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In-Situ Application of Batch Treatment for Water Management at Closed Mine Sites

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Roadmap

- Context and Relevance
- Study Objectives
- Phase I Bench Scale Studies
- Phase II In situ Batch Treatment
- Modelling and Scale-up
- Next Steps



Open Pits as a Water Management Resource?

INTRODUCTION

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- An open pit can be a resource or an opportunity at a closed mine site to manage mine waste and water quality
- Common applications
 - Repository for PAG or ML wastes
 - As a component of the overall site water management system
- Few examples where in situ batch treatment used as part of the constituent source term management strategy
 - Highland Valley Copper, BC
 - Selbaie, Quebec





- Can in situ batch treatment represent a practical, viable, effective low-cost alternative to conventional water treatment?
- Does in situ batch treatment meets the objectives of applicable mine closure codes and standards and associated regulations?



CASE STUDY **Nighthawk Lake Mine** Open Pit

CASE STUDY

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Environmental INTELLIGENCE

- The Night Hawk Lake Mine is within the Porcupine Gold Camp, east of the downtown core of the City of Timmins
- Former gold mine
- The site is currently owned and operated by Newmont-Goldcorp, Porcupine
- The Night Hawk Lake Mine Open Pit was mined between 1995 and 1999
- U/G mining dates to early 1900s
- The site has been reclaimed and is in an advanced state of closure

Study Objectives

CASESTUDY



• Although this research has targeted arsenic as a key constituent of interest, the efficacy of batch treatment will also be evaluated more broadly in terms of overall constituent leaching and mitigation.









BENCHSCALE

Theoretical	Actual	
	Batch #1	Batch #2
3:1	2	2
5:1	3	3
10:1	7	6
15:1	10	10
20:1	14	13
	20	19

Molar ratios (Fe:As) based on an approximate 0.6 mg/L of As pitwater source concentration

BENCHSCALE



BENCHSCALE



BENCHSCALE





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FIELDTRIN

FIELDTRIM



502300 502320 502340 502360 502380 502400 502420 502440 502460 502480 502500

Water Volume: 100,000 m3 Average Depth: 10m Maximum Depth: 22m

- Water quality in the open pit is measured routinely (annually)
- Elevated levels of a number of constituents, in particular arsenic
- Gradient of arsenic observed with depth
- Pit mixes fully with depth seasonally



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LED TRIAL

- Field study completed November 5th-12th, 2018
- Two water cannons used to apply dosage of ferric sulphate.
- 10% of the 100,000 m3 pit water was recirculated while applying a 20:1 (final) dosage of ferric sulphate in the recirculated water.
- This approach required less time and smaller process equipment that will translate overall to less capital and operating costs when scaled to larger pits.

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-ELD TRIAL



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FIELDTRIAL

ELD TRUN Results Total Arsenic



ELD TRUN Results Dissolved Arsenic











Phase II Field Scale Trial Summary

Environmental INTELLIGENCE

IELD TRIAL

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- pH values similar to pre-treatment
- Effective arsenic removal at surface and mid depths after 5 days of application
- Some cobalt removal at surface
- Monitoring the performance and behaviour of arsenic and iron over time is warranted



NHLP Modelling

Modeling









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Modeling

Scale Up using McEwen's Black Fox Mine Modelling



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Modeling



Black Fox Mine Summary

MODELLING

- Conceptual cost trade-off comparing conventional treatment to batch treatment strategies
- Costs were discounted using NPV with 3% discount rate model run for 160 years
- Integrating the pit into the water management strategy and utilizing in situ batch treatment provided opportunity for significant cost savings (3- to 4-times cost reduction over conventional WTP), without compromising environmental protection
- Closure Plan submitted for regulatory review with in situ batch treatment as the primary long term water quality management strategy
- Closure Plan has been accepted and "filed"



Next Steps Summary

NEXTSTEPS

- Using Environmental Intelligence allowed for alternative ways to manage water on site
- Monitoring program ongoing to evaluate long term performance of the insitu batch treatment
- Develop modelling scenarios to determine when batch treatment will be beneficial and when a water treatment plant may be optimal
- Follow up on the potential redox cycling to verify that it is a "closed" cycle and will not disrupt the clean surface water quality.
- Sludge stability test work suggested as part of this follow-up as the treatment solids settle (previous test work suggests the treatment sludge is not an ongoing source issue)



Thank You

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