AGENDA

SuRF- UK Phase 2 Workshop

CL:AIRE Office

10.00 – 4.00pm

Time	Title	Speaker
10.00 – 10.10	Welcome and Housekeeping	Nicola Harries
10.10 – 10.15	Aim of the Day	Jonathan Smith
10.15 – 10.30	Background to SuRF-UK	Richard Boyle
10.30 – 11.00	Presentation of Case Study No. 1 – Petroleum Retail Site	Jonathan Smith
11.00 – 11.15	Discussion	
11.15 - 11.30	Coffee	
11.30 - 12.15	Presentation of Case Study No.2 – Historic Copper Mine	Paul Bardos
12.15 – 12.45	Discussion	
12.45 – 1.45	Lunch	
1.45 – 3.30	Presentation and working through Case Study No. 3 – Brownfield Redevelopment	Frank Evans
3.30 – 4.00	Discussion	
4.00	CLOSE	

SuRF
SUSTAINABLE REMEDIATION FORUM UK

SuRF-UK Phase 2 Case Study Workshop

July 14th 2010 at CL:AIRE Office,

7th Floor, 1 Great Cumberland Place, London W1H 7AL

Attendees:
Jonathan Smith – Shell Global Solutions
Nicola Harries – CL:AIRE
Frank Evans – National Grid
Brian Bone – Environment Agency
Richard Boyle – HCA
Paul Bardos – r3
Peter Witherington - RSK
Mike Pearl - UKAEA
Mat Worbuoys – Atkins
Yolande Macklin – London Borough of Tower Hamlets
Mark Knight – Worley Parsons
Mark Stevenson – URS
David Thomas – CH2MHill
Scott Lewis – National Grid
Ray Dickinson – Defence Estates

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5.	Discussion	
6.	Presentation of Case Study No.2 – Historic Copper Mine	Paul Bardos
7.	Discussion	
8.	Presentation and working through Case Study No. 3 – Brownfield Redevelopment	Frank Evans
9.	Discussion	

ITEM	
1.	**Welcome and Housekeeping** Nicola Harries welcomed everybody to CL:AIRE's office, thanked them for attending and provided the house keeping details.
2.	**Aim of the Day** Jonathan Smith (JS) welcomed everybody on behalf of the SuRF-UK Steering Group and explained the agenda for the day and that this was the first workshop to engage with the brownfield and contaminated land community since the publication of the framework. He reiterated the Steering Group would value any feedback that people have on the framework, particularly from those that have tried to use it. JS explained that the Steering Group were now working on Phase 2 and outlined the work programme for Phase 2. JS explained that the Steering Group would particularly value assistance, feedback and direction on the proposed categories of indicators that were outlined in the framework document. Is coverage adequate, are there any gaps, are there too many too few, is it clear what the indicators are? The Steering Group would value steer to refine and develop the supporting elements to the framework.
3.	**Background to SuRF-UK** Richard Boyle provided a presentation to the background to SuRF-UK and a brief overview to the

	framework document and how the Steering Group hope it will be used.
4.	**Presentation of Case Study No. 1 – Petroleum Retail Site** JS presented case study No. 1 where Shell had undertaken a tiered sustainability assessment on a petroleum retail site. He explained how he had engaged with colleagues who had not had any involvement in the site to undertake the assessment and that this assessment was undertaken retrospectively as the site had already been remediated. He presented the site and background information and explained the aim was to road-test the SuRF-UK sustainable remediation framework and to compare a single remediation project under different sustainability appraisal tools. He wanted to look at the ease of application, and assessor/auditor skill requirement, cost and time it took to undertake the assessment, data requirements, consistency of resulting environmental management decision and to collect evidence to inform selection of an appropriate tier of sustainability assessment. JS explained the sequential process that they used starting simply and then progressing in complexity. Initially they undertook a Qualitative Assessment where a roundtable conversation was had and different remedial options were given a high/medium/low rating. Then a Semi-quantitative assessment was undertaken using Multi-Criteria Analysis (MCA), this was spreadsheet-based with scoring and weightings applied. Finally a Quantitative assessment using – Cost-Benefit Analysis (CBA) using an Environmental Economic consultancy. CBA was considered and used to inform a decision by the assessors. The conclusions of the exercise were: • Ranking of remediation options is similar in all 3 tiers - Management decision was very similar at all tiers • Clear rules, definitions and participant understanding are critical • Tiers Qualitative assessment successfully distinguishes between groups of options Quantitative assessment necessary to distinguish subtly different options Start simple, and quantify only where needed to resolve complexity • For ‘simple’ remediation decisions (e.g. an operational site, no land-use change), a low-tier assessment was robust
5.	**Discussion** There was discussion on what value that Cost Benefit Analysis (CBA) and Multi Criteria Analysis (MCA) can bring to a sustainability assessment, as these can be very expensive to undertake. It was agreed that these tools should be used within a broader framework once a qualitative assessment has been undertaken engaging with stakeholders to reduce the potential options available. There was also discussion on how to integrate the SuRF-UK framework and the existing Contaminated Land Report 11 (CLR 11) options appraisal process. The SuRF-UK framework document must be seen as a supplement to the options appraisal process identified in CLR 11. They are not two different processes. CLR 11 is an overarching framework and SuRF-UK framework provides a finer level of detail to assist in the decision process of a sustainable remedial option.

6.	**Presentation of Case Study No.2 – Historic Copper Mine** Paul Bardos (PB) presented a case study where he had undertaken a sustainability assessment on a Historic Copper Mine in Wales using the SuRF-UK framework. He explained that this work was undertaken as part of a wider project on biochar stabilisation that had been funded by the Technology Strategy Board, and was being exploited by C-CURE (established by Forest Research and the University of Surrey). PB explained the site and its history, the remedial options considered, Applying the SuRF-UK framework, objectives and stakeholders, scope, boundaries and technique, sustainability assessment findings, sensitivity analyses and conclusions. In conclusion the sustainability assessment indicated that for this case study biochar stabilisation offers the more sustainable remediation across all elements of sustainability (social, economic and environmental). The sustainability assessment approach used was a simple, cheap qualitative approach. It yielded clear outcomes after only two meetings. The case study showed how sensitivity analysis improved the robustness of findings. This work is still subject to validation, with some additional quantitative assessment on carbon footprinting of the bio-char and further and wider stakeholder engagement envisaged (pending agreements) but it is hoped that this will become a SuRF-UK Case Study when finalised.
7.	**Discussion** The discussion was wide ranging, taking both case studies as starting points, but ultimately taking a wider view encompassing delegates own experiences. **Indicators** There was discussion on the indicators that the C-CURE case study had used. It was felt that there needs to be good definitions for the indicators when undertaking an assessment so that all individuals understand what is being measured. It was felt that there was no need for more headline indicators that are already in the SuRF-UK framework. The idea is to use the same indictors by all so there is some consistency, transparency and benchmarking by the industry. It is all about balance, therefore if there is agreed consistency and then people will know the basis upon how decisions have been made. **Stakeholders** There was discussion on stakeholder selection? What about intergenerational aspects?. It was agreed that one must make the best endeavours when making a decision to include a wide selection of stakeholders, however you will always be working within constraints. Sustainability is subjective and therefore there will always be trading of vested interests but recording the decisions will add the transparency of the decision making process. It was agreed that you must limit the stakeholder numbers to make it workable and effective, however they must be varied. It is also important to identify temporary as opposed to permanent effects to stakeholders when undertaking your sustainability assessment. The planning process will often allow engagement with a wide selection of stakeholders so it may not be needed to duplicate. **Carbon Calculating** Carbon benefits were seen as important because they relate to a sustainability arguement where a policy principle (on climate change) is already in place. There was also discussion that carbon measurements were in some way pioneering for other issues of sustainability by establishing a precedent for wider assessments than risk alone. There was discussion that one way to add transparency across the industry for the carbon calculating tools of which there are many would be to see how carbon is being calculated by the different tools as there are many different ways. This way a Generic Assessment could be used which could be used across the industry which would be evidence based and add one level of transparency. **Risk Communication** How risk communication is undertaken was also discussed. It is felt that the technical community is not always very good at “layman” speak. When discussing risks to “lay” stakeholders it is very important to use the correct language. Not all stakeholders understand the terms quantitative and risk assessment. It was felt that this is where the SuRF-UK framework will help as it shows how decisions are following a process and how it can be an iterative process when engaging with stakeholders. It makes the decision process a much more robust, defensive and sensitive process. It was felt when engaging with wider stakeholders it may be important to demonstrate that different weightings could bring different answers to demonstrate transparency.

	Linkage to SuRF-UK Framework Both case studies 1 and 2 related to remedy selection for existing risk management goals: Stage B in the SuRF-UK framework. The discussions were fairly straight forward and detailed, and a common understanding of the processes for both case studies was evident
8.	**Syndicate Exercise Case Study No. 3 – Brownfield Redevelopment** Frank Evans (FE) presented a case study of a proposed brownfield development. The workshop attendees were provided a brief to: • Provide remediation options assessment to client supported by sustainability appraisal • How do we approach sustainability assessment? • What indicators are considered? The attendees were split into two groups of specialists and non-specialists. Attached in Powerpoint file are the outputs from the 2 groups.
9.	**Discussion** **Linkage to SuRF-UK Framework** Case Study 3 related to remediation planning: Stage A in the SuRF-UK framework. It was evident that the execution of the exercise and the subsequent discussion were less straight forward than for the earlier case study presentations. It appears from the two syndicate groups that they came up with two quite different thought processes about applying sustainability issues to remediation planning. There was discussion as to why this happened. It was felt that the "Specialist" group felt a lot more comfortable looking at a Solution Driven Starting Point, therefore they developed and adapted possible solutions as they went along and considered different sustainability issues. This was done without formal sustainability assessments but as a result of discussion: an informal iterative approach was undertaken. Site Owners at the meeting felt that this was the kind of pragmatic solution orientated process that was usually found in practical brownfield projects. Whereas the "Non-Specialist" group being more "lay" people were not as interested in the actual remediation solution. This highlights the importance of Stakeholder engagement early on to identify which indicators are most important to the different stakeholders. This would also help focus on the indicators of most importance. There was also discussion about "What are Boundaries?". It was felt that the understanding of "Boundaries" meant different things to people. It was felt that more guidance is needed here. Case studies would help illustrate stakeholder engagement as well as sustainability decisions. It was felt it was important to demonstrate how the framework can be used in a number of different ways. A sustainability appraisal can be an iterative process or used to compare different options. It was agreed that stakeholder groups take on very different roles in a sustainability assessment, so it was important to engage with the right stakeholders at the right stages. The attendees felt very comfortable looking at a solution driven remedy selection (Stage B) but less comfortable on Strategic Planning (Stage A) as it was felt this was a much more complex situation. **Closing** JS concluded the meeting and thanked everyone for attending. JS reiterated that the SuRF-UK Steering Group would take away the attendees thoughts and they would be circulating notes from the meeting. Two more meetings will be held where the exercise will be repeated amending in light of the feedback from the attendees.

NON SPECIALISTS
Boundaries

Residential End Use
Section 106
Project Consumption
Sale Date (deemed too restrictive)
Project based – Remediation Only
Canal Boundary
Most sustainable to point of build completion
Identify who is involved in site

1

Boundaries

- Timing- During Works, How long it lasts, level of disruption, post development on site (residual)

2

Stakeholders

Core Specialists

Non- Specialists

Stakeholders

Contaminated Land Officer

SEPA

Client – lawyer, site manager, finance

Consultant

Record retention

Contractor

Insurer

NHBC

Environmental Health Officer
Parish Council
Residents Association
Environmental Groups
Archaeology
British Waterways
Building Control
Planners
Highways
Developer/Housing Association

Utility Provider
Industrial Neighbour – communication only
Code for Sustainable Homes
Banks/Funders
Future Residents of Development

Non-Core

3

Indicators

- Social 1 : Human Health and Safety– Poisonous (toxic) smells, road safety, noise, dust emissions, not worker safety, compliance with local plan, quality of communication to workers, site security, wagon routes
- Social 2: Ethical and equity considerations – NIMBYS, Equality of approach to social and private housing, development next door - do not want it, amenity value of nature strip, time scale for project.
- Social 3: Impacts on neighbourhoods or regions – view of remediation, *exsitu, insitu* or do nothing, human health risks, blight removal, working hours, perception of remediation
- Social 4: Community involvement - canal side access – is it shut, working hours.
- Social 5 : Compliance – Demonstrate that all the boxes have been ticked
- Social 6: uncertainty – Confidence in Solution
- Economic 1 :Direct Econ. Costs – not that interested as more interested in indirect benefits
- Economic 2 : Indirect– Impact on house value – knock-on council tax needs/legacy, local employment opportunity, blight (short term) during works
- Economic 3: Employment: Are they going to use local labour
- Economic 4 : Gearing – Further inward investment, new school or roads (section 106)

4

SPECIALISTS
STAKEHOLDERS

Local (social) Housing Trust	Insurers	Contractor
Local Conservation Group	British Waterways	Client Site Manager
Highways	Local Planning Authority	NHBC
Parish Council	Sustainability Department	Consultant
Residents adjoining site (new)	Developer	Contaminated Land Officer/EHO
Residents adjoining site (old)	Utilities	Building Control
National Grid/Distribution		SEPA Land and Water
Archaeology		
SEPA		
Client		
Finance		
Flood		
Legal		
Finaciers/Banks		
Industrial Neighbours		
Local Authority		

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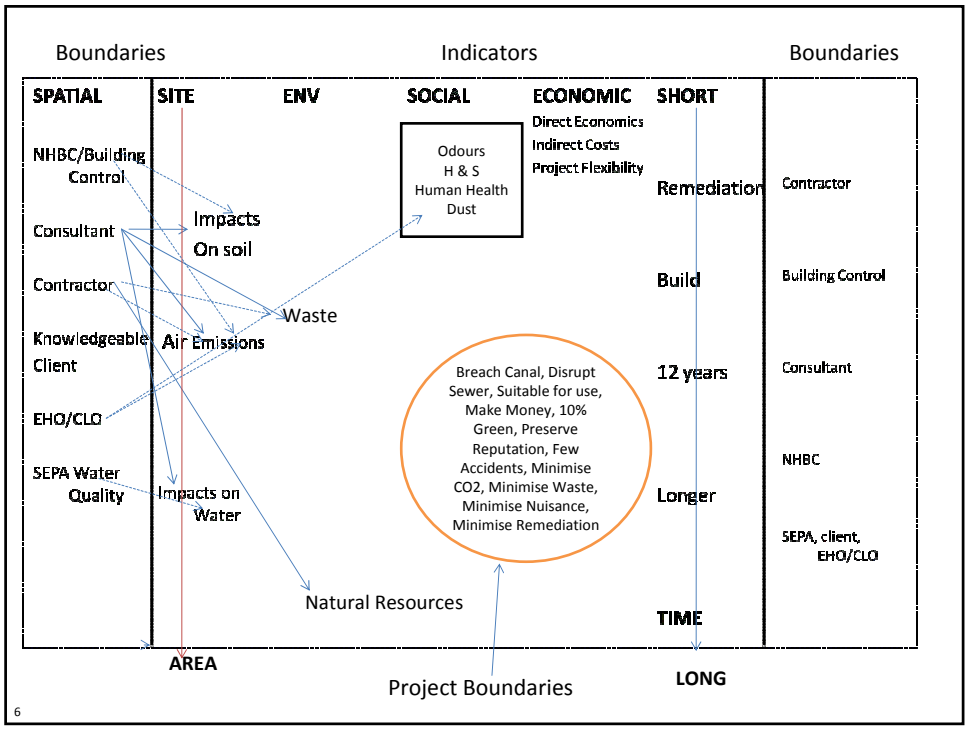

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NON SPECIALISTS
Group 1 – Boundaries

Residential End Use

Section 106

Project Consumption

Sale Date (deemed too restrictive)

Project based – Remediation Only

Canal Boundary

Most sustainable to point of build completion

Identify who is involved in site

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SEPA

Client – lawyer, site manager, finance

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SuRF-UK Phase 2 Workshop objectives

Jonathan Smith, Shell Global Solutions

CL:AIRE
14 July 2010

SuRF-UK Phase 2 project objectives

1. To develop ***worked examples*** to illustrate how the SuRF-UK framework may be applied to a ***range of (re)development scenarios, contaminant types and remediation technologies/techniques***.
2. To develop a ***structured checklist of practical sustainability indicators*** for use in a SuRF-UK sustainable remediation assessment.
3. To ***test the practicability of the above indicators*** during real sustainability assessment negotiations.
4. To ***consult with a wide range of stakeholders*** across the contaminated land and brownfield sector ***to validate the indicator checklist***, provide opportunities for external evaluation and case studies, and provide a ***platform for an influential sustainable remediation assessment approach in the UK***.

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Objectives this workshop

- Explore how the Framework works with real sites
  - 2 short case-study presentations (morning)
  - 1 interactive case study (after lunch)
- Interactive study
  - Set boundaries, options, indicators
- Test the proposed categories of indicators
  - Is coverage adequate? Any gaps?
  - Too many, too few?
  - Is it clear what the indicators are?
- Give Steering Group direction to refine and develop the supporting elements to the Framework

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SuRF-UK framework for evaluating sustainable remediation options

- Introduction / Recap

Richard Boyle – HCA

July 14th 2010
SuRF UK Phase 2 Workshop Meeting

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SuRF SUSTAINABLE REMEDIATION FORUM UK

Contents

- What do we mean by sustainable remediation
- Using sustainability in remedial decision making
  - Framework
  - Assessment

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SuRF SUSTAINABLE REMEDIATION FORUM UK

SuRF-UK Constituency

- Established in 2007, following the lead of SuRF.
- UK-based collaboration of regulators, industry, academics and consultants. Open forum meetings.
- Independent co-ordination by CL:AIRE (www.claire.co.uk/surfuk)
- Focus on holistic sustainability assessment of
  - Remediation input to high-level land-use planning
  - Remediation input to overall site / project design ('Better by Design')
  - Remedial strategy selection and remediation technology selection
  - Remediation implementation and verification
- Goals
  - A framework for assessing sustainable remediation
    - Effective, practical, regulatory acceptance
  - Sustainability indicator review

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Co-authors

- Prof. Paul Bardos, r3 Environmental Technology Ltd
- Dr Brian Bone, Environment Agency
- Dr Richard Boyle, Homes and Communities Agency
- Dr David Ellis, Du Pont
- Frank Evans, National Grid Properties Ltd
- Nicola Harries, CL:AIRE
- Prof. Jonathan Smith, Shell Global Solutions
- (Steering Group for SURF-UK)

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Drivers

- Industry (SAGTA)
  - Good practice, business ethics, sustainable procurement, CSR
- Regulatory (and indeed cross-sectoral)
  - Appropriate and reasonable solutions
  - Soil Framework Directive (draft); Water Framework Directive
- Planning
  - Sustainability tests in planning applications
  - Sustainability criteria in regional and local spatial planning
- Cross-sectoral backing in the UK
- Also response to worldwide interest:
  - EU (NICOLE, SuRF-UK, SuRF-NL?, EURODEMO+)
  - USA (e.g. SuRF, US EPA "green remediation", ASTM)
  - Canada, Australia

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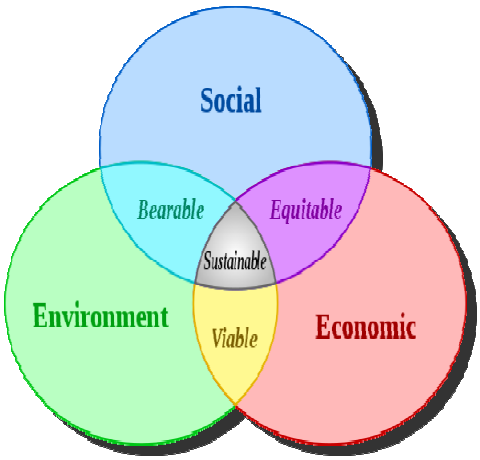
Defining sustainability…



'Development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (1987, Brundtland)

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Sustainable remediation: SuRF-UK definition

- '*the practice of demonstrating, in terms of* ***environmental*****,** ***economic*** *and* ***social*** *indicators****,*** *that the benefit of undertaking remediation is greater than its impact and that the optimum remediation solution is selected through the use of a balanced decision-making process*'

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SuRF-UK: Key principles

- Optimise risk-management based on consideration of social, environmental and economic factors, but always ensure:
  - **Principle 1:** Protection of human health and the wider environment
  - **Principle 2:** Safe working practices
  - **Principle 3:** Consistent, clear and reproducible evidence-based decision-making
  - **Principle 4:** Record keeping and transparent reporting.
  - **Principle 5:** Good governance and stakeholder involvement
  - **Principle 6:** Sound science

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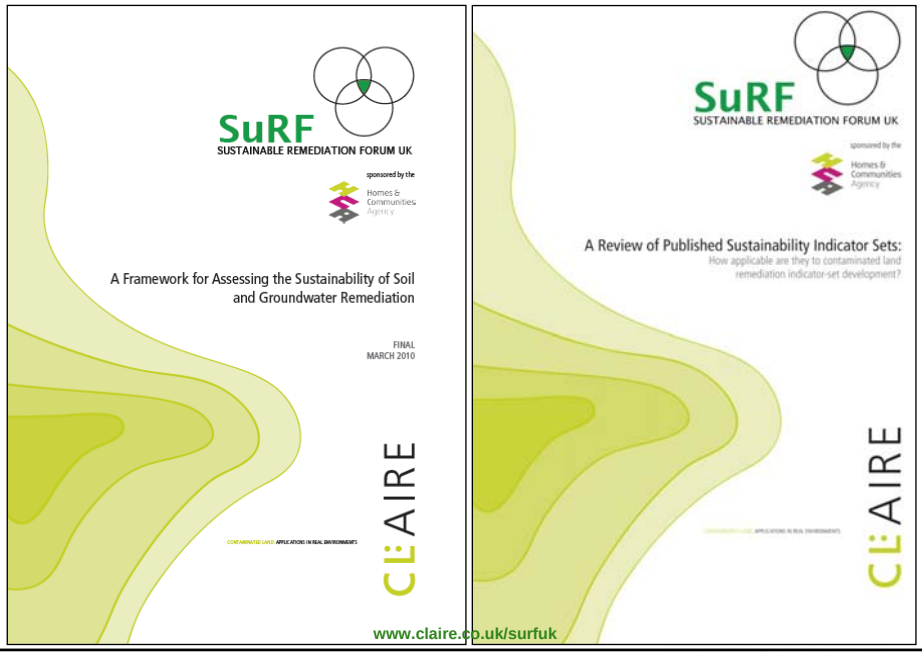
SuRF-UK, www.claire.co.uk/surfuk



Regulatory acceptance: Foreword to report

John Palfalvy
Policy Advisor, Brownfield Land
Department of Communities and Local Government

Tom Coles
Contaminated Land Policy Team
Department for Environment, Food and Rural Affairs

Trevor Beattie
Director Strategy, Performance, Policy & Research
Homes and Communities Agency

Gareth Hall
Director General, Department for the Economy and Transport
Welsh Assembly

Sheena Engineer
Land Quality Policy Manager
Environment Agency

Calum MacDonald
Director of Environmental and Organisational Strategy
Scottish Environmental Protection Agency

Theresa Kearney
Principal Scientific Officer
Northern Ireland Environment Agency within the Department of the Environment

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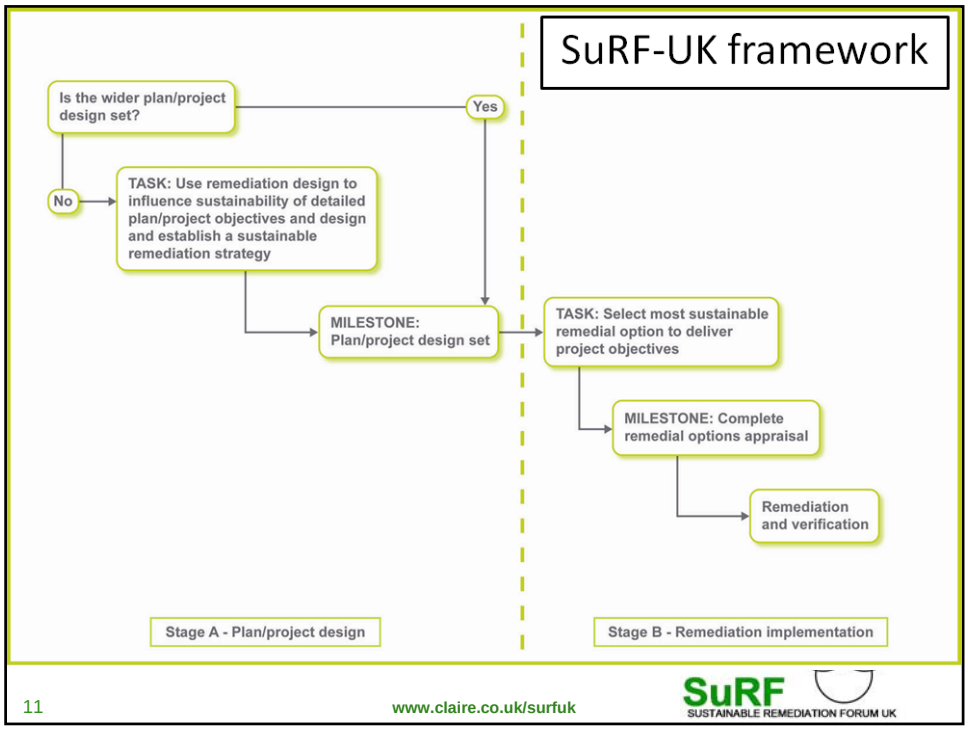

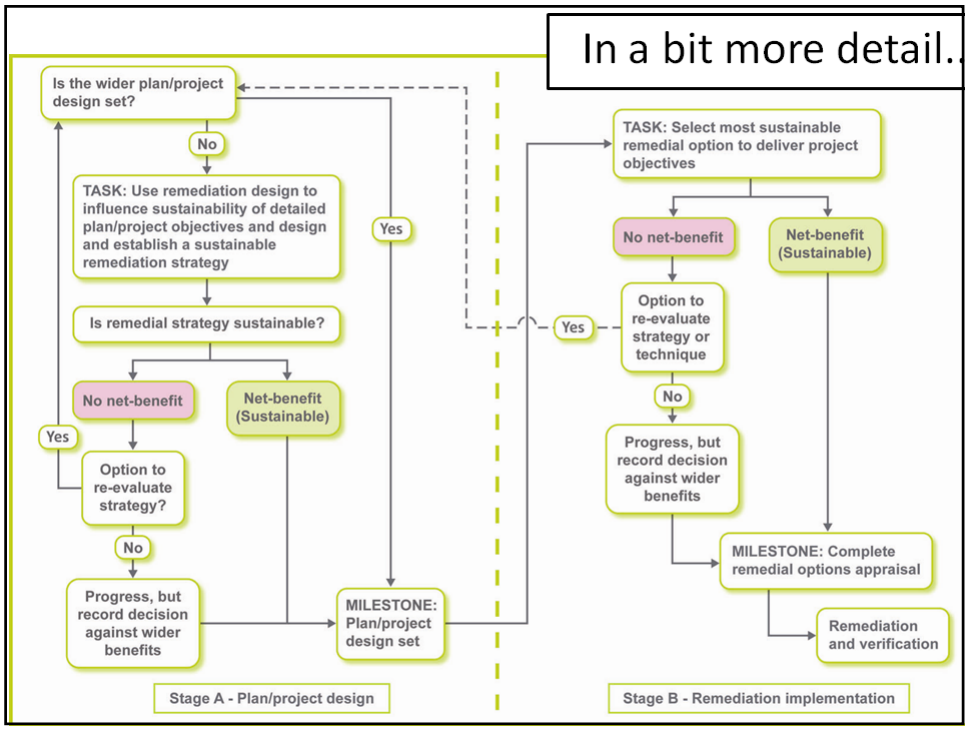

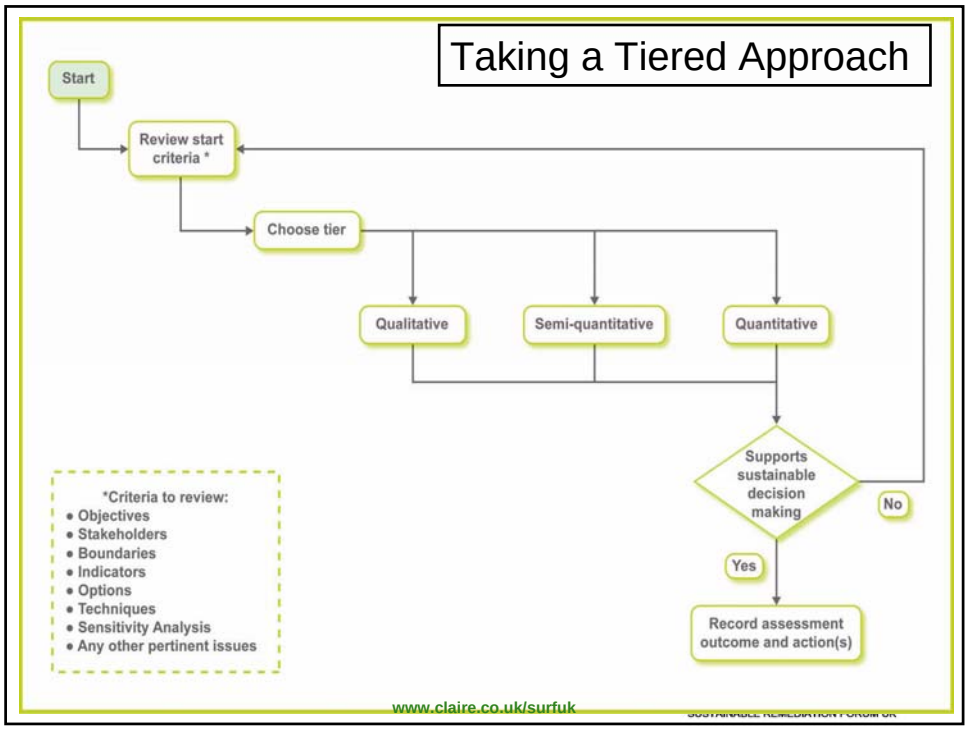

Stages in sustainability assessment

- Agreeing objectives
  - What is being compared and why
- Agreeing which stakeholders to engage with
  - Reviewing objectives accordingly
- Determining boundaries (e.g. project scope)
- Agreeing what sustainability is (which indicators)
- Agreeing how these indicators will be assessed and an overall "picture" of sustainability brought forward (and verified in due course)
- Executing the comparison
- Interpreting findings and carrying out sensitivity analyses

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Sustainability is wide-ranging in its scope: SuRF-UK headlines (in development)

Environmental	Social	Economic
1. Impacts on air (including climate change; 2. Impacts on soil; 3. Impacts on water; 4. Impacts on ecology; 5. Use of natural resources and generation of wastes; 6. Intrusiveness.	1. Impacts on human health and safety; 2. Ethical and equity considerations; 3. Impacts on neighbourhoods or regions; 4. Community involvement and satisfaction; 5. Compliance with policy objectives and strategies; 6. Uncertainty and evidence.	1. Direct economic costs and benefits; 2. Indirect economic costs and benefits; 3. Employment and capital gain; 4. Gearing; 5. Life-span and 'project risks'; 6. Project flexibility.

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SuRF-UK Phase 2

- Objectives:
  - Trial the framework with real cases studies
  - Investigate the indicator categories further
  - Benchmark different assessment methods for the same site(s)
- Timescale
  - April 2010 to April 2011

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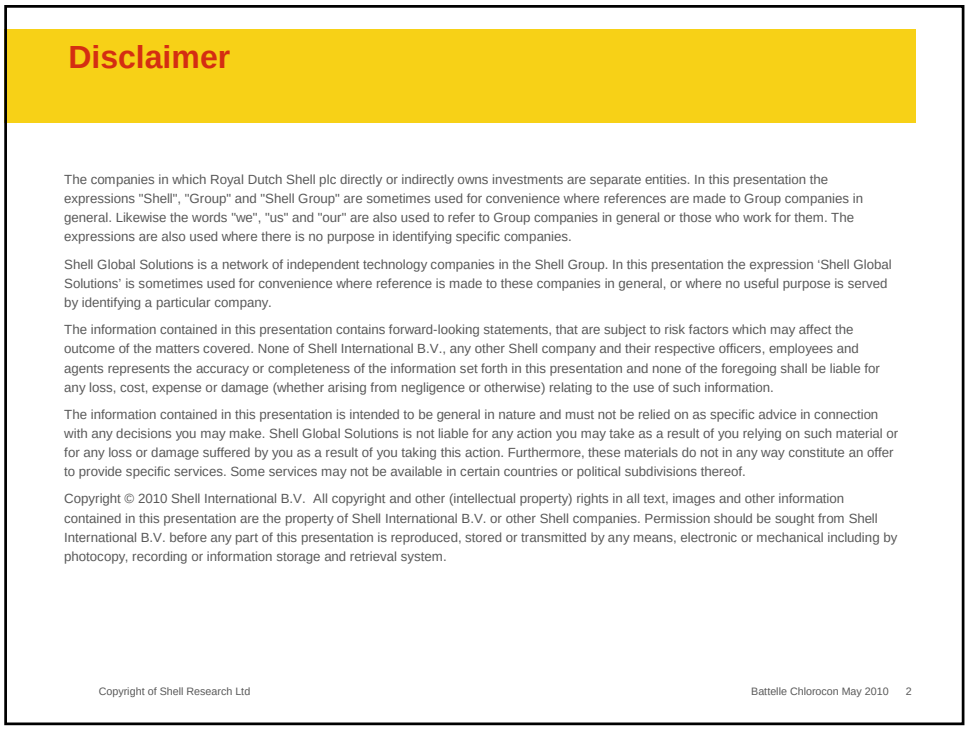


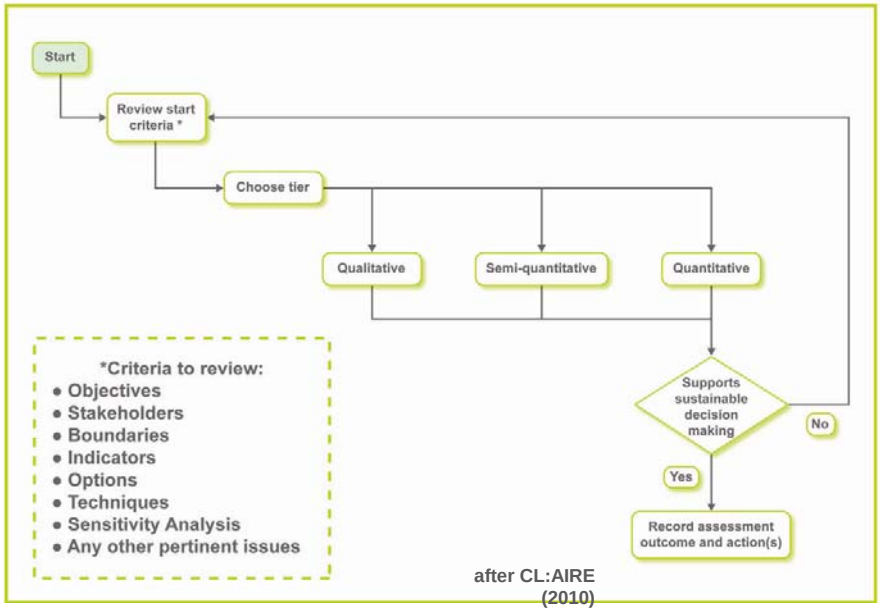
Take-away Message

- Benchmarking shows simple and rapid sustainability assessments can result in robust remediation decisions

PROJECT OBJECTIVES

- To 'road-test' the SuRF-UK sustainable remediation framework
  - Retail filling station in UK
- To compare a single remediation project under different sustainability appraisal tools (SuRF-UK tier 1-3)
  - Ease of application, and assessor/auditor skill requirement
  - Cost and time
  - Data requirements
  - **Consistency of resulting environmental management decision**
- To collect evidence to inform selection of an appropriate tier of sustainability assessment

SuRF-UK Tiered Assessment Framework



after CL:AIRE (2010)

Scope of sustainability appraisal

- Sustainability appraisal objectives
- Stakeholders
- Boundaries
  - Spatial
  - Temporal
  - Life-cycle
- Sustainability indicators

SuRF-UK sustainable remediation indicator categories

Environmental	Social	Economic
1. Impacts on air (including climate change; 2. Impacts on soil; 3. Impacts on water; 4. Impacts on ecology; 5. Use of natural resources and generation of wastes; 6. Intrusiveness.	1. Impacts on human health and safety; 2. Ethical and equity considerations; 3. Impacts on neighbourhoods or regions; 4. Community involvement and satisfaction; 5. Compliance with policy objectives and strategies; 6. Uncertainty and evidence.	1. Direct economic costs and benefits; 2. Indirect economic costs and benefits; 3. Employment and capital gain; 4. Gearing; 5. Life-span and 'project risks'; 6. Project flexibility.

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Benchmarking approach

- Sequential process. Start simple, progress through tiers.
- Qualitative
  - A 'round-table conversation'
  - High/Medium/Low rating for each factor
- Semi-quantitative – Multi-Criteria Analysis
  - Spreadsheet-based
  - Scoring and weightings applied
- Quantitative – Cost-Benefit Analysis
  - Environmental Economic consultancy undertook detailed CBA.
  - CBA considered and used to inform a decision by assessors

Battelle Chlorocon May 2010 8

Site history

- Petrol filling station, tanks installed 1989
- January 2002: Reported loss of unleaded petrol
- Site characterisation (Geodelft)
  - January 2002 – Tier 1 risk assessment
  - July 2002 – Tier 2 risk assessment
- 2002:Tanks decommissioned; new tanks and lines installed
- Remediation (TerraVac)
  - DPVE – March to September 2003: ca. 8600 litres recovered
    - Verification: August 2004 – Boundary site investigation (GD)
  - SVE – February to July 2006: ca 400 litres recovered
    - Verification: July 2006 (Terravac)
    - Post treatment: January/May/June 2007 – GW RA report (RSK)
- Cost-benefit assessment: May - August 2008 (WP)
- Post-treatment GW monitoring: Jan 2009

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Site Location

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Hydrogeology

- Triassic Sherwood Sandstone: Principal Aquifer
  - Resource Protection Zone (SPZ 3),
  - Boughton PWS 2.5 km to north east (down hydraulic gradient)
  - Amen Corner PWS 2km to south west (up hydraulic gradient)
  - Boughton SPZ 2 boundary ~0.75 km north east
  - Data
    - Budby Forest PWS: K ~ 4 m/d, n_e ~ 0.25
    - Regional GW gradient through site ~ 0.0055
- Alluvial clays, silts and gravels (≤ 3 m)
- Surface water bodies
  - River Maun, 180m, no hydraulic continuity GW→SW

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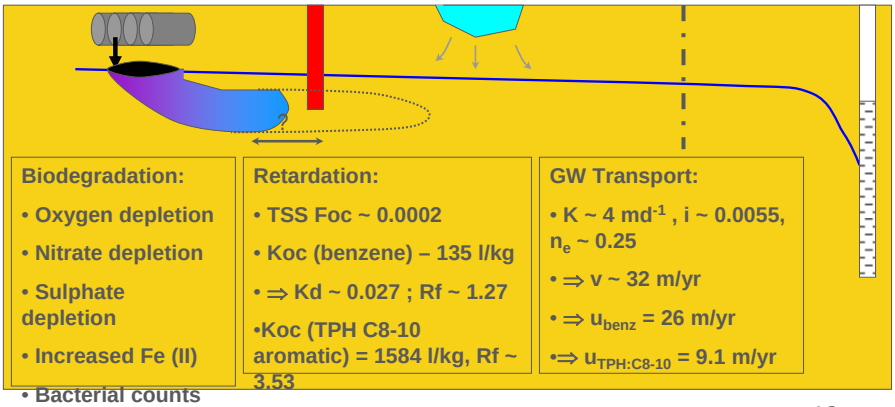
Hydrogeological conceptual model

Potential compliance / receptor location (for existing releases)

GW abstraction → 2500m
SPZ 2 boundary (P20) → 760m
River Maun → 180m
GW resource (P20) → 50/100m

Target Conc. 1 µg/l benzene DWS; 140 µg/l C8-10 (WHO/TPH CWG)



Biodegradation:
- Oxygen depletion
- Nitrate depletion
- Sulphate depletion
- Increased Fe (II)
- Bacterial counts

Retardation:
- TSS Foc ~ 0.0002
- Koc (benzene) – 135 l/kg
- ⇒ Kd ~ 0.027 ; Rf ~ 1.27
- Koc (TPH C8-10 aromatic) = 1584 l/kg, Rf ~ 3.53

GW Transport:
- K ~ 4 md^{-1} , i ~ 0.0055, n_e ~ 0.25
- ⇒ v ~ 32 m/yr
- ⇒ u_{benz} = 26 m/yr
- ⇒ $u_{TPH:C8-10}$ = 9.1 m/yr

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MNA assessment (R&D P95)

- Source removal:
  - Tanks decommissioned (2002)
  - LNAPL removed by DPVE (2003)
  - SVE / bioventing of unsaturated zone impact (2006)
- NA Lines of Evidence: Primary
  - Concentration (or toxicity, flux, mass) decrease over time
- Secondary
  - Geochemical species (electron acceptor depletion)
- Tertiary
  - Microbial evidence

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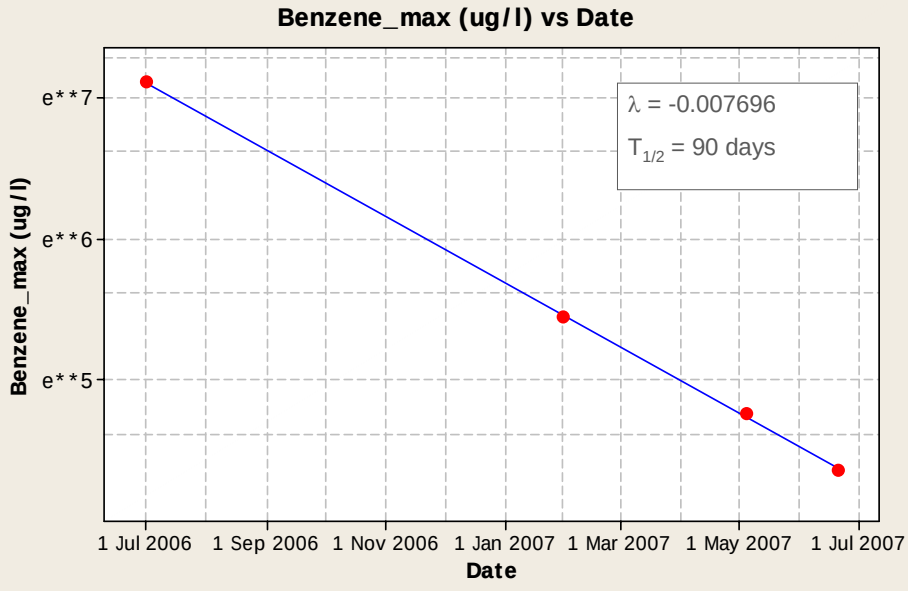

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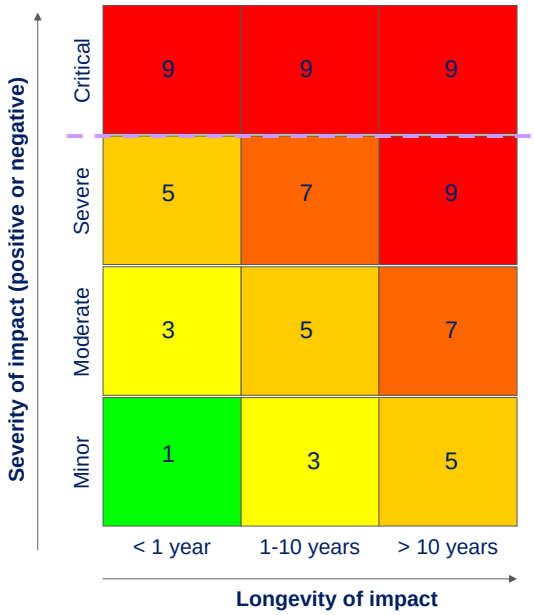
Measured degradation rates, 2006-07: summary

	Max. plume conc.		Mean plume conc.	
Compound	**Rate, λ**	**Half-life (days)**	**Rate, λ**	**Half-life (days)**
TPH (C_{8-10} aromatic)	0.00641	108	0.003177	218
Benzene	0.007696	90	0.006346	109
Toluene	0.006509	106	0.00558	124
Ethylbenzene	0.003596	193	0.002182	317
Xylene	0.001637	423	0.002256	307

Tiered sustainablility assessment

- Scoring system
- Link out to spreadsheets
  - Qualitative
  - Semi-quantitative
- Sustainability metric definitions

Scoring matrix provided to assessors



Sustainable Assessments Outcome (selected options)

Rank	Tier 1 (Qual.)	Tier 2 (MCA)	Tier 3 (B/C ratio) (CBA)
1	A, B, C	B	A (1.27)
2		A	B (1.09)
5		C	C (0.97)
8		D	F (0.86)
11	E		D (0.8)
14	D, G	E, G	E (0.58)
15	F	F	G (0.4)

A	DPVE
B	DPVE+MNA
C	In situ bioremediation
D	P&T
E	Excavate & dispose
F	Receptor treatment
G	Do nothing

FINDINGS #1

	Qualitative	Semi-quantitative	Quantitative
Time/effort	0.5 – 1 day	1 – 3 days	~1 week
Data	Generic data generally adequate		Site-specific valuation necessary
Practicability: Individual assessor	OK. Sufficiently simple ranking	Difficult to represent range of views	OK – relies on external valuation data
Practicability: Stakeholder group	OK. Sufficiently simple ranking. Enjoyable process!	OK. Considerable debate on scores	OK – debate centred on assumptions embedded in CBA
Summary	Able to differentiate between different types of remediation option. Not able to resolve subtlety. Quick, easy.	Added numbers to qualitative assessment, but debateable whether added robustness. Difficult with a single assessor.	Able to resolve subtlety . Full CBA data hungry – use partial CBA where difference between options. Not all valuation data exists

FINDINGS #2

- Objectives of sustainability assessment must be clear
  - Scope of assessment must be clear, and agreed, by all parties
- Sustainability factor definition is critical
  - All parties need to be clear what they are scoring/valuing
  - Care needed to avoid double counting, or omission
- Remediation selection

CONCLUSIONS

- Ranking of remediation options is similar in all 3 tiers
  - Management decision was very similar at all tiers
- Clear rules, definitions and participant understanding are critical
- Tiers
  - Qualitative assessment successfully distinguishes between groups of options
  - Quantitative assessment necessary to distinguish subtly different options
  - Start simple, and quantify only where needed to resolve complexity
- For ‘simple’ remediation decisions (e.g. an operational site, no land-use change), a low-tier assessment was robust

Initial Sustainability Appraisal of a C-CURE biochar application – Exercise

Paul Bardos, r3 environmental technology ltd

July 14th 2010
SuRF UK Workshop Meeting

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Acknowledgements

- SURF-UK Steering Group
- C-CURE
  - Tony Hutchings, Forest Research; tony.hutchings@forestry.gsi.gov.uk
  - Frans de Leij, University of Surrey

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Contents

- Case Study Site
- Remedial Options
- Ambition for applying the SuRF-UK framework
- Objectives and stakeholders
- Scope, boundaries and technique
- Sustainability assessment findings
- Sensitivity analyses
- Conclusions

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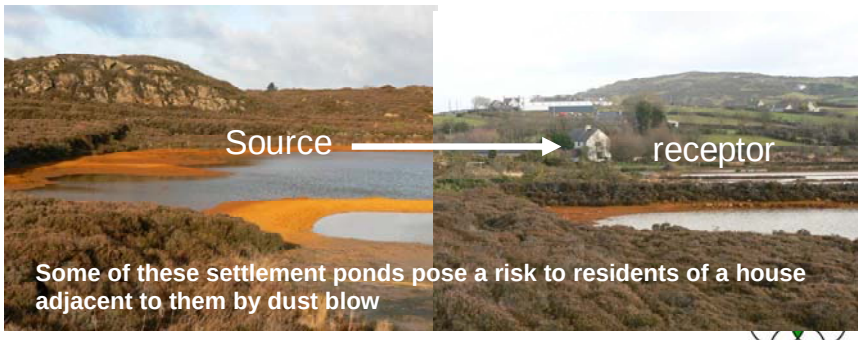
Exercise - Case Study

- Parys Mountain is a historic copper mining area near Amlwch in Anglesey
- On the site are a number of sediment settlement ponds. These are dry for part of the year



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Some important features of the site

- Contamination: mainly cationic heavy metals
- Major interest in preservation of landscape (heather), but settlement ponds are too toxic / acidic for heather in their current condition
- Major interest in preserving archaeological features and built remnants
- Assume a preference against imported fill materials
- Relocation of householders not possible, and risk reduction therefore very important
- First possible application of a new technology (biochar)
- Limited site access, narrow roads, open access to site
- The settlement ponds have been subject to annual flooding by acidic leachate form the rest of the mine site; this will be diverted away from the settlement ponds
- The remediation team includes reputable main consultant and contractor, suppliers like C-CURE would be subcontractors

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Remedial Options Under Consideration

- Treatment with biochar
  - 2% amendment by mass of surface layers, production by-product from renewable energy from waste biomass (e.g. agricultural wastes), low bulk density, incorporation by conventional agricultural techniques (e.g. at this scale rotavating), high sorption of cations, high pH buffering capacity
  - New technology, first application, supported directly by C-CURE
  - Stabilise sediment pond surface by revegetation to reduce dust blow
- Treatment with agricultural lime ($CaCO_3$)
  - 5% amendment by mass of surface layers, produced from a primary resource, energy intensive, neutralisation releases CO_2, incorporation by conventional agricultural techniques , operates by neutralising pH and precipitating cations
  - Established technique for mitigating metal availability
  - Stabilise sediment pond surface by revegetation to reduce dust blow

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Remedial Options Under Consideration

- Excavation and removal
  - Remove sediment (which has no archaeological value) and refill ponds
  - Established approach
  - Excavation and removal off site (off island)
- No intervention
  - Take no action
  - "Control"

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Properties / Mechanisms of C-Cure charcoal

- Able to adsorb between 2 and 4 mol of divalent heavy metal ions per kg charcoal (equivalent to a CEC of 400 - 800 meq/100g)
- Ca 90% of the metal adsorption can be explained as ion-exchange
- Heavy metal ions (Zn, Ni, Cu, Pb, Hg) are exchanged against K, Ca and Mg
- A small percentage of metal removal (10%) is due to formation of metal-carbonates
- Due to alkalisation some metals precipitate as metal-salts
- Heavy metal affinity to charcoal : Hg > Pb > Cu > Cd > Zn > Ni
- Once adsorbed, metal adsorption is stable at pH 3.5 - 4

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Ambition for applying the SuRF-UK framework

- Risk management objective: protection of householders from dust blow from the Parys Mountain settlement ponds
- Sustainability management objective: compare sustainability qualitatively for the remedial alternatives identified for this goal
  - C-CURE biochar stabilisation *in situ*
  - Lime stabilisation *in situ*
  - Excavation and removal to landfill; replacement by clean fill
  - No intervention
- Note this was a "pre-study", since then a lot has changed, including the remedial alternatives under consideration

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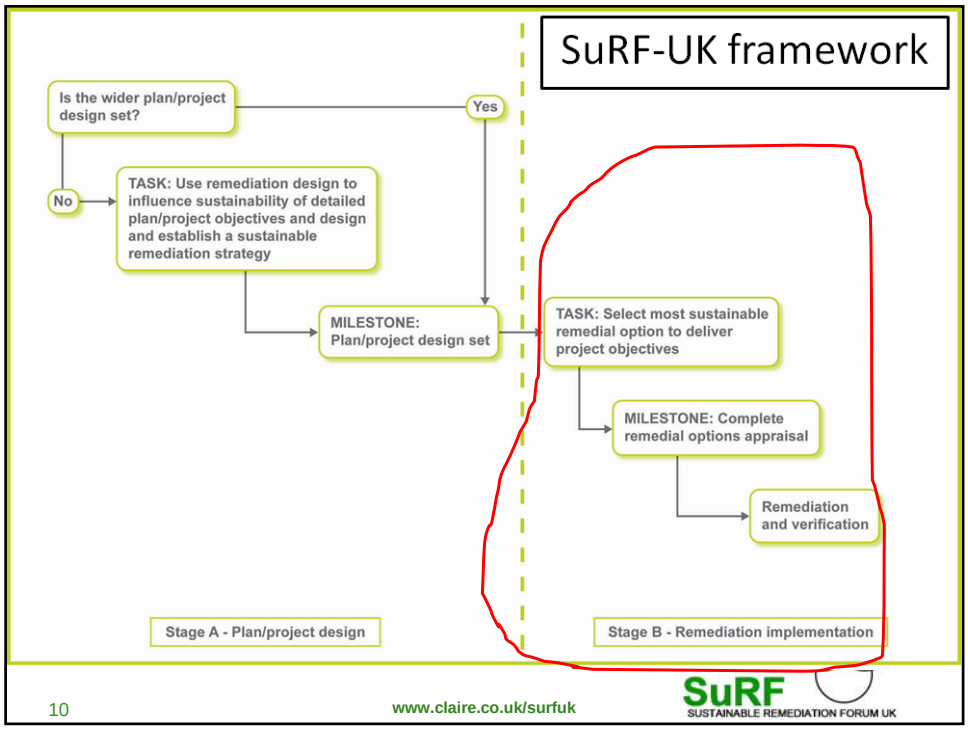
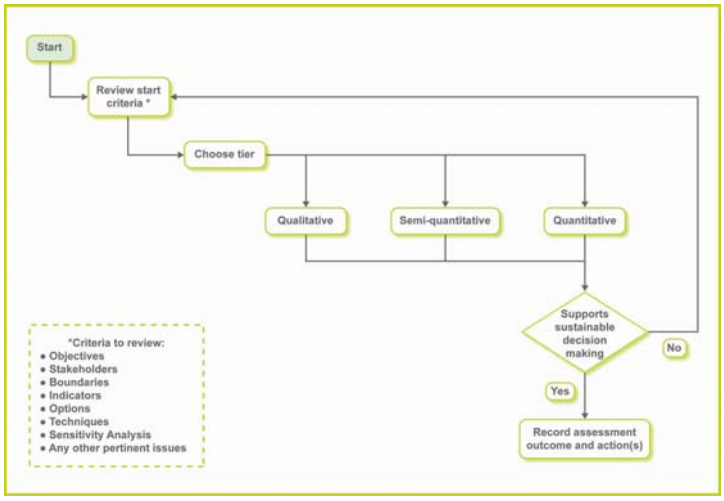


SuRF-UK



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NICOLE suggested stages in sustainability assessment

1. Setting objectives
2. Agreeing scope, boundaries and approach
   - Using SURF-UK headline categories to assist setting scope
   - Using simple ranking to compare options for a selection of headlines
3. Execution and sensitivity analyses
   - Bespoke method

• All underpinned by stakeholder engagement

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Objectives and stakeholders

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Objectives

- Project (system) being assessed
  - Remediation work for the mitigation of human health risks to a residential property adjacent to disused sediment ponds.
- Alternatives considered:
  - C-CURE biochar stabilisation in situ; lime stabilisation in situ; excavation and removal to landfill with replacement by clean fill; and no intervention
- Aims of the appraisal
  - To identify the most sustainable remediation approach from the options available across a holistic and broad view of sustainable development, based on the draft headline categories from SURF-UK
- Consequences of the analysis
  - Determination and selection of most sustainable approach

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Stakeholders

- Service provider and technology vendor
- Ideally wide ranging
  - Client, regulator, householder, other interested parties
- This was not possible straight away because of commercial considerations
- Narrow basis → "scoping study" rather than a full sustainability assessment
- Wider stakeholder engagement → validation of the sustainability assessment

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Boundaries and scope

- Boundaries
  - System: delivery of the "clean site" and its impacts whether local or distant, temporary or permanent
  - Life cycle: consumption by the project, but not the impacts of producing capital equipment (like a digger etc)
  - Proximity: operational area of the project = local
  - Permanence: duration of the project = temporary
- Scope: break out SuRF-UK headlines to full indicator set
  - See handout
- Decide relevance to case study and just use those relevant (record all decisions)

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Overarching Headline Categories

Environmental	Social	Economic
➢ impacts on air – including climate ➢ impacts on soil ➢ impacts on water ➢ impacts on ecology ➢ use of natural resources and generation of wastes ➢ intrusiveness.	➢ impacts on human health and safety ➢ ethical and equity considerations ➢ impacts on neighbourhoods or regions ➢ community involvement and satisfaction ➢ compliance with policy objectives and strategies ➢ uncertainty and evidence	➢ direct economic costs and benefits ➢ indirect economic costs and benefits ➢ employment and capital gain ➢ gearing ➢ life-span and 'project risks' ➢ project flexibility

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Technique (at the indicator level)

- Used rankings
  - to avoid arbitrary scoring arguments
  - to avoid separate considerations of how to score pros vs cons
- Used categories
  - high, medium, low importance to avoid weightings and associated arguments
  - local / distant and temporary / permanent to allow us to distinguish effects only taking place over the project, and effects only taking place within the project area
- But rankings to not show "scale of difference", so
  - Identified "stoppers", i.e. a condition on an indicator that means a remedy cannot go ahead
  - Identified "outliers"
- Rankings for relevant indicators
  - what gets closest to the ideal condition?

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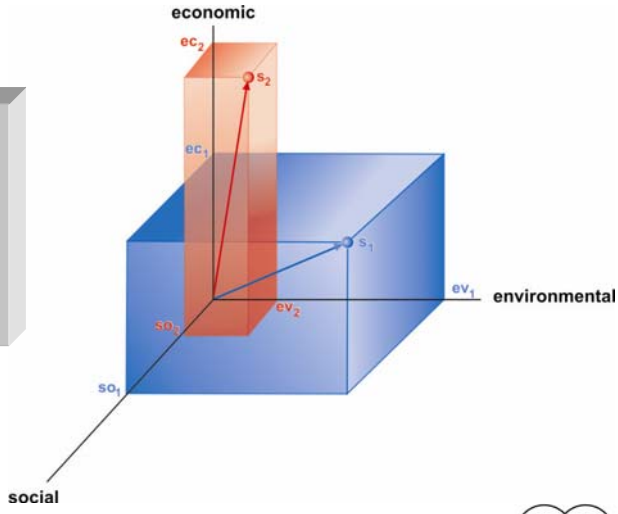
Aggregation / visualisation (bespoke r3)

'Development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (1987, Brundtland)



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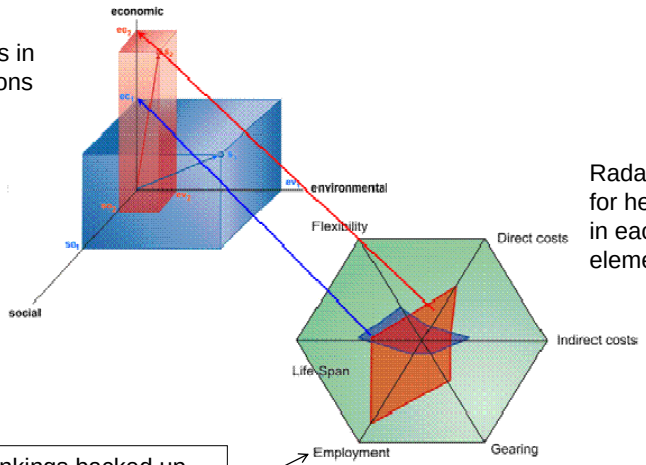
Technique – aggregation & visualisation

3 elements in 3 dimensions



Radar plots for headlines in each element

Individual rankings backed up by an evidence table for each headline

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Selecting indicators and ranking options to compare them

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For instance: headline = Environmental →Intrusiveness

Indicator						
Aesthetic impact on landscape						
Impacts on archaeology						
Impacts on built environment						
Impacts of light						
Etc etc						

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For instance: Environmental →Intrusiveness

Indicator	Rel'ce
Aesthetic impact on landscape	Yes
Impacts on archaeology	No
Impacts on built environment	Yes
Impacts of light	No
Etc etc	

Considered already under built environment

Daylight operations only expected

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For instance: Environmental →Intrusiveness

Indicator	Rel'ce	Ideal
Aesthetic impact on landscape	Yes	In keeping
Impacts on archaeology	No	-
Impacts on built environment	Yes	None
Impacts of light	No	-
Etc etc		

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For instance: Environmental →Intrusiveness

Indicator	Rel'ce	Ideal	Biochar	Lime	Landfill	No action
Aesthetic impact on landscape	Yes	In keeping	1	1	1	4
Impacts on archaeology	No	-	-	-	-	-
Impacts on built environment	Yes	None	2	2	4	1
Impacts of light	No	-	-	-	-	-
Etc etc						

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For instance: Environmental →Intrusiveness

Indicator	Rel'ce	Ideal	Biochar	Lime	Landfill	No action
Aesthetic impact on landscape	Yes	In keeping	1	1	1	4
Impacts on archaeology	No	-	-	-	-	-
Impacts on built environment	Yes	None	2	2	4	1
Impacts of light	No	-	-	-	-	-
Etc etc						

No heather for no intervention

Risks of damage from disturbance, greatest for removal to landfill, nonexistent for no intervention

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For instance: Environmental →Intrusiveness

Indicator	Rel'ce	Ideal	Biochar	Lime	Landfill	No action
Aesthetic impact on landscape	Yes	In keeping	1	1	1	4
Impacts on archaeology	No	-	-	-	-	-
Impacts on built environment	Yes	None	2	2	4	1
Impacts of light	No	-	-	-	-	-
Etc etc						
Average			**1.8**	**1.6**	**3.2**	**2.2**

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Findings

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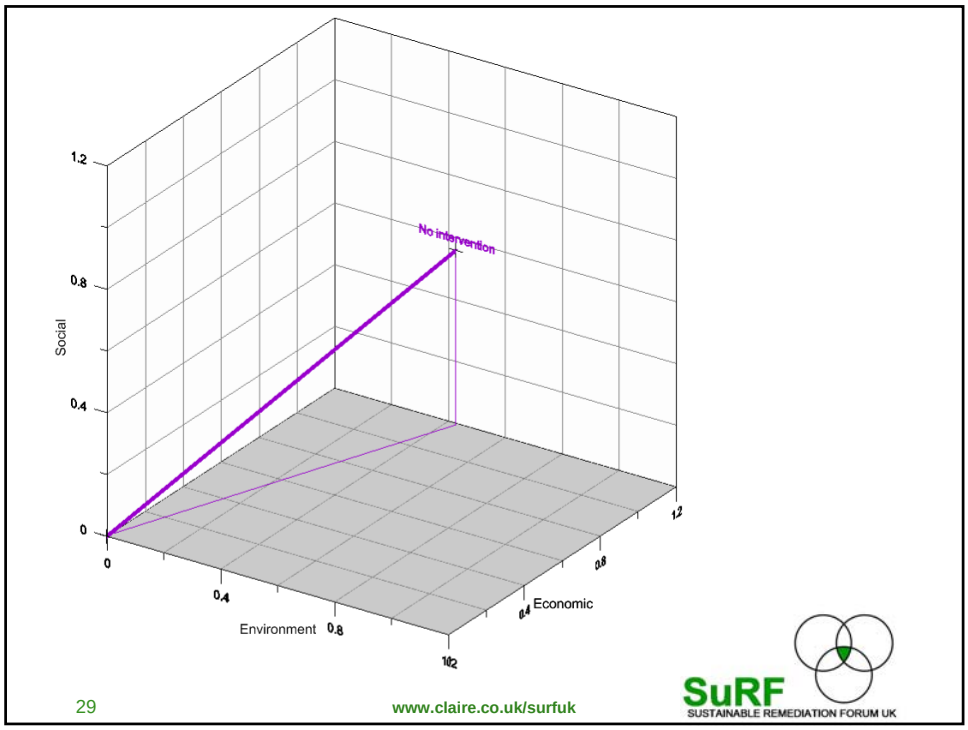

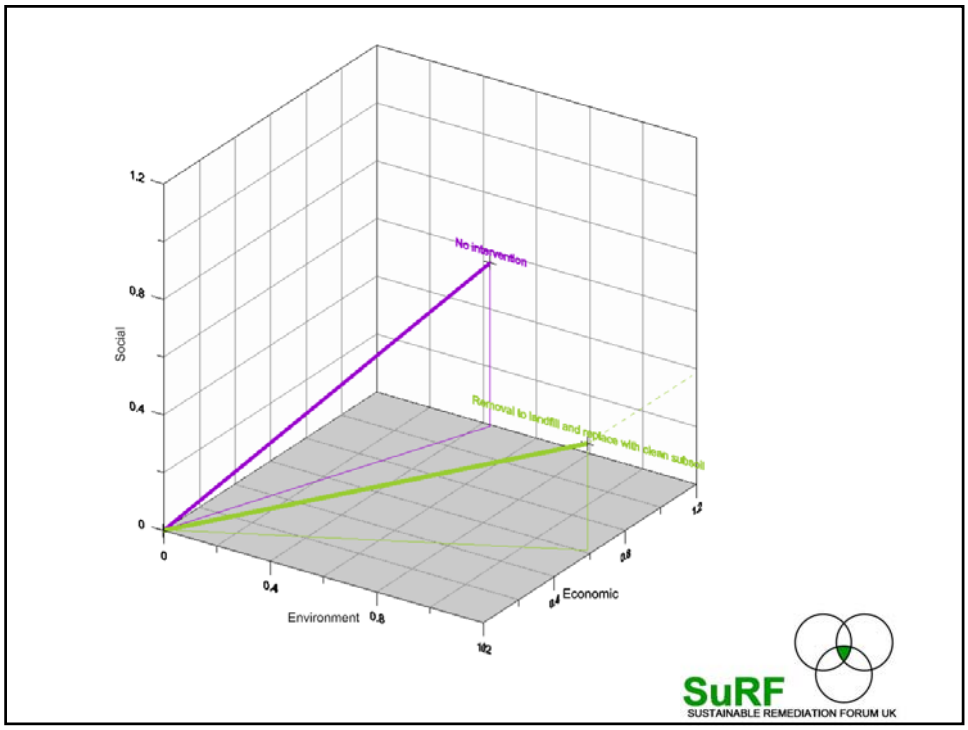

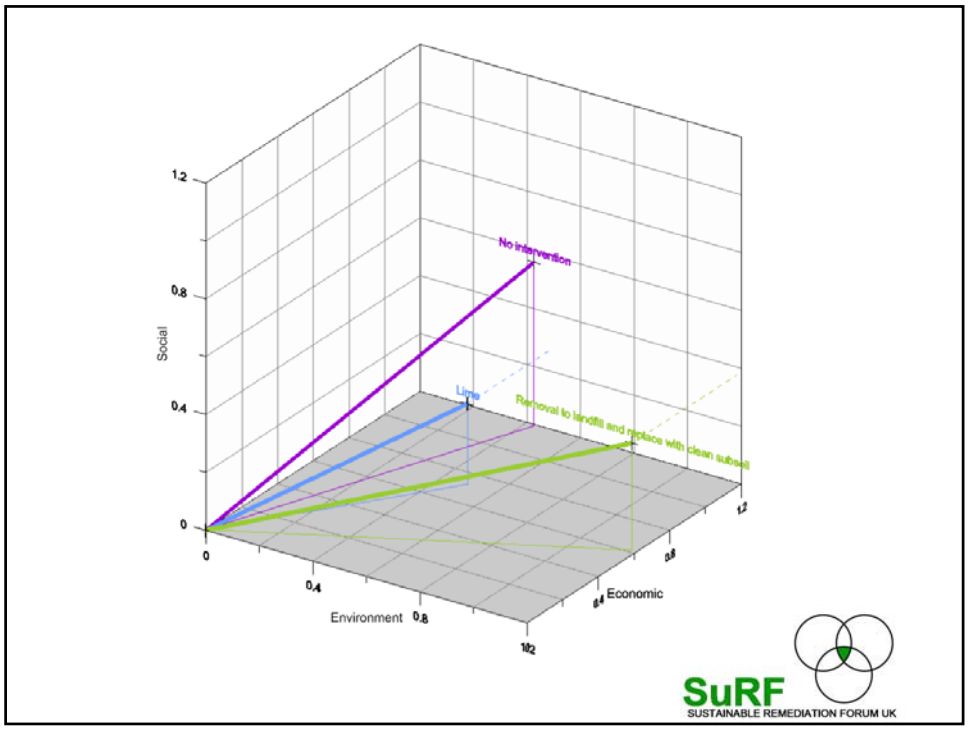

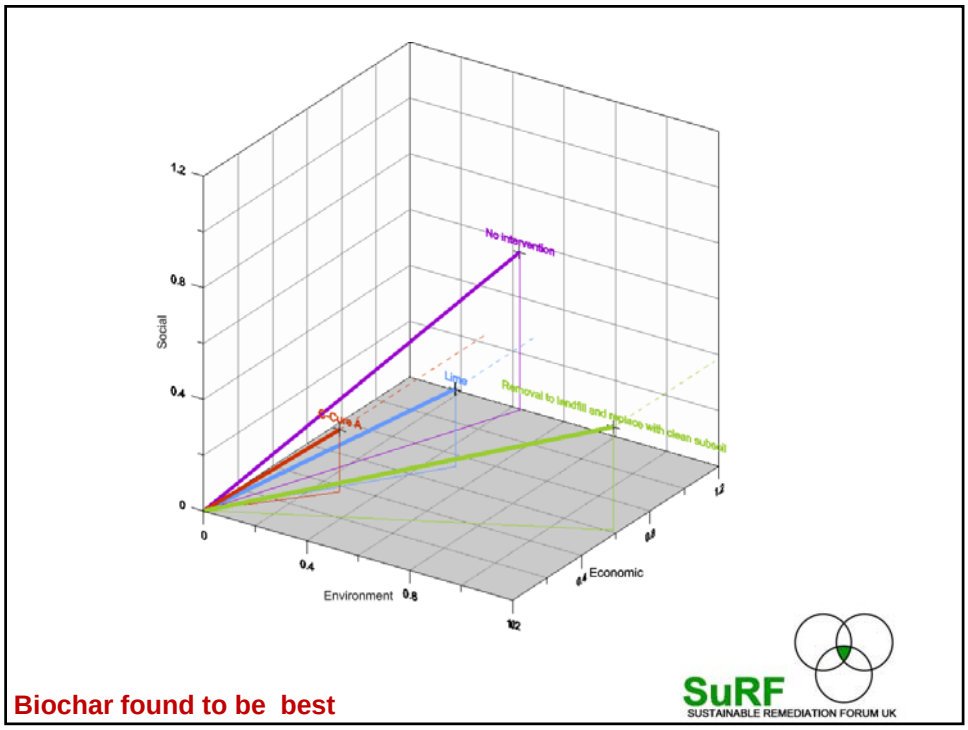

Environmental element in detail

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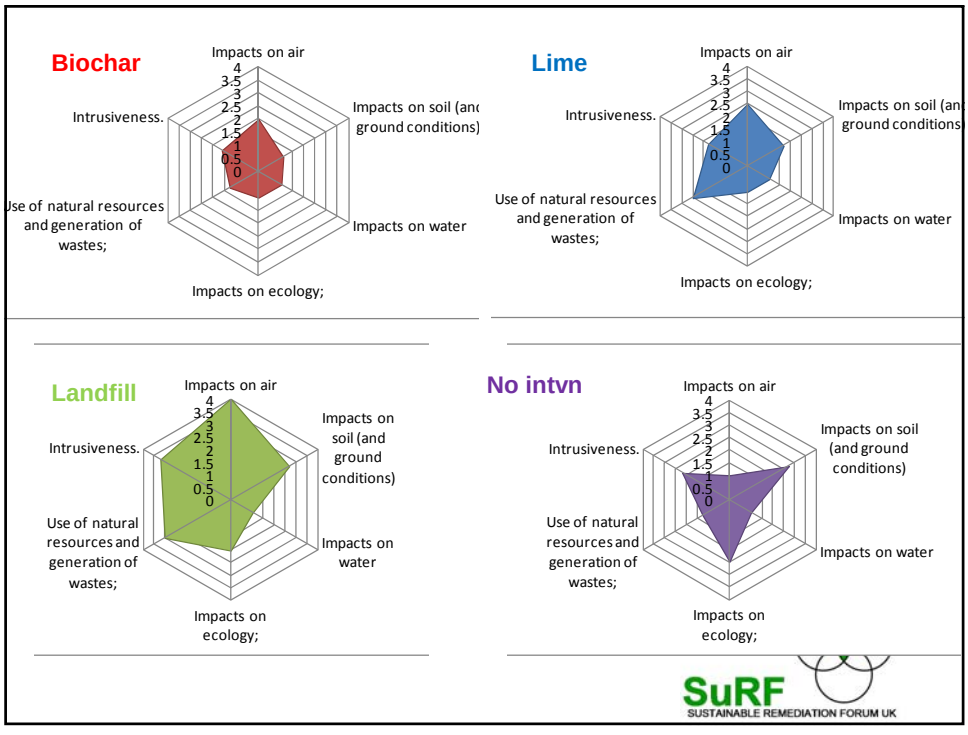

Social element in detail

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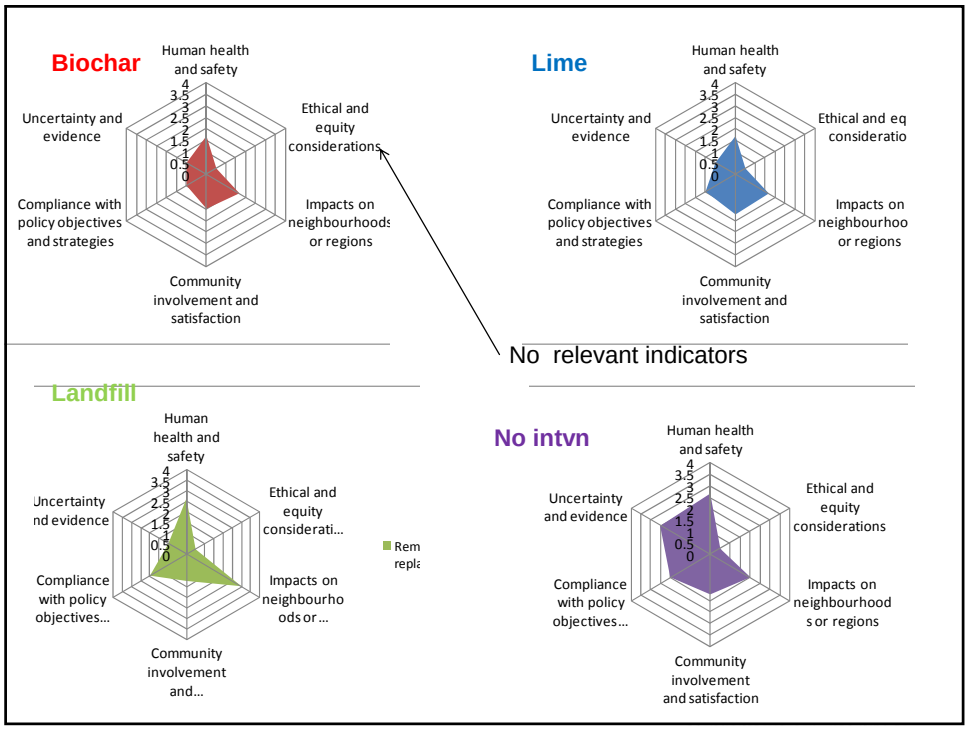

Economic element in detail

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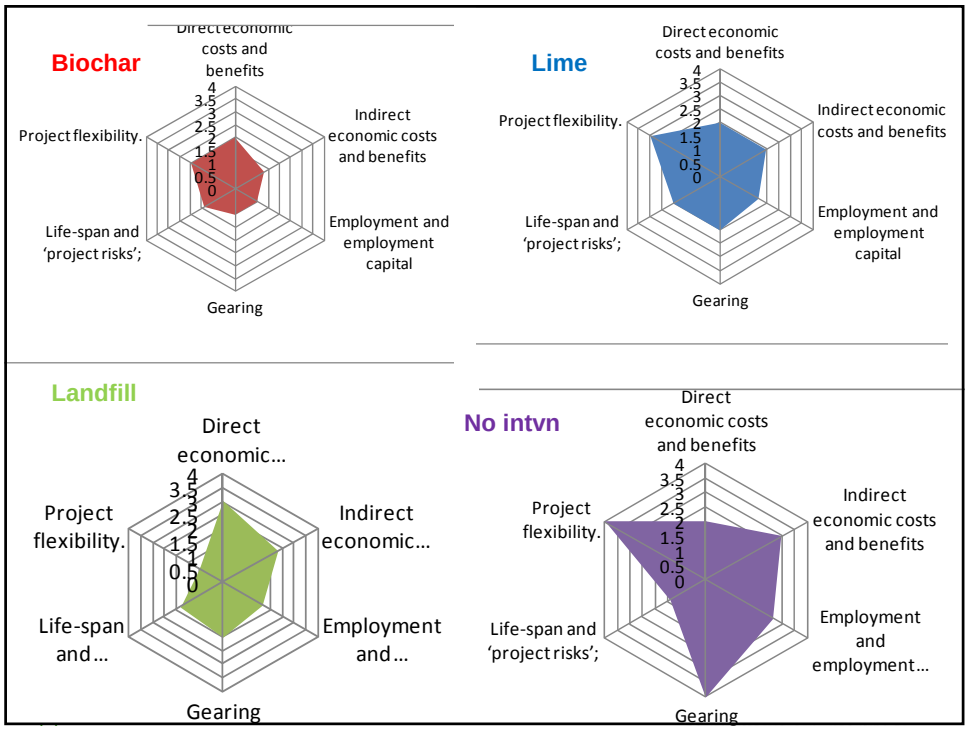

Sensitivity analyses – are we sure biochar is best?

- Removing presumption against importation of fill materials
- Considering “high” importance indicators only
- Considering “permanent” effect indicators only
- Considering “local” effect indicators only
- Different ways of aggregating social headline categories
- C-CURE biochar remained best in all sensitivity analysis scenarios
- In some scenarios the positions for “no intervention”, “lime stabilisation” and “landfill alternatives” changed relative to each other
- Stop conditions on lime stabilisation (reversibility) and no intervention (failure to protect human health)

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Conclusions and Next Steps

- In this case biochar stabilisation offers the more sustainable remediation across all elements (social, economic and environmental)
- A simple, cheap qualitative approach yielded clear outcomes (two meetings)
- Sensitivity analysis improved the robustness of findings
- Subject to validation
- Suggested next steps
  - Roll out to a wider stakeholder grouping for the site
  - Examine some aspects in a quantitative way
    - Carbon footprint
  - Hopefully this will then be a SuRF-UK Case Study

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Sustainability "vectors"

C-Cure Amendment	$\begin{pmatrix} en.29 \\ so.23 \\ ec.36 \end{pmatrix}$		
Lime Amendment		$\begin{pmatrix} en.50 \\ so.28 \\ ec.72 \end{pmatrix}$	
Removal to Landfill and Replacement with Clean Fill	$\begin{pmatrix} en1.2 \\ so.37 \\ ec.61 \end{pmatrix}$		
No intervention		$\begin{pmatrix} en.44 \\ so.57 \\ ec1.2 \end{pmatrix}$	

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Thank you for listening

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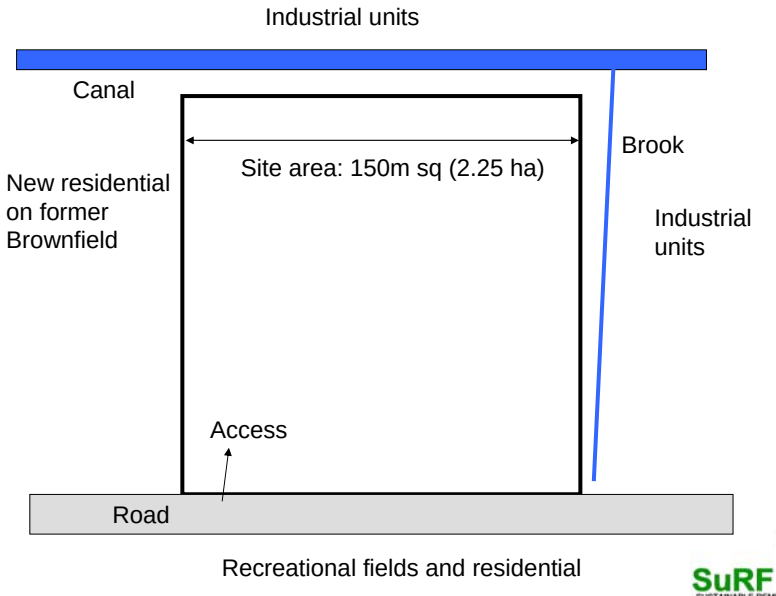
Developing a Sustainability Assessment on a Brownfield site

Frank Evans
National Grid Property Ltd

SuRF
SUSTAINABLE REMEDIATION FORUM UK

Site: Environmental setting



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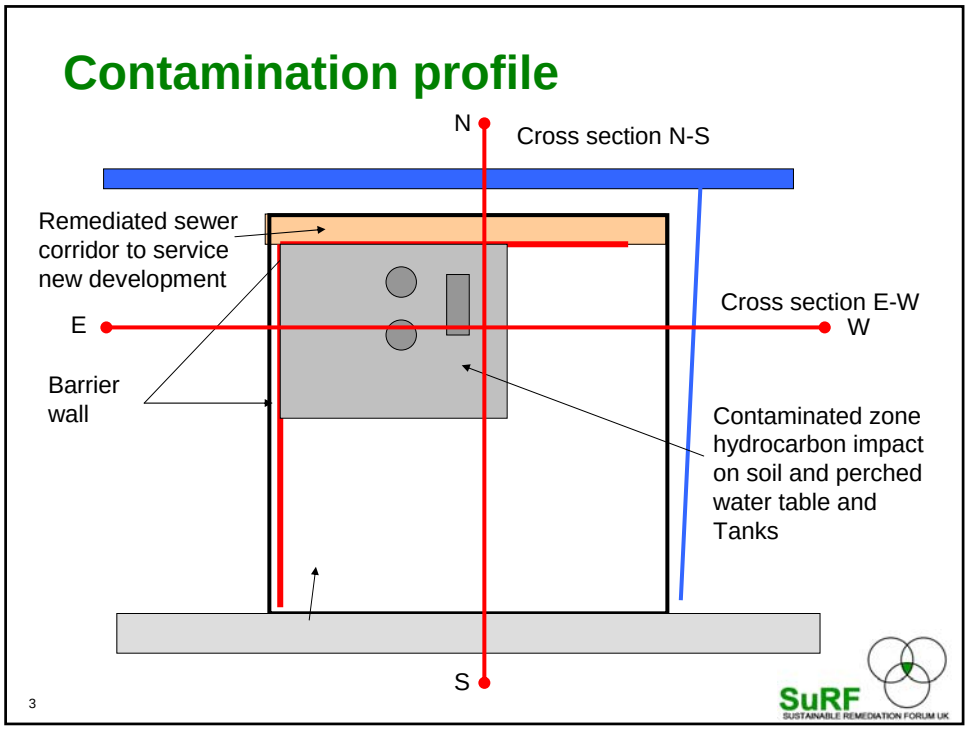
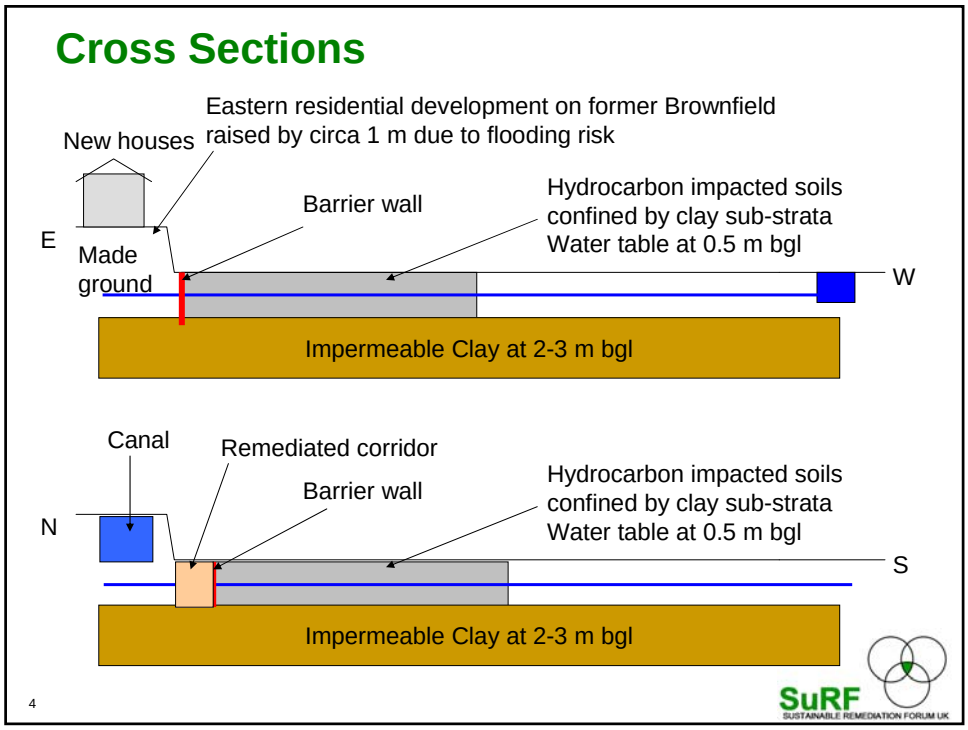
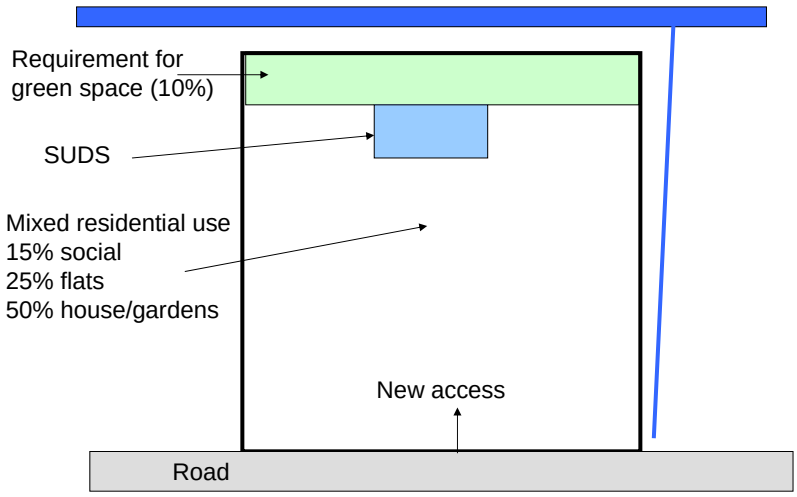




Planning opportunity



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Remediation Design

- Opportunity to develop a sustainable remediation strategy – link to wider development opportunity
- Influence location of mixed-use zones
- Requirement for green space
- Consider requirement to raise levels
- Contamination source is c.5000 m3 of hydrocarbon-impacted soils, free product and tank structures

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The Brief

- Provide remediation options assessment to client supported by sustainability appraisal
- How do we approach sustainability assessment?
- What indicators are considered?

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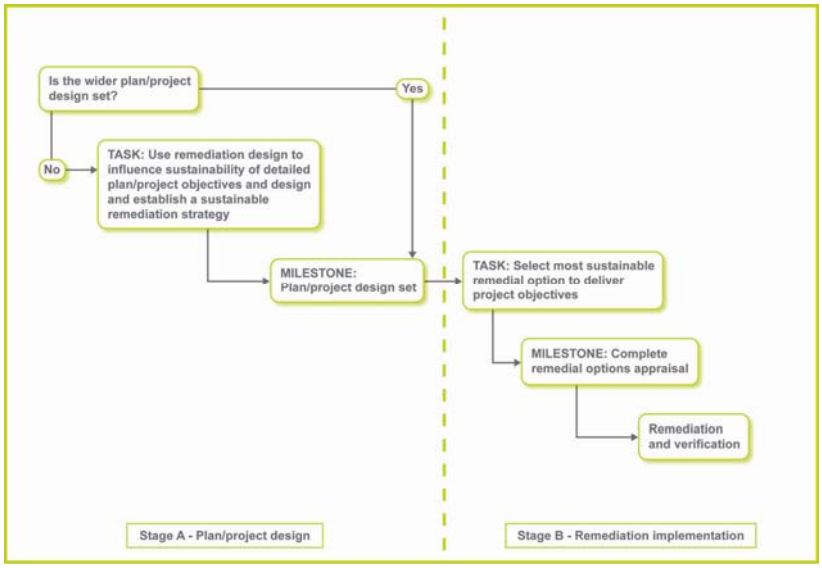
Applying the SuRF-UK Framework (A)



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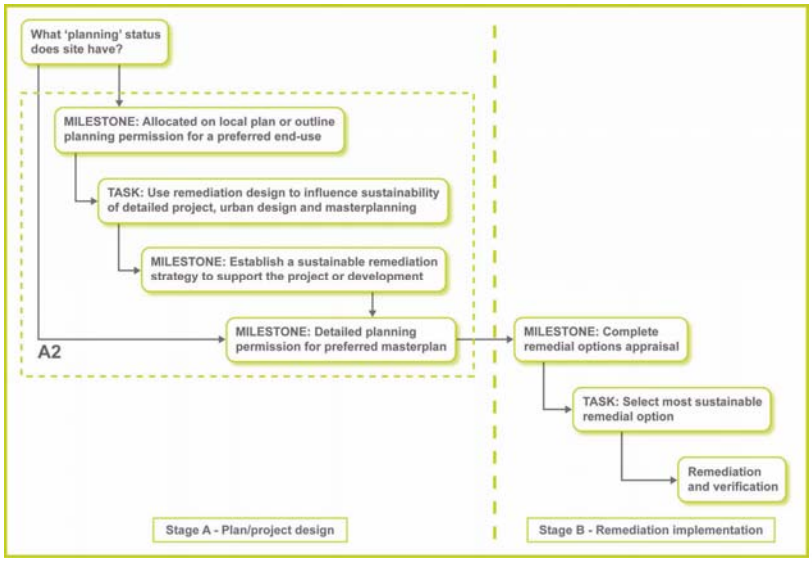
Applying the SuRF-UK Framework (A2)



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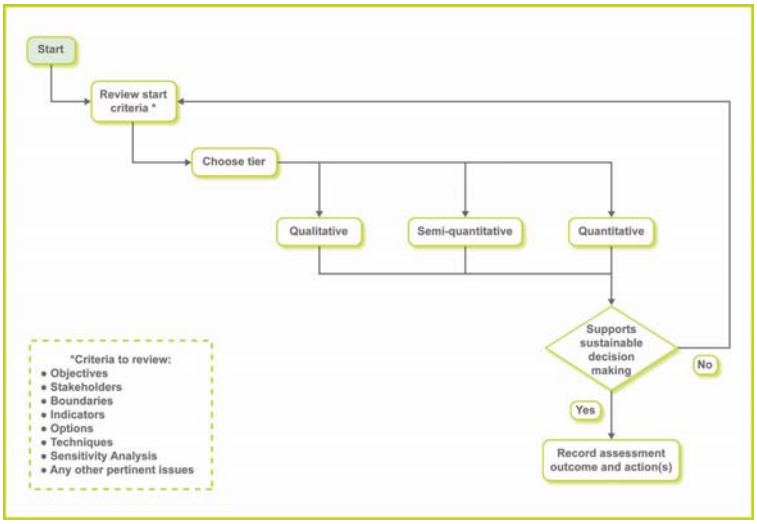
SuRF-UK Framework for assessment



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Some Boundaries

- Preferred end-use for site is ‘residential’ and is acceptable option under local plan
- Groundwater risk assessment demonstrates contained source with no deep or lateral migration of contaminants

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