

Dominion Diamond Corporation

Jay Project – Water
Quality Modelling
Workshop

July 6, 2015

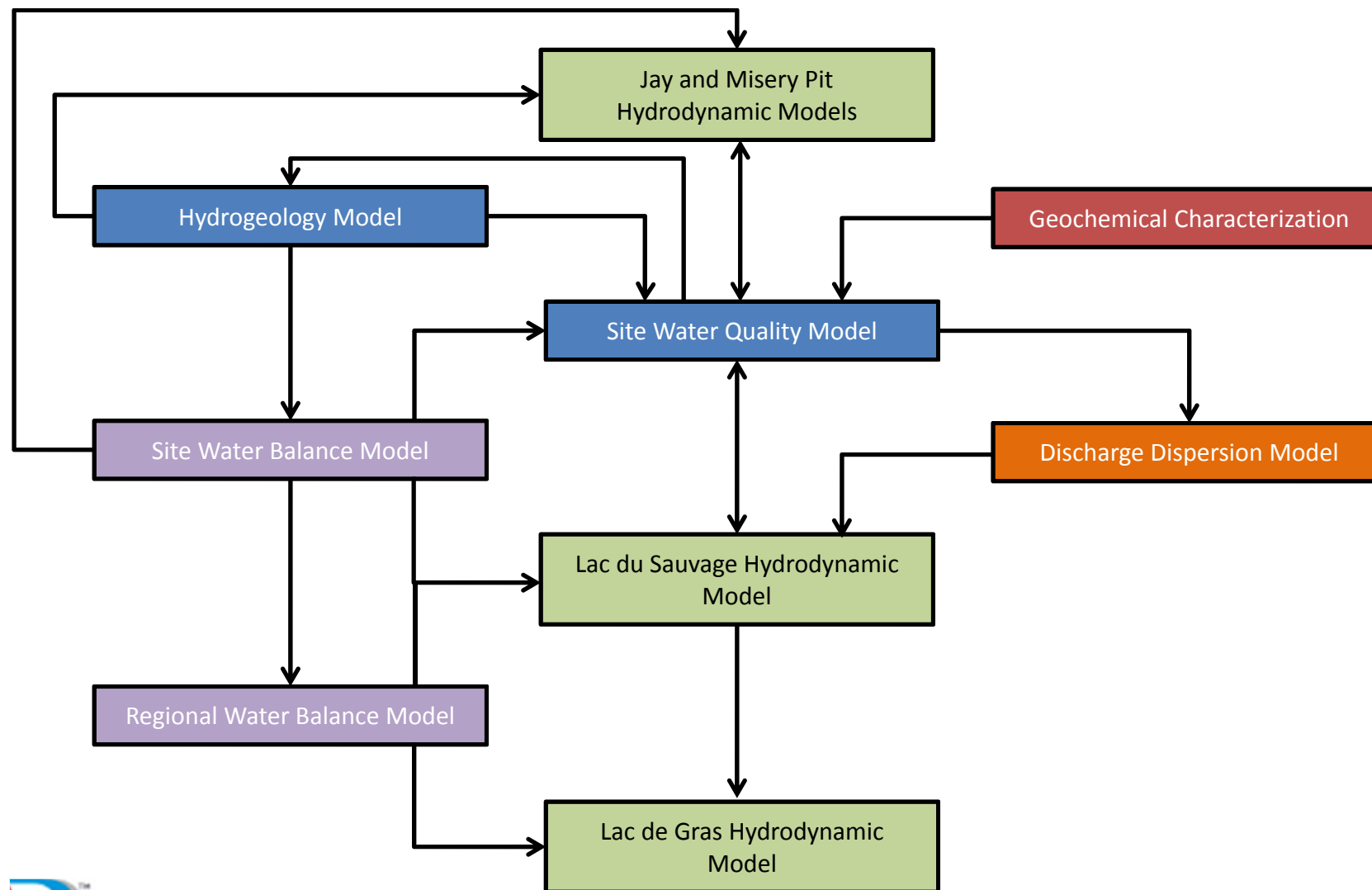


Outline

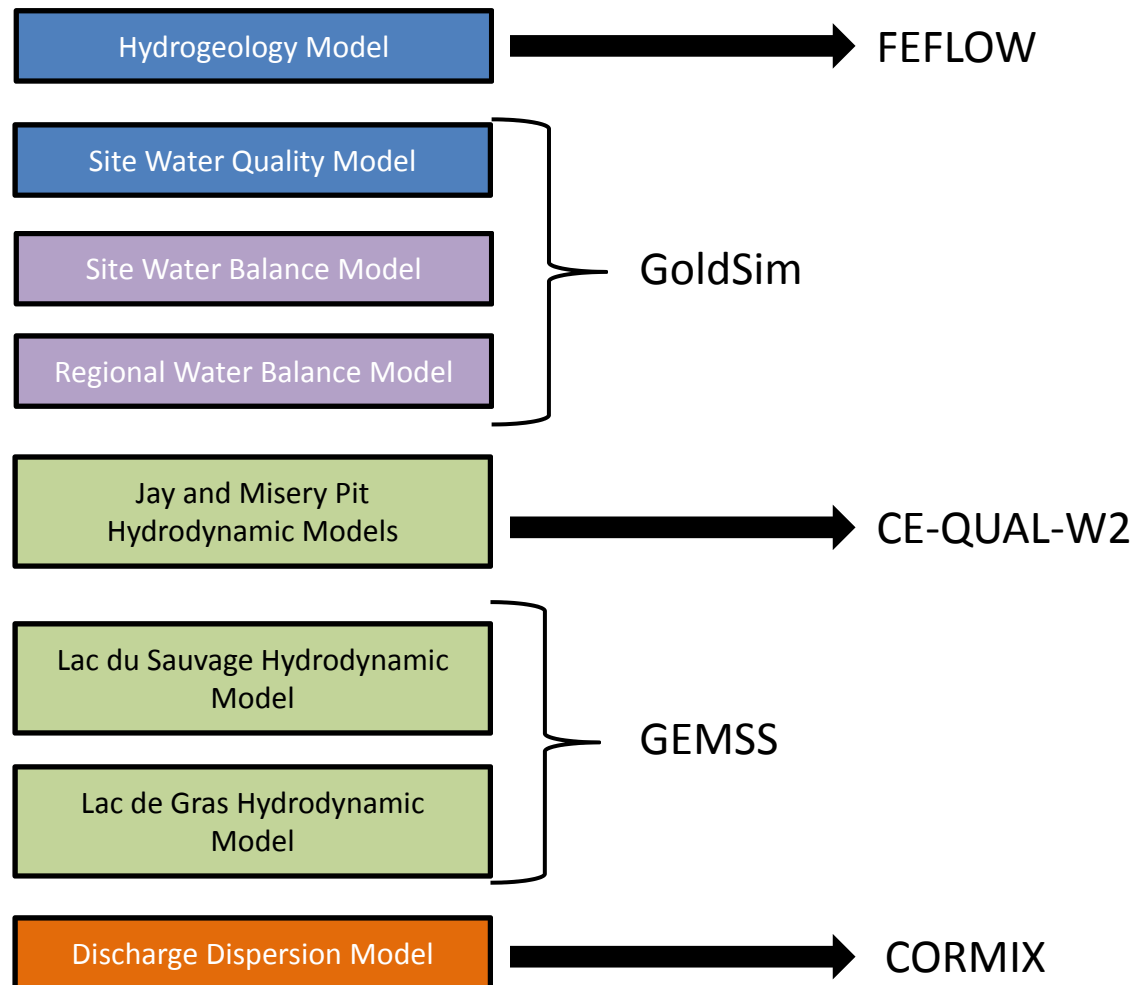
- Model Linkages
- Pit Lake Water Quality Modelling
- Model Scenarios
- Lower Bound Scenario
- Hydrogeology – Uncertainty Analysis

MODEL LINKAGES

Model Linkages

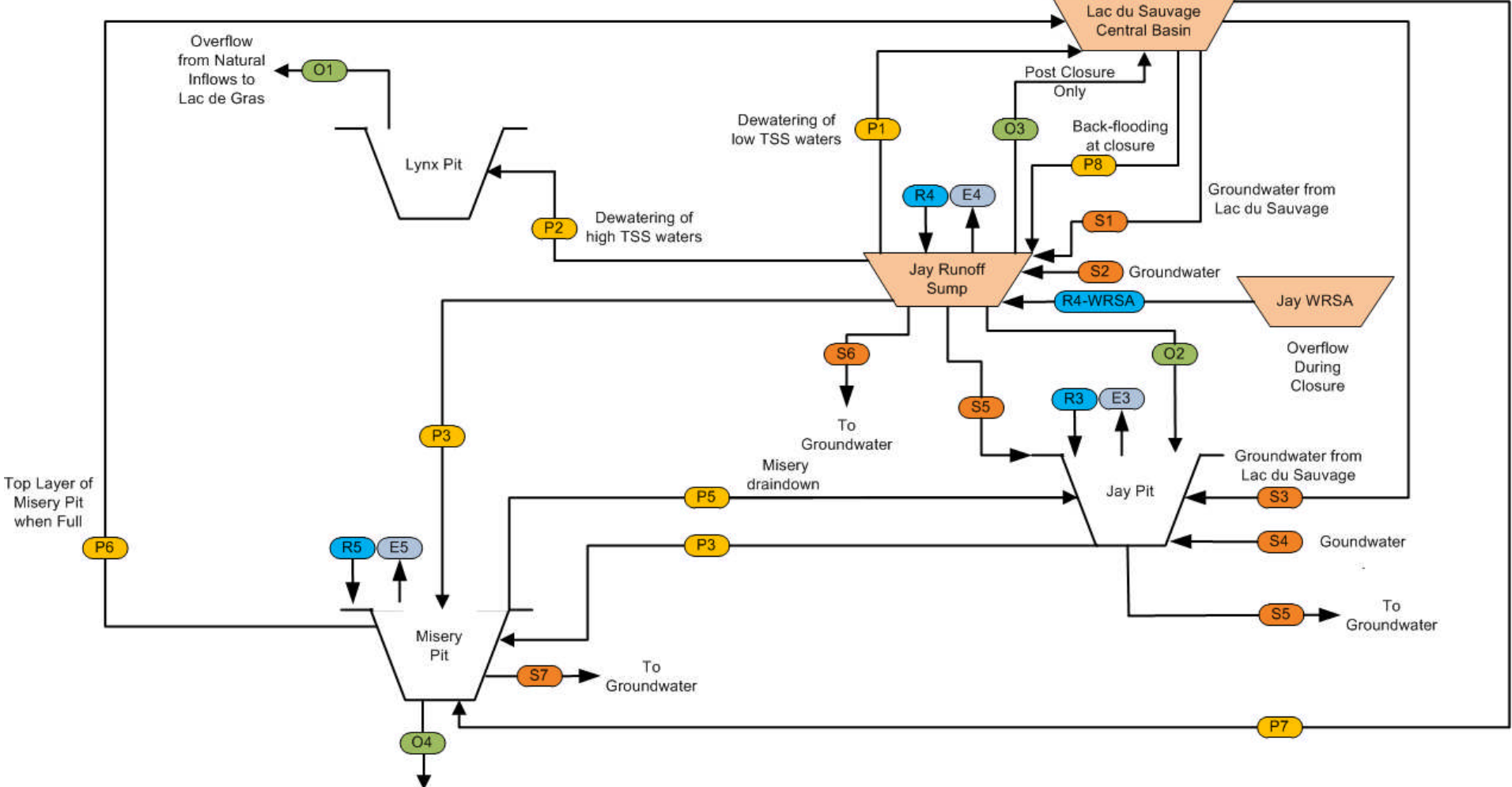


Model Linkages

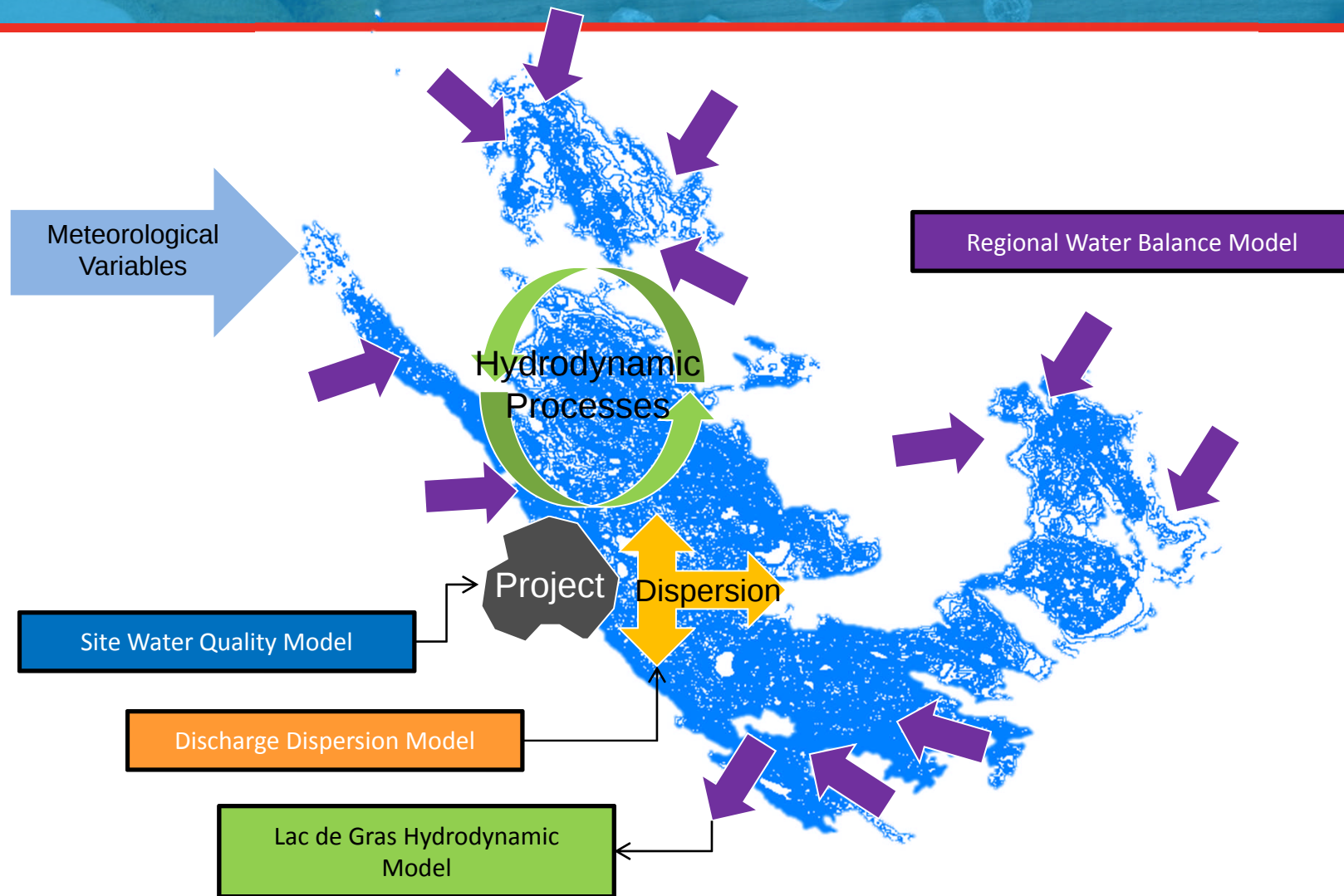


- Models were identified to simulate specific processes
- Each model is interlinked at key times and nodes
- Models are interdependent
- Approach consistent with other mines in NWT (Vandenberg et al. 2015)

Site Water Quality Model



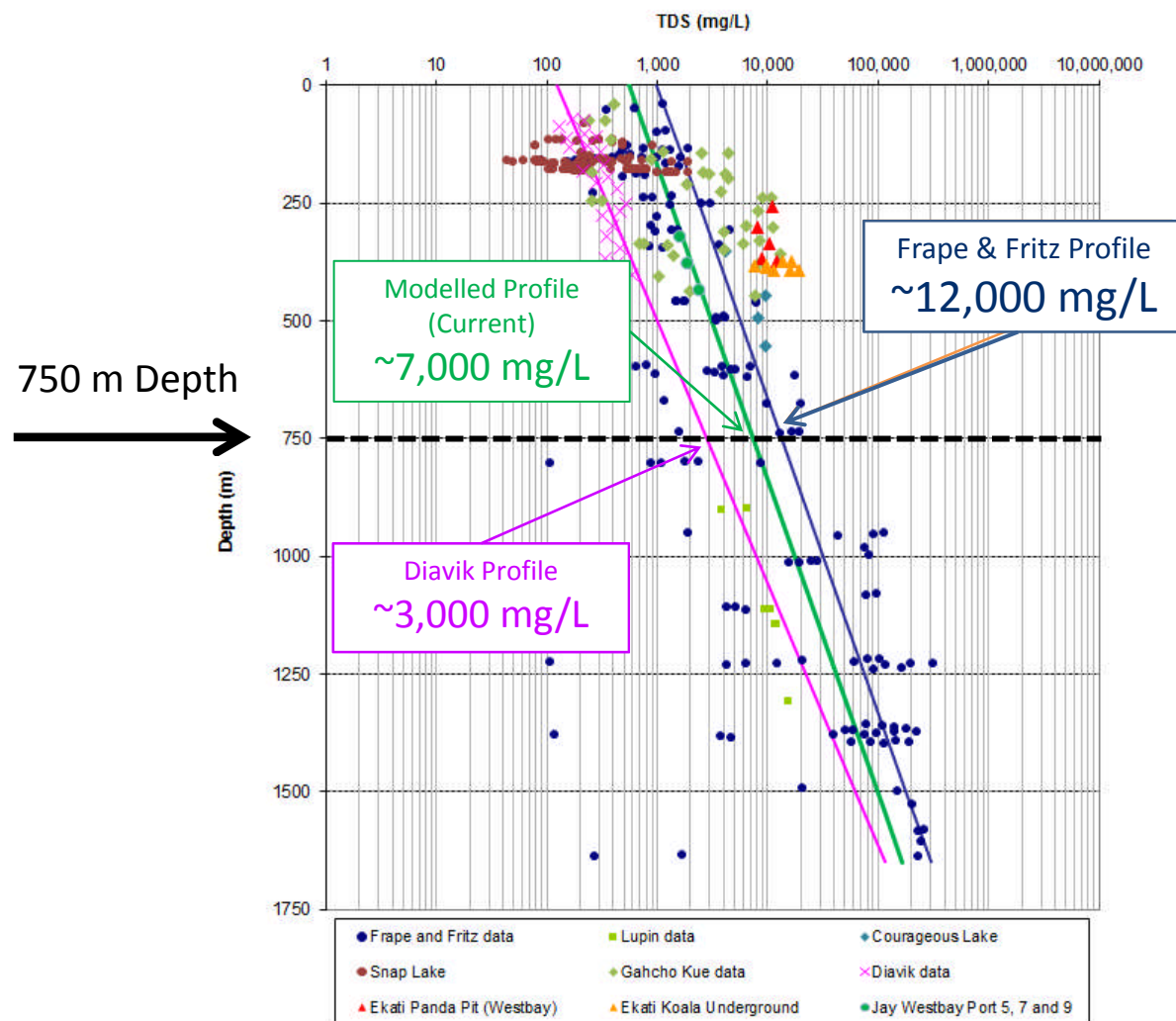
Lake Models





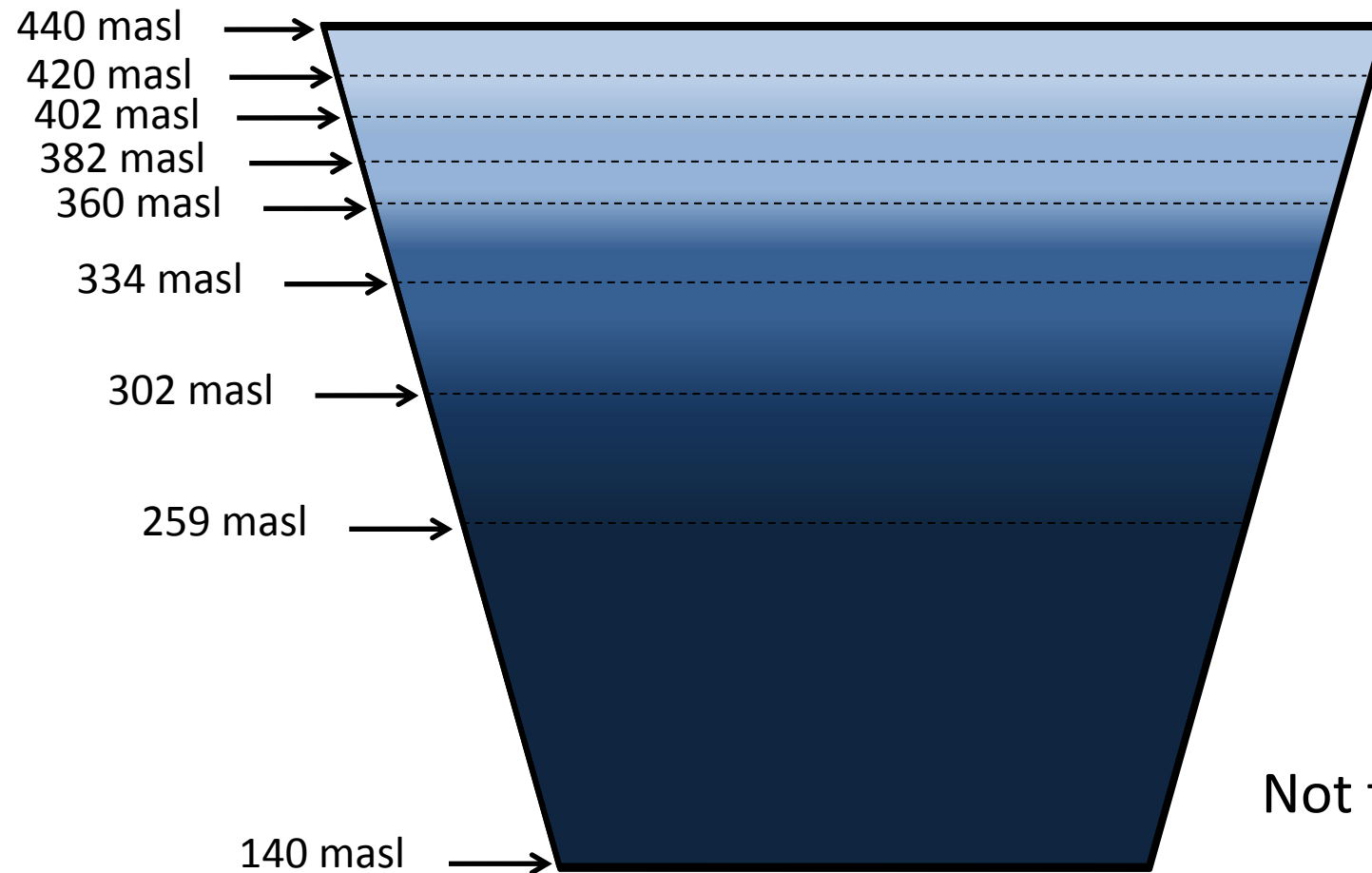
PIT LAKE WATER QUALITY MODELLING

Groundwater Profile



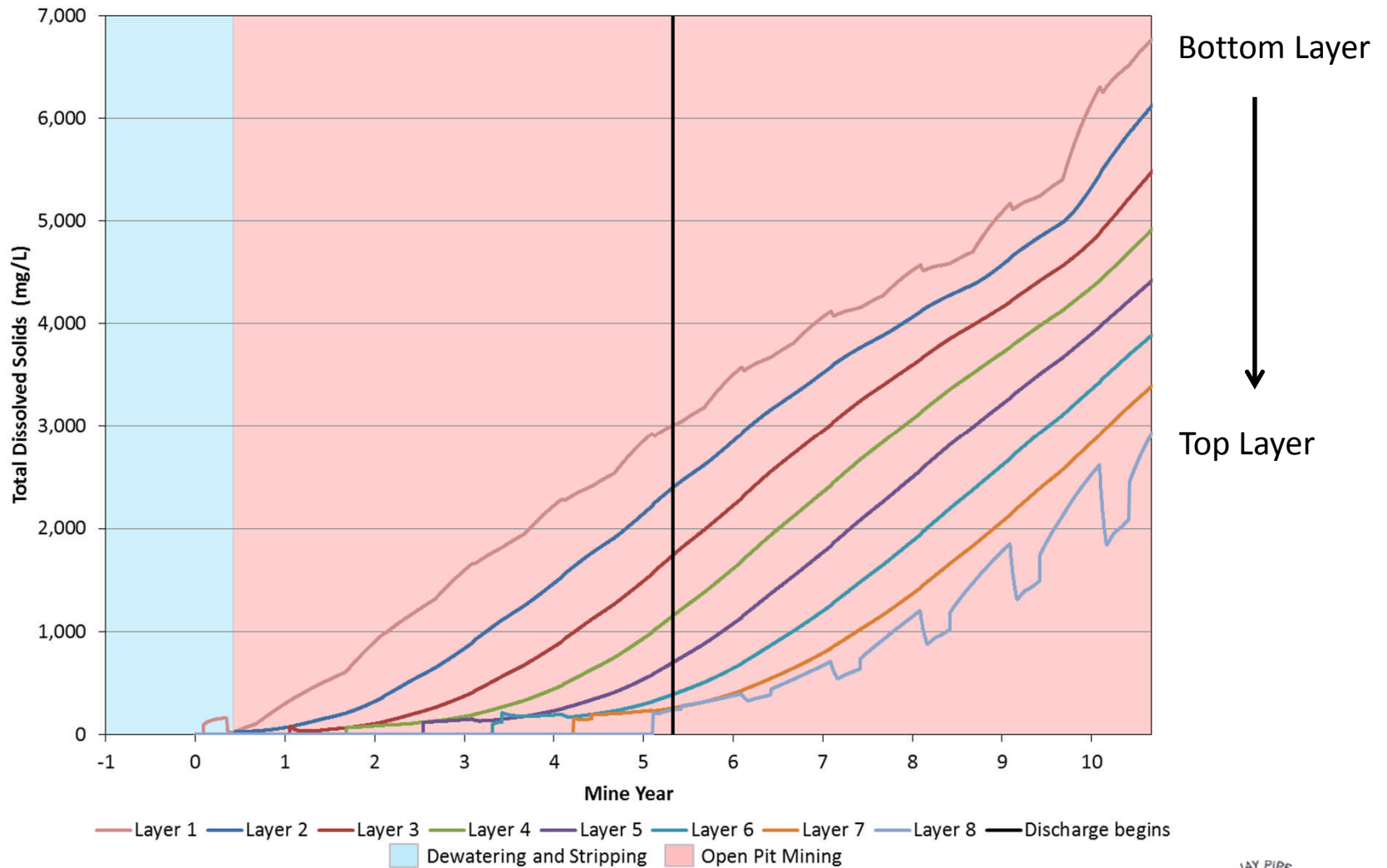
Misery Pit Conceptual Model - Operations

Conceptual Pit Lake Stratification

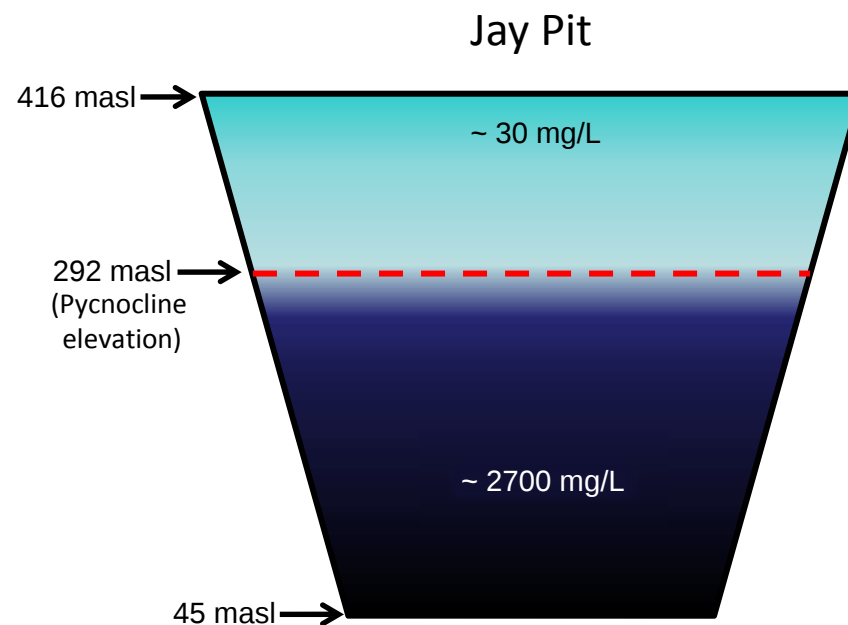
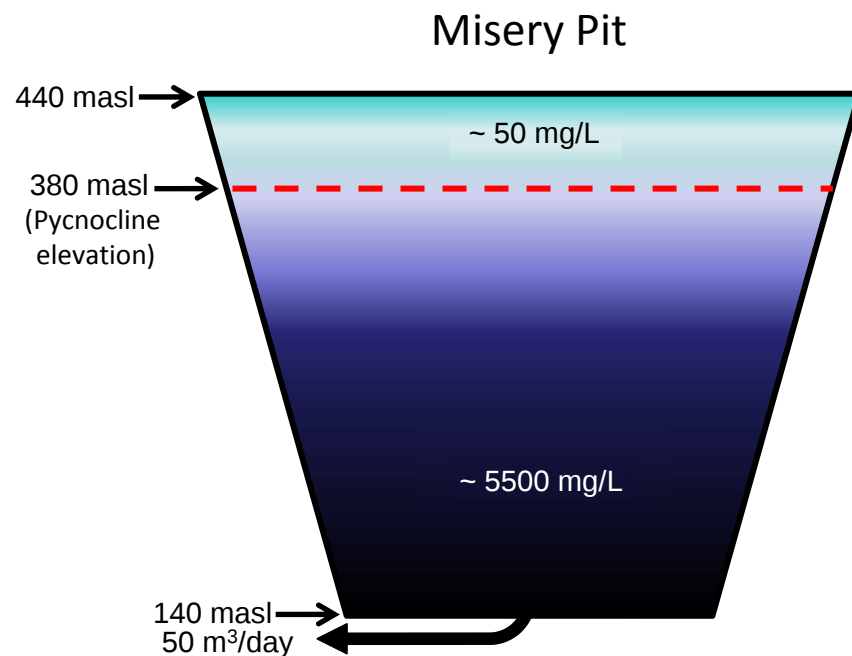


Not to Scale

Misery Pit Water Quality – Updated Assessment Case

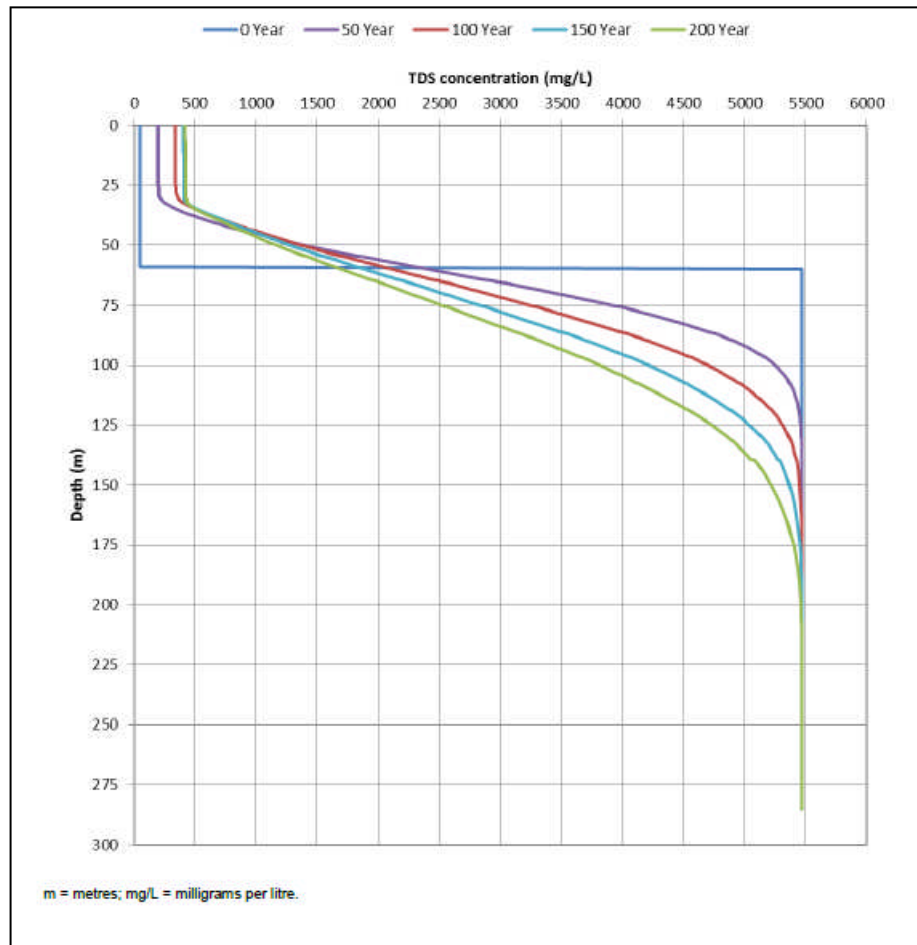


Pit Lake Conceptual Model - Post-Closure Updated Assessment Case

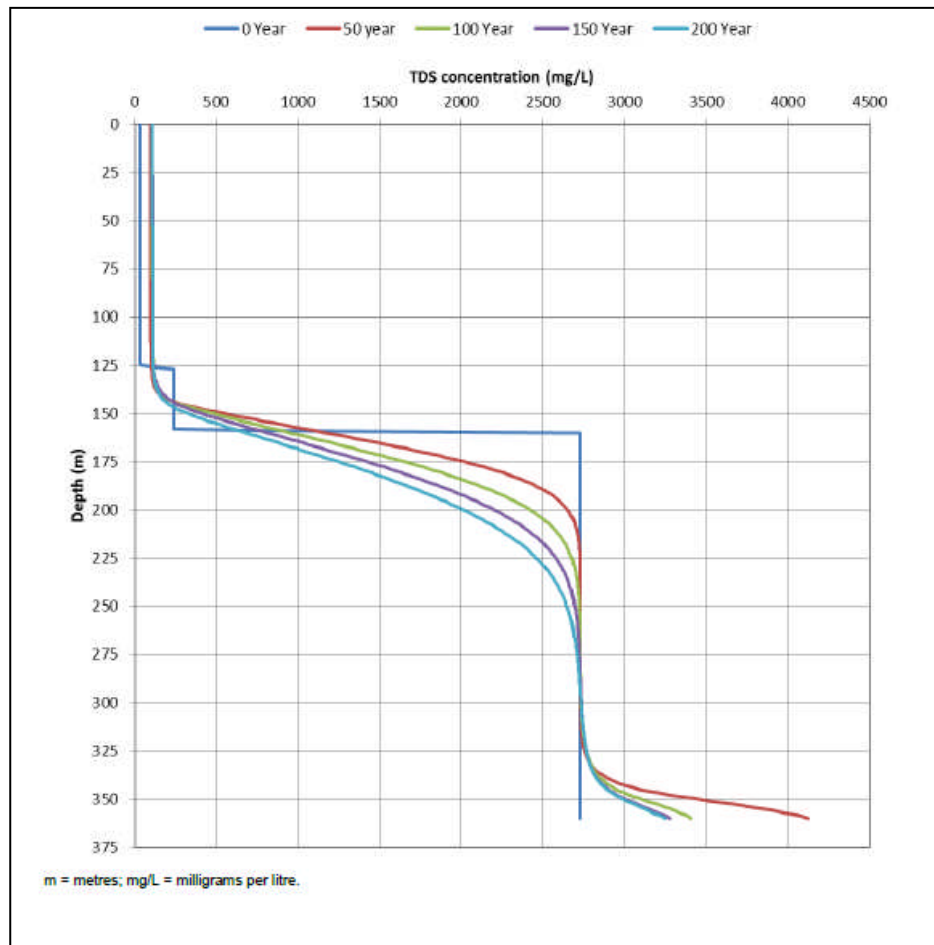


Not to Scale

Hydrodynamic Water Quality Model Results – Updated Assessment Case



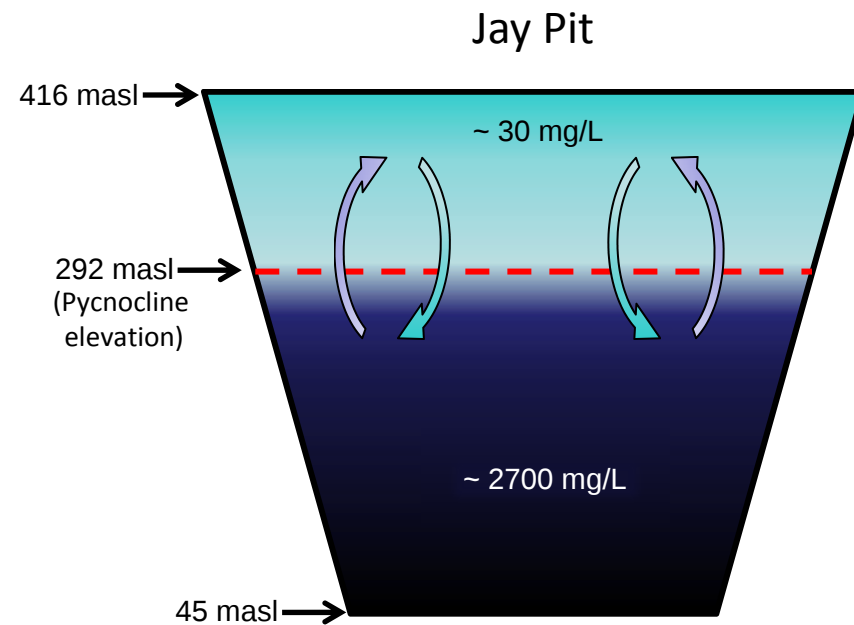
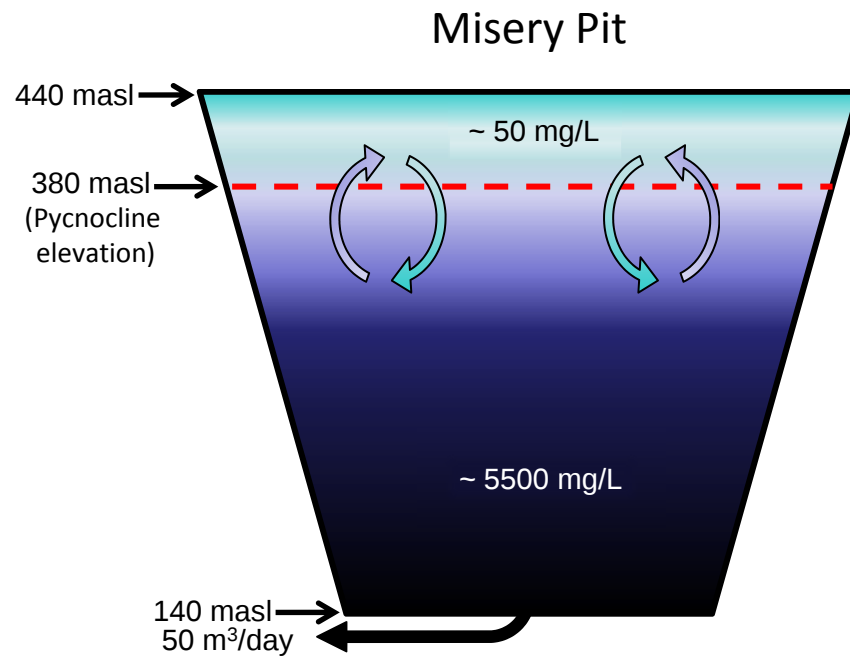
Misery Pit



Jay Pit

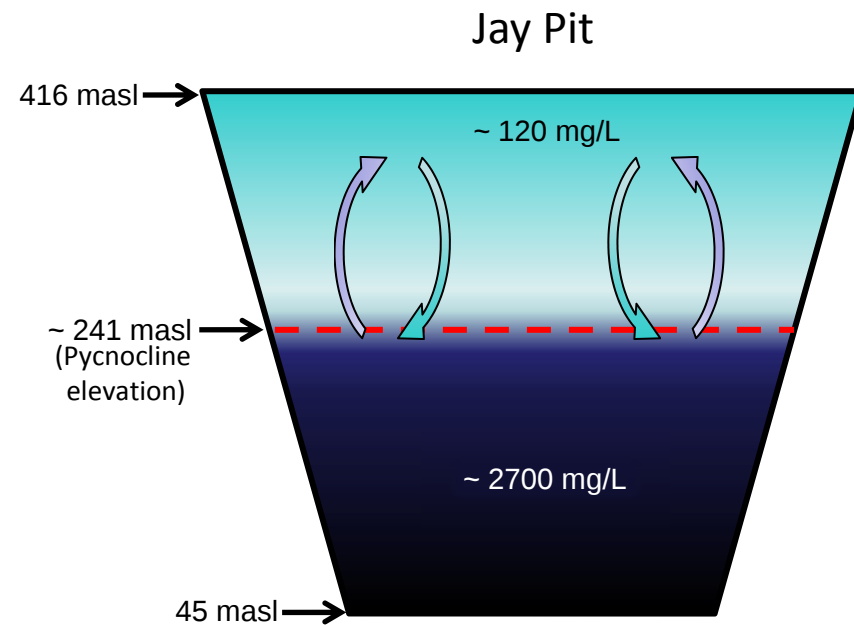
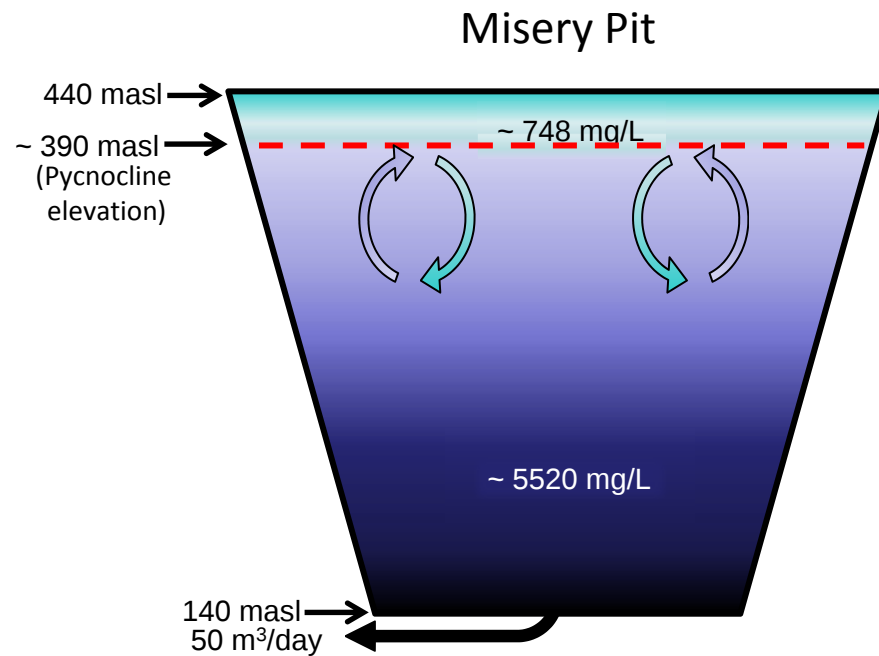


Pit Lake Conceptual Model - Post-Closure Updated Assessment Case



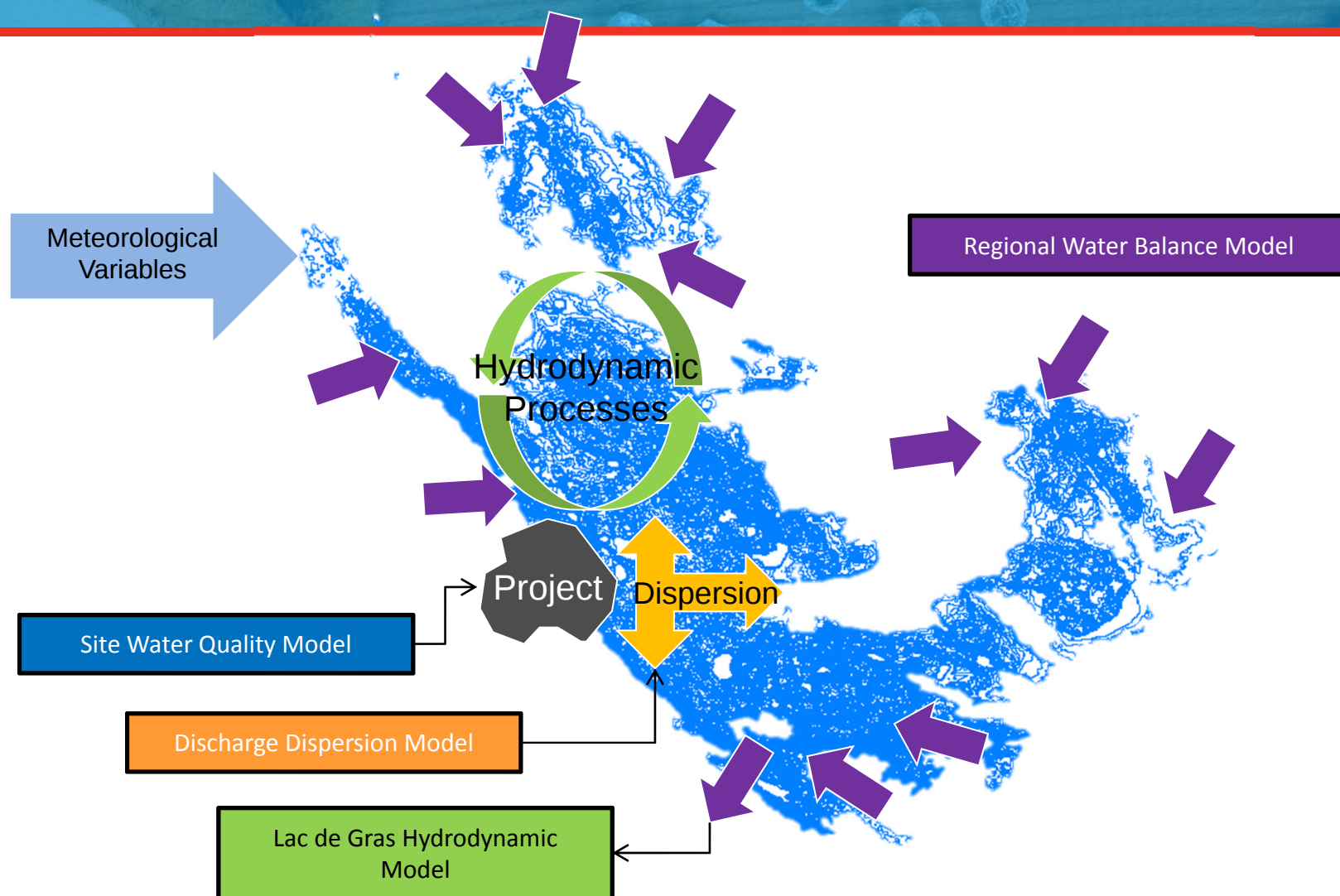
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Pit Lake Conceptual Model - Post-Closure Updated Assessment Case

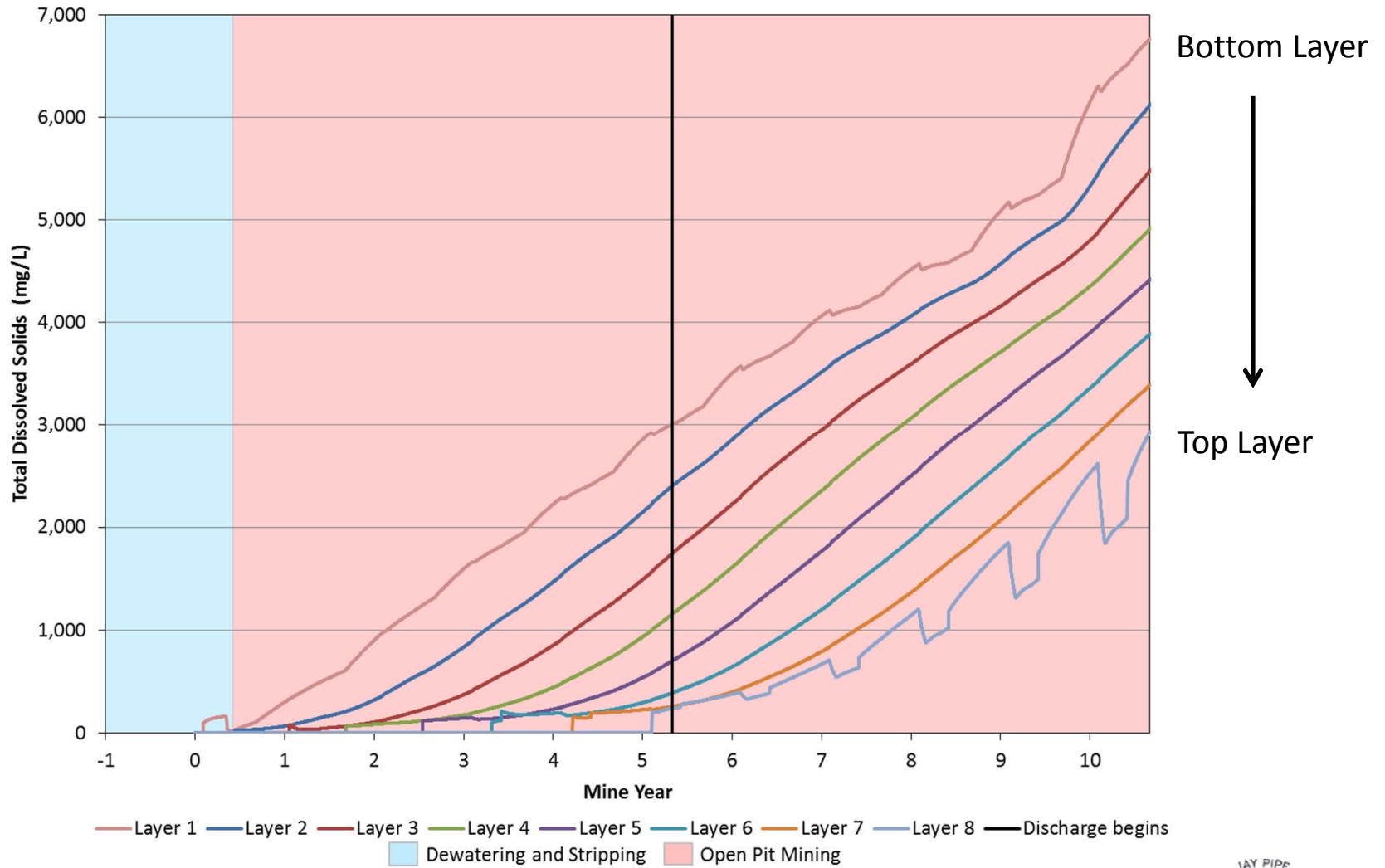


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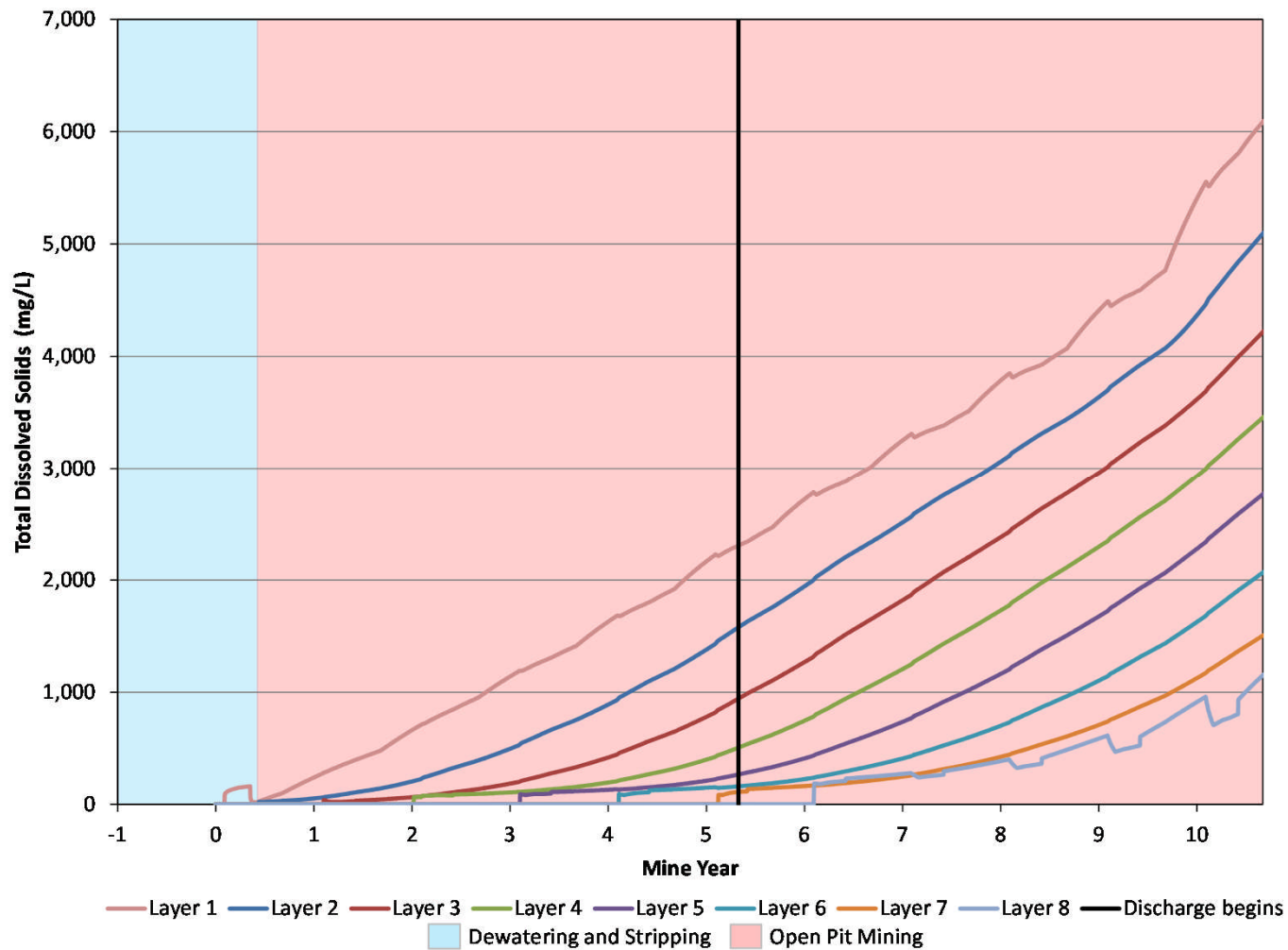
Lake Models



DAR Case



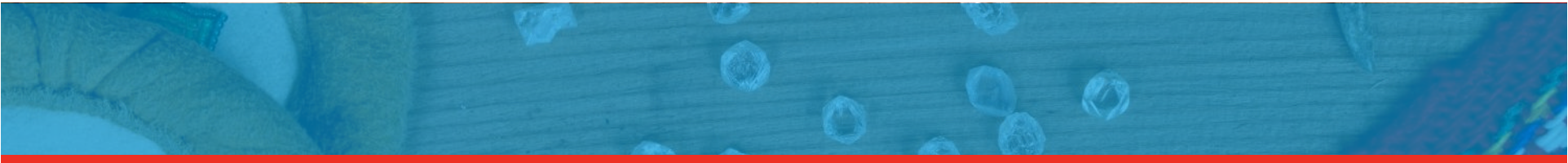
Reasonable Estimate Case



Bottom Layer



Top Layer



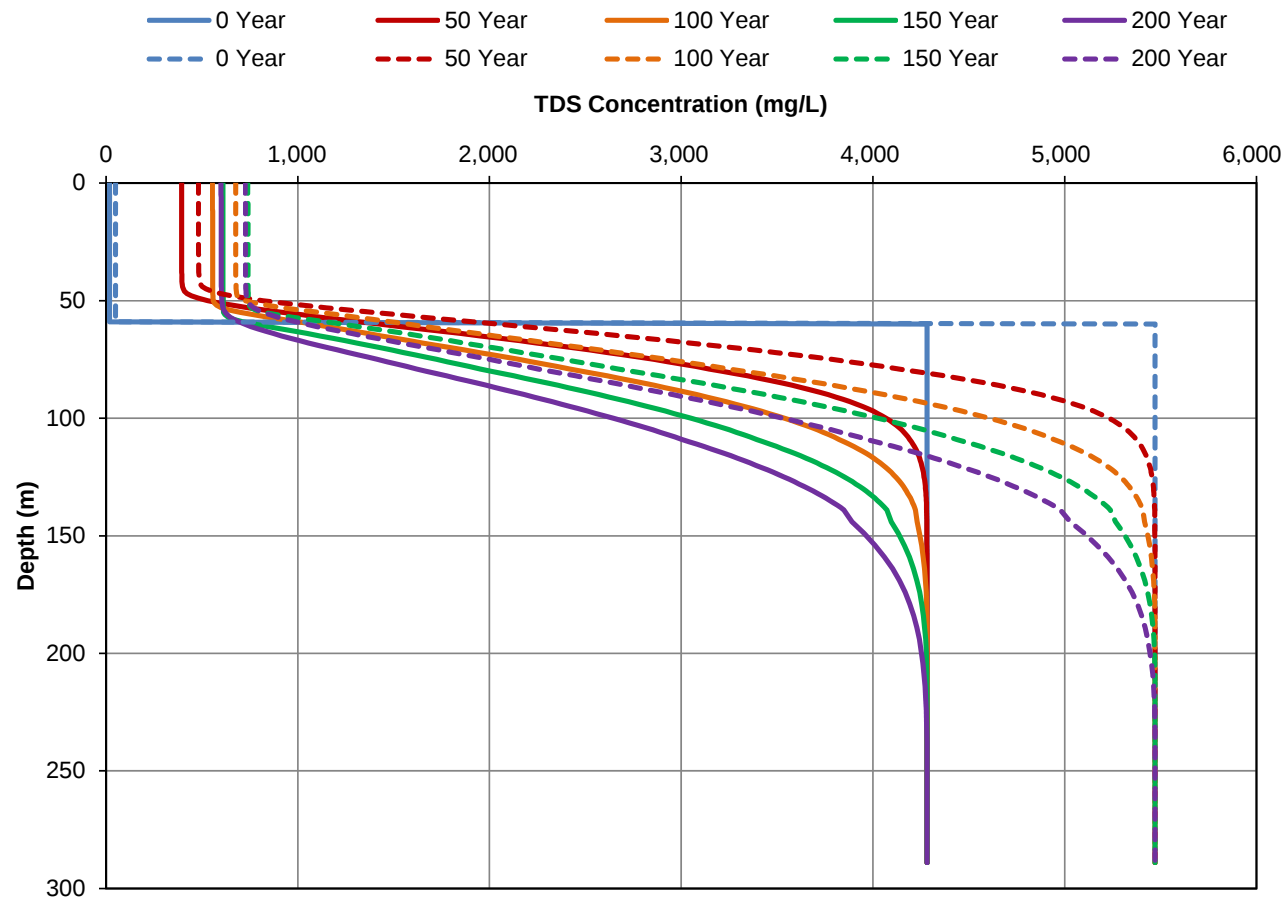
MODEL SCENARIOS

Model Scenarios

Model	Description
Updated Assessment Case	Updated Diavik discharge flows and modifications to Pit Lake Model Assumptions
Reasonable Estimate Case	Model to provide a more likely but less conservative (i.e., expected) estimate of Project discharge water quality Less conservative than the DAR case
Lower Bound Scenario	Model to evaluate meromixis in the Jay and Misery Pits considering lower inflows to the Jay Pit and resultant lower concentrations in Misery Pit

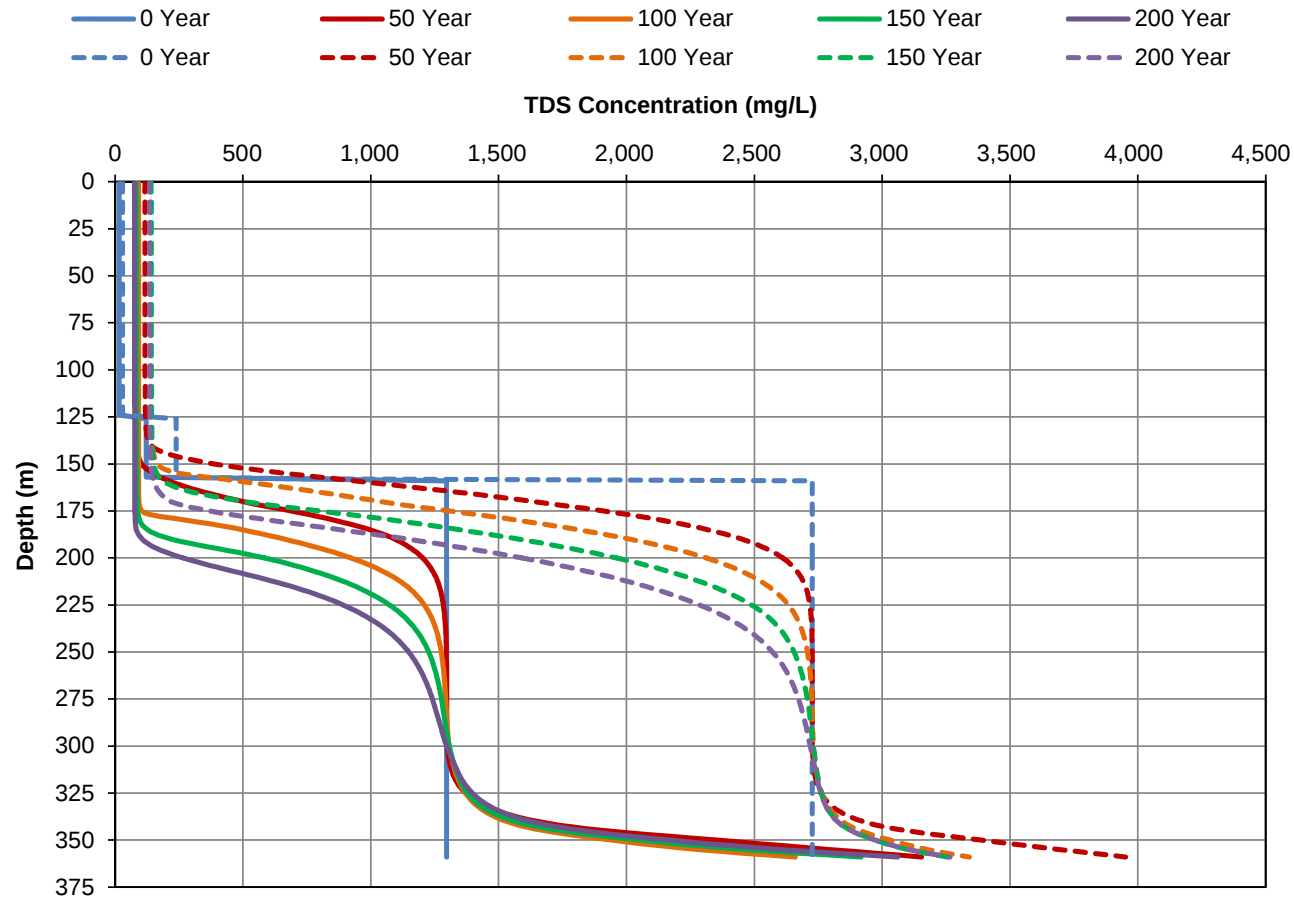
Hydrodynamic Modeling Results – Reasonable Estimate Case

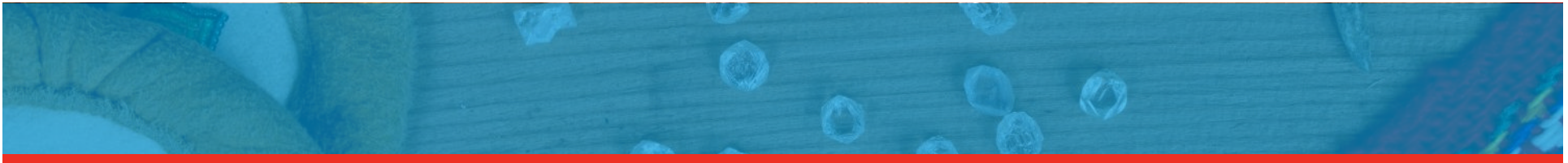
Misery Pit



Hydrodynamic Modeling Results – Reasonable Estimate Case

Jay Pit

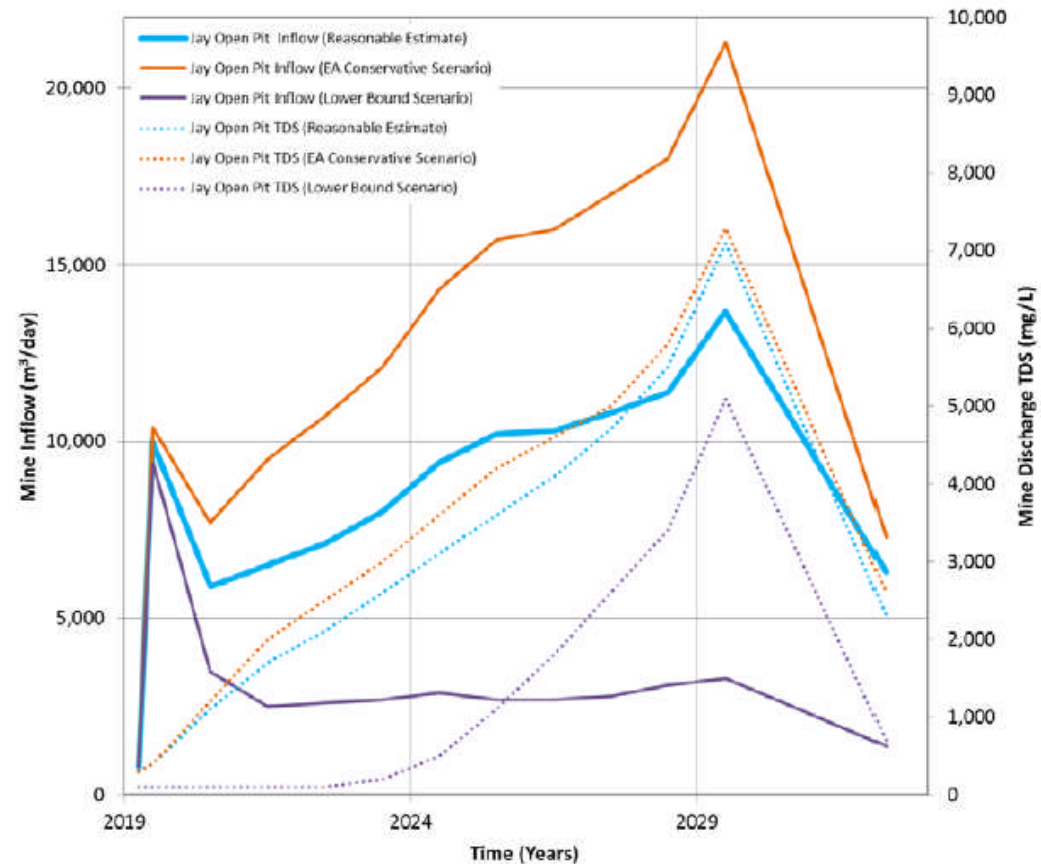




LOWER BOUND SCENARIO

Lower Bound Scenario

- Enhanced Permeability Zone (EPZ) reduced to 20 metres
- Porosity reduced to 0.005
- Hydraulic conductivity of the EPZ reduced to 1×10^{-6} m/s
- Projected groundwater quantity and quality carried forward into site water quality model and hydrodynamic models

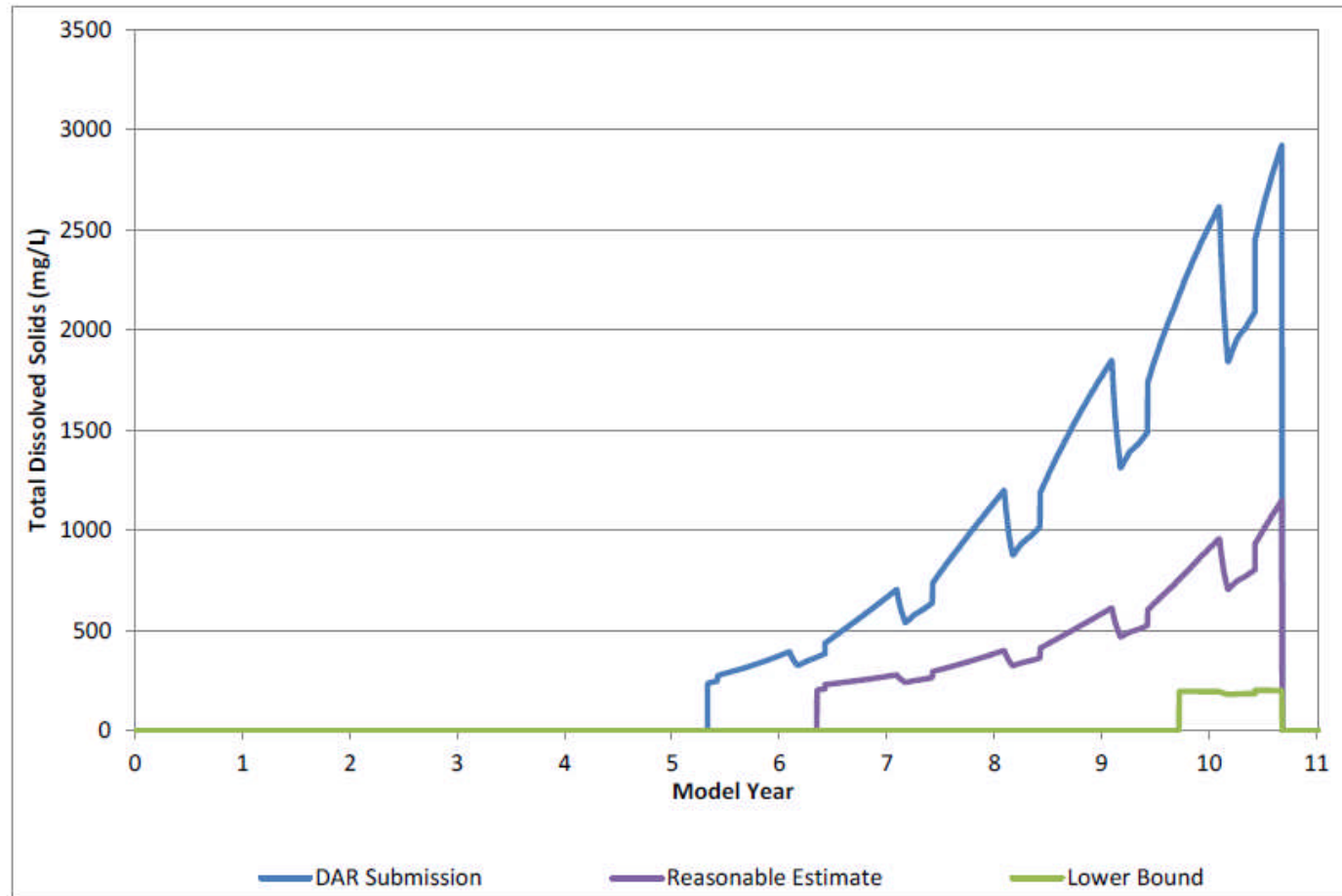


m³/day = cubic metres per day; mg/L = milligrams per litre

July 13, 2015



Misery Pit Discharge Water Quality



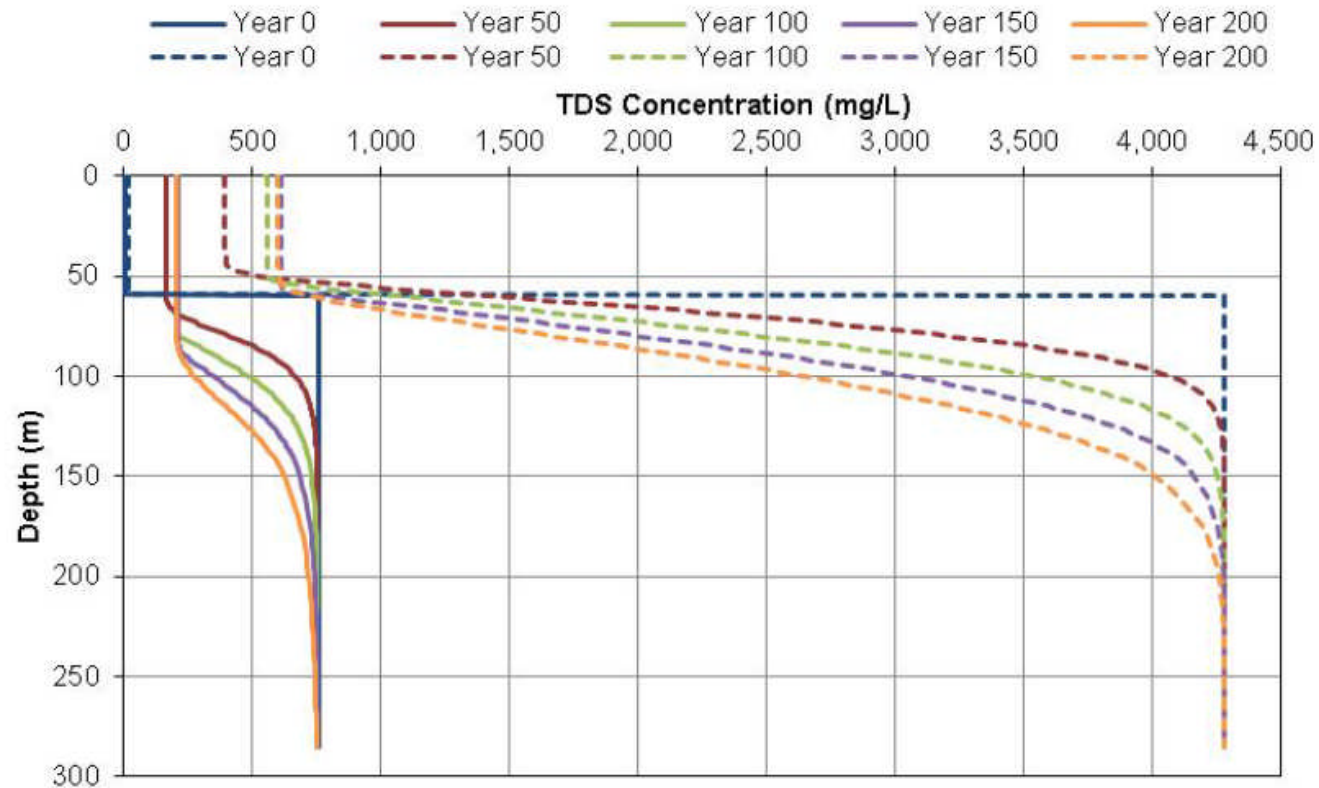
mg/L = milligrams per day

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Hydrodynamic Modelling Results – Lower Bound Scenario

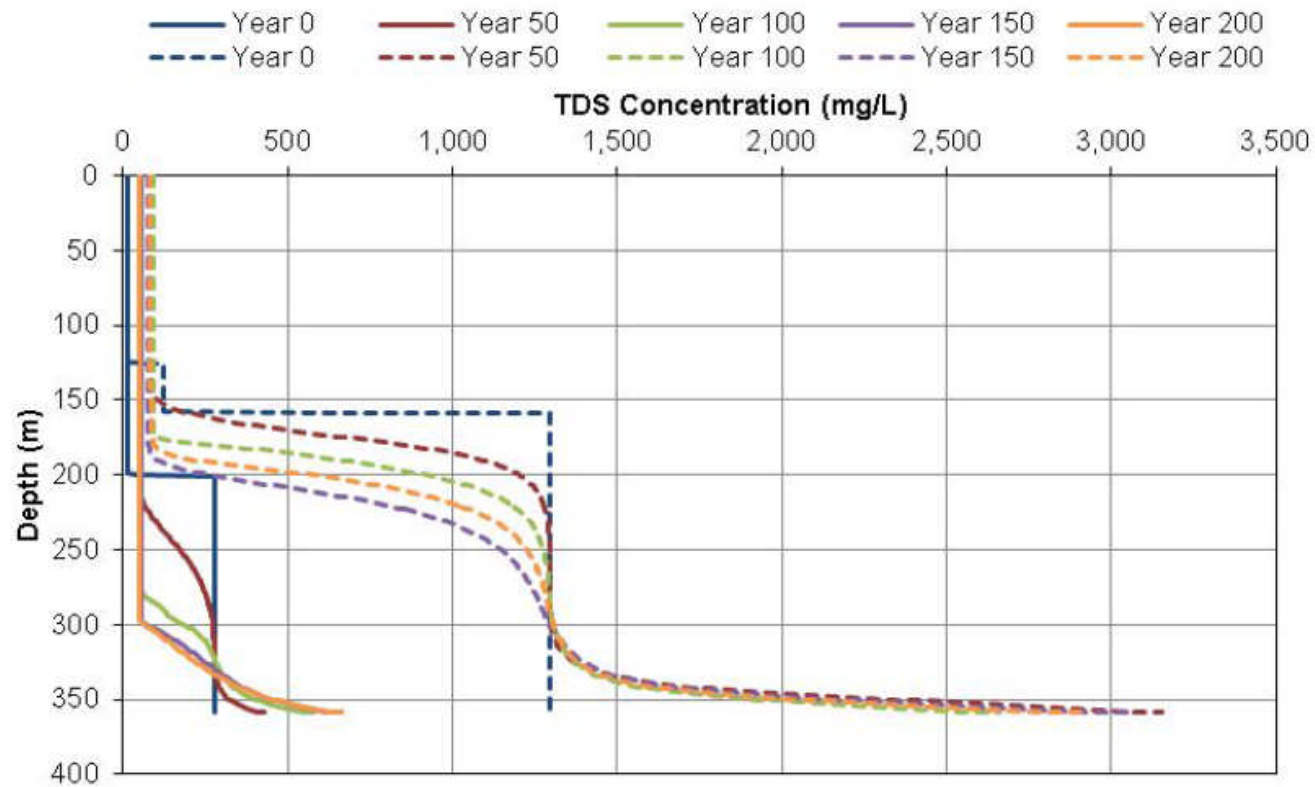
Misery Pit



Note: Solid Lines - Lower Bound Scenario, Dotted Lines - Reasonable Estimate Scenario.
TDS = total dissolved solids; m = metre

Hydrodynamic Modeling Results – Lower Bound Scenario

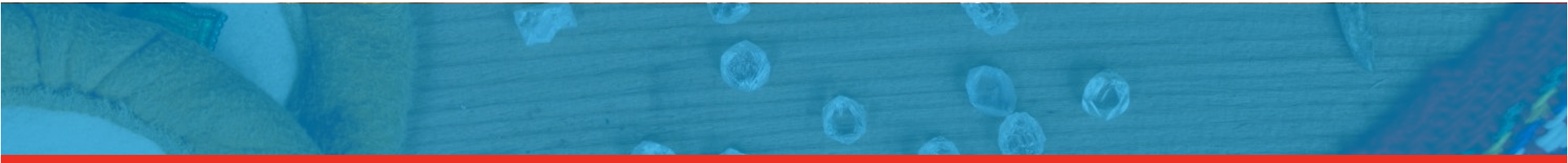
Jay Pit



Note: Solid Lines - Lower Bound Scenario, Dotted Lines - Reasonable Estimate Scenario.
TDS = total dissolved solids; m = metre

Summary – Lower Bound Scenario

- Jay Pit groundwater inflows and TDS concentrations were lower in comparison to the reasonable estimate and DAR cases
- The reduced groundwater inflows delay the timing of discharge from Misery Pit to Lac du Sauvage until the last year of operations
- The reduced groundwater inflow TDS concentrations to the Jay Pit result in a decrease in the Misery Pit discharge TDS concentrations to Lac du Sauvage and mixolimnion and monimolimnion concentrations in the Misery and Jay Pits
- Hydrodynamic modeling indicates that both the Jay and Misery pit lakes will stratify and meromictic conditions will persist throughout the 200-year model period



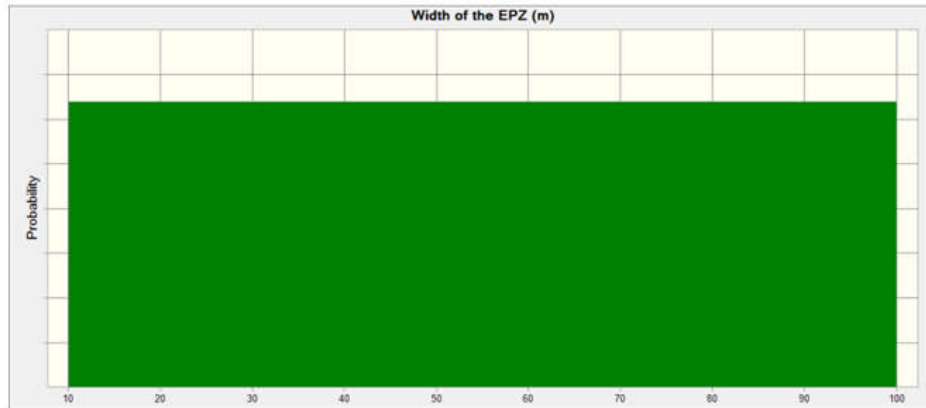
HYDROGEOLOGY – UNCERTAINTY ANALYSIS

Uncertainty Analysis

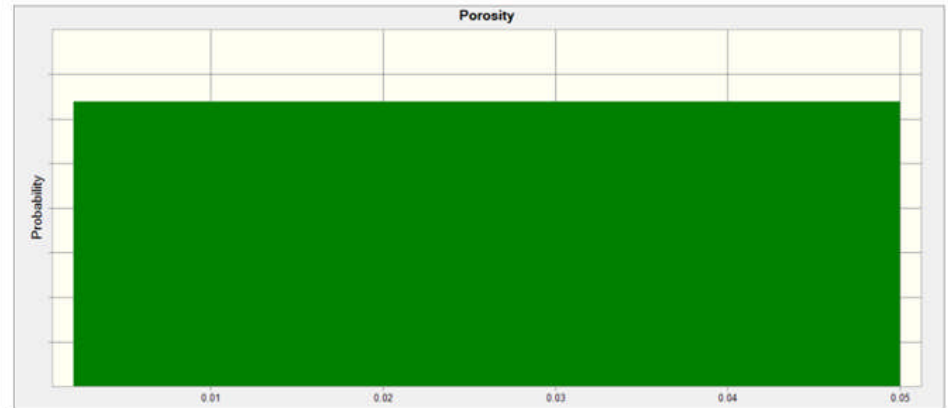
- Monte Carlo Model
 - 2D Monte Carlo for 500 realizations
 - Analysis on four parameters
- First Order Approximation
 - 3D approximate method
 - Analysis on eight parameters

Probability Distribution Functions

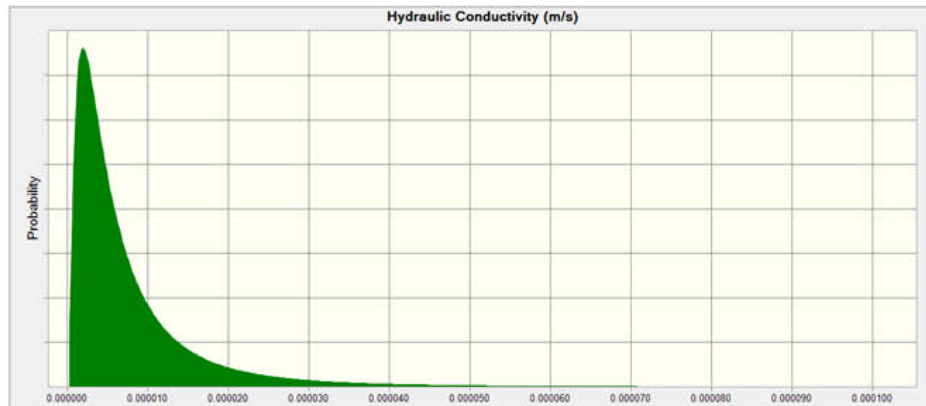
Width of the Enhanced Permeability Zone



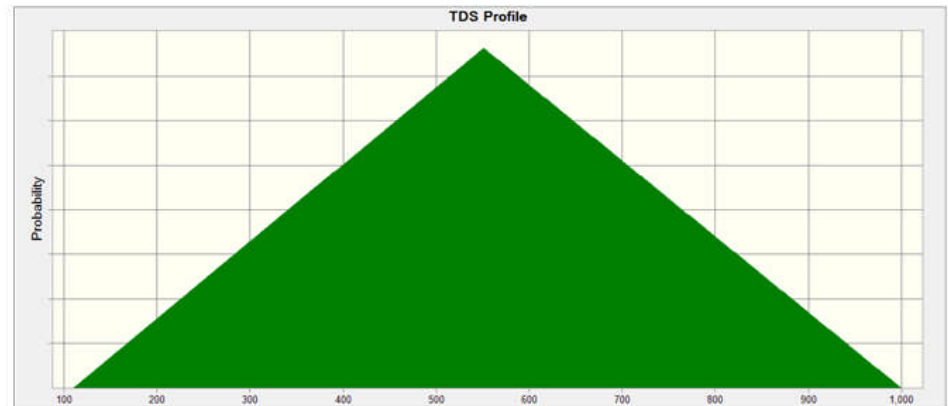
Porosity



Hydraulic Conductivity

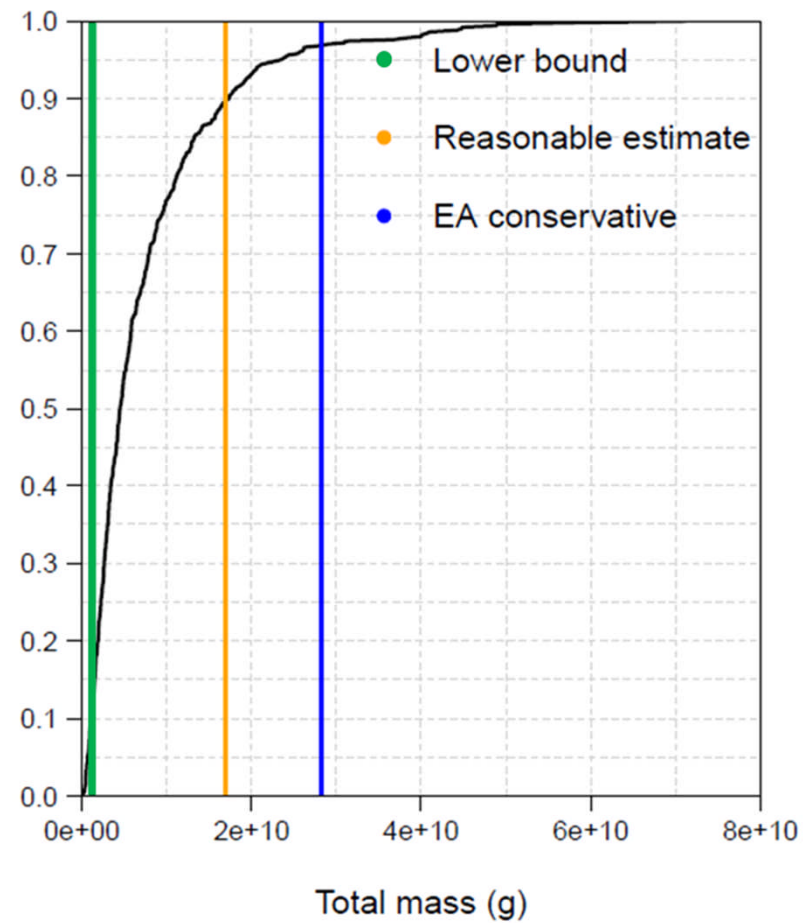
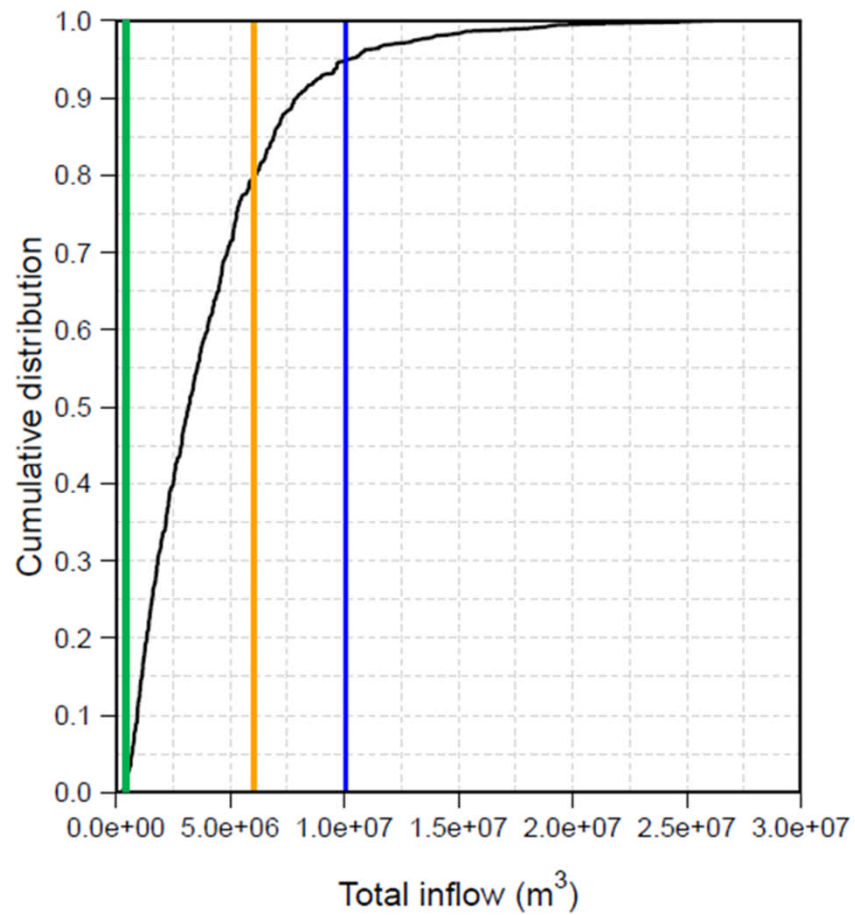


Total Dissolved Solids Profile

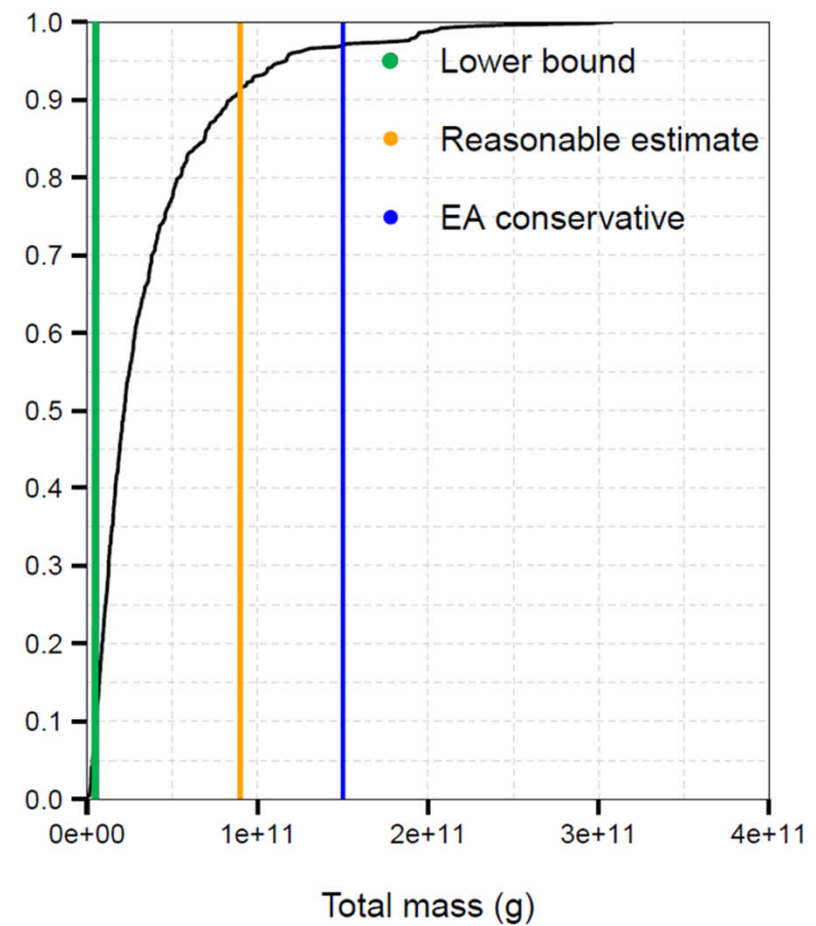
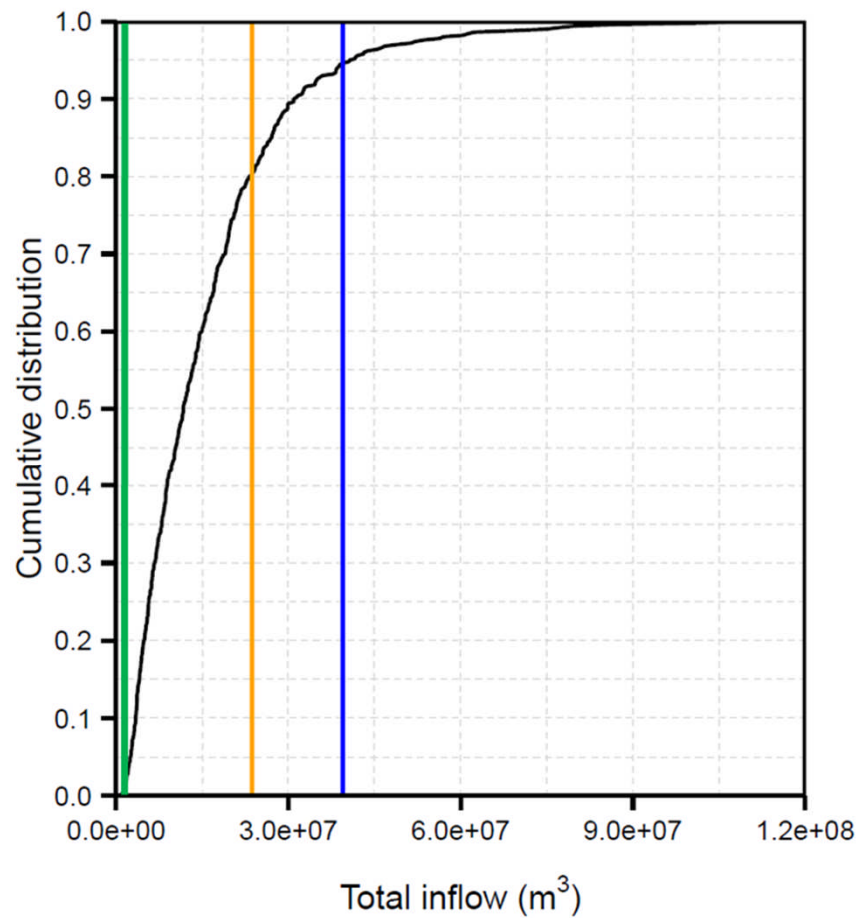


EPZ = enhanced permeability zone; TDS = total dissolved solids; m = metre; m/s = metres per second

Cumulative Probability Plot in 2023



Cumulative Probability Plot in 2029 (end of mine)



Confidence Intervals

Confidence Intervals – Monte Carlo

Scenario	2023		2029 (end of mining)	
	Total Inflow (percentile)	Total Mass (percentile)	Total Inflow (percentile)	Total Mass (percentile)
EA Conservative	95	97	94	97
Reasonable Estimate	80	90	80	91
Lower Bound	1	12	1	11

Confidence Intervals – First Order Approximation (Assuming Normal Distribution) (End of Mining)

Scenario	Total Flow (percentile)	Total Mass (percentile)
EA Conservative	97	99
Reasonable Estimate	82	88
Lower Bound	27	31

Questions?

