

Greenspace and brownfield regeneration

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Forest Research



Greenspace and brownfield regeneration

- Who are Forest Research
- Our involvement with SUBR:IM
- Why are **we** interested in greenspace and brownfield regeneration
- Integrated and sustainable greening
- SUBR:IM research and outcomes
- Guidance, tools and decision support
- Summary and conclusions



About Forest Research

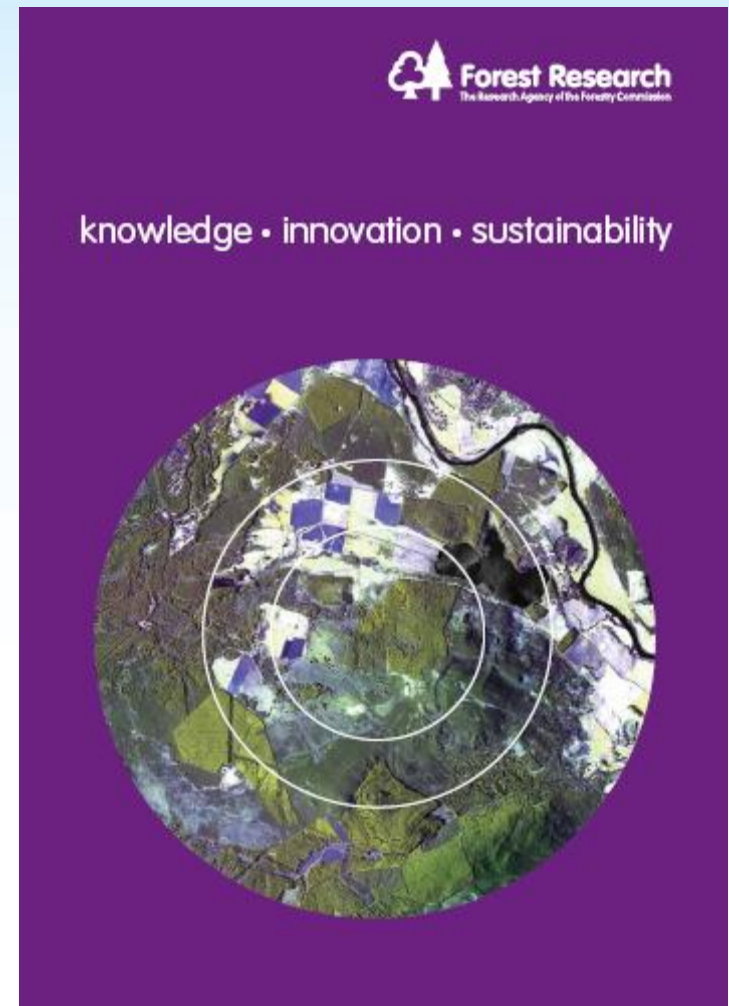
“One of the world’s leading centres of research into woodlands and forestry”

Our aims and objectives

We aim to provide research services relevant to UK and international forestry interests and inform and support forestry’s contribution to UK governmental policies. Our core roles are to provide the evidence base for UK forestry practices and to support innovation.

Trees have a profound influence on our lives:

- On our environment and health
- On our access to green space
- On our landscapes and their biodiversity
- As a raw material for construction, fuel and other uses
- On livelihoods and the rural economy



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<i>Project</i>	<i>Title</i>
A	Project and portfolio management
B	Role of development industry
C	Multi-level decision making process
D	Metrics
E	Robust sustainable technical solutions
F	Integrated remediation and greening
G	Quality in land remediation
H	Restoration of acid tar lagoons
I	Impacts of climate change on pollutant linkage
Ja	Property investment and brownfield development
Jb	The governance of sustainable development
K	Novel special purpose composts
L	The use of charcoal for in-situ remediation
M	Re-conceptualising brownfield regeneration
N	Design for Deconstruction (DfD)
O	Brownfields, flooding and climate change
P	Designing and managing wetland habitat systems on brownfield land
Q	Governance of Brownfield Regeneration: Institutions, Policies, Outcomes, and Best Practice in the UK and Germany

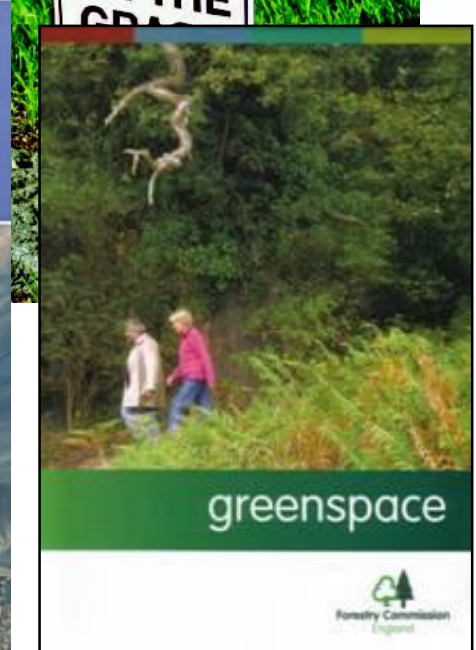
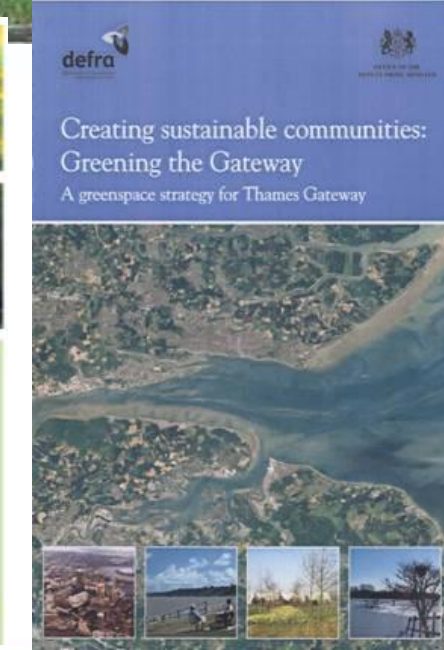
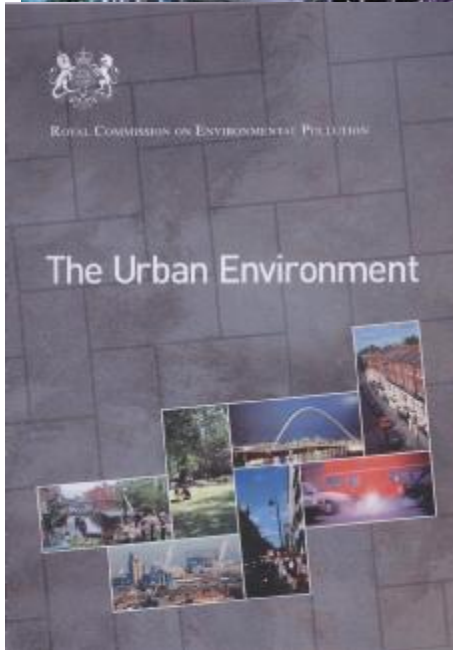
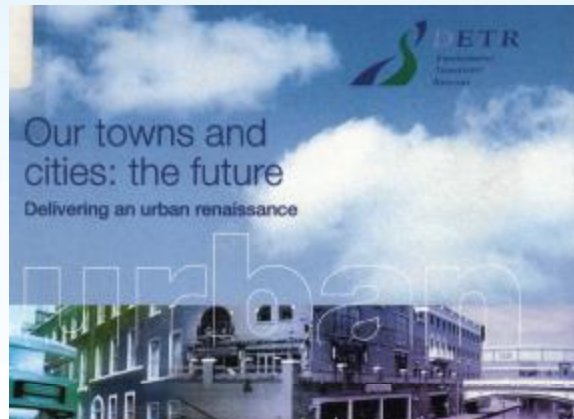


Projects

Projects led or co-led
by Forest Research



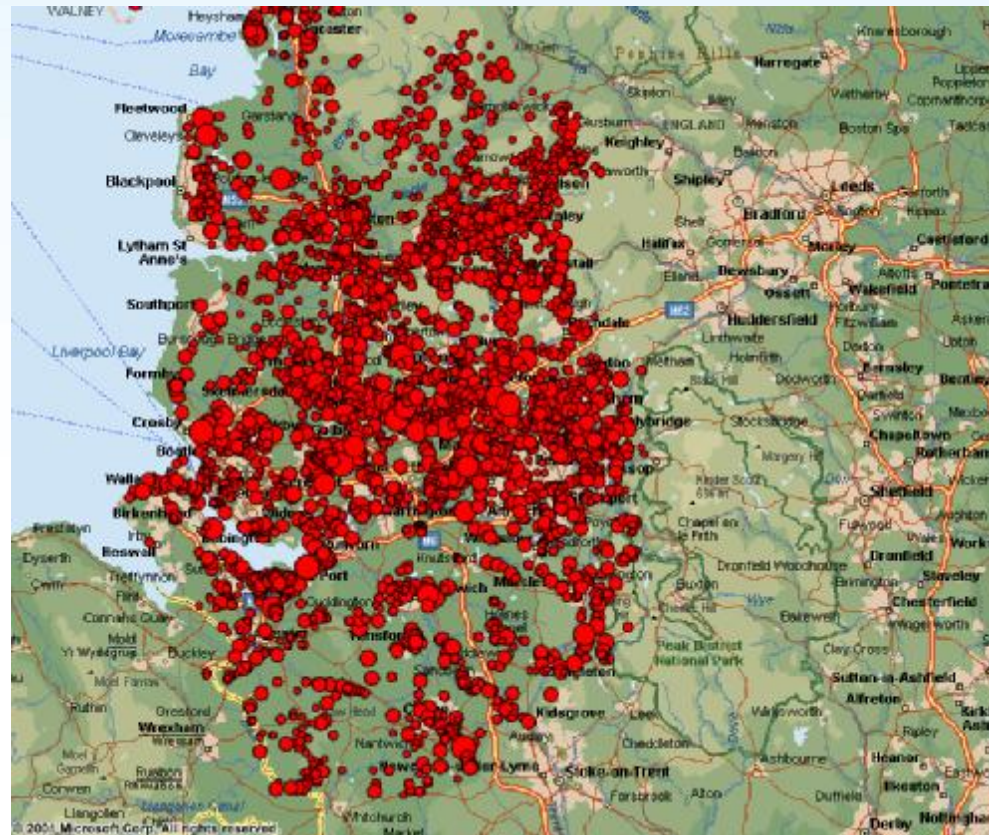
Greenspace drivers



Community Forests in Great Britain



Newlands sites in Merseyside



Sites from <2 ha to > 50 ha

Strategy for England's trees, woods and forests

- Published next week
- Cross government strategy
- Includes policy to integrate trees, woodland and other **greenspace** into regeneration and **brownfield** restoration, as a cost effective and sustainable contribution to local environmental quality



Some benefits of Urban Greening

Social Value

- Aesthetic value
- Amenity value
- Raise sense of community ownership and well-being
- Health improvements
- Education facility for local schools

Ecological Value

- Provide 'natural' habitat
- Protect unique habitats
- Link 'green islands' to form 'green corridors'
- Promote biodiversity

Remedial Value

- Phytoremediation and Phytostabilisation -
'The use of plants to immobilise, convert, or remove contaminants'

Economic Value

- Increased land value
- Increased property prices
- Increase in inward investment
- Prevent social and economic spiral of decline



Some reported impacts

- Nottinghamshire coalfields
 - significant impacts on red-list bird species
 - 1000 volunteer days per year and 500 school pupil visits per year
- FC 'Capital Modernisation Fund' sites
 - £10K per ha to create
 - £4k per annum per ha direct 'public benefit'
- Newlands
 - Property valuation reports – significant increase in property values of the area



Management for *Integrated* greening

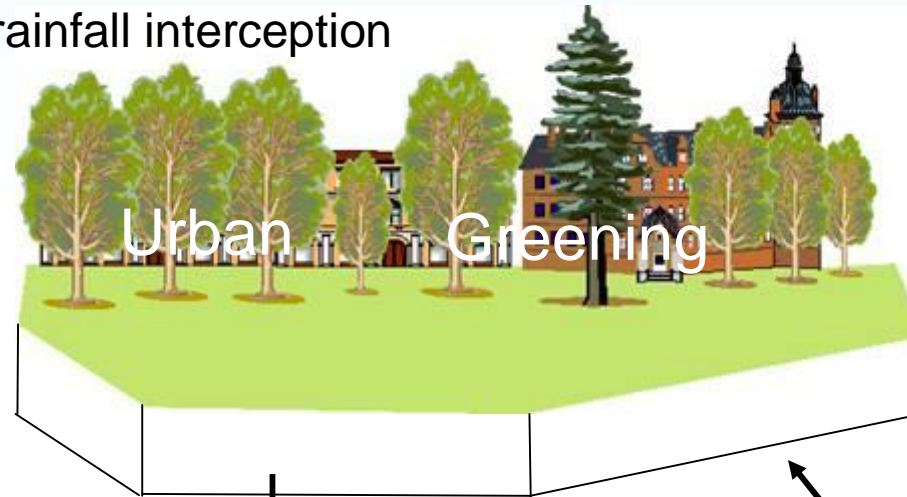
Environmental benefits:

e.g. heat island reduction,
atmospheric pollutant interception,
urban biodiversity

evapotranspiration



rainfall interception



Public benefits:

e.g. economic
regeneration,
education,
landscape &
habitat
improvement,
sport/recreation,
provision of
shade, climate
change mitigation

Phytostabilisation;
contaminant break
down

← use of organic
wastes

↓ Reduced leaching
to surface and
groundwater

↖ Waste minimisation
through re-use of
brownfield 'soil' or
remediated materials



SUBR:IM Work package 'F' objectives

- review existing information on integrated remediation and greening systems
- assess the sustainability of sample integrated remediation and greening systems
- develop improved and new integrated remediation and greening solutions by performing experimental work
- develop environmental, economic and social sustainability criteria for urban greening
- provide technology transfer on achieving integrated sustainable urban remediation and greening



Integrated remediation and greening project *tasks*

1. a literature review of remediated soils and their role in urban greening
2. a survey of practitioner's attitudes to urban greening (in collaboration with projects based at Cambridge, Reading and Surrey Universities)
3. experimental research programme investigating suitability of bioremediated and thermally remediated materials for use in urban greening
4. detailed field survey of sample brownfield sites that have been restored to urban greenspace



Review of remediated soil properties

Soil property	Remediation treatment				
	SVE/air sparging	Thermal desorption	Bio-remediation	Chemical extraction	Physical separation and soil washing
Available water capacity		X	*	X	
Potentially Toxic Elements (PTE)	**	**	*	**	*
Acid neutralising capacity		X	*	X	
Organic matter	*	X	**	X	
Nutrient content	X	XX		XX	X
Nutrient holding ability		X	*	X	
Seed bed establishment	*	*	*		
Microbial activity	*	XXX	**	XXX	X

XXX Serious detrimental effect, XX Moderate detrimental effect, X Slight detrimental effect, Blank: No effect, * Positive effect ** Significant positive effect

Review of amendment suitability

Remediation technique	Mineral fertilisers	Lime	Cake sewage sludges	Thermally dried sewage sludges	Paper mill sludges	Greenwaste and municipal waste	Woodwastes
Soil vapour extraction/air sparging	**	-	*	**	*(secondary sludges)	*	-
Thermal desorption	*	*	**	*	*	**	*
Bioremediation	**	-	*	*	*	*	*
Chemical extraction	*	**	**	*	*	**	*
Solidification/stabilisation (phosphate stabilisation)	**	**	*(phosphate stabilisation)	*	*(phosphate stabilisation)	*(phosphate stabilisation)	-
Physical separation and soil washing	*	-	**	**	*	**	*

** Highly suitable

* Useful

- No advantage



Experimental programme

To test the ability to grow trees, grass and wildflowers in remediated 'soils', with and without compost amelioration



Experimental design

Two tree species:

Poplar
Alder

Two amenity grass mixes:

Sandy substrate
Clay substrate

Two wildflower/grass mixes:

Sandy substrate
Clay substrate

Three compost treatments:

No addition
Low rate (25% v/v)
High rate (50% v/v)



Soil treatments tested

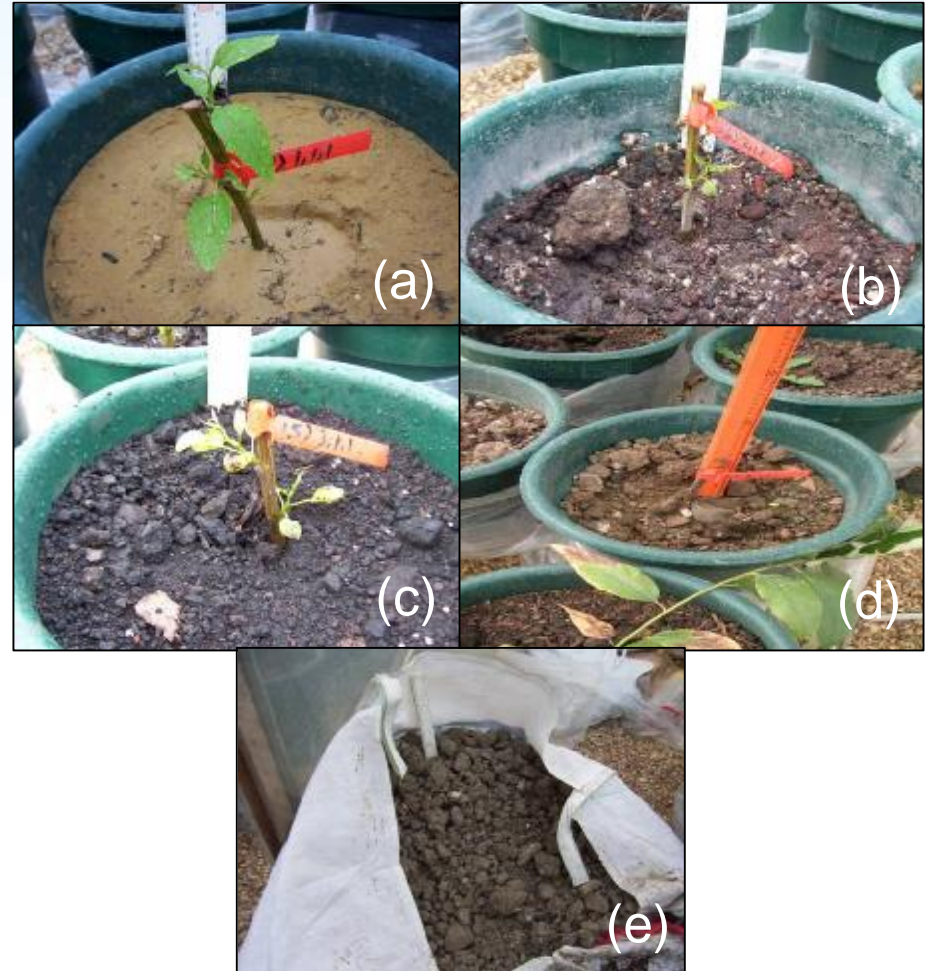
(a) Sand (control)

(b) Unremediated material containing organic contaminants (HC)

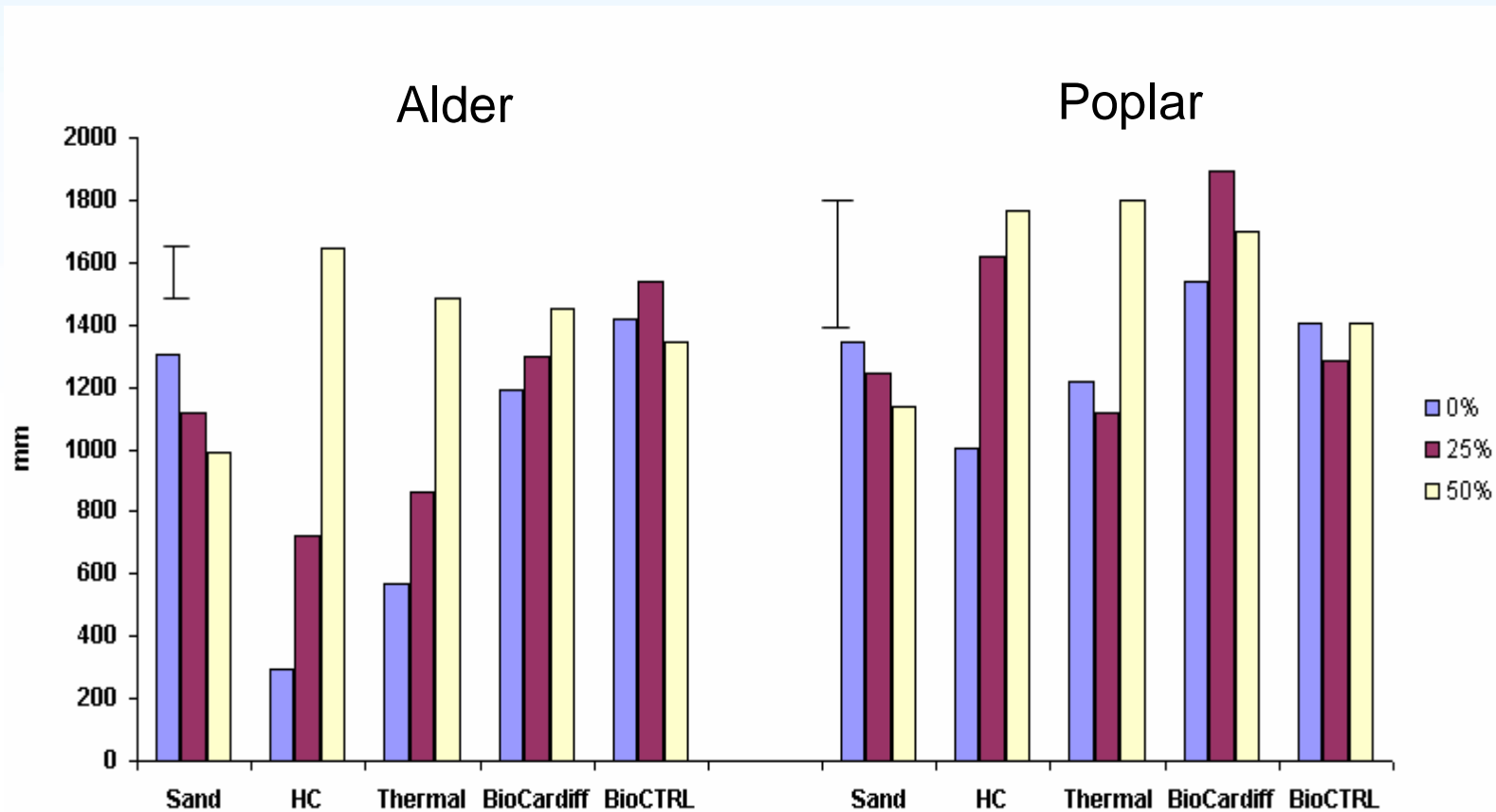
(c) Above material, thermally remediated (Thermal)

(d) Bioremediated sandy loam material formerly contaminated with organic contaminants (BioCardiff)

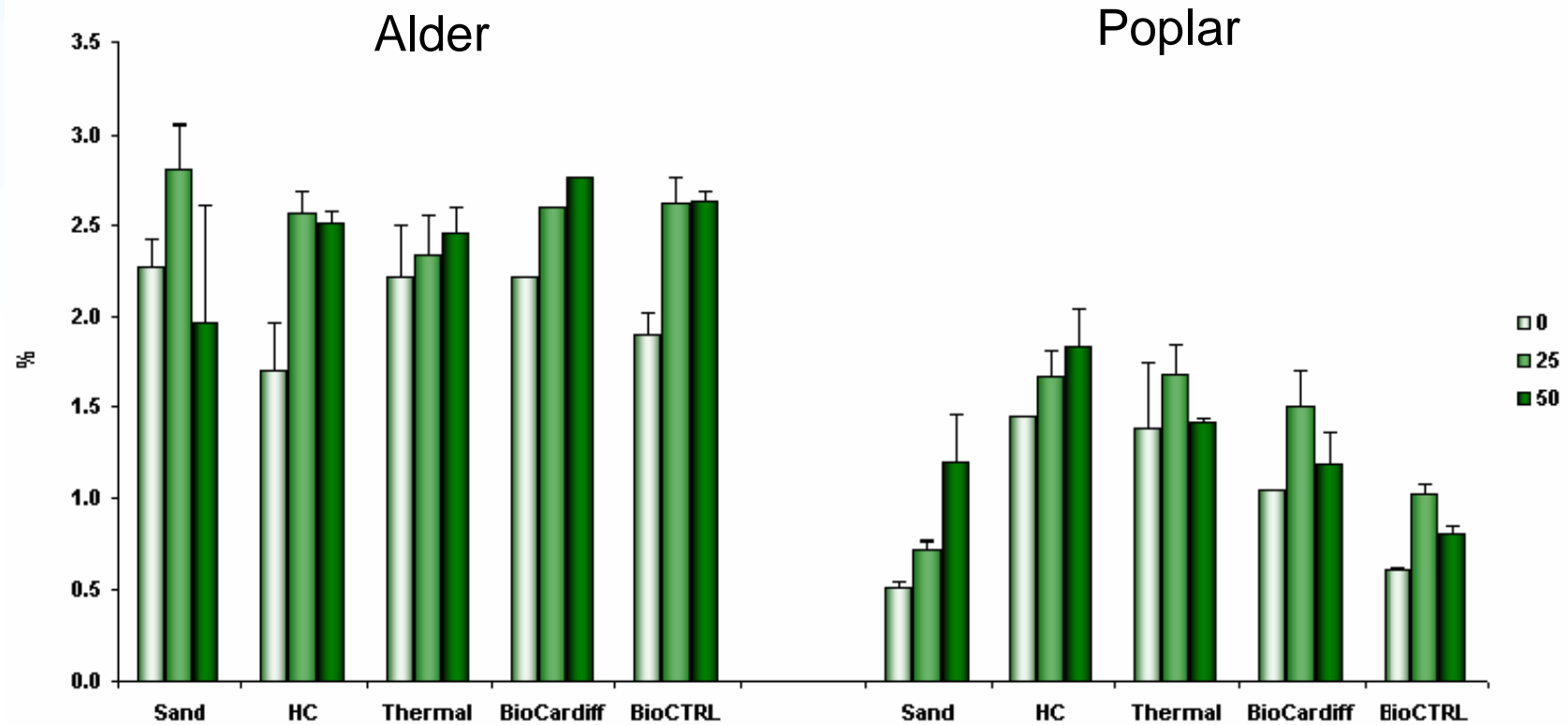
(e) Bioremediated clay material formerly contaminated with organic contaminants (BioCTRL)



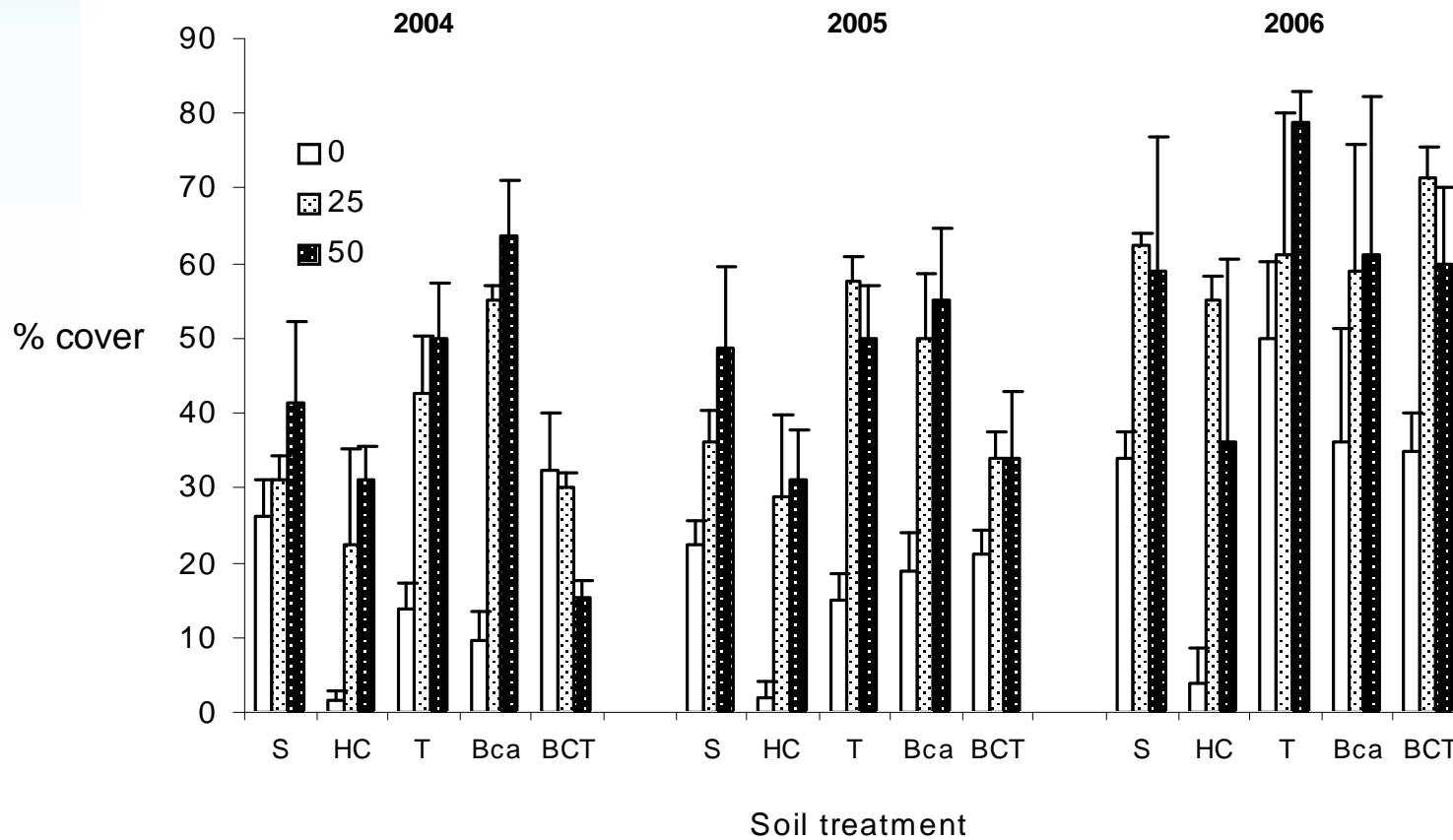
Main stem heights for Alder and Poplar after two growing seasons



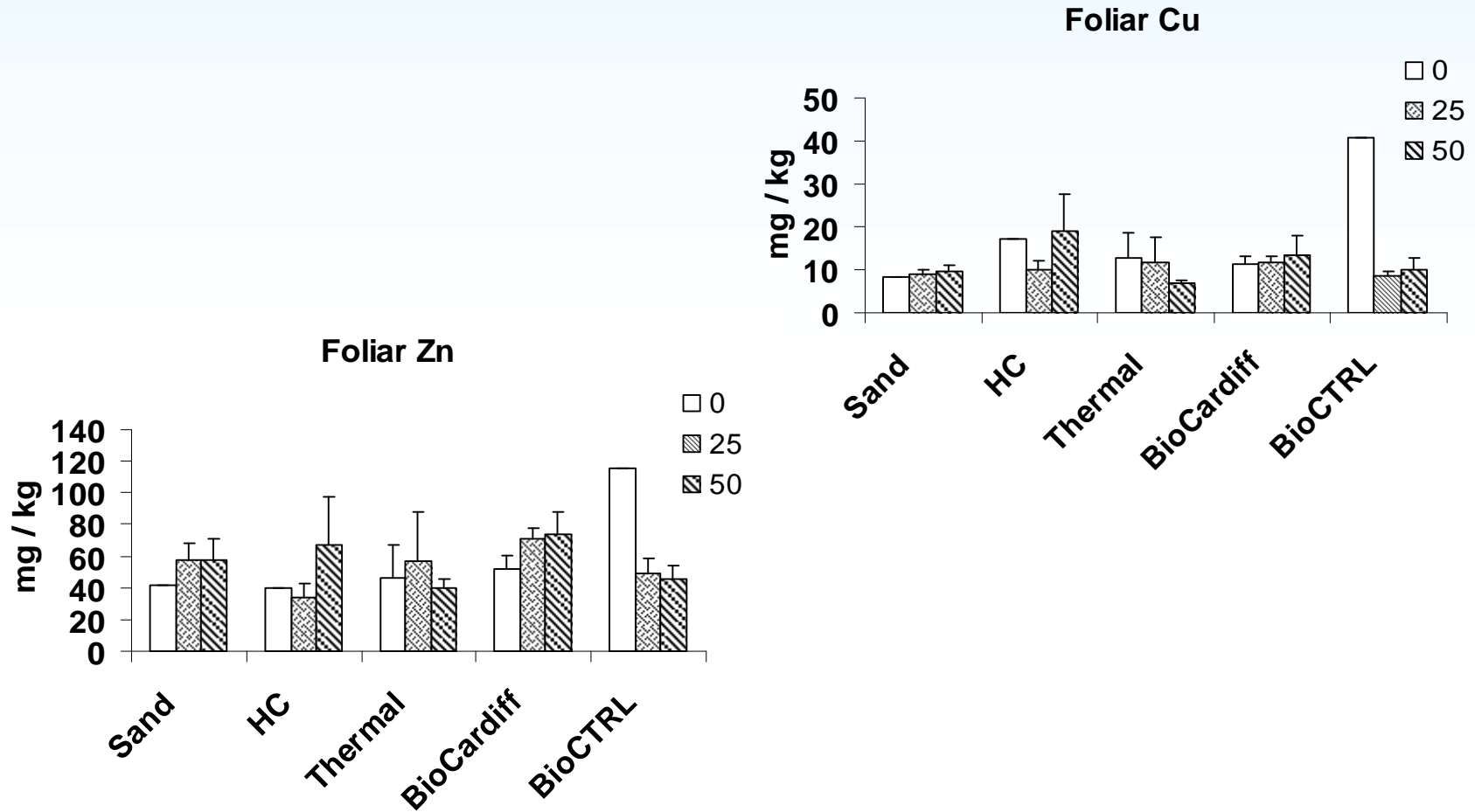
Nitrogen foliar concentration (%)



Grass cover over three years



Grass micronutrient concentrations (mg kg^{-1})



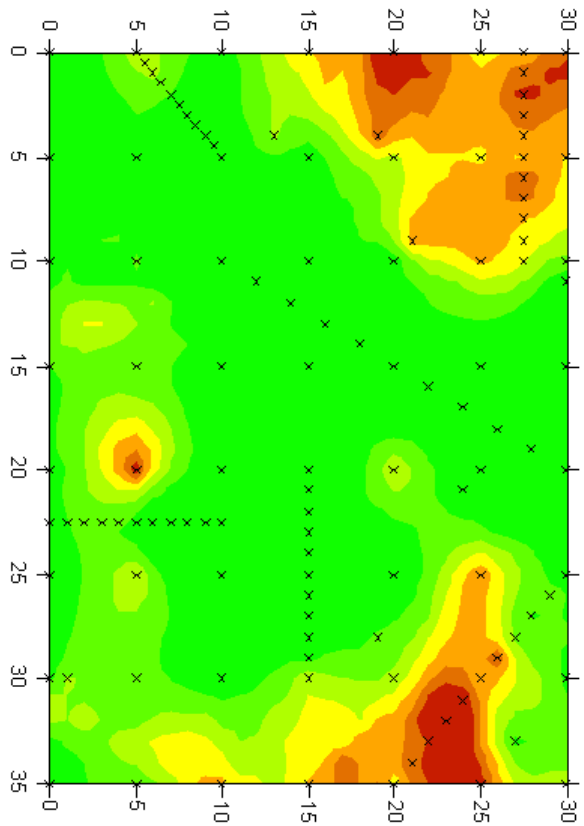
Conclusions

- Plant growth is possible on certain remediated materials and this is improved with the addition of compost
- Growth in contaminated material was reduced compared to remediated material
- Adding compost at the lower rate improved growth in all treatments for trees, grass and wildflower/grass mix
- Adding compost at the higher rate did not produce any further significant improvements over the lower rates for the grass mixes

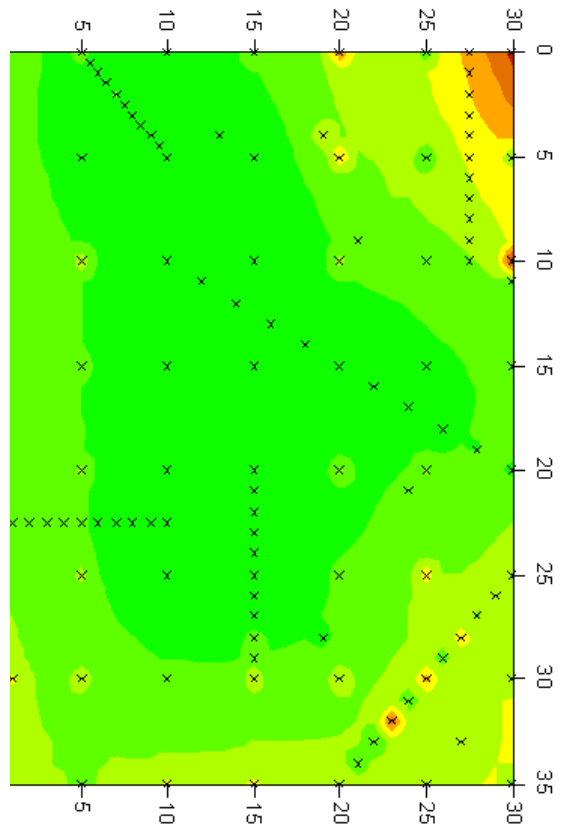


Field investigation

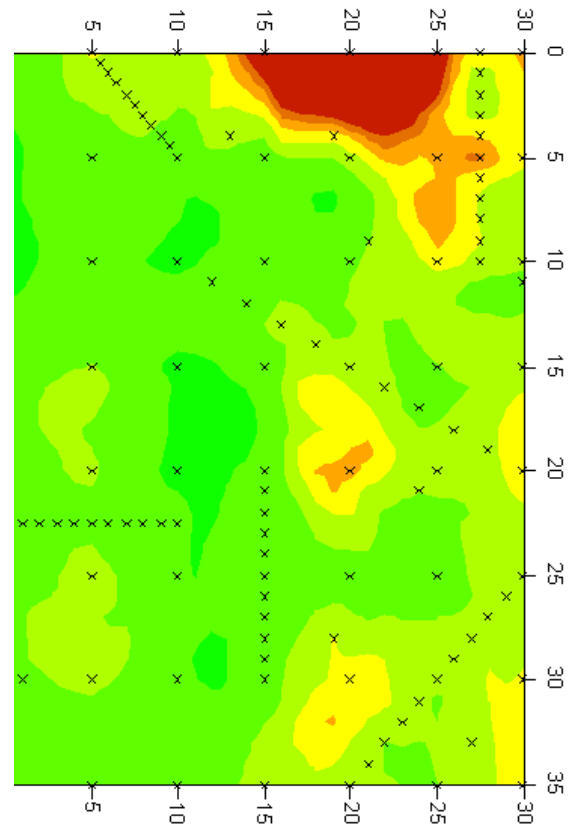
FPXRF (Total)



CaCl₂ (Extractable)



Bioindicators



Soil amendments

- Develop sustainable remediation techniques that will rely on the use of waste or cost-effective materials;
- Enhance biodegradation and immobilization capability of such materials;
- Reduce contaminant levels using soil amendments;
- Induce revegetation to stabilize the treated soil;
- Facilitate plant growth and provide soil conditioning and nutrients to a wide variety of vegetation.



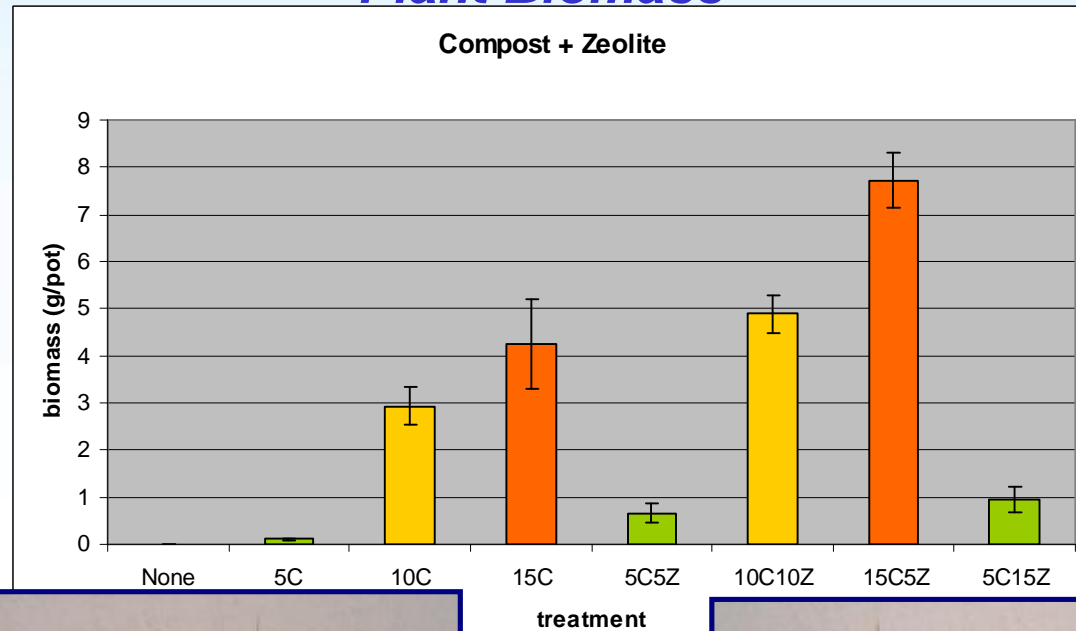
Example soil amendments

- Lime
- Sewage sludge
- Sewage sludge compost
- Spent mushroom compost
- Greenwaste compost
- LimeX (Sugar Beet industry)
- Food waste composts
- Iron oxides
- Charcoal
- Zeolitic clays

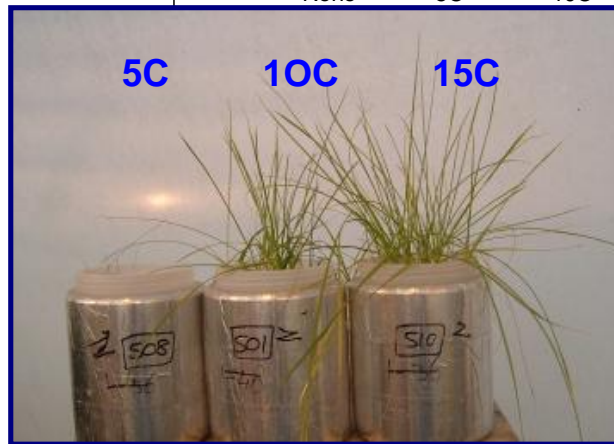


Compost and Zeolites

Plant Biomass

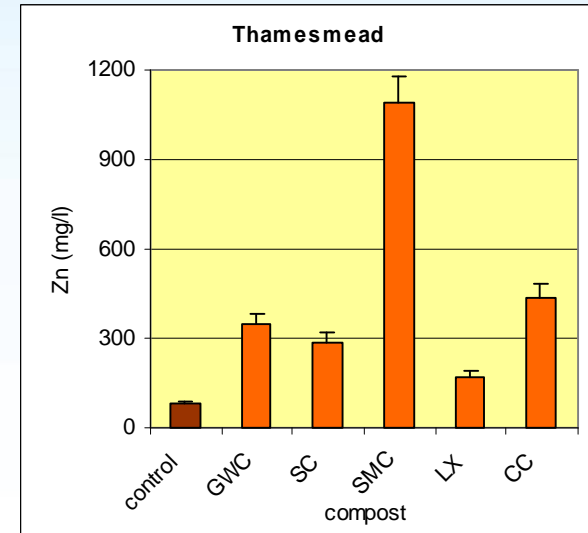
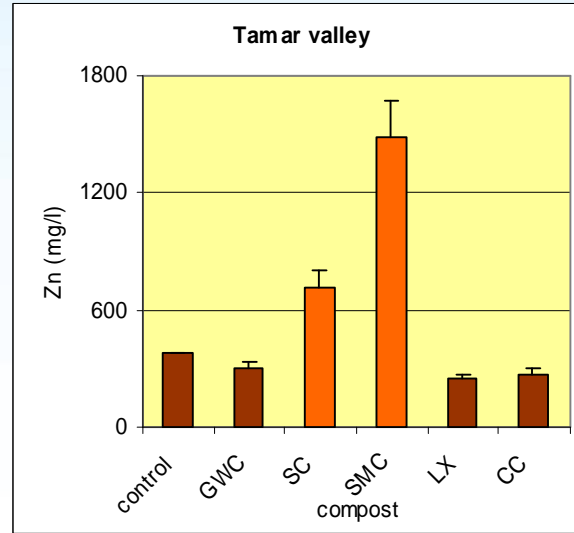
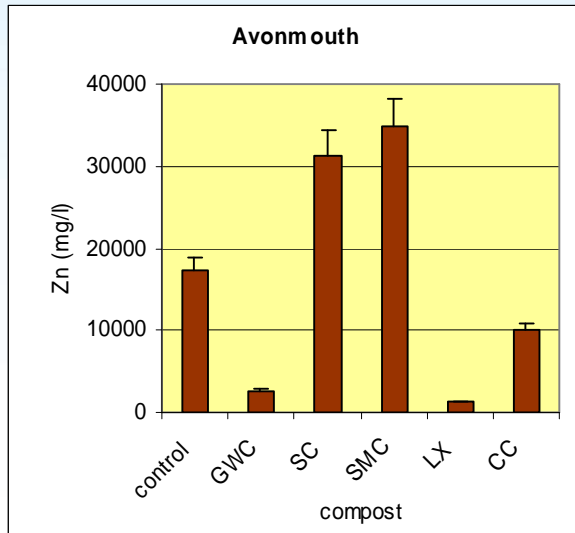


Tamar Spoil

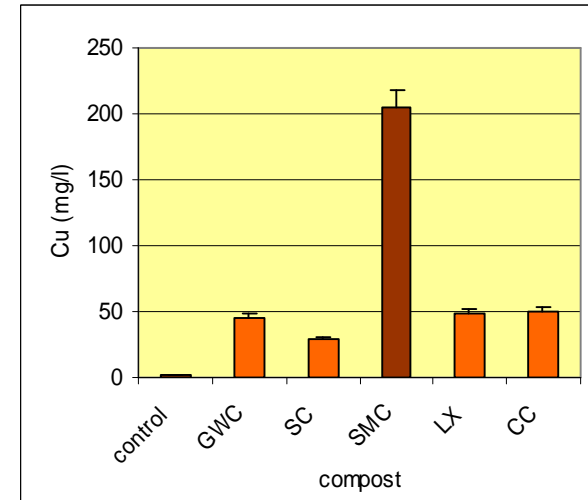
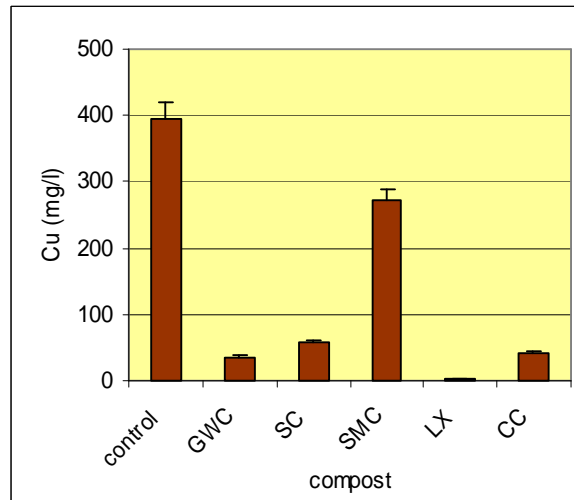
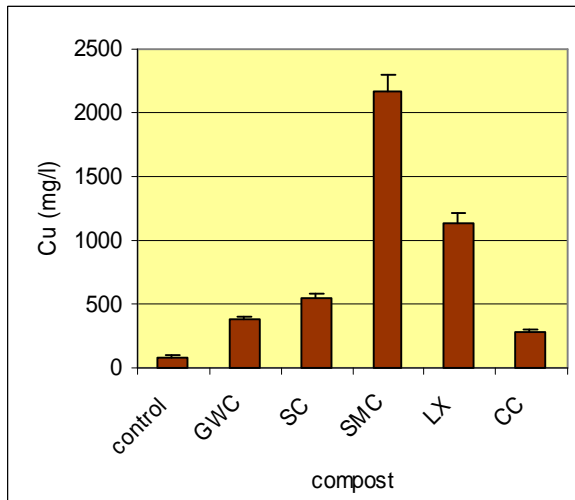


Compost amendments - health warning

■ Metal originates from amendment

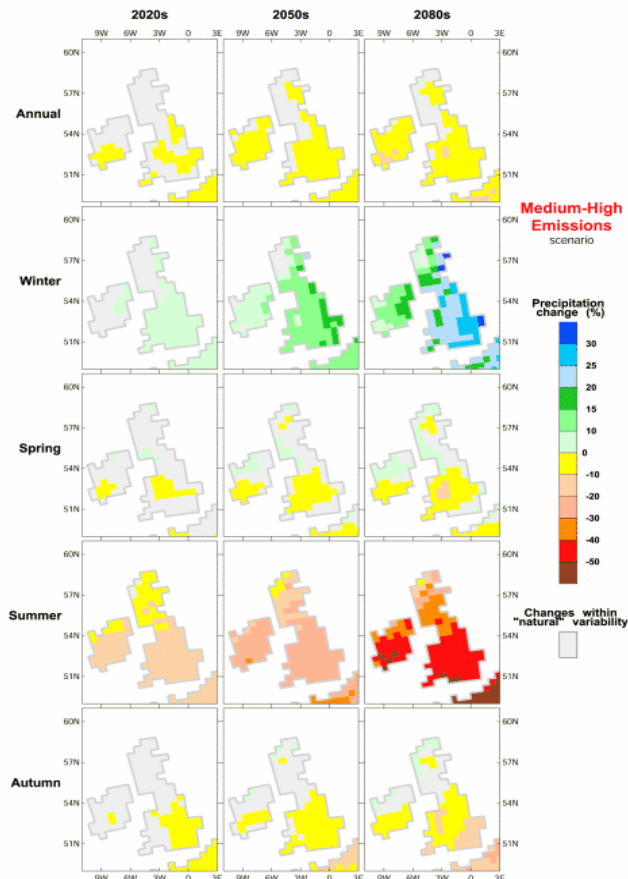


Zn



Cu

Change in UK precipitation by the 2080s (seasonal mean) Medium – High emissions scenario



Source: UKCIP02 Climate Change Scenarios (funded by DEFRA, produced by Tyndall and Hadley Centres for UKCIP)

UKCIP02

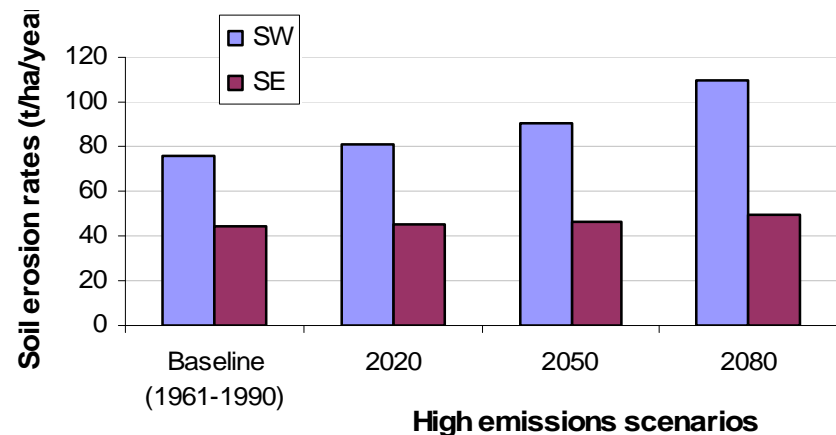


Climate change and greenspace

- Mitigation against soil erosion
- Carbon impacts of improved footway and cycleway access
- Species choice for urban planting
- Reclamation standards for future climate conditions
- Shade provision of greenspace

Soil erosion

SW grid versus SE grid



Field investigations



← Eastbrookend Country Park (over 10 years old): Large country park

Russia Dock ecology park →



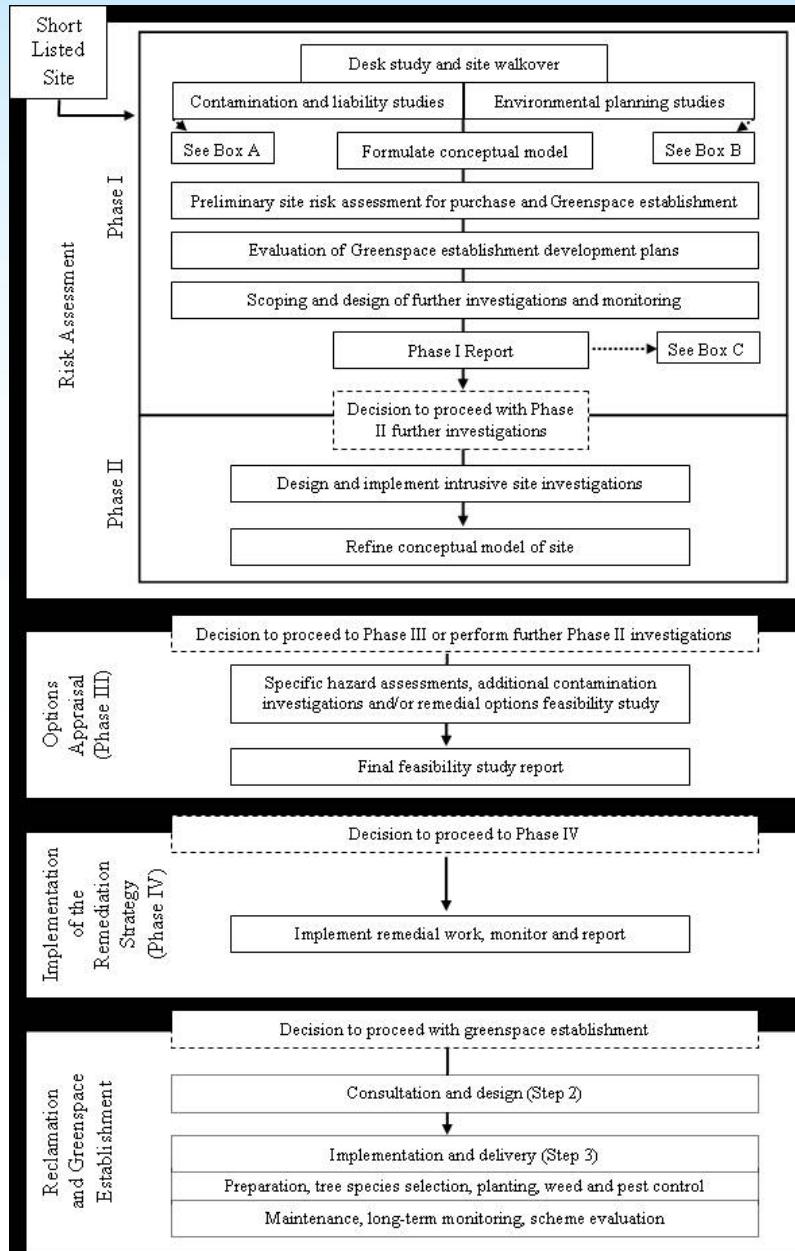
Thames Barrier Park (8 years old) formal park →



Guidance, tools and decision support

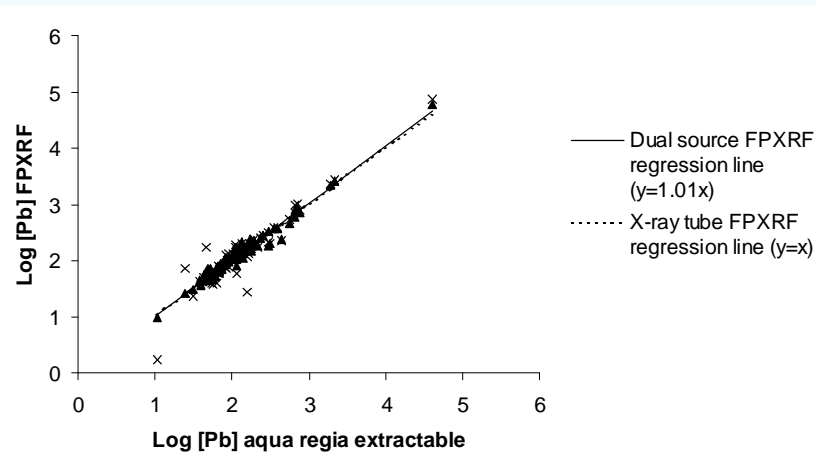


Site assessment and greenspace creation



In-Situ Analysis Using FPXRF

300 second analysis time



Element	r
Fe	0.93
Ni	0.42
Cu	0.85
Zn	0.87
Cd	0.26
Pb	0.89
Mn	0.71
As	0.93

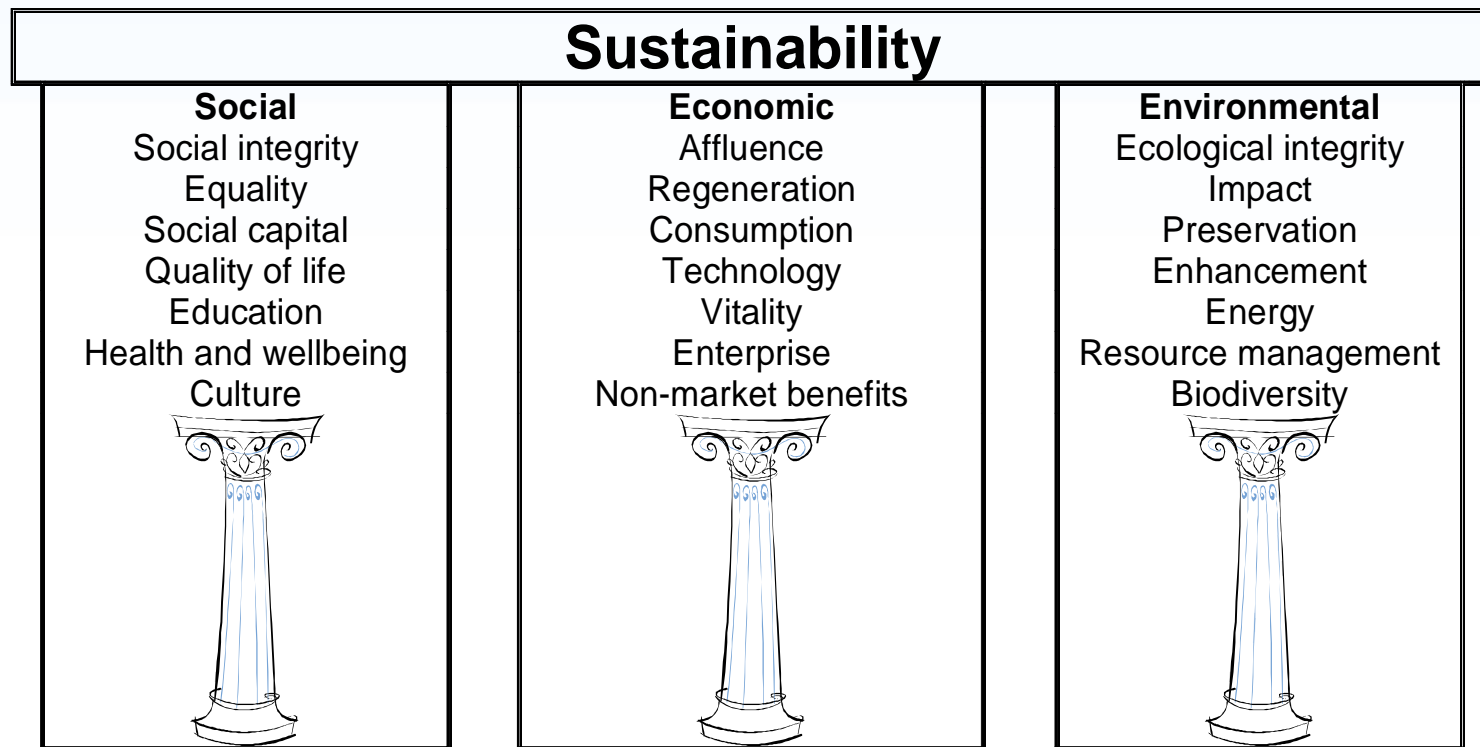
Greenspace impacts – Monitoring and evaluation



“Methuselah”

Why another M&E Framework?

Toolkits, Frameworks and pre-designed questionnaires are available,
so are we just reinventing the wheel?



Methuselah system objectives

- Provide the evidence base for land regeneration at national, regional, programme and site scales
- Assess policy delivery and benefits through green infrastructure
- Attract funders and inward investment
- Assess delivery of local wants and need
- Improve best practice and identify guidance needs
- Help identify pertinent indicators
- Help cost-in M&E at the proposal stage



A standardised monitoring procedure

ensures data quality

limits subjectivity

clarifies requirements

simplifies process

locally, regionally & nationally
comparable data-sets

saves time and money



Best practice and industry guidance



Introducing BEST PRACTICE GUIDANCE FOR LAND REGENERATION

Best Practice Guidance for Land Regeneration is a series of guidance notes based on research and practical experience in the regeneration of brownfield land for woodland and forest greening after uses.

This series is a toolkit for practitioners and all those responsible for restoring land back to natural or semi-natural uses, particularly involving trees and woodland.

Best Practice Guidance Notes are now available for:

1. Soil sampling, density, saturation and expected land prior to green space establishment
2. Labouratory analysis of soils and soils
3. Design needs to achieve better woodland establishment
4. Lease flipping
5. Imported soil or soil for planting materials placement
6. Application of sewage sludges and composts
7. Fertiliser application in land regeneration
8. Native and non-native trees, shrubs and herbaceous plants
9. Material specifications
10. Tree planting
11. Weed control

Over the next 2-3 years we are aiming to cover the following topics:

- Survey design
- Tree stock types
- Arred water of private supply
- Paved areas and street landscaping
- Woodland maintenance
- Landform design
- Site maintenance
- Drainage and water management issues
- Road design
- Tree health
- Water features
- Dealing with contamination
- Sources of further guidance and advice

Forest Research

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Public: 0800 60 60 60

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CLARE SUB 3
March 2016

sub:im bulletin

CLARE's SUB:IM bulletins present practical outcomes of research by the SUB:IM consortium which have direct application to the brownfield and contaminated land communities. This bulletin considers the impact of climate change on contaminated land and brownfield regeneration.

Copyright © CLARE (Contaminated Land Applications in Real Environments)

Climate Change, Pollutant Linkage and Brownfield Regeneration

1. INTRODUCTION

There is little doubt that our climate is changing. Proper management of contaminated land must require an understanding of the magnitude of the risk to current and future pollutant linkages between source and potential receptors. It is almost inevitable that changes in environmental conditions and processes will affect the standards of remediation required to ensure receptors are not significantly impacted in the future. Remediation choices being made should be informed by future land use, climatic conditions and local demographics. Tools and guidance are needed now to assist the remediation industry in developing and adopting techniques so that they will be suitable for the future. This bulletin summarises the work carried out as part of the SUB:IM (Sustainable Urban Brownfield Regeneration Integrated Management) research consortium. It synthesises current scientific perspectives and strategies, provides preliminary technical evidence of potential impacts of climate change on contaminated land and remediation systems and discusses potential remedial adaptation strategies.

2. STAKEHOLDER PERSPECTIVES AND STRATEGIES

Two stakeholder groups given prominence in government reports on adaptation to climate change are local authorities and the development industry. These two latter organisations are crucial to the production and management of the urban environment and to the design and implementation of climate change mitigation and adaptation measures. This is especially true in relation to strategies and measures that might be applied to the remediation of contaminated land. As such they were the focus of a study using survey techniques to determine how aware and prepared they are to report of the likely impact of climate change for brownfield remediation.

When responses of the 'developers' group towards climate change are examined (Figure 1) it suggests that the potential impacts of climate change on site remediation are not considered to be as substantial as they are on major planning layout, building design, construction and choice of materials phase of the building lifecycle. However, there were some group differences and residential developers placed more importance on remediation impacts than choice of materials on the construction process. Similarly, most developers believed that subsidence, flooding and storms were more important than other higher risk processes in the remediation phase being facing (Figure 2). Finally, in relation to remediation options, developers suggested that there was still some concern over the issue of future climate change. They would therefore be more likely to select reject a particular option and use an alternative, or switch, if there were no additional costs. This suggests that developers are currently cost-driven in this respect.

To follow up the survey work, six interviews were conducted with three practitioners and three developers. Generally, and unsurprisingly, the level of knowledge regarding the impact of climate change on remediation was greater amongst the first group than the latter. As one practitioner put it:

My own personal view is that there are just a lot of questions raised about the use of new science and the need for ongoing and new data on the soil and suspect that a number of cases for adequate remediation would give us the real cost of waiting may well be worth the extra cost.

Two developers were aware of potential future problems, but tended to limit the issue as discussed to water concerns over flooding. As one developer suggested:

Remediation... most of the issues do with climate change are related to do with flood risk and flood risk assessment, so the focus on our side... just if it is coming at all of the problems you have and then it would be a rather appropriate design choices.

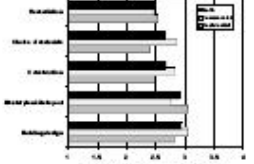




Figure 1: Climate change and impact on stages of the development process.

Figure 2: Type of climate change impact.

For more information on SUB:IM, please visit www.subim.org.uk
If you would like further information about other CLARE publications please contact CLARE, Email: clare@clare.co.uk, Website: www.clare.co.uk
This document is an output of the CLARE project, funded by the Department for Environment, Food and Rural Affairs (Defra) and the Natural Environment Research Council (NERC).

www.forestry.gov.uk/landregeneration

www.clare.co.uk

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Land regeneration and urban greening

Establishment of greenspace in the urban and periurban environment

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Best practice **Regeneration in action** **Monitoring the benefits**

The benefits >


Urban woodlands and greenspace can fulfil many functions within a community and bring about environmental, social and economic benefits. It also contributes towards sustainable development of derelict and deprived areas.

Woodlands and greenspace can vastly improve the appearance and perception of an area, which is a key factor in encouraging further investment to a region. Sites that have been subject to past industrial use provide a valuable resource for greenspace establishment.

Developing best practice >

The Forestry Commission's extensive experience in the reclamation of derelict land to a green end use has resulted in the production of best practice guidance and decision support tools:

- ▶ Best Practice Guidance Notes
- ▶ Decision Support Software
- ▶ Data Management System

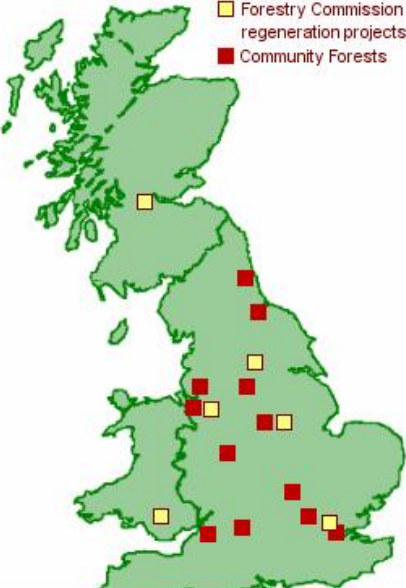


The role of the Forestry Commission >

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Click on a regeneration project near you.



■ Forestry Commission regeneration projects
■ Community Forests

Start | My Documents | Forest Research - Useful... | Land Regeneration - ... | 10:03



SUBR:IM outputs : summary

- Greater confidence in use of remediated soils for green infrastructure
- Methodological development of site assessment methods for green infrastructure
- Better understanding of role of composts and other amendments
- Decision support system for monitoring and evaluation of greenspace (**Methuselah**) being developed
- Step change in understanding of need and benefits of cross disciplinary thinking and working



Final conclusions

- Greenspace involving woodland is well suited to establishment on most types of brownfield land
- Woodland and greenspace can offer a sustainable solution to land reclamation and regeneration, but...
- It must be planned in early in the reclamation/ remediation process
- Greenspace may help in land remediation, but...
- It must be appropriate to the needs of the community



Thanks for listening

Please follow up interest:

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