Giant Mine Remediation Project

Water Treatment

Outline

- Underground Water
- Water Treatment Plant (WTP)
- Work activities
- Process & Layout
- Bench scale tests
- Sludge Characterization

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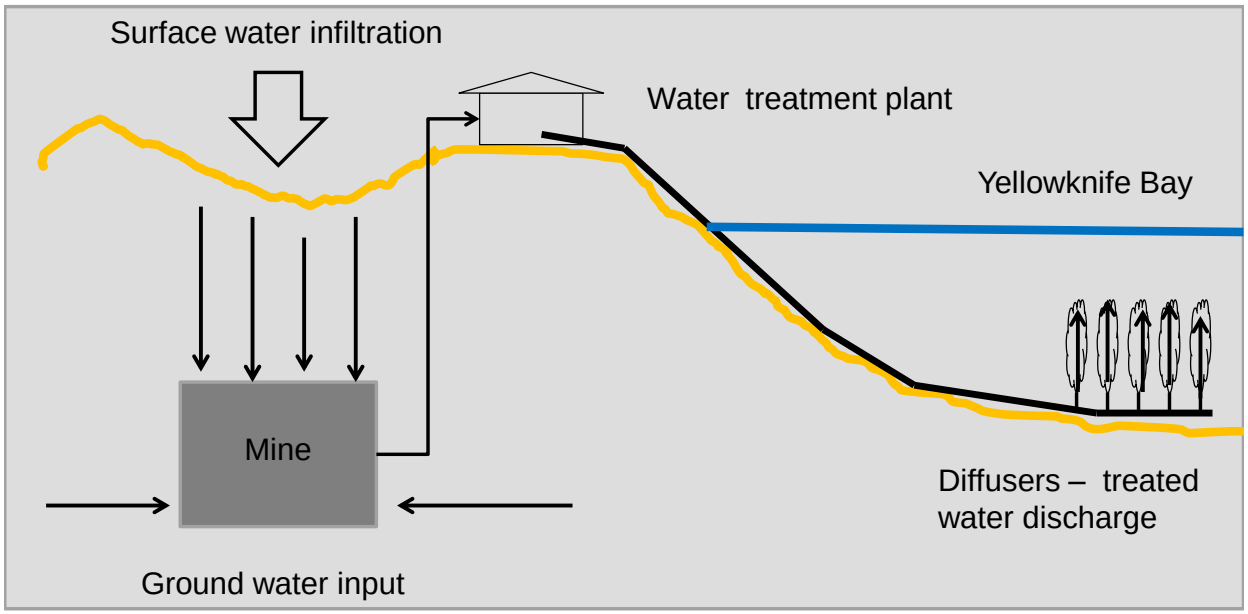
Overview Mine Water – Collection – Treatment – Discharge



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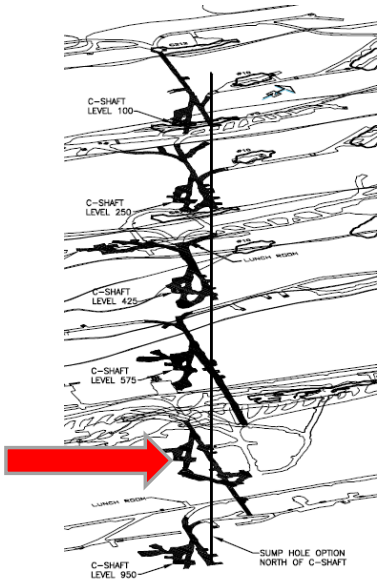
Yearly Volumes To Be processed (m3)

	Average Year	Wet Year
Pre-Freezing	630,000	822,200
DAR	540,000	
Post Freezing	404,300	517,500
DAR	345,000	

Initial Raw Water Pump Placement

- 25 m below 750 level near C Shaft
  - Current water level 10 m below 750 at C Shaft



Design Criteria

Flows & Storage			
Short-Term			
	Average Treatment Flow Rate	26.0	L/s
	Peak Wet Year Flow Rate	33.9	L/s
	Maximum Equalization Storage Volume Required	177,000	m^3
Long-Term			
	Average Treatment Flow Rate	16.7	L/s
	Peak Wet Year Flow Rate	21.3	L/s
	Maximum Equalization Storage Volume Required	0	m^3

Minewater Quality

- Parameters of Concern
  - Arsenic
  - Suspended Solids
  - pH
  - Zinc

- Sampling & Monitoring Program
  - High test (up to 7300 mg As/L)
  - Blended water to surface (est. up to 280 mg As/L)

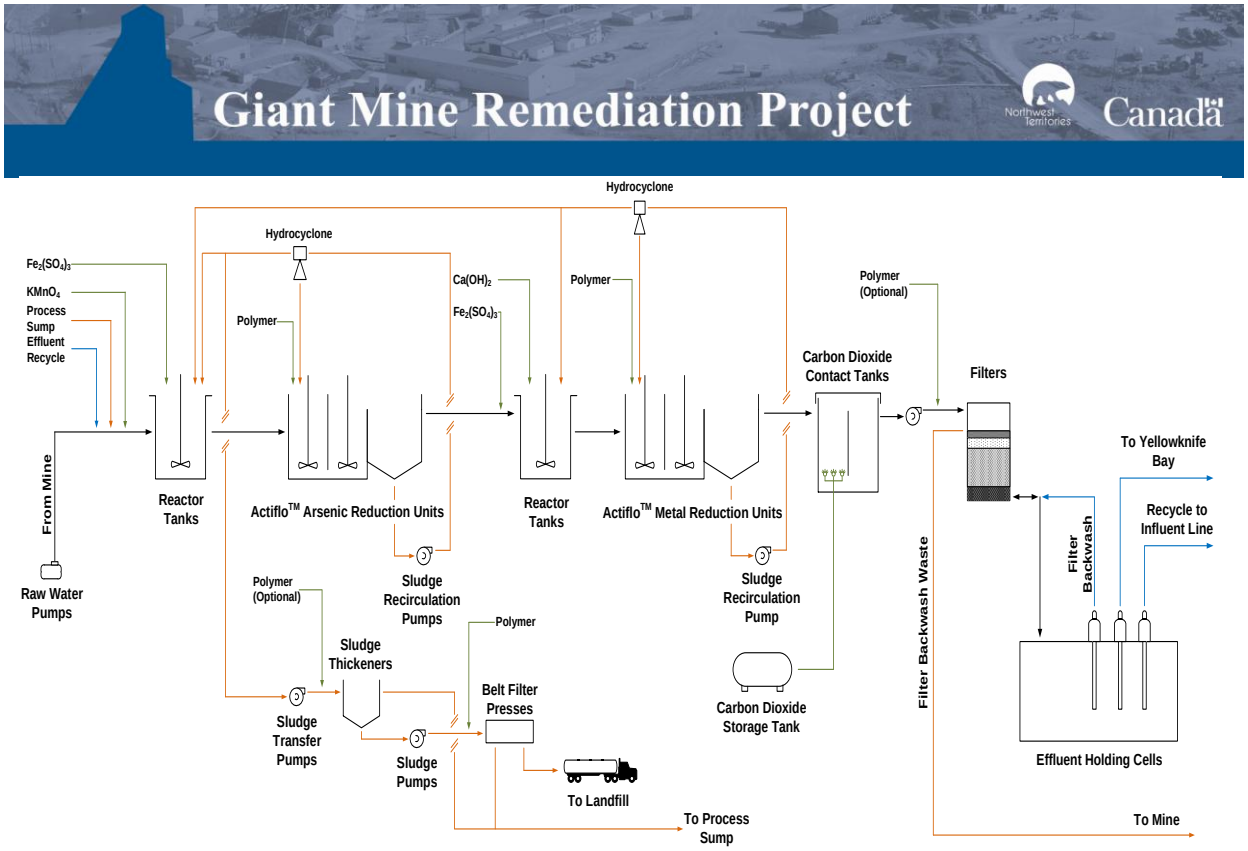
Performance Criteria

Parameter	Existing Treatment Plant Effluent (2009-2010 data)	New Treatment Plant Effluent (Predicted)	Maximum Average Concentration[a) (b)]	Unit
Ammonia	0.005 – 0.067	No change	12	mg/L
Arsenic (total)	0.205 – 0.418	0.20 target	0.50	mg/L
Total Suspended Solids	<1.0 - 14	<5 (target)	15	mg/L
Nickel	0.0234 – 0.0687	No change	0.50	mg/L
Cyanide	<0.002 – 0.0145	No change	0.80	mg/L
Copper	0.0054 – 0.0162	No change	0.30	mg/L
Lead	<0.0001 - <0.00025	No change	0.20	mg/L
pH	6.24 – 8.96	7.5 – 8.0 (target)	6.5-9.5	units
Radium 226	<0.005 - <1.0	No change	0.37	Bq/L
Zinc	0.0028 – 0.0713	No change	0.20	mg/L
Oil & Grease	0.005 - <2.0	No change	5	mg/L

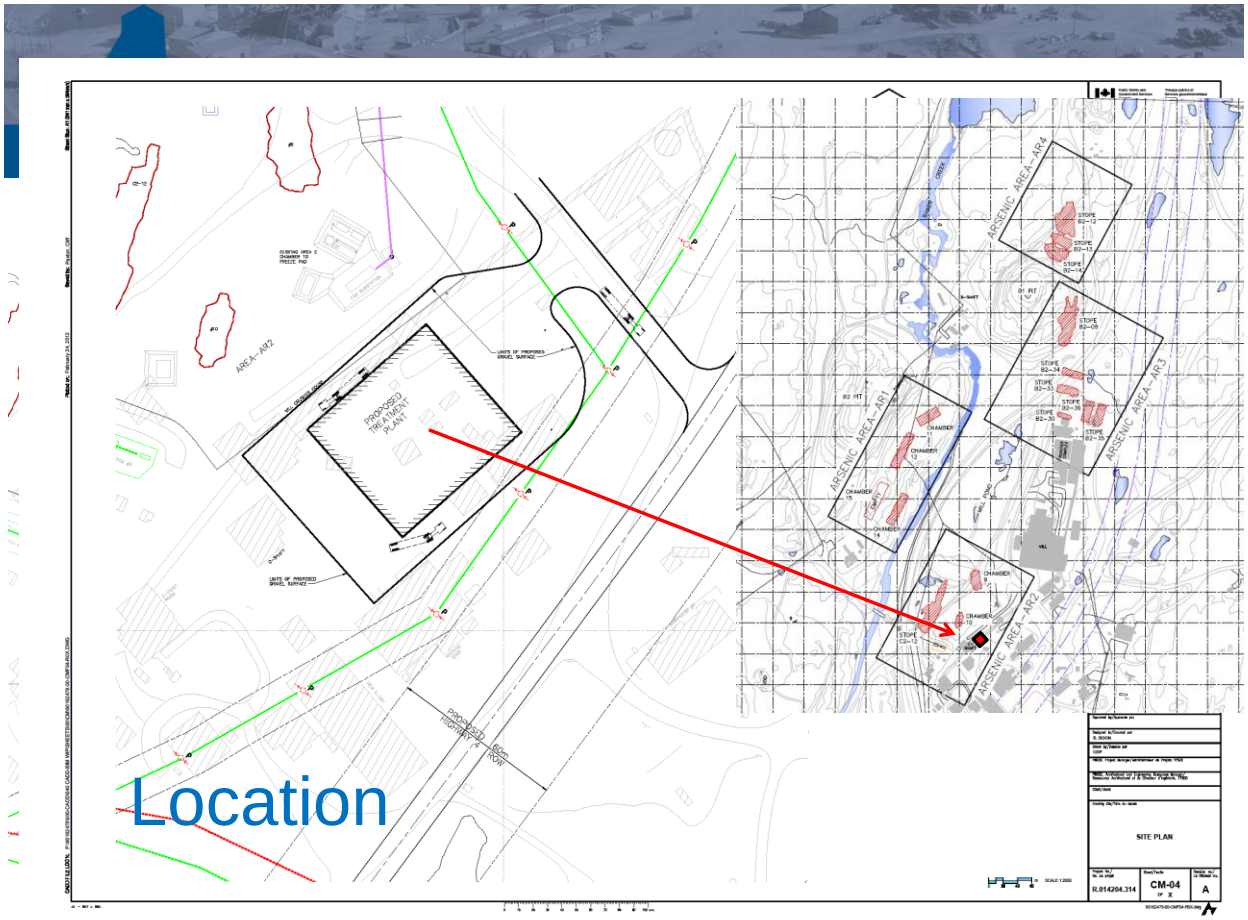
(a) Based on the former water licence (N1L2-0043) for the existing treatment plant
(b) Maximum rolling average of four consecutive results

- Three main steps in arsenic removal
  - Oxidation of arsenite to arsenate
    - $3H_3AsO_3 + 2MnO_4^- \longrightarrow 3H_2AsO_4^- + 2MnO_2 + H_2O + H^+$
  - Precipitation of arsenate
    - $Fe^{3+} + AsO_4^{3-} \rightarrow FeAsO_4$
  - Removal of precipitate
    - Clarification and filtration

Process Design



Process Design – Process Flow - BAT


Location
PROPOSED TREATMENT PLANT
AREA-AR2
ARSENIC AREA-AR1
ARSENIC AREA-AR2
ARSENIC AREA-AR3
ARSENIC AREA-AR4
SITE PLAN
CM-04
R.914204.314

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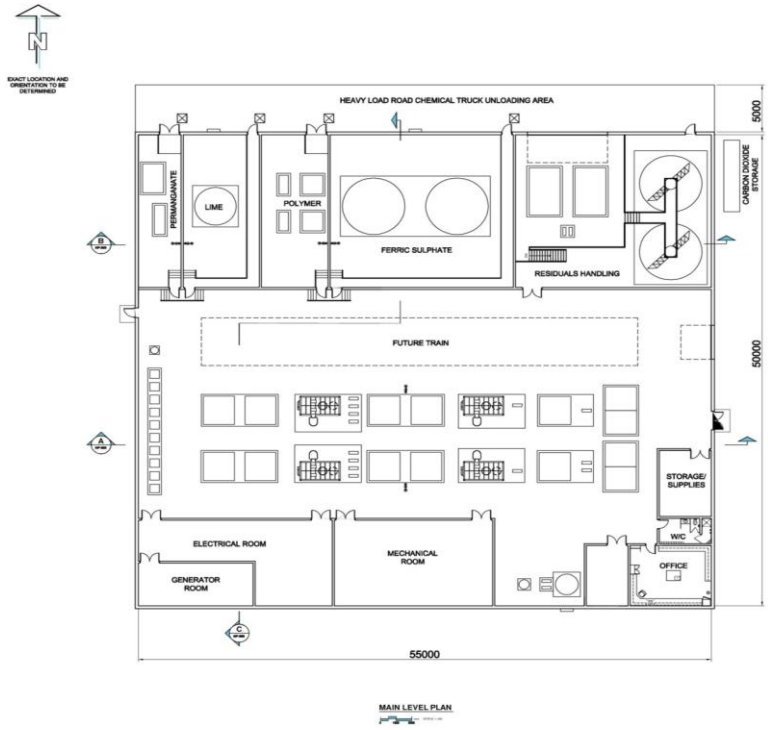

Layout - Plan view

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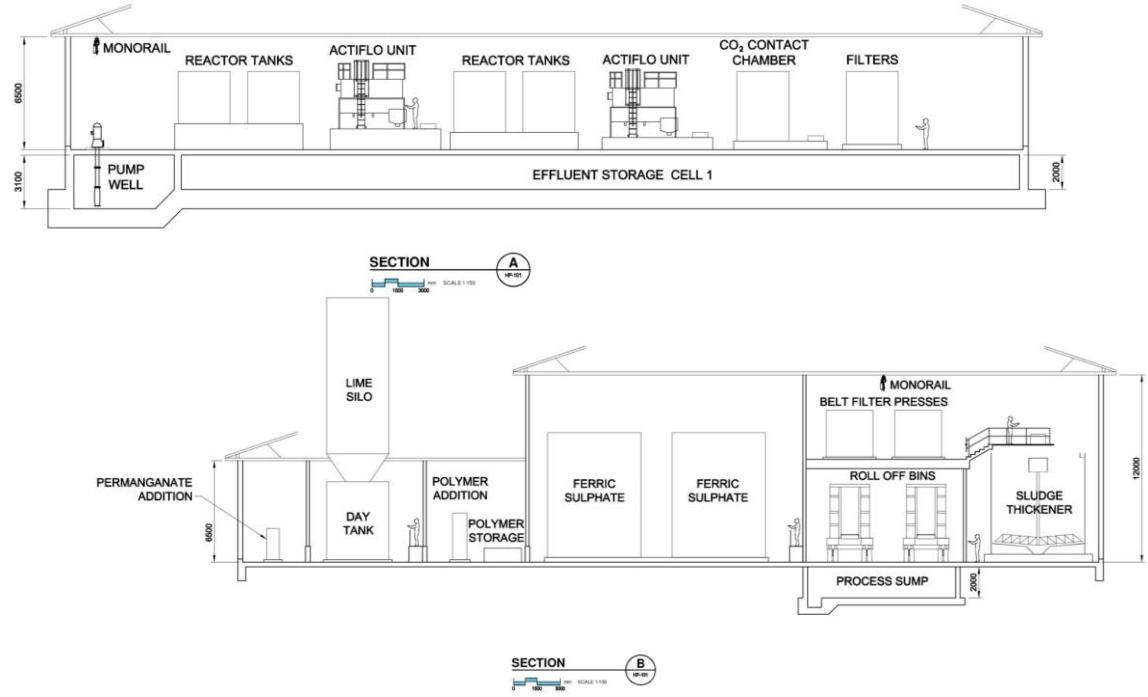
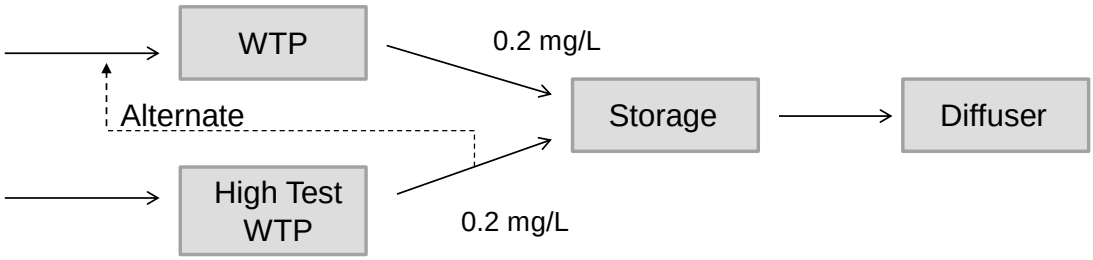


Potential High Test WTP Component

- Continued review of a potential separate treatment segment specifically designed to treat high test water.
- Detail design of WTP is to consider the benefits of:
  - Retaining the high test piping system & possibly expanding it
  - A separate treatment segment specifically designed to treat high test water until freeze is completed



Bench Scale Tests

- Jar tests are extension of preliminary design activity
- Jar tests were carried out in Edmonton – March 19 to 23, 2012
- Objectives
  - Process Verification
  - Refine recommended treatment system
  - Precursor to pilot trials
  - Confirm chemical choice/process settings
  - Achieve total Arsenic < 0.1 mg/l
  - Residuals sampling
  - Parallel bench scale tests at manufacturers site (April 10 to 24, 2012)

Main Results

- Two step process required (i.e. oxidation/coagulation and lime precipitation
- Pilot trials identified process achieves total As concentration below 0.2 mg/l
- Confirmed proposed treatment chemicals
- Achieved optimized chemical dose rates
- Lowest chemical dose rates obtained with process alternative (i.e. lime precipitation followed by oxidation/coagulation)
- Confirmed treatment process for next level of design

Sludge Characterization

- samples of the sludge generated from the ETP and deposited in the settling pond were sampled on March 12, 2012
- Composite sample collected using a backhoe reaching into the sediments at the base of the settling pond
- Leachable arsenic analysis performed

	ETP Sludge	
Sample Number	Total Arsenic Detection Limit of 0.10 mg/kg	Leachable Arsenic (TCLP) Detection Limit of 0.20 mg/L
S.P. 1	17,400 mg/kg	0.23 mg/L
S.P. 2	22,700 mg/kg	<0.20 mg/L

- Sludge not classified as a hazardous waste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