Decision Support Tool- Giving transparency and justification in weathered hydrocarbon remediation

The remediation market

- Remediation designs and practices are not commonly integrated with SI Companies
- Many Remediation companies have limited portfolio of techniques
- The market is conservative to technology
- Licence issues may be confusing
- Fit for purpose- says who?

What would make on site ex situ bioremediation a more attractive option?

- Certainty
  - Can I meet target values?
- Informed assessment
  - Can I do something to increase the rate of degradation or the nature of the end-product
- Sustainable
  - Economic
  - Environmental
- Transparency for selection of technology
  - If I rank it against the competing technologies; is it the best?

Where is the market status at the moment?

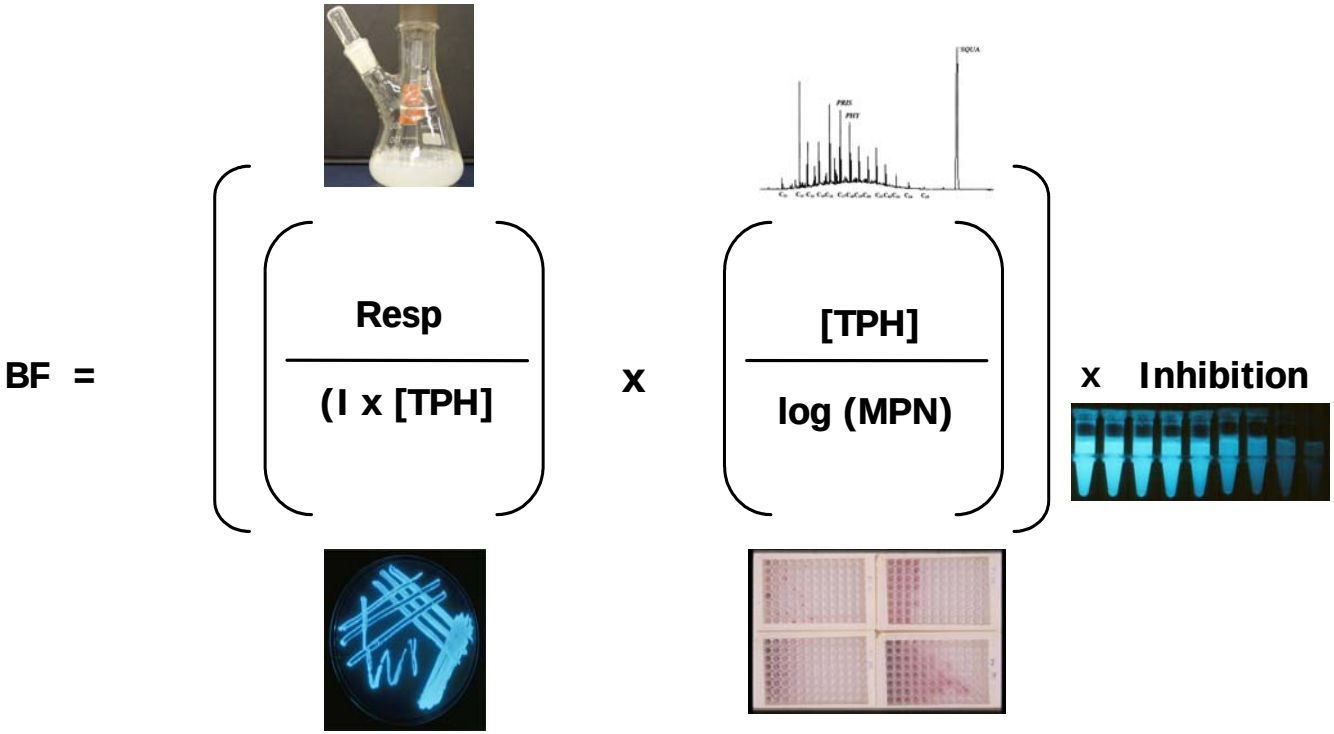
- Test cases demonstrate success
- Cost benefit is unclear at the moment
- Few laboratories facilitate in decision making process
- Integrated thinking is absent-
  - from the Phase 1 through to the re-use of the materials

Predicting Success

- Physical
  - Structure, PSA, moisture holding capacity
- Biological
  - Microbial numbers and activity, performance of degraders, confirm habitat suitability
- Chemical
  - Total and bioavailable hydrocarbon, co-contaminants, nutrients

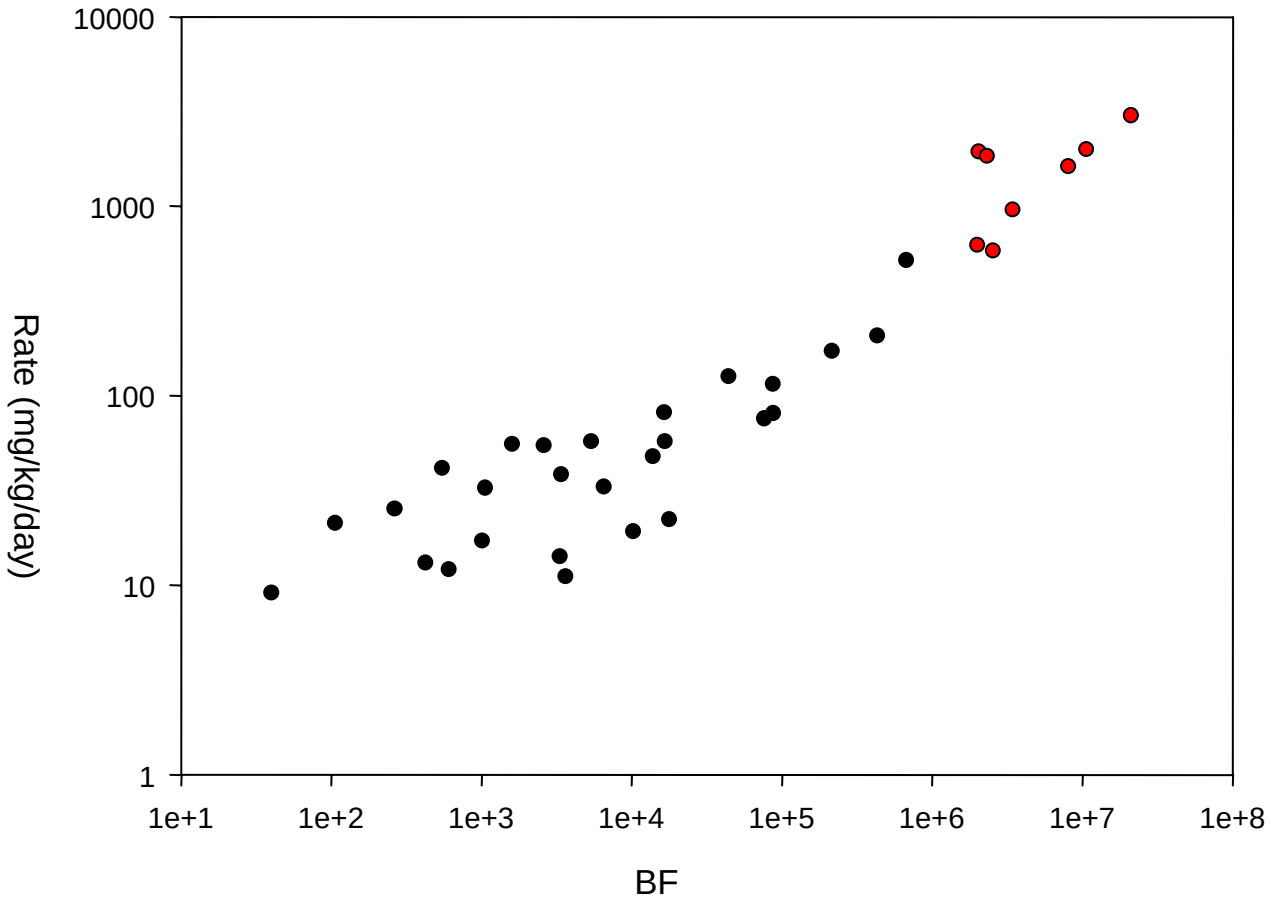
These features can be integrated with empirical testing

- At *Remedios* we developed a set of tests for predictive degradation
- These have been applied to 50 test sites with incredible success rates
- The key attributes are biological and chemical but these are then overseen in a physical and engineering context

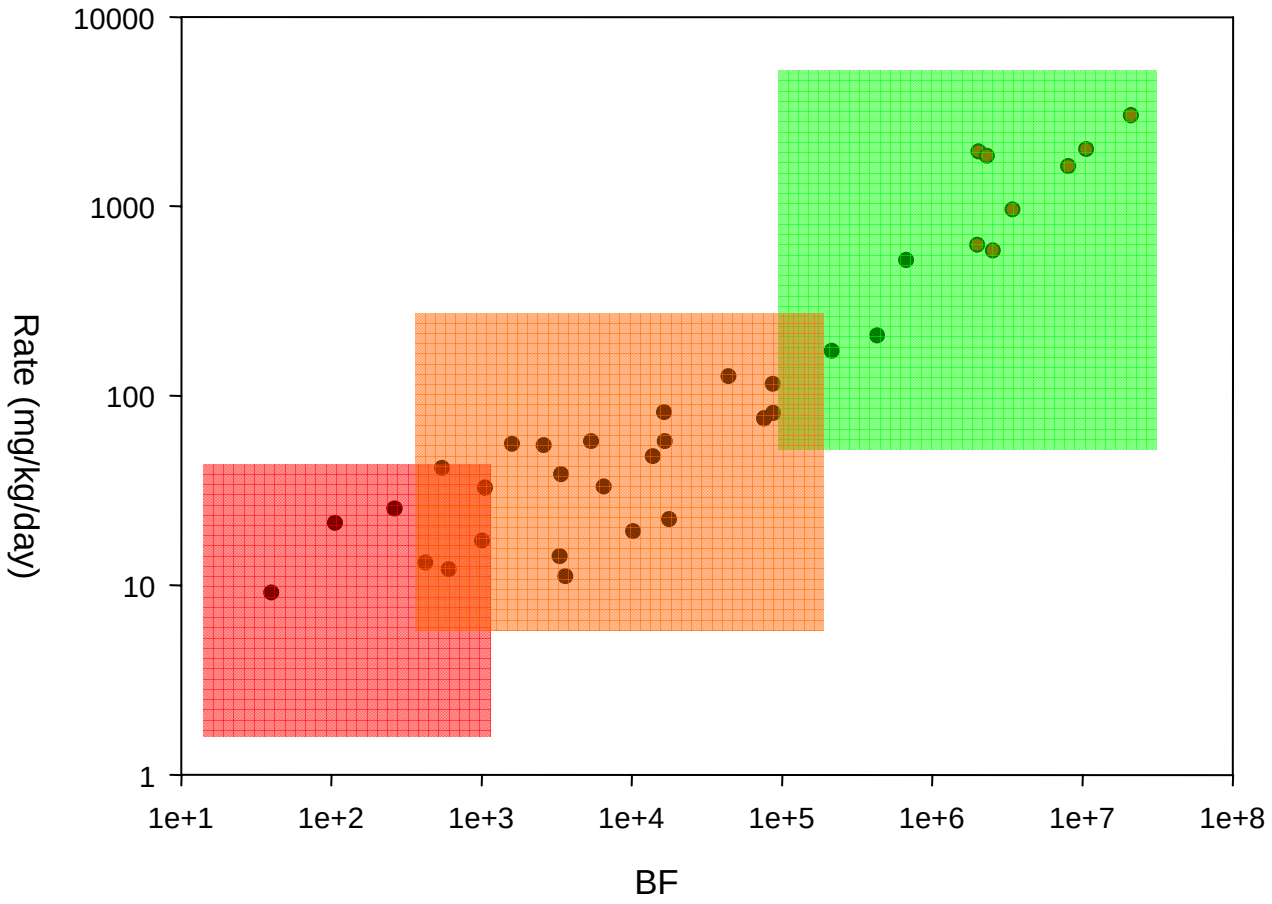


BF = bioremediation function
I = induction
[TPH] =TPH concentration
MPN = most probable number
Resp = respiration

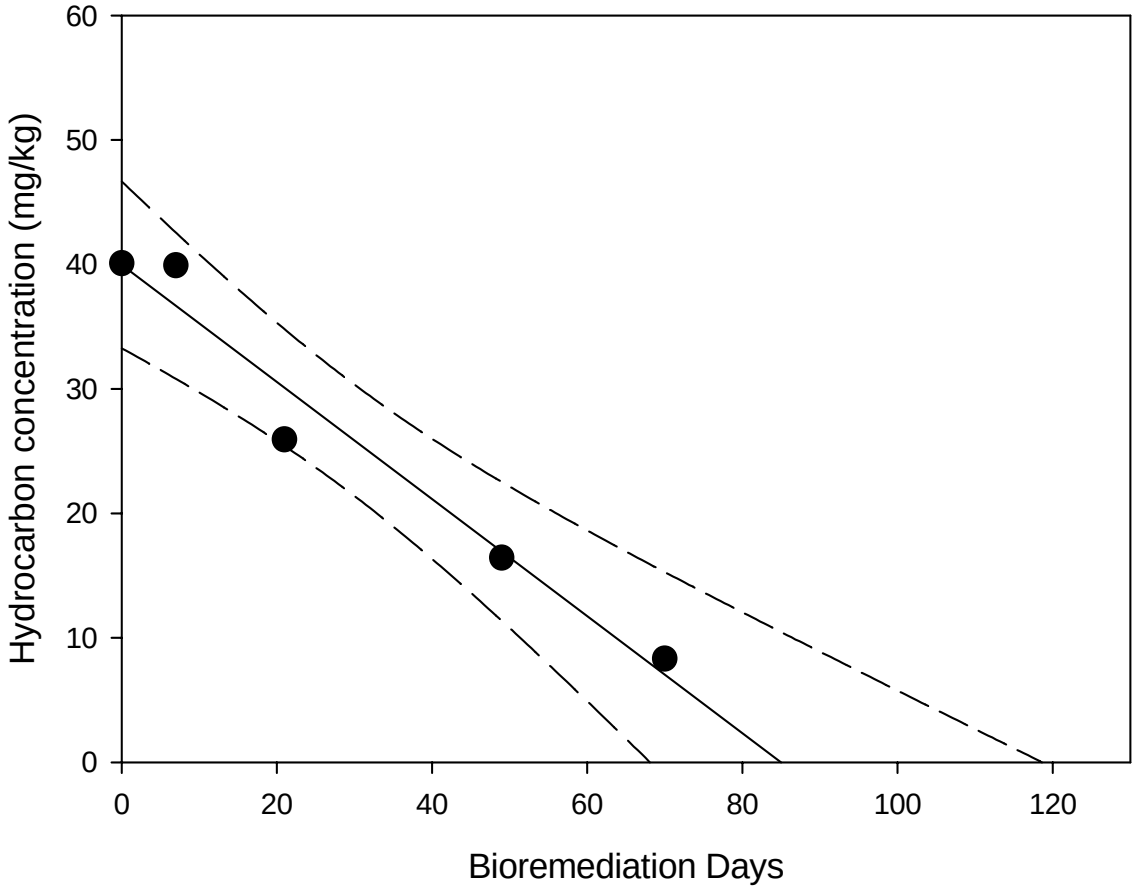
BF & Rate of Degradation



BF & Rate of Degradation



What does this mean?



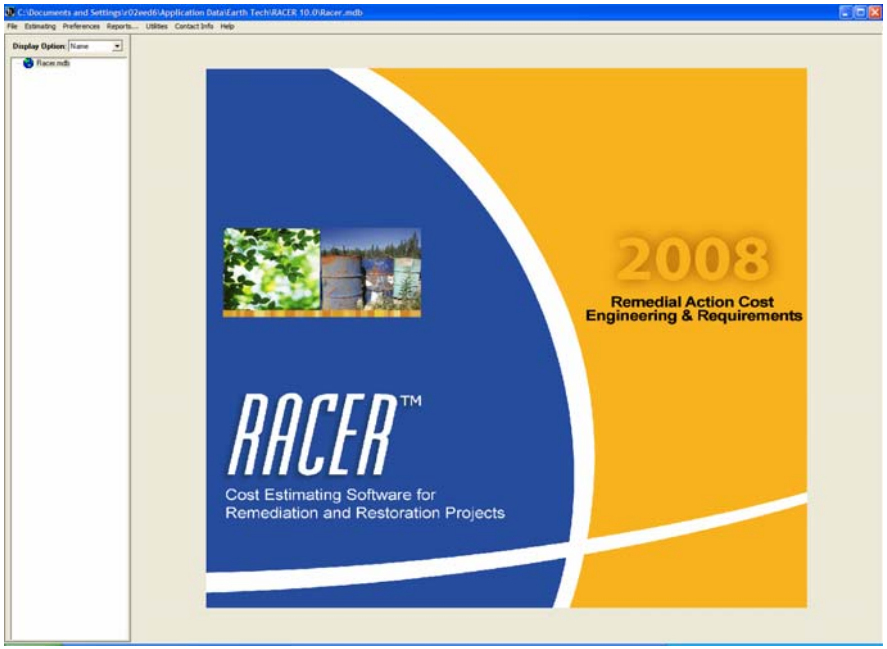
This is a single product……..

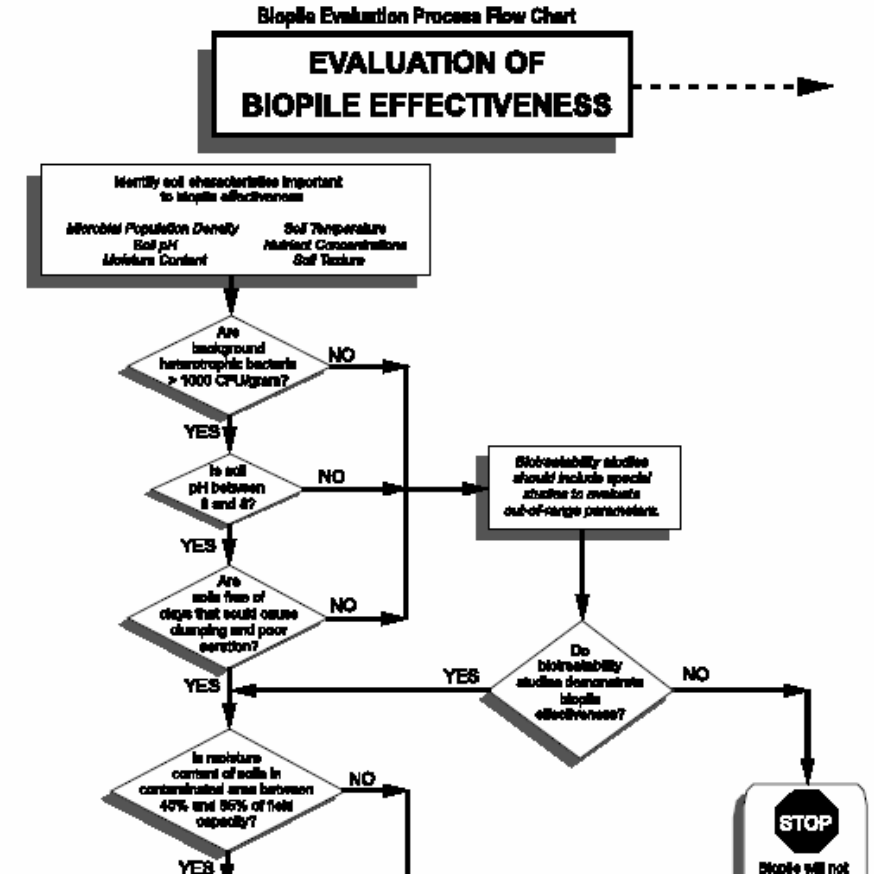
- The purpose of Promise was not to champion a single product
- And this *Remedios* algorithm is just a single step in the refinement of remediation success
- Require to assess the wider market and all the techniques available

So what is on the market to help us?

- Guidance documents
  - Lack specificity and flexibility
- The Battelle and USEPA books and documents
  - Been around a while and have not evolved
- A few software systems to support decision but these are very data heavy programmes
  - Racer is $5k and requires enormous amount of data and doesn't help decision making

So what is on the market to help us?





What do Regulators and Insurers Seek?

- An explanation of how decisions were made
- Justification that the technique will meet the clean-up criteria
- Holistic assessment of the full process

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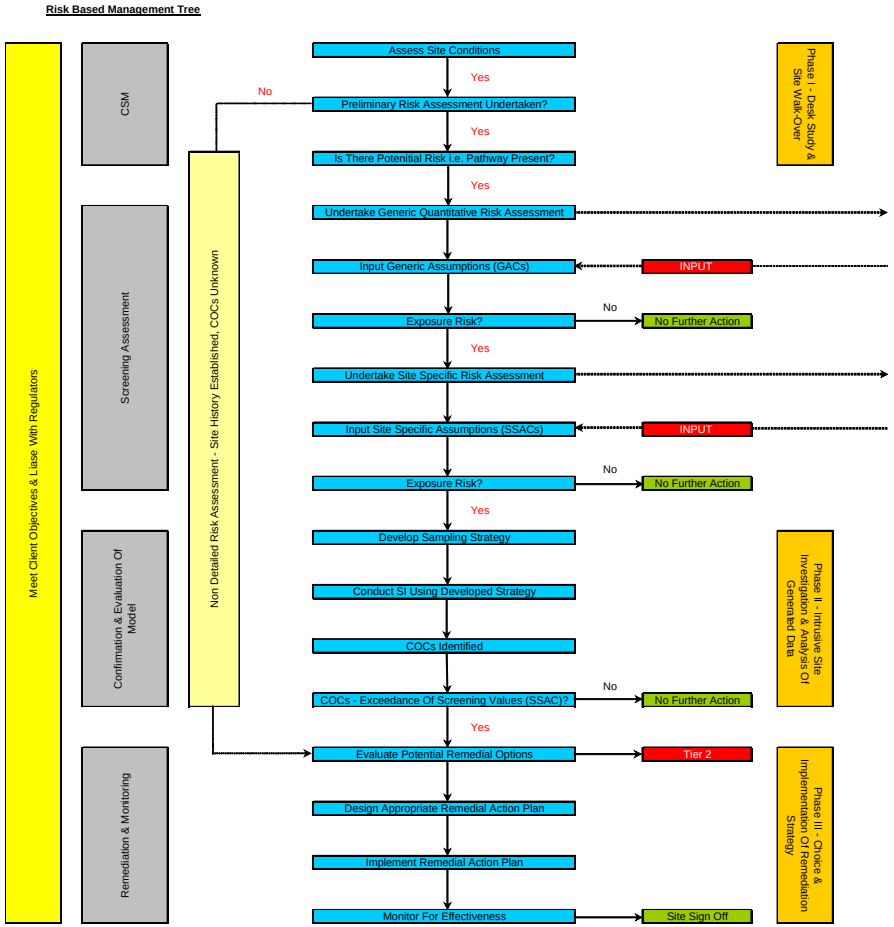
- Enables a transparent justification of the suitable technology from the outset of site works
- Gives focussed and streamlined support for targeting best options
- Interfaces with the web to enable continual updating as practices become established and lessons are learned

A multi-tier approach



- Tier 1- places in the context of a risk-based framework
- Tier 2- evaluates all the suitable comparative options
- Tier 3- aids the decision making for optimisation

- Tier 2
- Permissibility and certainty
  - Applicability
  - Permissibility
  - Certainty
- Economic and duration
  - Capital
  - Operations and maintenance
  - Market constraints
  - Remediation duration
- Environmental credit

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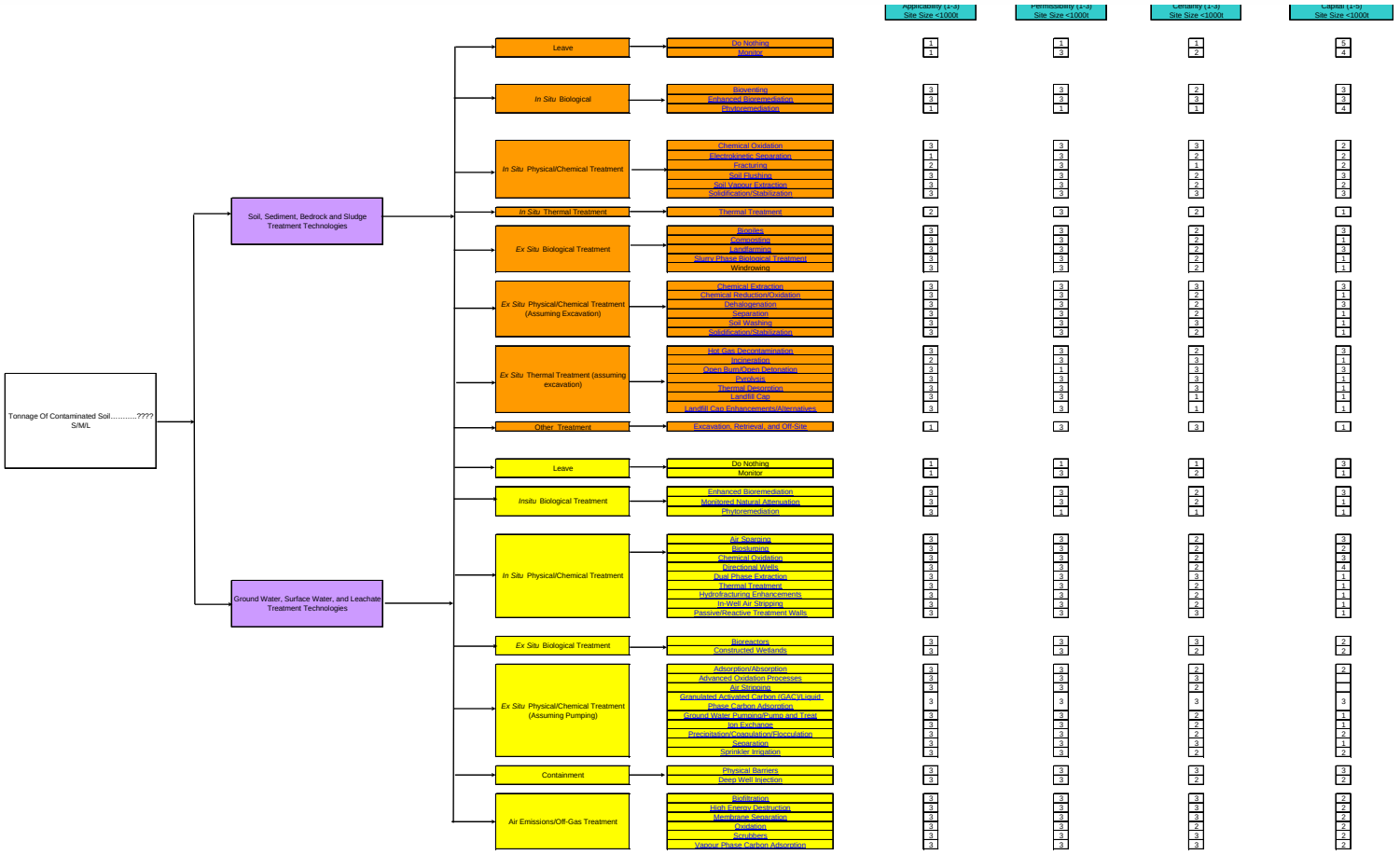

Optimising Biopile processes for weathered hydrocarbons within a risk management framework

Remedios™

UNIVERSITY OF ABERDEEN

Promise

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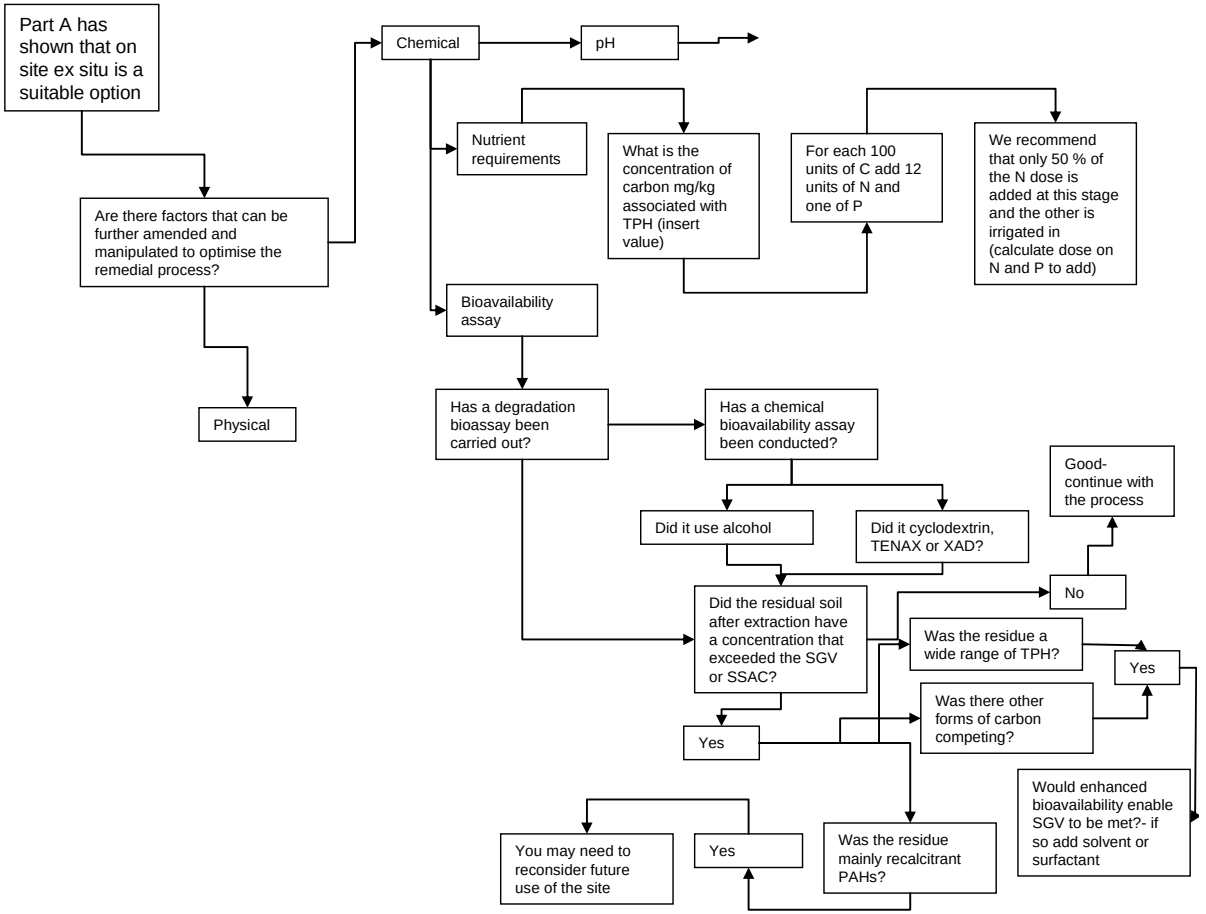
Tier 3A



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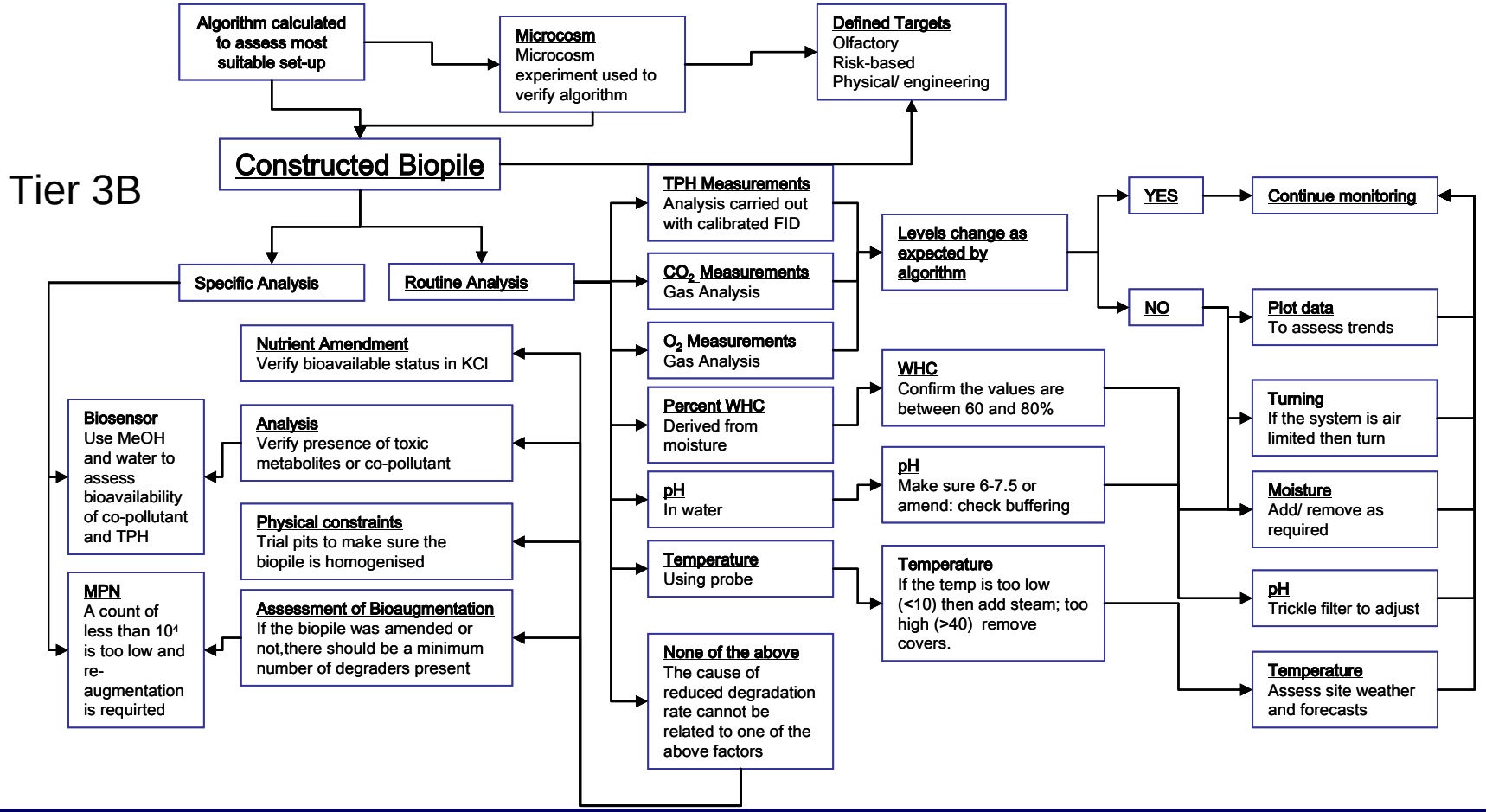
Tier 3B



remediation dst

- Technology and techniques are supported by web information
- Profile enables ease of updating
- Initial focus on bioremediation being progressed
- Transparent support of screened materials on the web
- Test validation performed
- www.abdn.ac.uk/remediation-dst