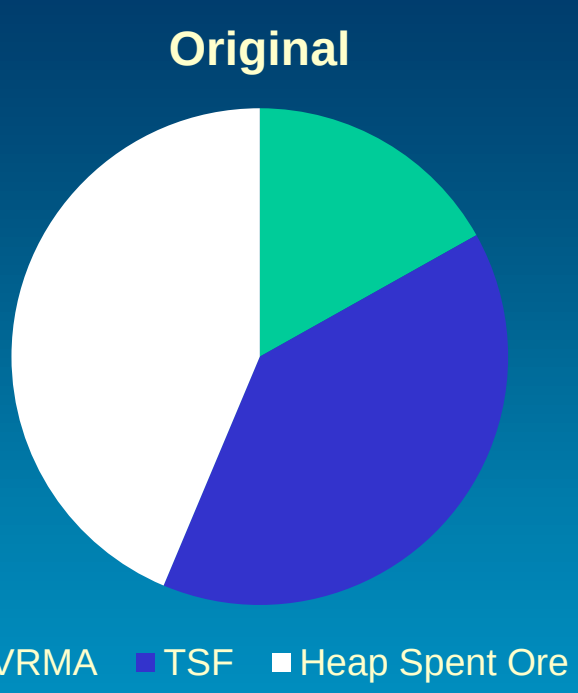
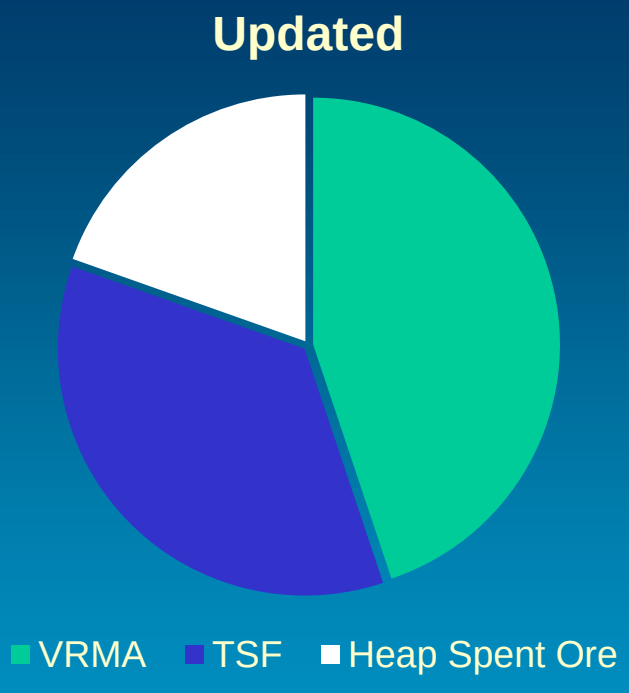
Year 1-5 Water Balance





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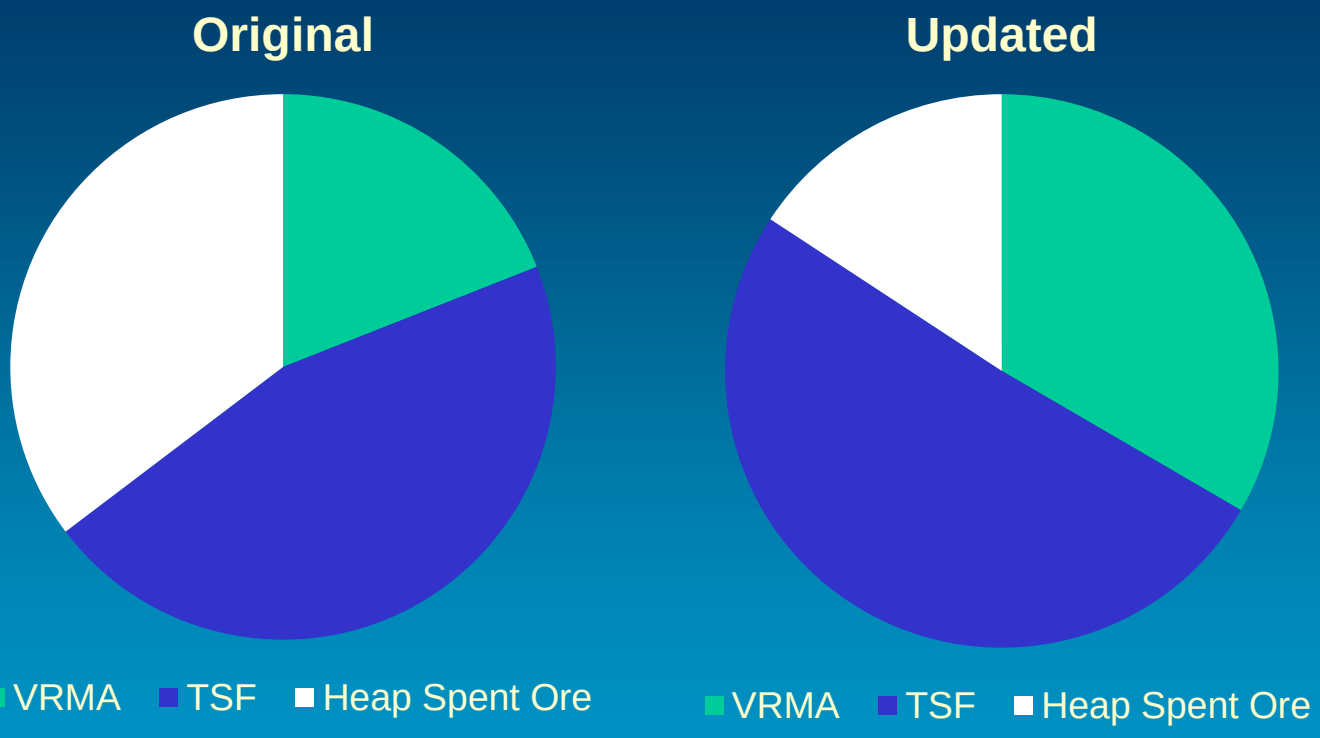
Year 6-10 Water Balance



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Conclusions

- Very little AG material is present
- Water treatment may not be required to meet Philippine inland and/or marine WQ standards in Years 1-10
- Further study required to determine water treatment needs for feasibility study
- Capital and O&M costs for water treatment may be deferred by ten years

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Potential Unit Operations If/When Water Treatment Is Needed

- Neutralization
- Co-precipitation
- Coagulation/flocculation
- Clarification
- Media or membrane filtration
- Biological treatment
- Sludge dewatering
- Reverse osmosis or ion exchange
- Disinfection

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Questions?

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