Department of Industry Tourism and Trade

Rum Jungle Rehabilitation

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MLRA Closure Workshop – May 31 2024

NORTHERN TERRITORY GOVERNMENT

Key Issues For Rehab Planning at Rum Jungle

- Water Quality Performance Objectives
  - Remediation
  - Post Remediation
- Current Sources of Contamination
- Geochemical Characterisation of Waste & Implications for Remediation
- Water Quality Profile of the Main Pit
- Interception and Treatment of Groundwater
- Project Outcomes

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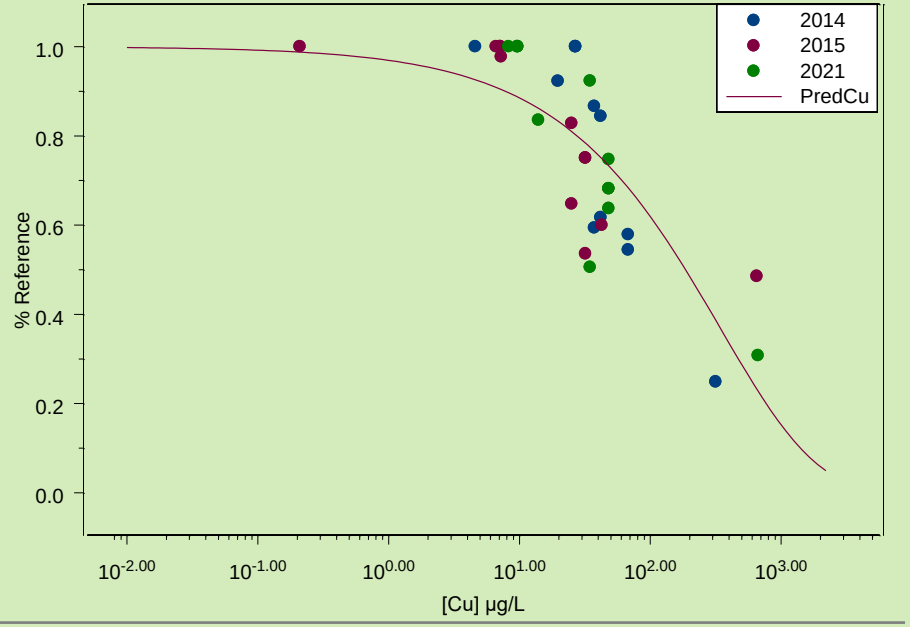
Local WQ Objectives – The Process

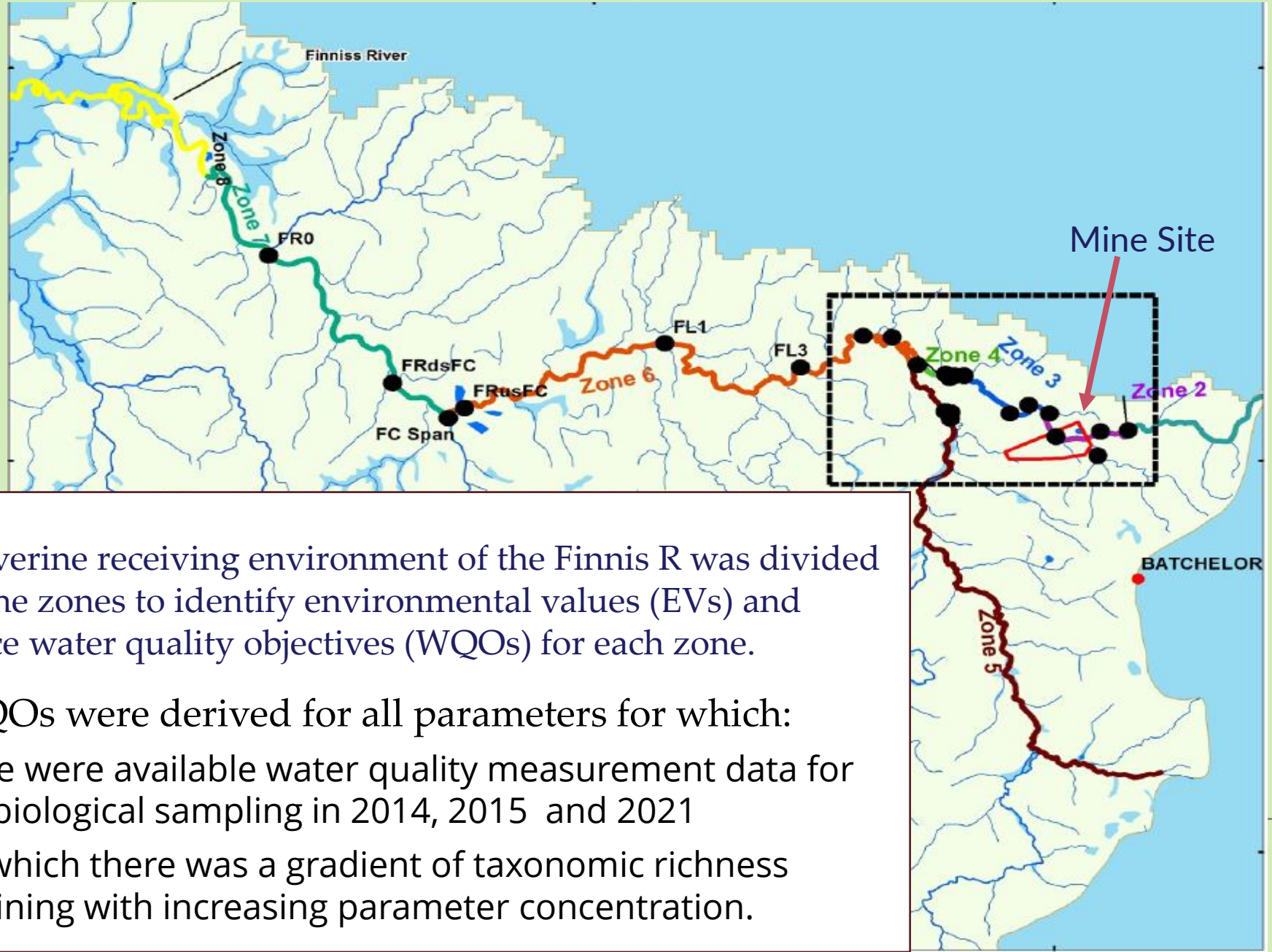
(1) Consultation with all stakeholders to identify the key environmental values (including cultural) to be protected

In practice the final EVs centred on aquatic ecosystem protection levels because these were both the lowest applicable numerical guideline values among the other environmental values considered, and were agreed to by the indigenous community representatives to be appropriately protective of cultural and spiritual values

(2) Three years of sampling 3 trophic levels of aquatic biota – vertebrates, invertebrates and algae - to provide the data needed to derive the site specific objectives



Developing Local WQ Objectives



pH, **Cu**, Zn, Ni, Co, Mn, U, Se EC, SO4, Mg

The riverine receiving environment of the Finnis R was divided into nine zones to identify environmental values (EVs) and produce water quality objectives (WQOs) for each zone.

LDWQOs were derived for all parameters for which:

- there were available water quality measurement data for the biological sampling in 2014, 2015 and 2021
- for which there was a gradient of taxonomic richness declining with increasing parameter concentration.

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Water Quality Objectives (µg/L) *

Analyte	ANZG 2018 80%	LDWQC 80%	LDWQC 70%	WQ 95th ile
Cu	2.5	28	60	668
Zn	31	180	210	4671
		Post Rehab	Construction	

* For the mine site where current level of protection is only 1%; WQO applies to dissolved concentrations.

There are major advantages (compared to ANZG default) to having the LDWQ Objectives for the Rum Jungle Project.

However:

- 3 years for the required stakeholder consultation to identify highest environmental values to protect, and to do the biological survey work
- Another 3 years from when the EIS was submitted to final acceptance of the concept by Commonwealth and Territory regulators, despite the approach being best practice under the Australian and NZ WQ Guidelines (2000 and 2018)

Key Message:

Don't leave it until the "last minute" to start developing WQ criteria for site rehabilitation or closure

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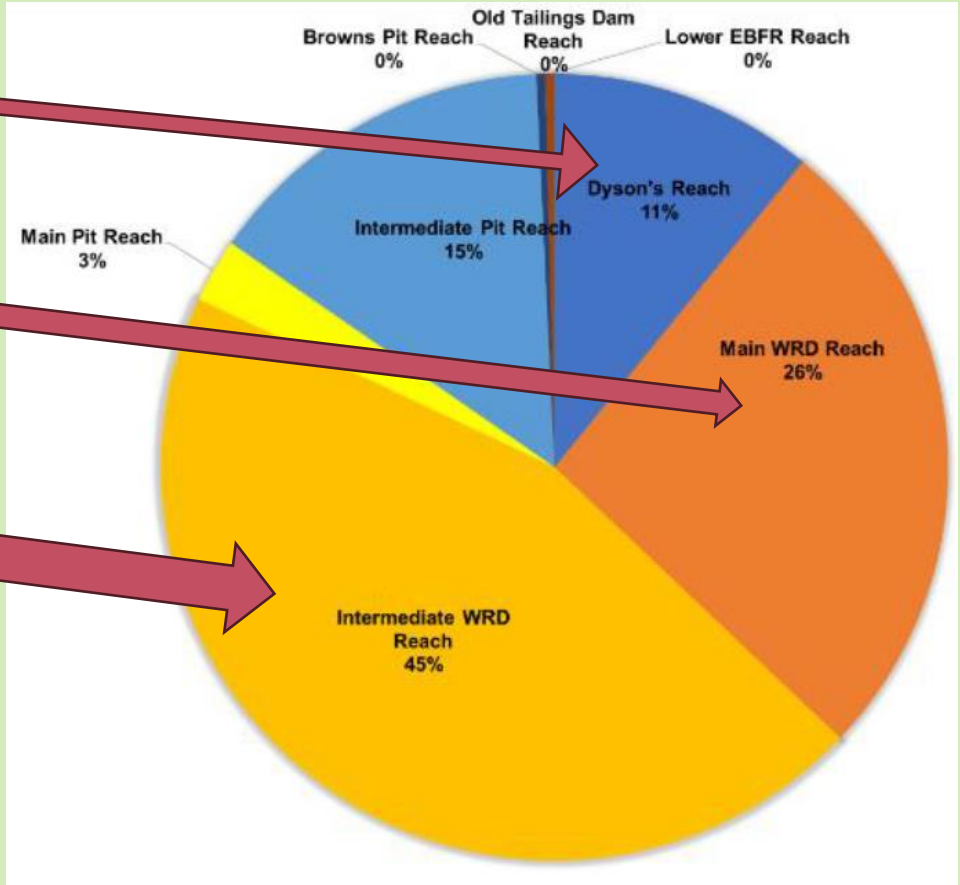
Current Sources of Cu Contamination

Annual Load Balance Model – Flows and Water Quality



Waste Characterisation

The sulfidic waste at Rum Jungle is already Partially Oxidised

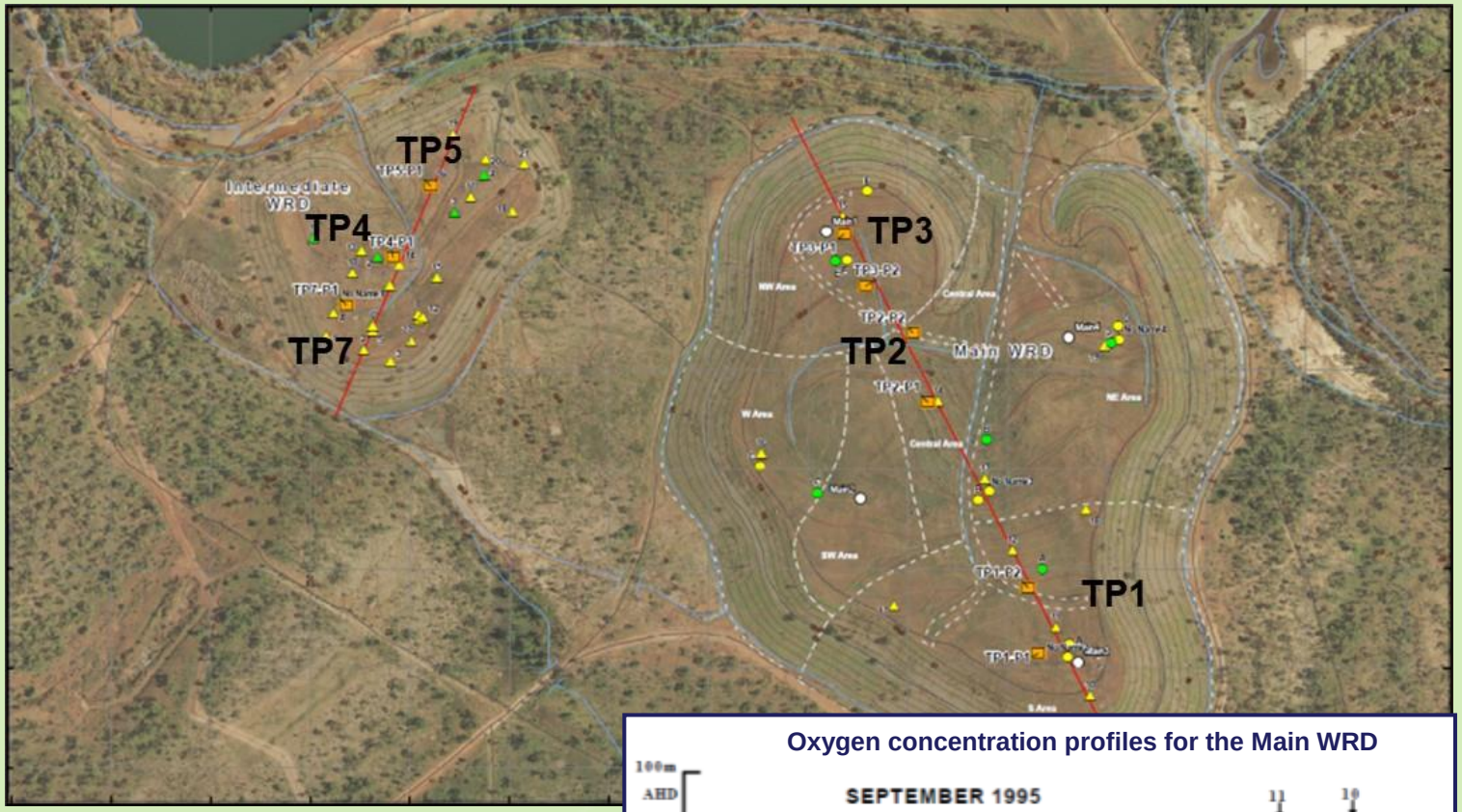
Contains:

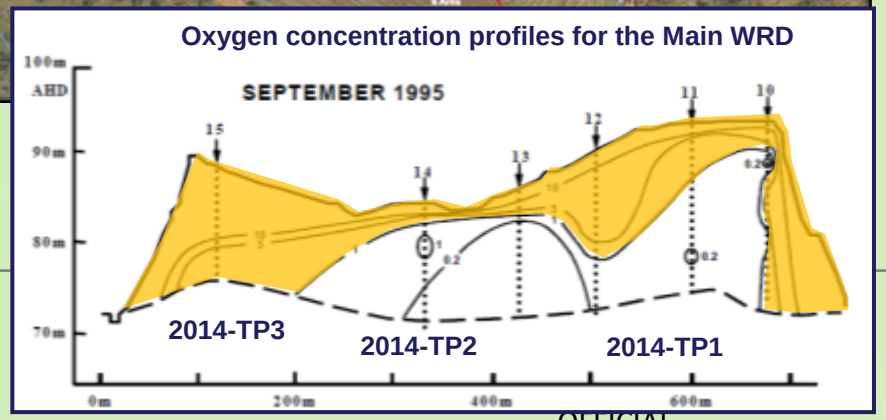
- *Incipient Acidity - Residual sulfides that can oxidise in the future*
- *Existing acidity – mix of soluble metals and acidity and poorly soluble secondary minerals (jarosite - ($KFe_3(SO_4)_2(OH)_6$ formed at pH <3*

Waste Management Strategy needs to address both (incipient and existing acidity) of these source terms:

- *Residual Sulfides- best practice is to submerge underwater to prevent further oxidation*
- *Existing acidity - chemical neutralisation to prevent future leaching*

Mine Waste Characterisation –Sampling (1)





Seven 'test pits' across WRDs

- 3rd Quarter 2014
- Up to 100 m long, 50 m wide, 20-30 m deep to ground surface
- Representative sampling of waste rock, laterally and vertically

Sampling (2)

- Samples collected every 1 m interval with excavator to a depth of 5 m
- 75 mm sieve bucket used to separate coarse and finer material
- Sub 75 mm material stored in 20L pails for further analyses
- Combination of dozer and excavator used to lower (via benching) sample platform every 5 m

2 x CAT D10T Bulldozer

35 ton Komatsu excavator

Komatsu articulated dump truck (ADT)

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Sampling (3)

Sampling (4)

Sampling (5)

Mine Waste Characterisation

- Conventional Acid Base Accounting +XRD mineralogy + quantification of total existing acidity
- Used to Classify waste into Acid Forming categories
    - PAF –I (highest) to PAF (III) - lowest

WASTE ROCK GEOCHEMISTRY

- **Potentially Acid Forming (PAF) Waste Rock**
  - PAF-I High Priority
  - PAF-II Medium Priority
  - PAF-III Low Priority

- **Non Acid Forming (NAF) Waste Rock**
  - NAF Backfill or construction material

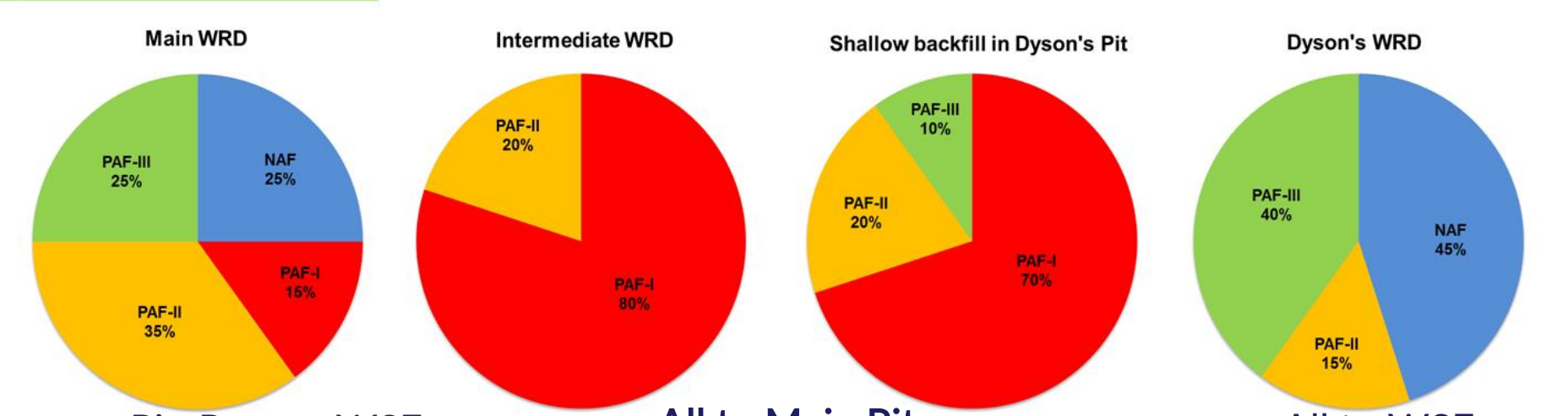
AMD Potential

High

Medium

Low

Minimal



Some to Pit, Rest to WSF

All to Main Pit

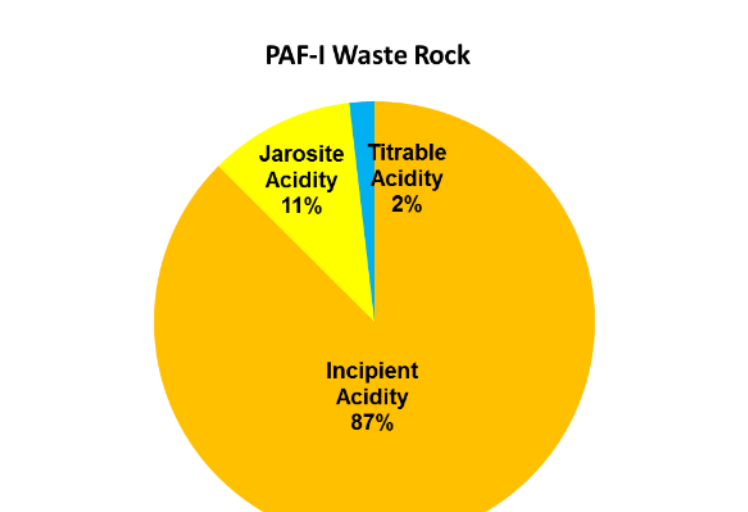
All to WSF

WRD CHARACTERISATION RESULTS

Distribution of Acidity Types in PAF Material

Type	AMD Potential	Jarosite Acidity, kg H_2SO_4/t	Titratable Acidity, kg H_2SO_4/t	Incipient Acidity, AP kg H_2SO_4/t
PAF-I	High	12.1 (13.8)	2.0 (2.4)	99.5 (38.6)
PAF-II	Medium	5.6 (5.5)	1.0 (1.0)	26.4 (10.9)
PAF-III	Low	2.9 (3.8)	0.7 (0.8)	8.0 (12.2)

Existing Acidity



Existing Acidity is Dominated by Jarosite

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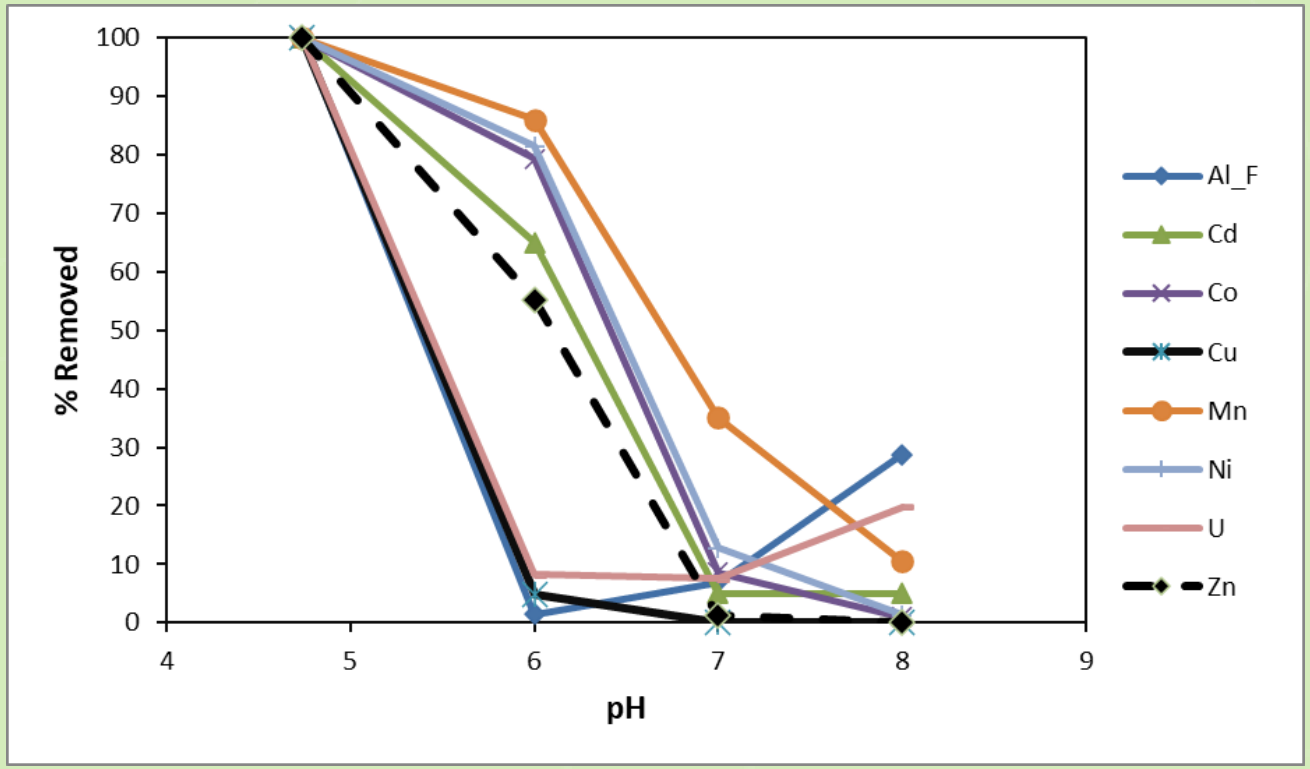
Source Term Reduction – Neutralisation of Existing Acidity



When neutralised to pH 7 with Ag Lime ($CaCO_3$):

- Co, Mn, Ni < 1 mg/L
- Fe, Al, Cu, Zn < 0.2 mg/L
- U < 10 µg/L

Neutralant Demand (1)

Neutralant demand very conservatively estimated for each PAF class by:

- Calculating 80th percentile of existing acidity contents for each PAF class, with a rinse pH of <5
- Using acidity content of <2cm particle size class to estimate acidity content of whole rock mass, using field measured PSD data for scaling
- ***Results in 60% (at least) overestimate of neutralant demand***

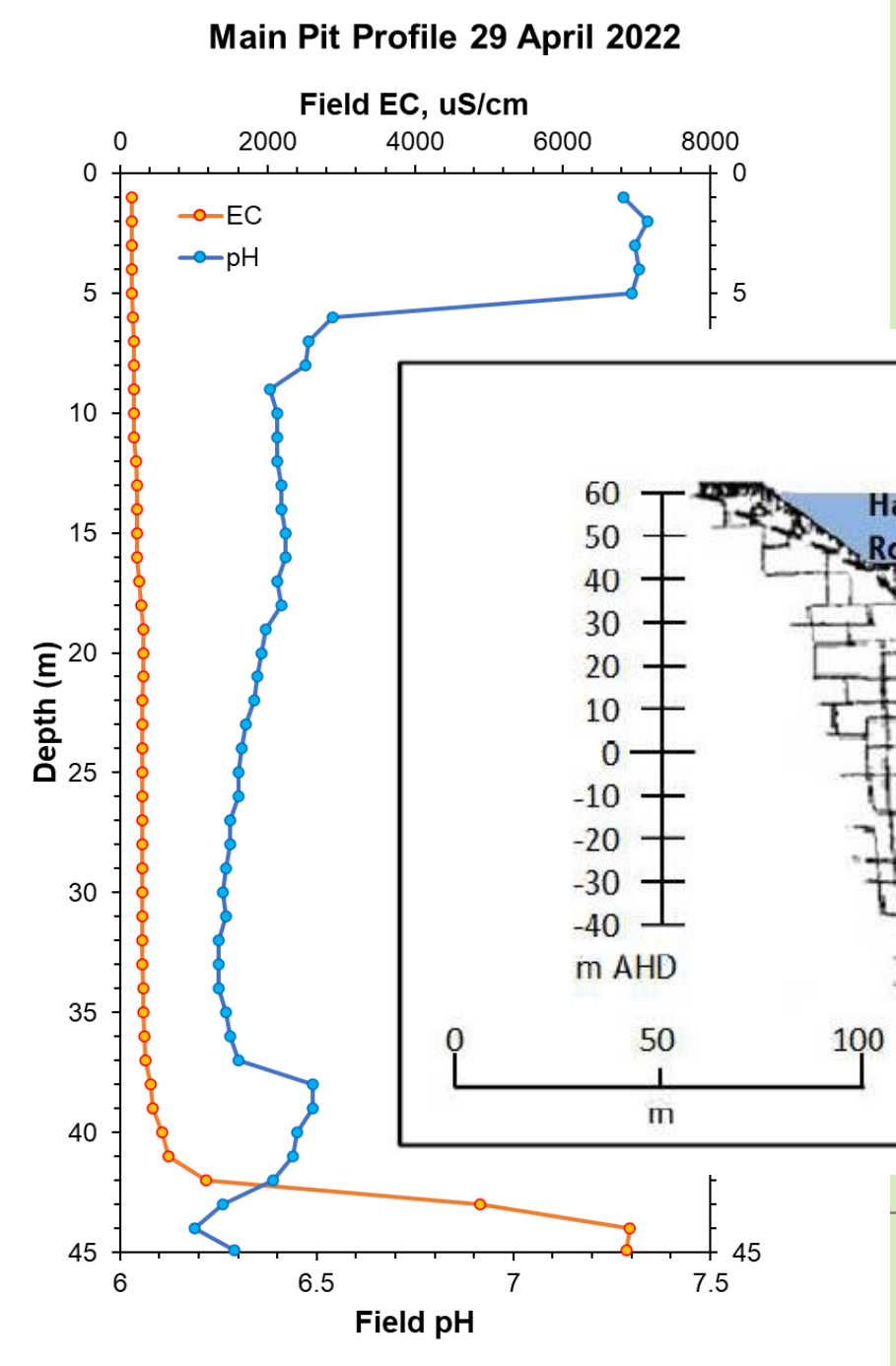
PAF-I	24 kg $CaCO_3$/t
PAF-II	11 kg $CaCO_3$/t
PAF-III	5 kg $CaCO_3$/t

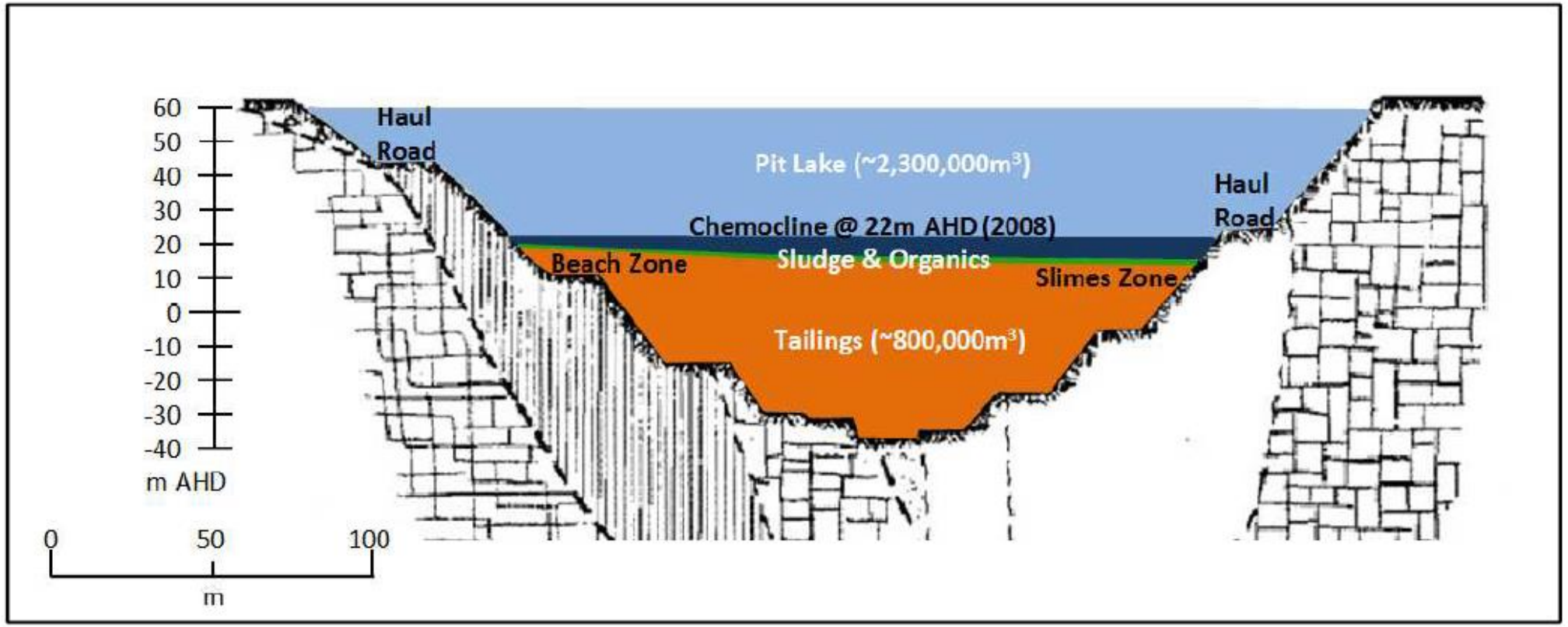
Waste Management Summary

- **PAF-I and PAF-II rock re-located to the Main Pit & amended with sufficient lime to neutralize existing acidity**
  - Release of incipient acidity (AP) will be prevented by submergence under re-bounding GW table
  - Ag Lime ($CaCO_3$) will be mixed dry with waste rock to minimise porewater concentrations of acidity and metals

- **Residual PAF-II, all PAF-III and contaminated materials from elsewhere on site relocated to new WSF**
  - Ingress of water and oxygen minimised by cover design, paddock dumping construction and compacted fine-grained material between lifts
  - Existing acidity and potentially soluble metals neutralised by addition of Ag lime

Pit Backfill Challenges

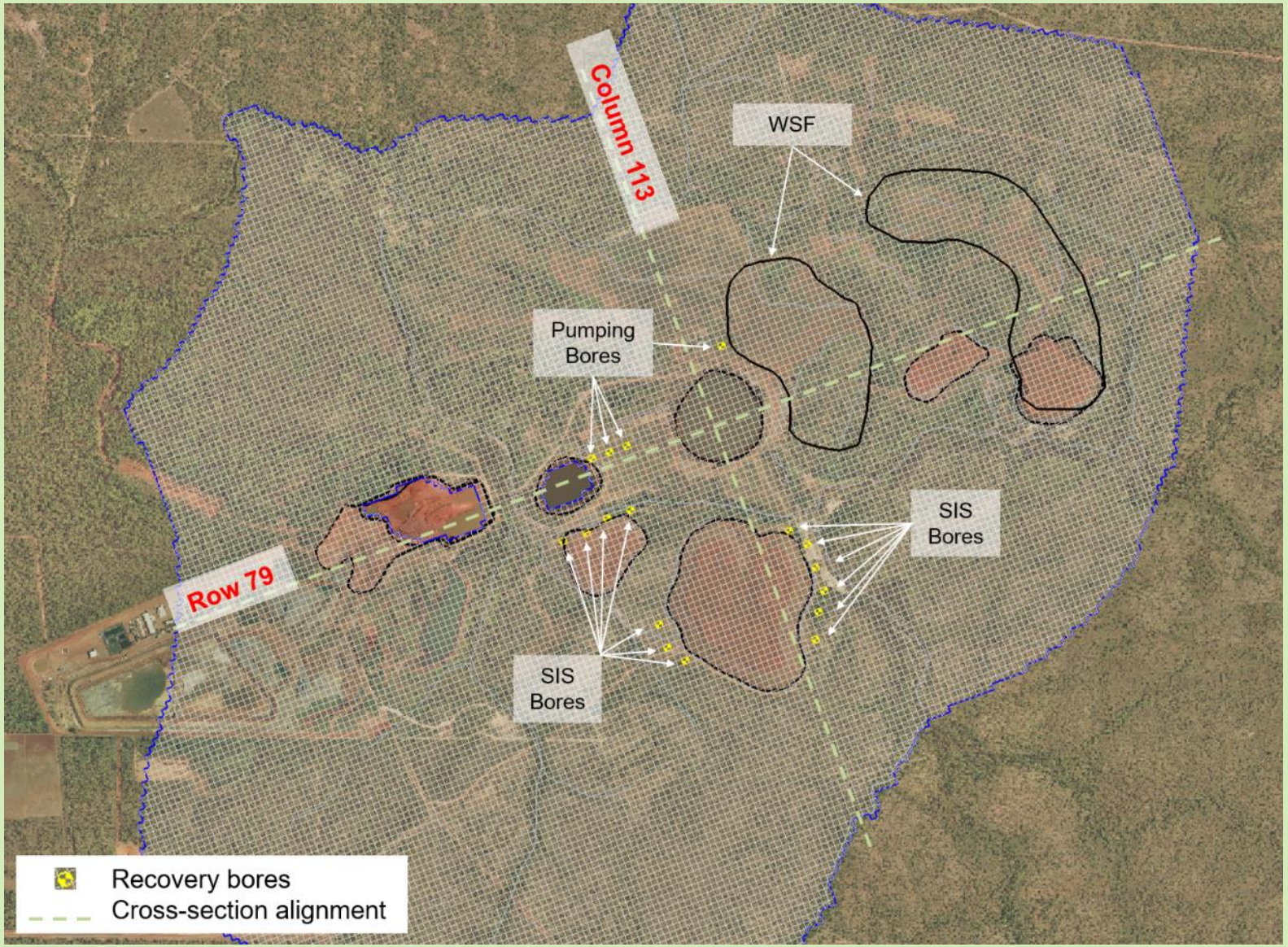




Ground Water

Near surface groundwater is currently a major source of contamination

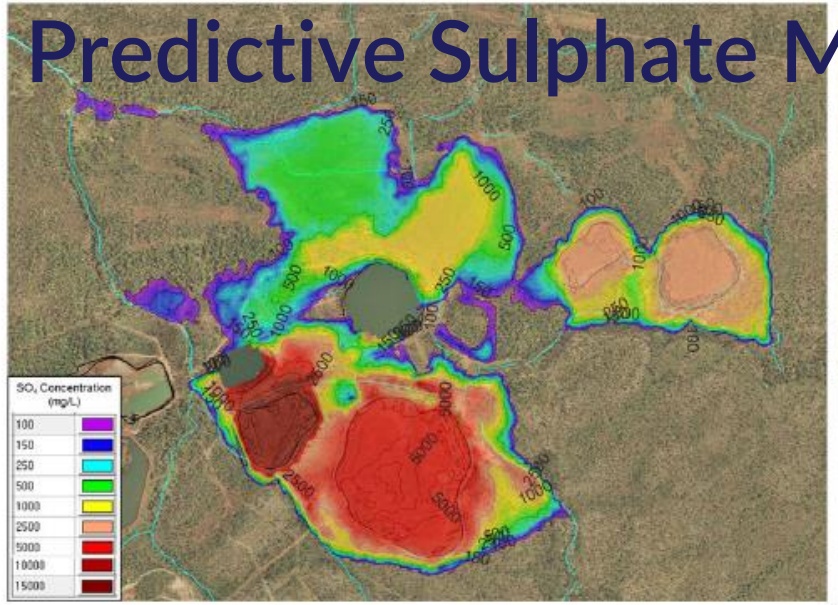
Unless this is addressed as part of the remediation works it will continue to impact on d/s water quality long after the bulk earthworks are completed and delay the meeting of post rehabilitation water quality targets.



Seepage Interception System

- Approx. 19 locations across site
- Aligned to stop EBFR contamination

Predictive Sulphate Modelling



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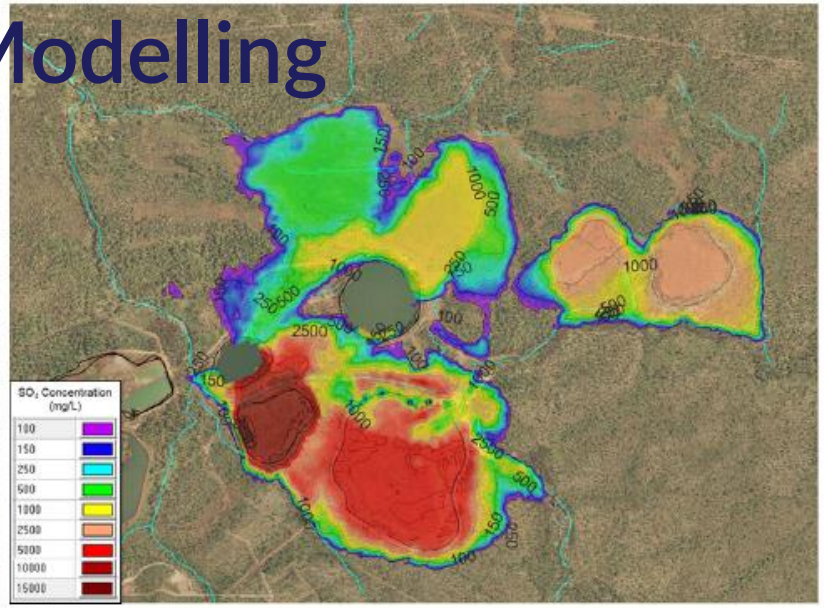
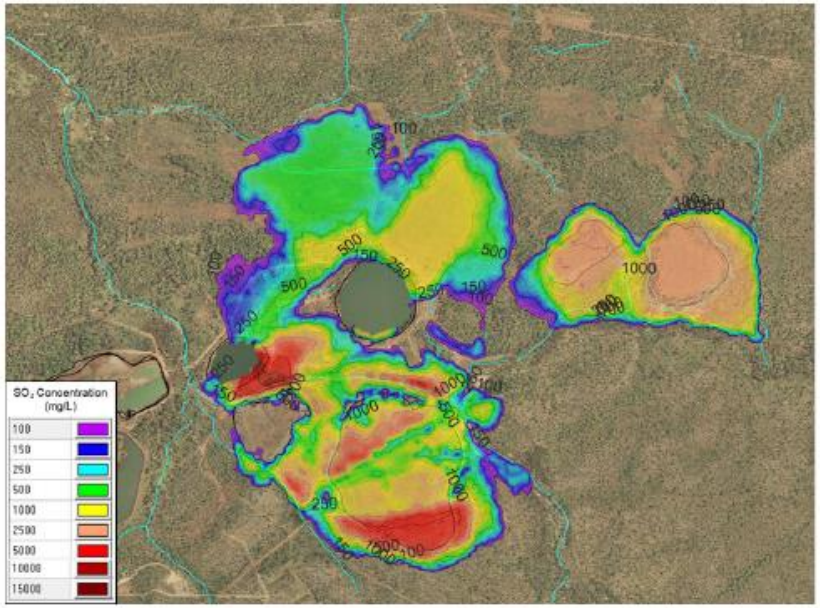


Year 2



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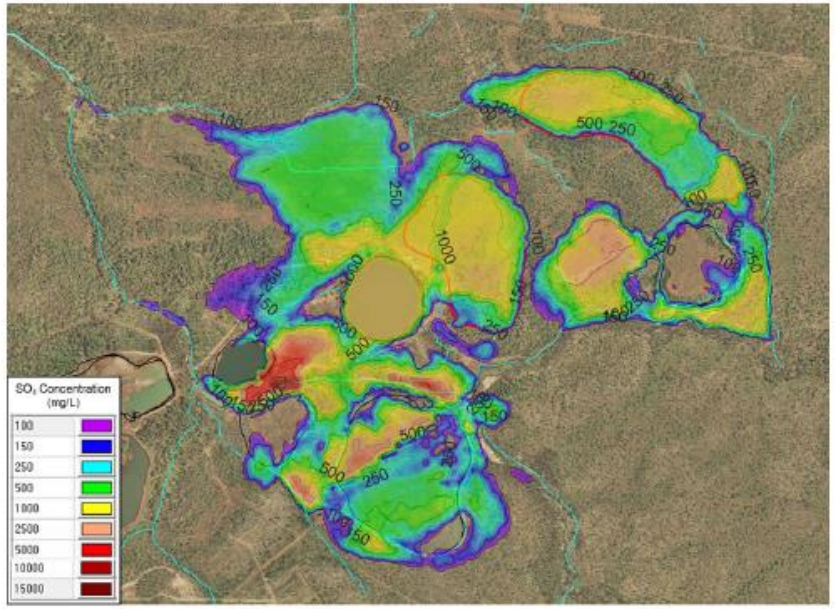

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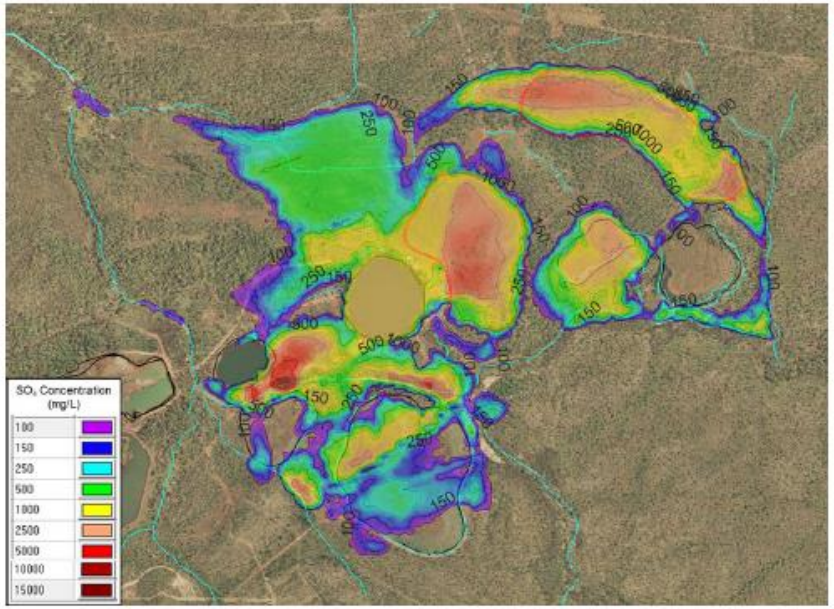

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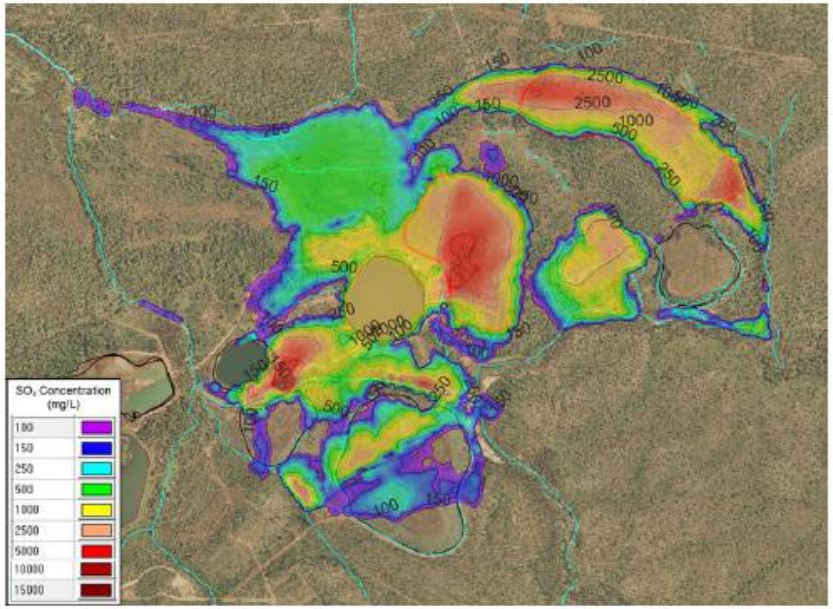
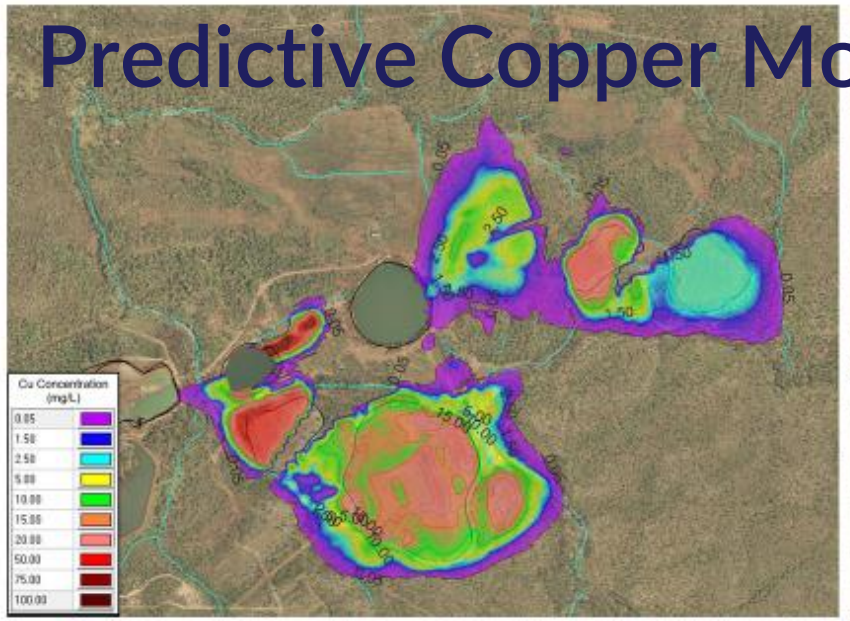


Year 10

Predictive Copper Modelling



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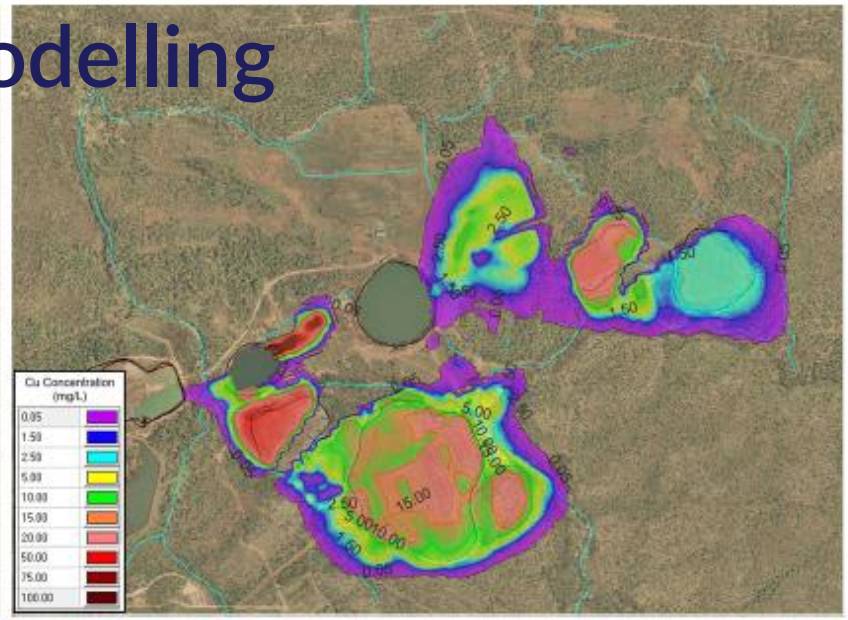

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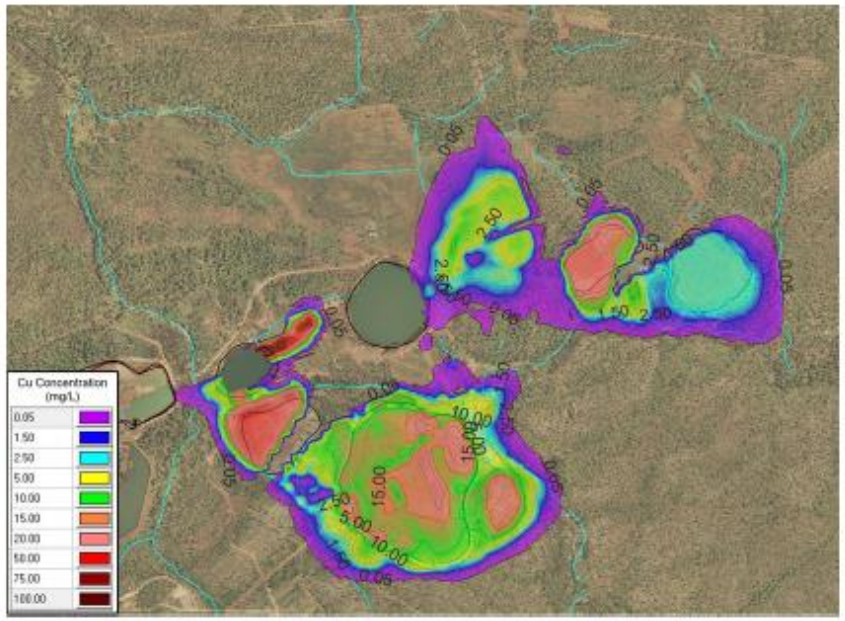

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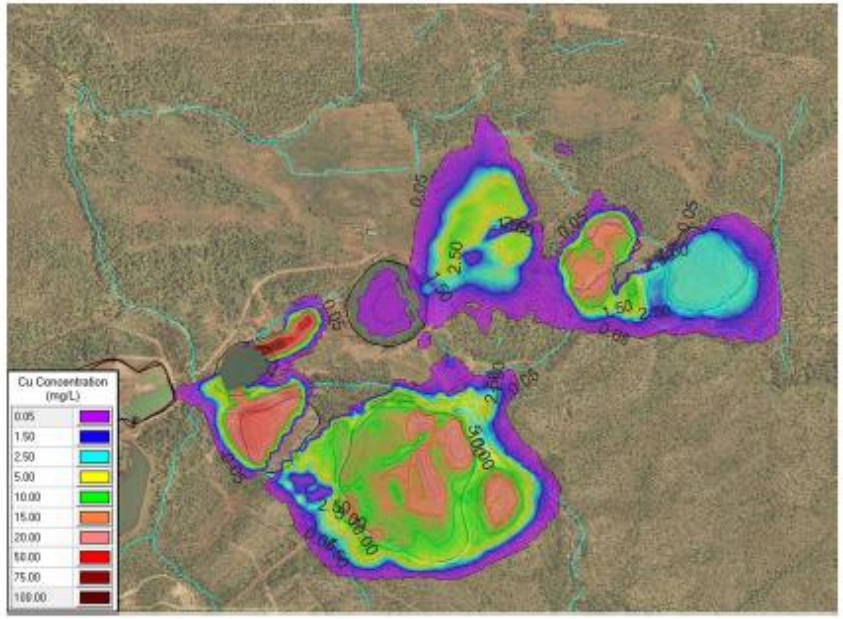

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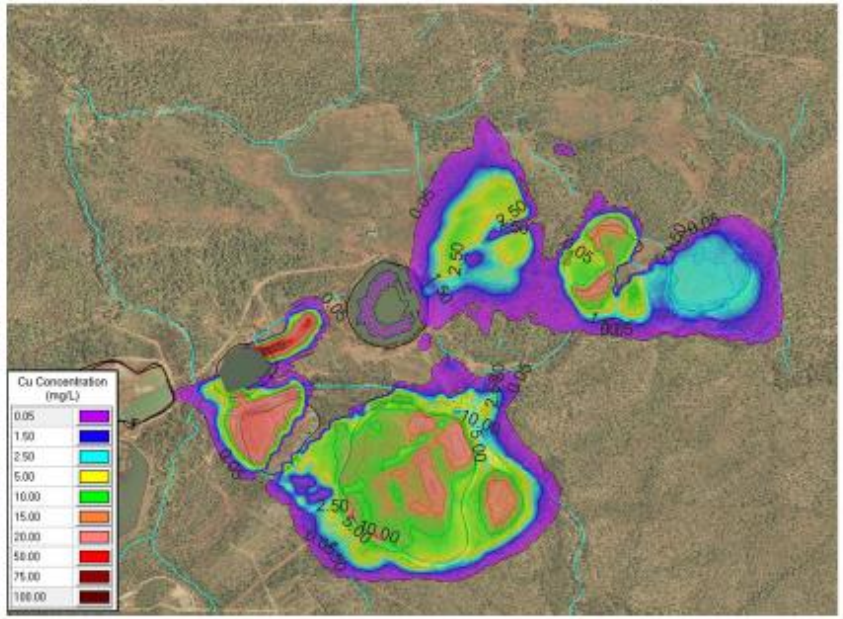

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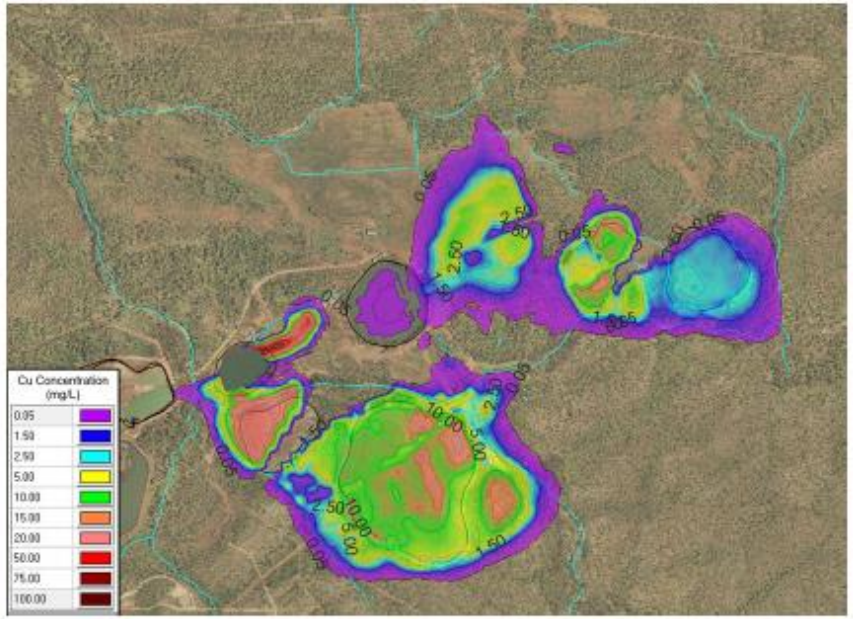

Year 10

Modelling Predictions for Cu Load

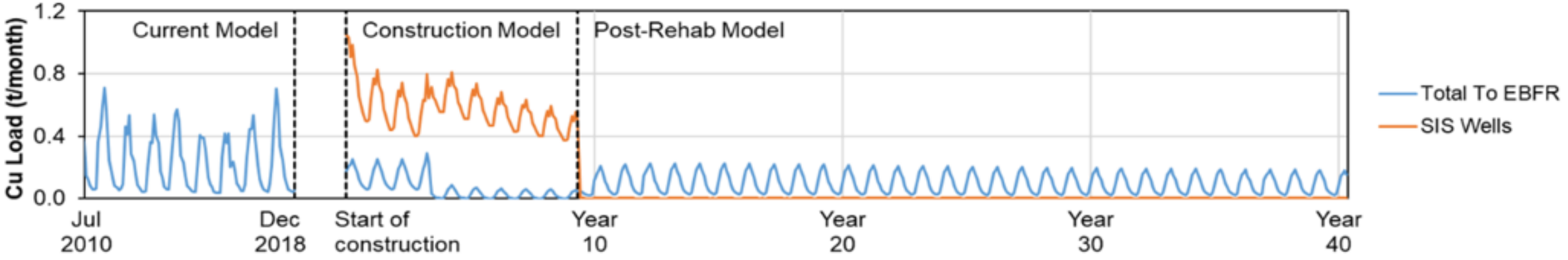

Figure 10-37. Simulated and Predicted Copper Loads, Base Case Scenario

Project Outcomes
Waste Containment and SIS

Reduction of Copper reporting to the EBFR from 2.5 t/year to 0.24 t/year

Reduction of Sulphate reporting to the EBFR from 2000 t/year to 938 t/year

This represents an increase from less than 1% species protection to 80% d/s of the mine site

Questions?

https://nt.gov.au/industry/mining/legacy-mines-remediation/remediation-projects/rum-jungle-rehabilitation/rum-jungle-rehabilitation-plan

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