



Case Study: Performance of the Operating Demonstration-Scale Constructed Wetland Treatment System at Minto Mine

September 2018

Introduction – Minto Mine CWTS

Minto Mine

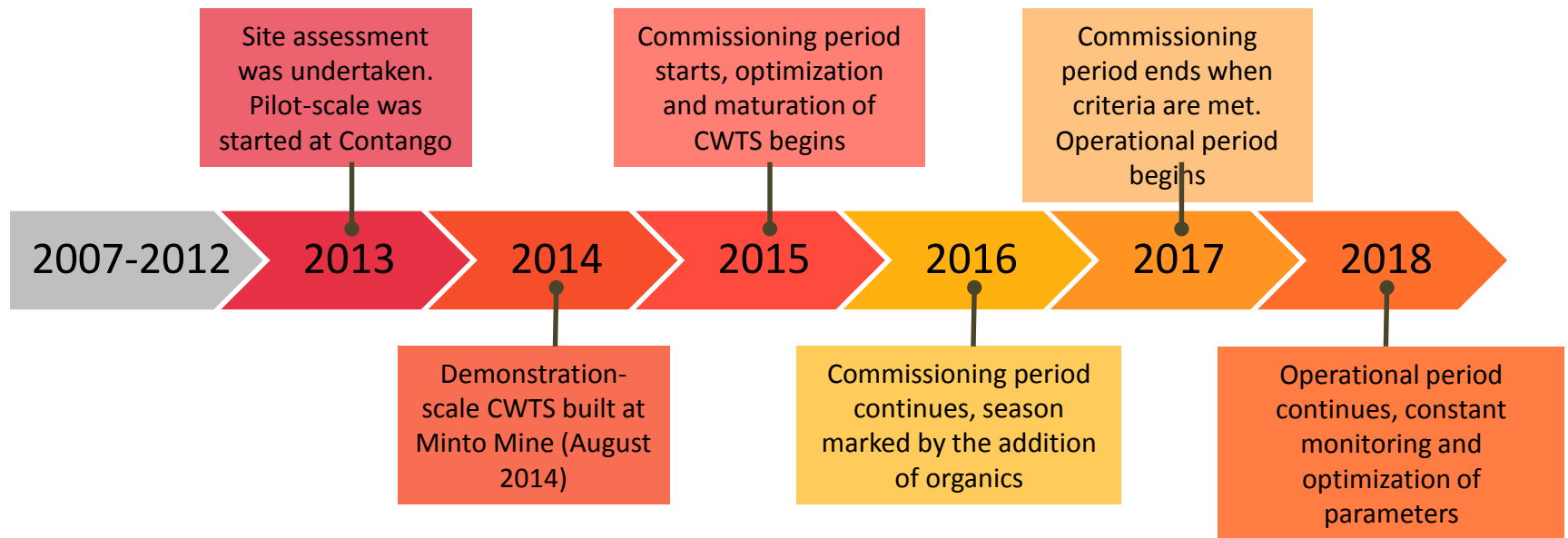
- Located on Selkirk First Nation Category A settled land
- Began operation in 2007
- Open Pit (until recently) and underground mining method
- Focused on copper production with gold and silver by-products

Why the use of Constructed Wetlands Treatment Systems?

- Minto Mine was looking for passive closure options for treatment of mine impacted water
- Use of Interstate Technology and Regulatory Council (ITRC) – mining waste treatment technology decision tree
- CWTS were determined to be the best option for treating mine impacted water at closure



Phased Approach Implementation at Minto Mine

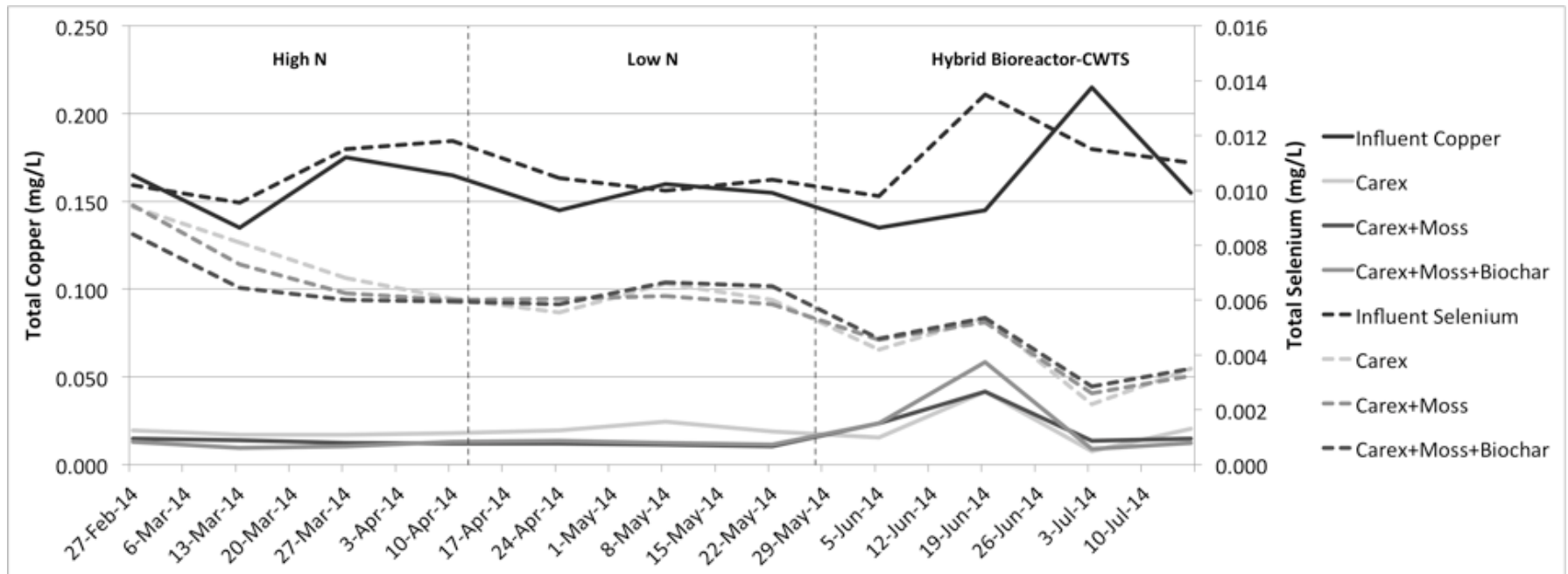


Pilot Scale CWTS

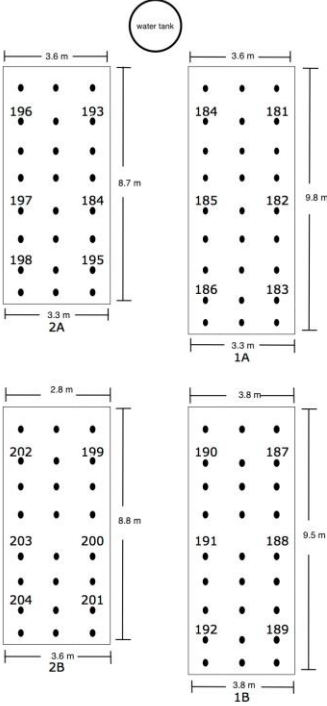


Pilot Scale CWTS - Results

- Addition of straw and hay (alfalfa) to the pilot scale CWTS was done to increase
- Resulted in better treatment of Se
- Aquatic sedges and mosses were capable of treating water for Cu and Se
- Biochar did not show significant effect on the treatment in the Pilot Scale



Onsite Demonstration Scale CWTS



ROAD



Demonstration Scale – Plant Acclimation 2015 - 2017



May 2015



August 2015



June 2016

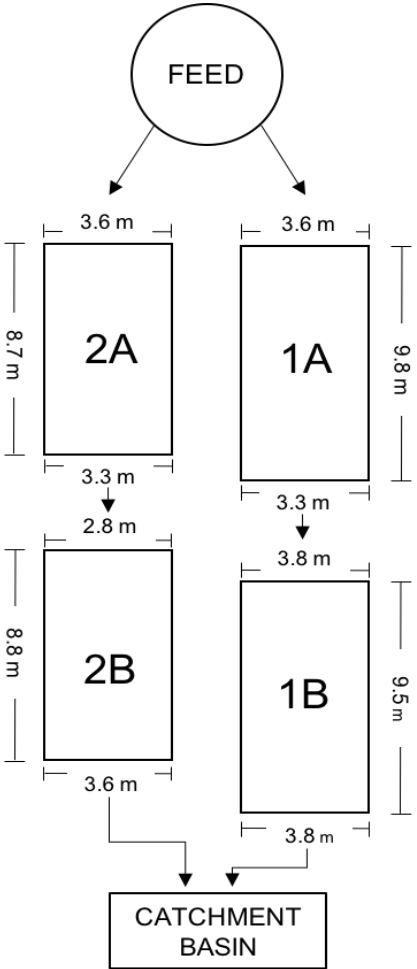


September 2016



July 2017

CWTS Setup at Minto Mine



Contaminants of Potential Concern treated for in the CWTS



Cadmium
Copper
Molybdenum
Selenium
Zinc
Nitrate

CWTS in 2018



Monitoring

- Explanatory parameters
- Water samples (weekly)
- Soil and micro sampling
- Vegetation
- Soil redox – monitors CWTS maturation and confirms targeted reducing conditions



Microbial Processes – Microbial Diversity

Main contributors to the treatment pathways:

- Denitrifying bacteria – nitrate treatment
- Selenium-reducing bacteria – selenium treatment
- Sulphide-producing bacteria - metals/metalloids treatment through formation of metal-sulphides

- Roots
- Detritus
- Moss
- Soil



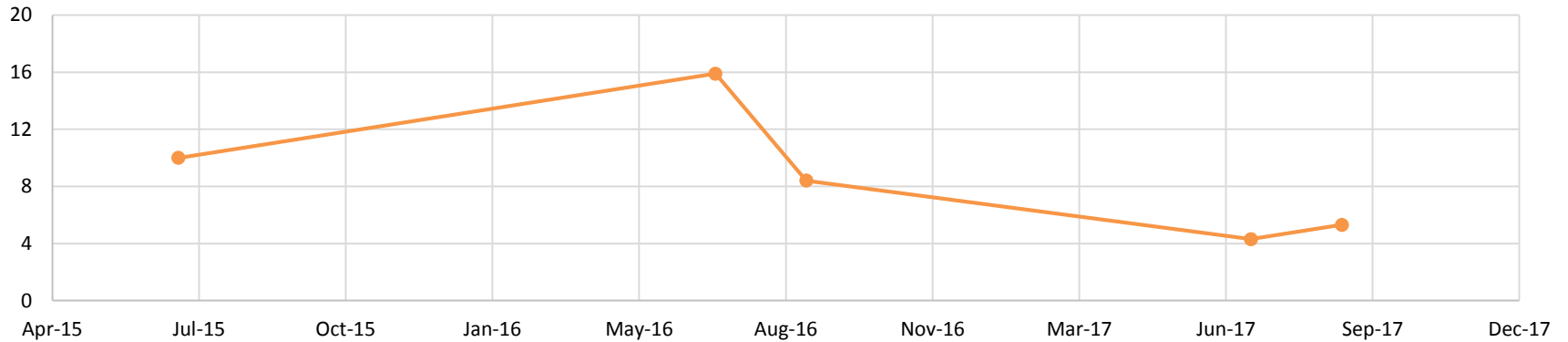
Commissioning vs Operational

Criteria that were necessary to the transition from commissioning to operational.

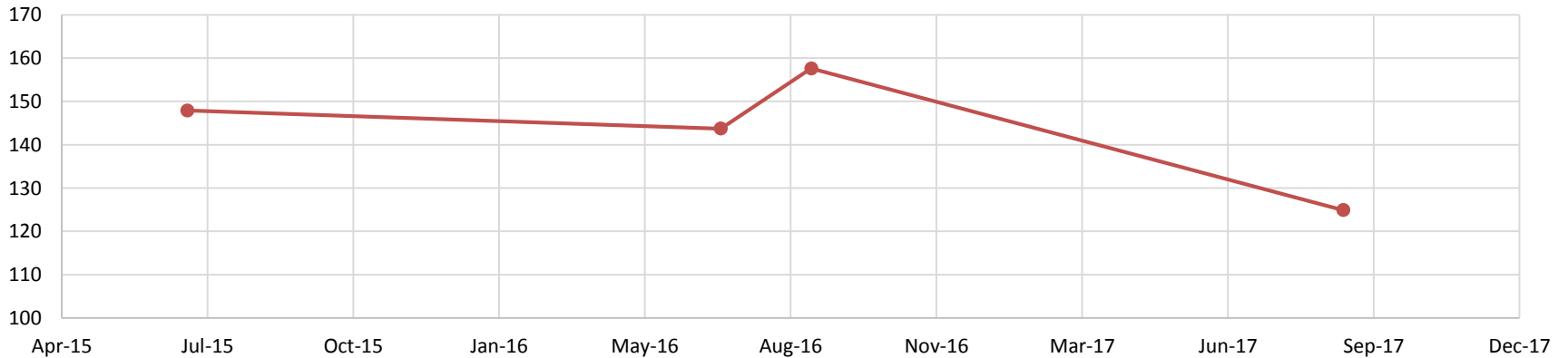
- Plant establishment and maturation
- Establishment of reducing conditions within the CWTS
- No aqueous copper concentrations through the CWTS
- Microbial population establishment and maturation to levels similar or better than the pilot-scale

Performance – Explanatory Parameters

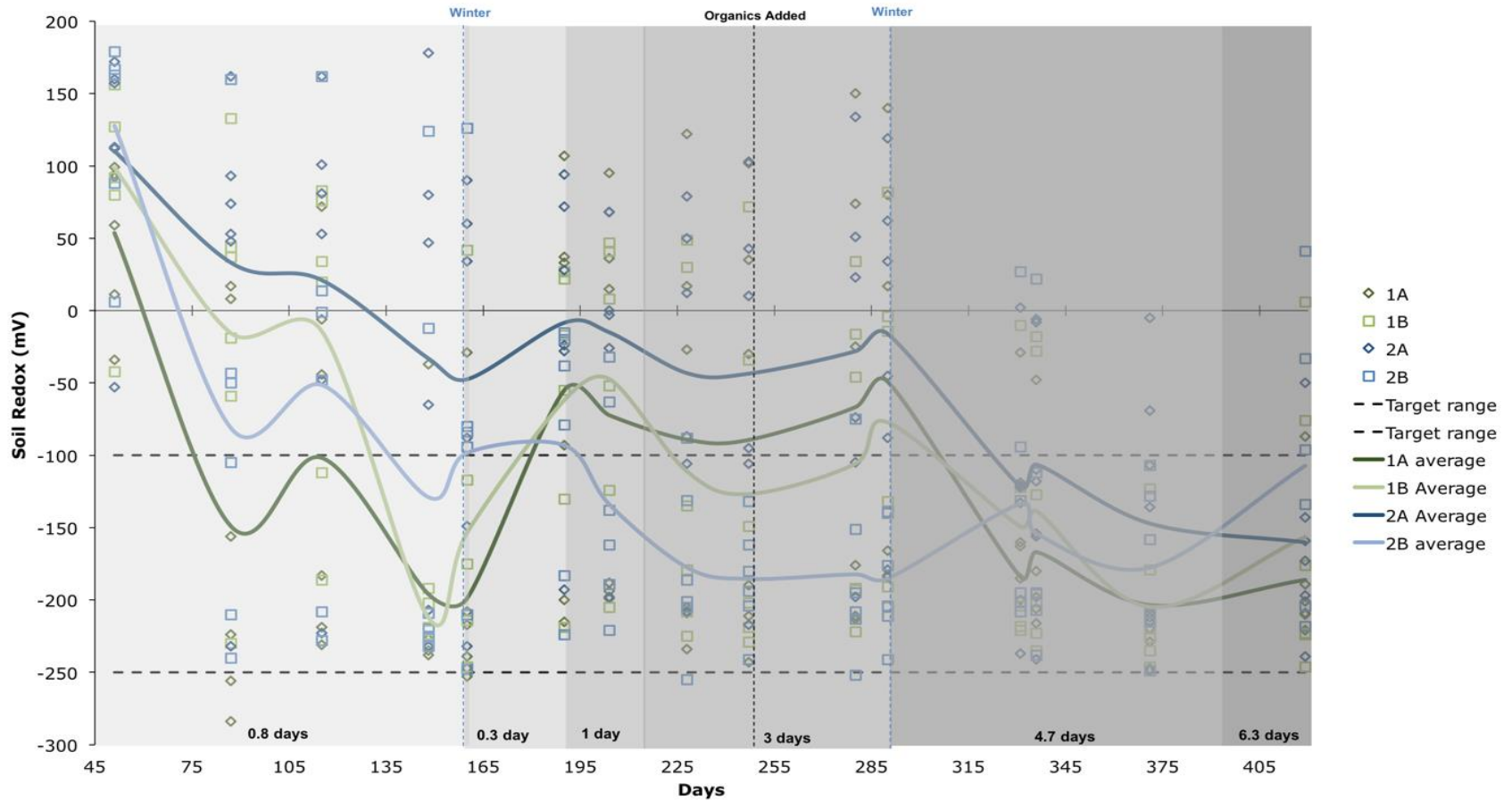
DO (mg/L)



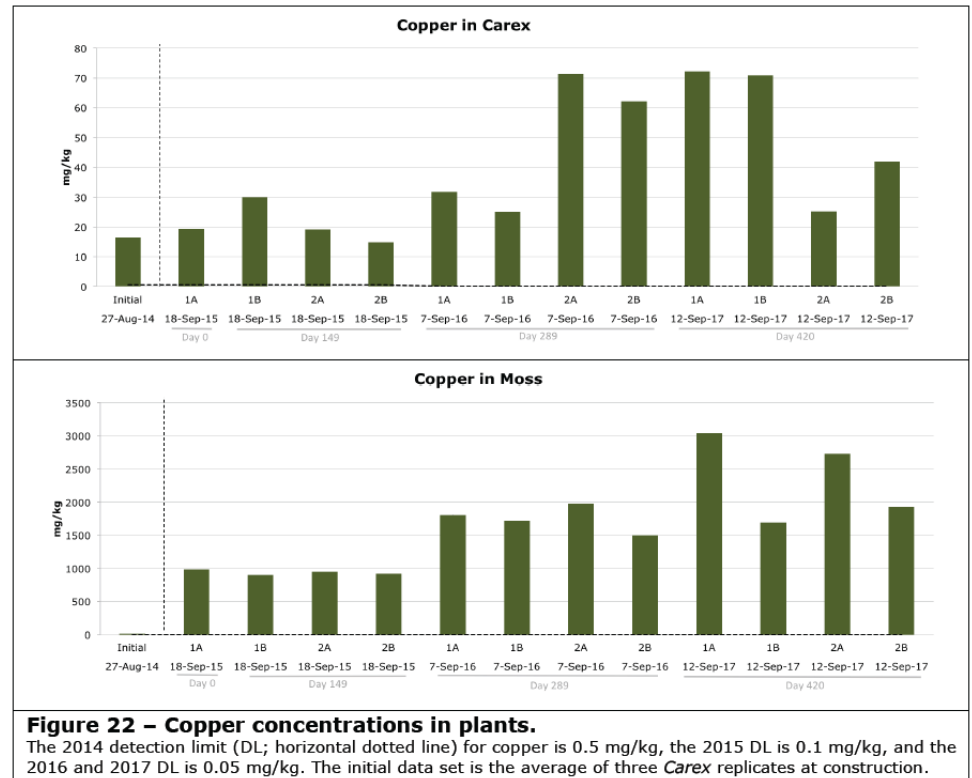
ORP (mV)



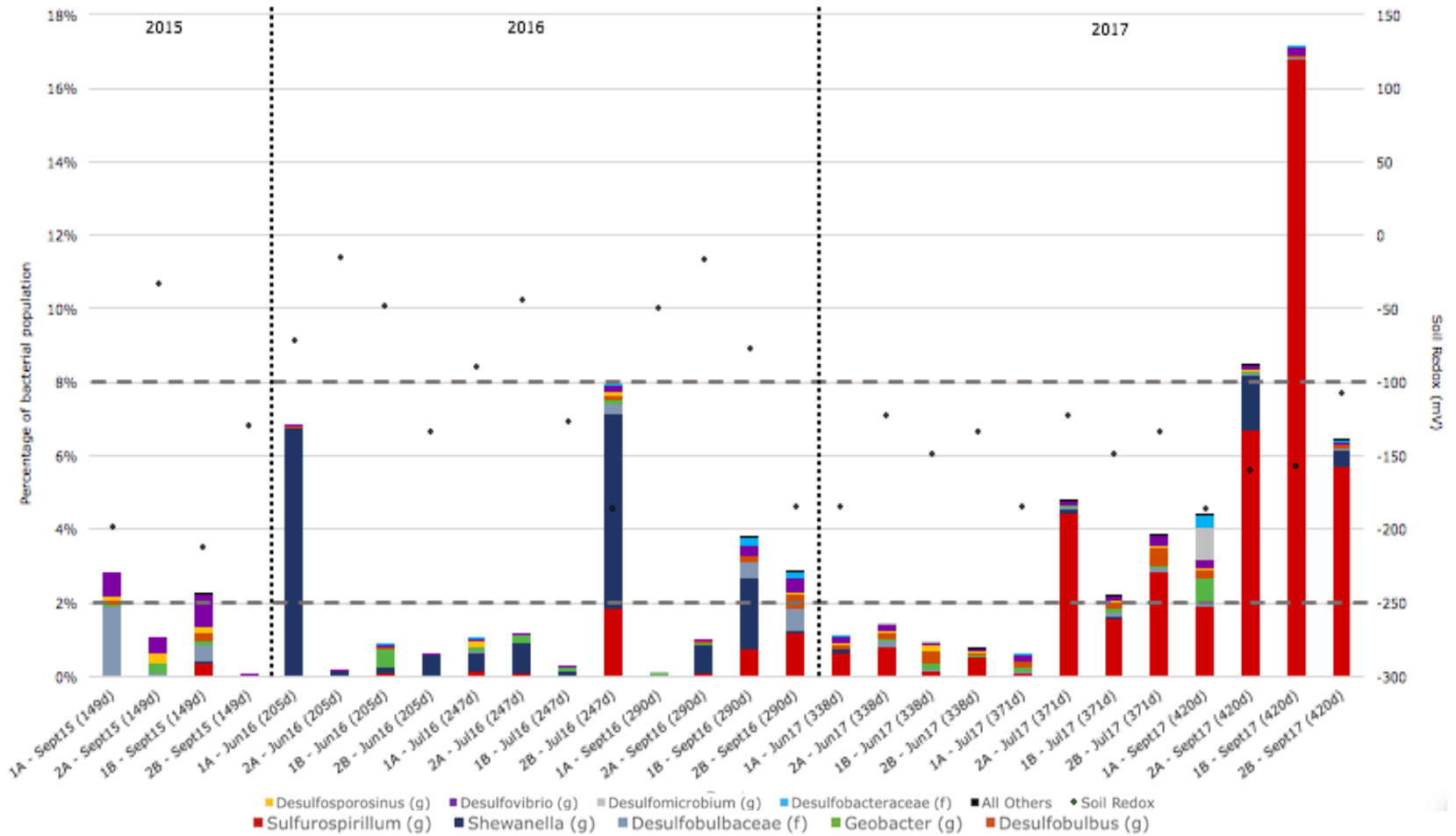
Performance – Soil Redox



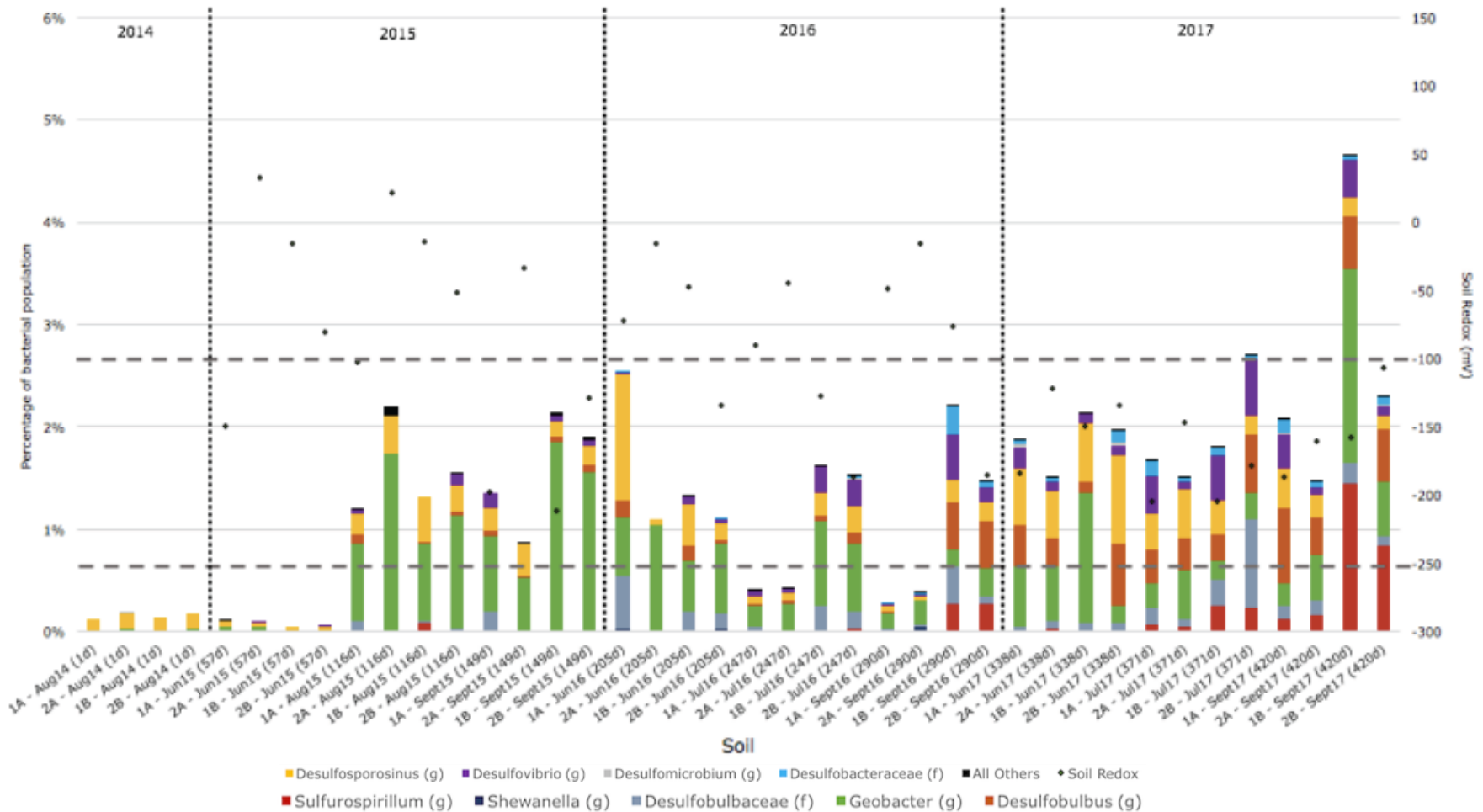
Performance - Vegetation



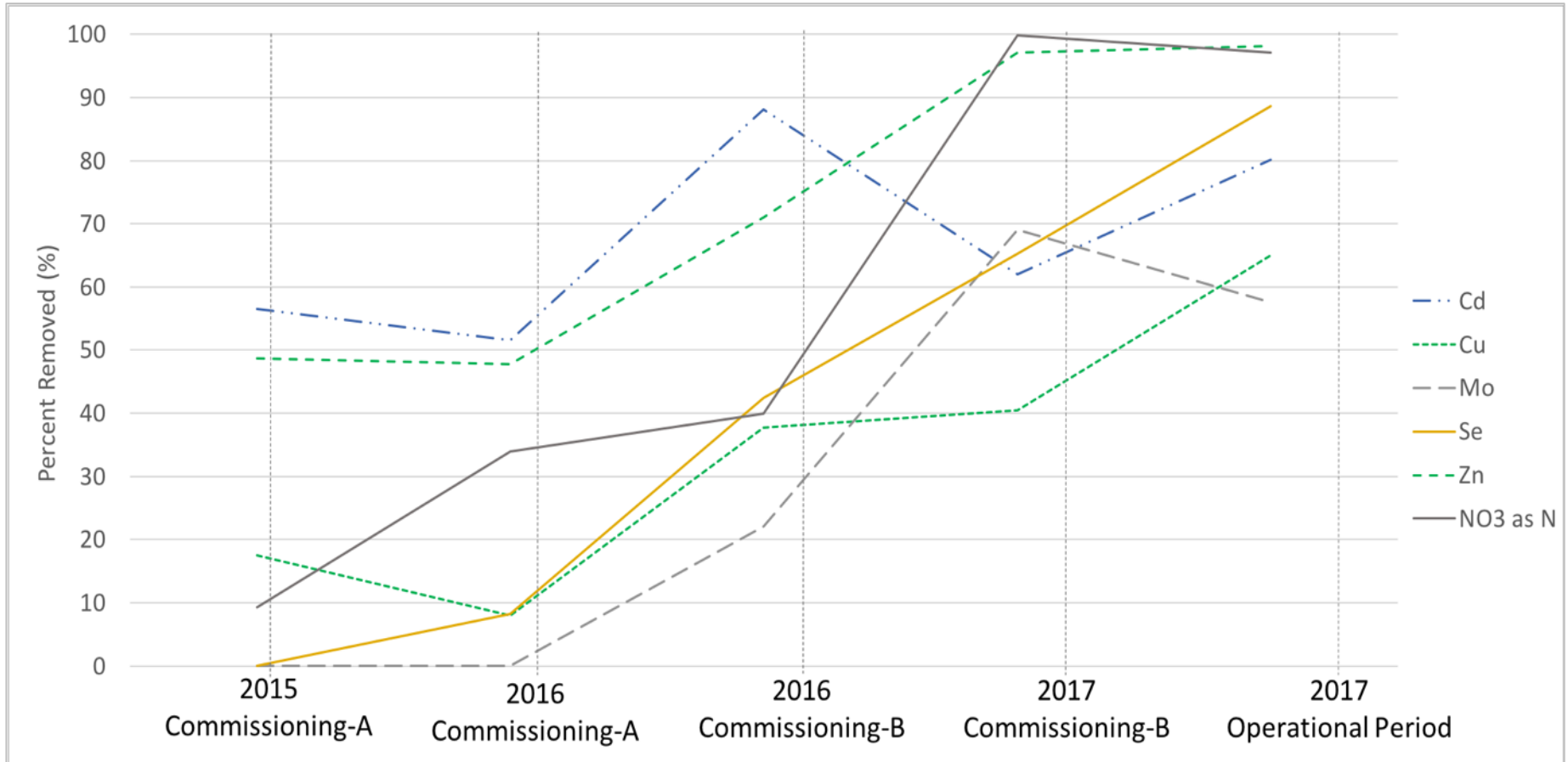
Performance – Microbial Populations in Roots



Performance – Microbial Populations in Soil



Performance – Metal Removal



Challenges Encountered

- Soil copper leaching
- Aphids



2018 – Activities

- Iron (II) Sulfate Heptahydrate addition
- Monobasic Potassium Phosphate Fertilizer
- Planned to assess performance under conditions that would be similar to full-scale
- Testing various HRTs
- Metal Removal in 2018



Full-Scale CWTS Design

- Considerations to be taken on the construction of the full-scale CWTS:
 - Sizing
 - Location
 - Passive treatment systems and maximum flow capacities
 - Substrate
- Full scale CWTS would only be constructed during final closure phase

Acknowledgements



Contango Strategies Ltd.

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