Chemical and biological tests to assess the viability of amendments and *Phalaris arundinacea* for the remediation and restoration of historic mine sites

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1. The Problem

- Historic metal mining tailings and spoil are typically too physically, chemically and biologically deficient for spontaneous re-vegetation, allowing the redistribution and mobilisation of contaminated soils [1]
- There are currently over 750 un-remediated historic metal mines in the UK
- A previous scoping study by the University of Strathclyde highlighted the contribution of mineral processing areas as sources of particulate and dissolved potentially toxic elements (PTE) entering the Upper Derwent river system

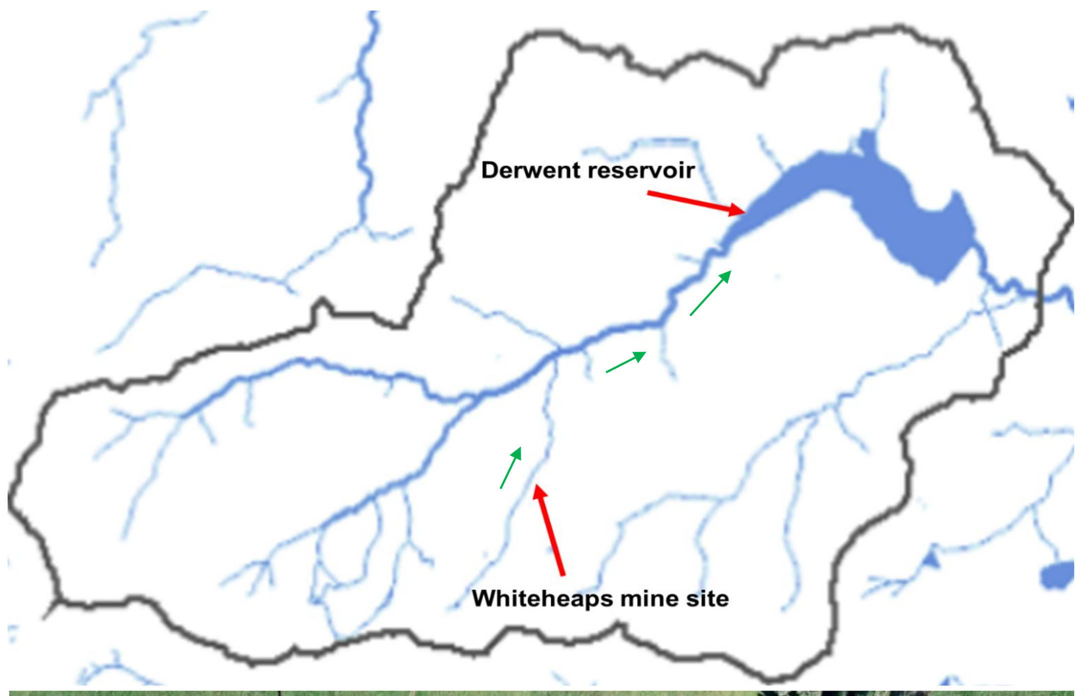


Table 1: Results of sample analysis of sites WH3 (NY946465) and WH5 (NY948465)

Determined	Unit	WH3	WH5
pH	Value	6.7	7.1
Copper	mg/kg	545	890
Zinc	mg/kg	1852	5150
Lead	mg/kg	13873	9112
Arsenic	mg/kg	40.7	66.2
Cadmium	mg/kg	5.07	6.3
Nitrate Nitrogen	mg/kg	<1	<1
Ammonium Nitrogen	mg/kg	<1	<1
Available Phosphorus	mg/l	<2.5	<2.5
Available Potassium	mg/l	30	34

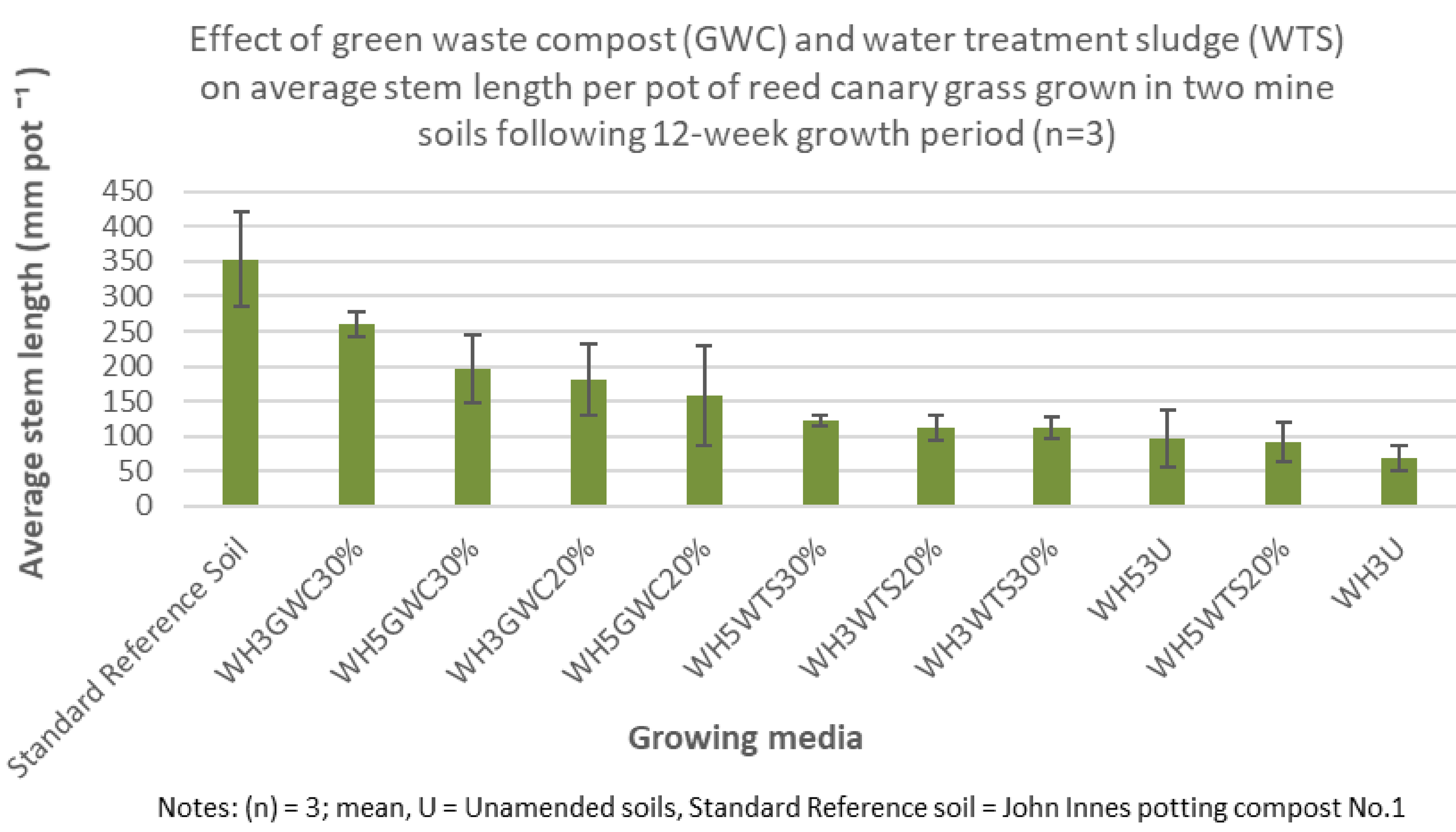
2. Our Approach

- In-situ biological and chemical stabilisation is increasingly considered the best option when managing the risks associated with historic mining [1]. This study aims to trial the use of plants and amendments capable of PTE immobilisation.
- Pot trials using bulk samples and amendments have followed an adapted British Standards (BS/EN 11269-2:2013) method for the effects of PTEs on above ground plant growth.
- Although several recent studies have conducted similar pot trials, very few have applied their results to a field trial, a recommendation commonly made in key literature reviews [1]

Pot trials - week 12 - WH3

Reed Canary Grass (RCG)

- Phalaris arundinacea
- Native perennial
- Able to colonize and stabilize contaminated soils
- Low planting cost, rapid growth and dense rooting habit of RCG make it a useful species for phytostabilisation [2]



Water treatment sludge (WTS)

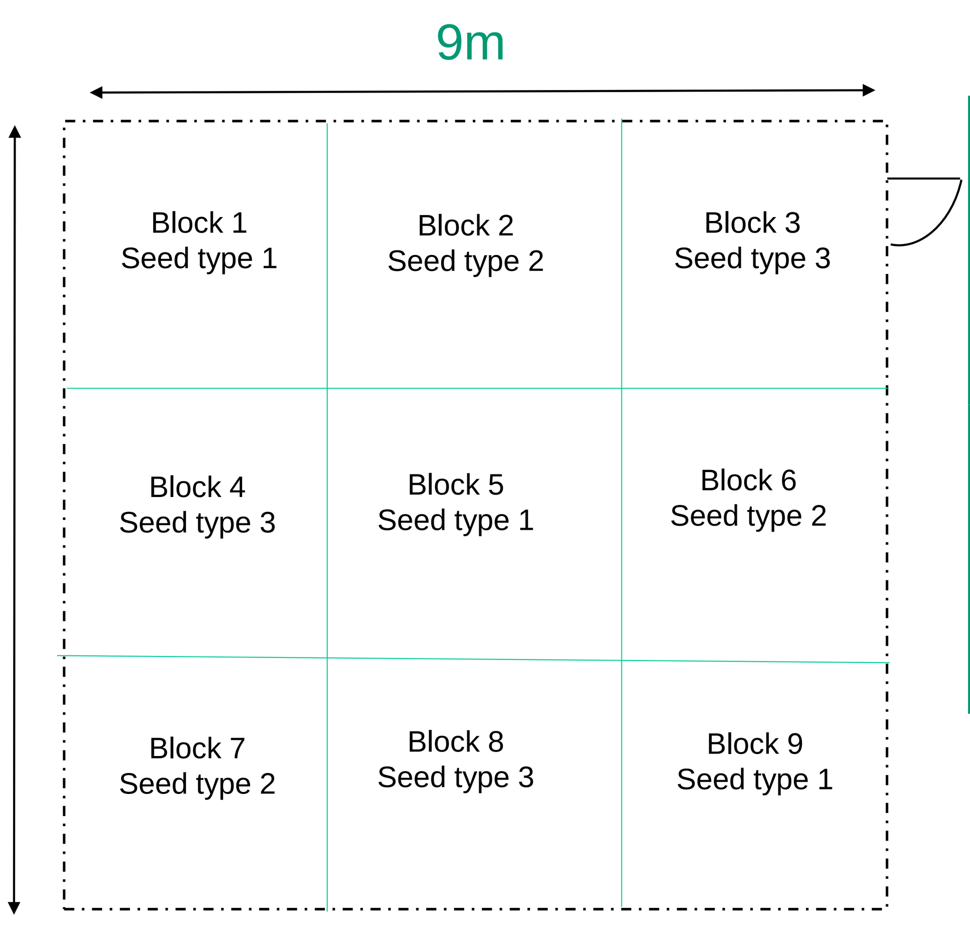
Green waste compost (GWC)

Anticipated effects of soil amendments

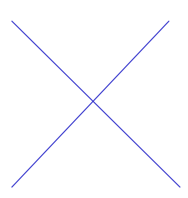
- Increase in organic matter, nutrients and cation exchange capacity providing better growth conditions
- Pb & Zn - preferentially bind to mineral oxides (WTS), reducing bioaccessibility and leachability [3]
- Cd and Zn - preferentially bind to humic acids (WTS and GWC), reducing PTE bioaccessibility and leachability

3. Current Work – Field Trial

- The initial results of the pot trial experiments have informed the design of a two year field trial which will commence in Summer 2019
- Two 9m x 9m fenced sites (WH3 & WH5)
- Per site: (9 x blocks, each of 4 x amendments of 9 x individuals) = 324 RCG plants (3 x varieties x 27 individuals per amendment)
- Soil will be unamended or amended with 30% w/w (amendment weight/ soil weight ratio) of WTS, GWC and an equal mix of both



Block example (3m grid)



= 1 RCG plant

Acknowledgements

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References

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