SuRF-UK: A framework for evaluating sustainable remediation options, and its use in a European regulatory context

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Abstract:
Government and corporate policies frequently require actions that contribute to sustainable development, as defined by the 'Brundtland Commission'. The contaminated land industry seeks to manage risks associated with the presence of contaminants in soil and groundwater, and has been generally regarded as playing a positive role in contributing towards sustainable development. However, remediation activities can also consume resources, such as energy, water and aggregate, generate waste materials and emissions to air and water, cause social impacts to local communities and infrastructure such as roads, and introduce safety hazards for workers and residents. In some circumstances the negative impacts of remediation activities can exceed the positive benefits that the remediation achieves.

Sustainable development requires consideration of environmental, social and economic considerations, and of short- and long-term issues in order to select the best overall solution. A number of groups are active in developing frameworks and indicators to embed sustainable development criteria into soil and groundwater remediation decision-making, commonly termed sustainable remediation. The results of work by the Sustainable Remediation Forum in the UK (SuRF-UK) are presented, which has established a tiered approach to incorporating sustainable development principles into risk-based remediation decisions, within the frame set by UK legislation and good practice guidance. The framework has wider application, and is designed to be consistent with the requirements of key European Union directives.

INTRODUCTION

Management approaches for land and groundwater contamination have evolved in recent decades. From an initial recognition of the issues in the 1960 and 70's, through attempts to remediate for multifunctional end-use (1980's), and technical risk-based criteria (1990 – 2000's), the industry is now entering a period where sustainable development criteria are becoming more dominant (SURF 2009). It has often been assumed that remediation is a beneficial activity, almost regardless of how it is undertaken (Sanders 2007), but it is now apparent that remediation activities are not sustainable *per se*, and that poorly considered or operated schemes may cause more detriment than they remedy (SURF 2009). Consequently interest in remediation that can be shown to contribute to sustainable development goals - 'sustainable remediation' – is growing around the world (Illaszewicz and Gibson, 2009).

Sustainable development was defined by the United Nations World Commission on Environment and Development (commonly referred to as the 'Brundtland Report') as "*development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs*" (UN, 1987). This is commonly interpreted as meaning those actions which, having regard to social, environmental and economic factors, and to short and term-term issues, maximise the overall benefit.

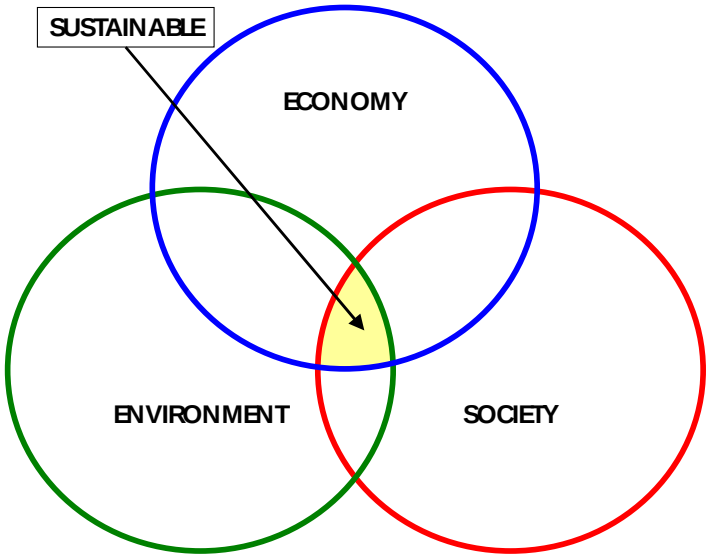

Figure 1. The three components of sustainable development

Consideration of the three components of sustainability – Society, Environment, Economy can be used within the remediation industry to develop strategies and to select remedial techniques that directly and measurably contribute to achieving sustainable development. This is increasingly important for the following reasons:

- Corporate and government policies on sustainable development
- Legislative requirement
- Climate change issues and CO_2 emission reduction strategies
- Energy consumption
- Resource consumption (e.g. water, aggregate)
- Public sentiment
- Customer sentiment
- Investor sentiment
- Safety risks
- Many remediation projects have failed to achieve non risk-based objectives and continued expenditure and environmental emissions occur for minimal or no additional risk reduction
- Many remediation technologies trade one kind of pollution for another

INTERNATIONAL SUSTAINABLE REMEDIATION INITIATIVES

In response to these issues, a number of initiatives have been established to develop an understanding and capability on sustainable remediation, both within industrially contaminated land (Bardos 2008) and mining sectors (Worrall et al. 2009). The Sustainable Remediation Forum (SURF) was established first, in the USA in 2006 (www.sustainableremediation.org). In Europe, SuRF-UK (the United Kingdom's Sustainable Remediation Forum) (www.claire.co.uk/surfuk)) was established shortly after the US effort was initiated. A NICOLE working group (focussed on the whole of Europe) on sustainable remediation then followed the UK initiative (www.nicole.org). Several tools have been developed to facilitate these efforts including the Sustainable Remediation Tool (SRT) developed by the US Air Force Centre for Engineering and the Environment (AFCEE): http://www.afcee.af.mil/resources/technologytransfer/programsandinitiatives/sustainableremediation/greenandsustainableremed/index.asp) (Forbes et al 2009). The AFCEE effort is designed to facilitate sustainable remediation within the US Department of Defense (DOD) in regards to their global policy that now requires a sustainable remediation analysis on all DOD remediation projects. In addition applied research (e.g. RESCUE: http://www.rescue-europe.com/index_mf.html; SUE-MOT: http://sue-mot.org/; SUBRIM: http://www.subrim.org.uk/) and regulatory initiatives are also active in the USA (some of which are focused on 'green' rather than strictly sustainable remediation) (USEPA 2008) and Sweden (http://www.naturvardsverket.se/en/In-English/Menu/), while the Environment Agency (for England & Wales) has also published a considerable body of research (Environment Agency 1999a, 1999b, 2000a, 2001).

THE SUSTAINABLE REMEDIATION FORUM – UK (SuRF-UK)

SuRF-UK is a multi-stakeholder initiative to develop a framework for sustainable remediation, which involves incorporating sustainable development principles in remediation decision-making. Established in 2007, it has involvement and support from industry, service providers, government agencies and academia. It has recently issued a 'framework for assessing sustainable soil and groundwater remediation' for public consultation (CL:AIRE, 2009a), and a review of sustainable development indicator sets that might be applied to sustainable remediation assessments (CL:AIRE, 2009b).

THE SuRF-UK FRAMEWORK

SuRF-UK has defined sustainable remediation as *the practice of demonstrating in terms of environmental, economic and social indicators, that an acceptable balance exists between the effects of undertaking remediation activities and the benefits the same activities will deliver*.

The framework is founded on the basis that sustainable actions can only be selected if an assessment of the environmental, social and economic criteria that influence and result from the decisions is made. The optimum (most sustainable) solution is that which maximises the overall benefit. A number of key principles were identified that should be considered in the design, implementation and reporting of sustainable remediation schemes. These are:

Principle 1: Protection of human health and the wider environment. Remediation should remove unacceptable risks to human health and the environment, and give due consideration to the costs, benefits and technical feasibility.

Principle 2: Safe working practices. Remediation works should be safe for workers on-site, local communities and the environment.

Principle 3: Consistent, clear and reproducible evidence-based decision-making. Sustainable remediation decisions are made having regard to environmental, social and economic factors, and to current and future implications. A sustainable remediation solution optimises the benefits achieved[1].

Principle 4: Record keeping and transparent reporting. Remediation decisions, including the assumptions and supporting data used to reach them, should be documented in a clear and easily understood format in order to demonstrate to interested parties that a sustainable (or otherwise) solution has been adopted.

Principle 5: Good governance and stakeholder involvement. Remediation decisions should be made having regard to the views of stakeholders and following a clear process that they can participate in.

Principle 6: Sound science. Decisions should be made on the basis of sound science, relevant and accurate data, and clearly explained assumptions. This will ensure that decisions are based upon the best available information and are justifiable and reproducible.

It is recognised that a wider range management decisions often affect the scope of remediation work and its sustainability assessment, and these can impact the scope of possible remediation approaches in two ways. Firstly in terms of regulatory and planning controls on environmental risks, say to human health, water and the wider environment – these considerations relate to the desired end use of the site; secondly, practical boundaries such as the time and space available to carry out remediation, could also limit the range of possible interventions.

The decision points recognised by SuRF-UK as impacting contaminated land management for a particular site are (Figure 2):

- High level decision making for policy and regional spatial planning by national government / regional agencies;
- Local level land-use planning and policy – by local authorities;
- Project based decision making that sets remedial objectives (e.g. related to risk management / development needs) for land owners and developers; and,

[1] In certain projects it is recognised that non-optimum remediation decisions may be made because other factors are more influential in optimising the benefit from a development scheme. Considering regulatory implications and recording why such a decision was taken should be a minimum requirement for any decision making process.

- Remedy selection and implementation including monitoring and verification implications.

Sustainability assessment is possible at each of these stages, though it is recognised that a distinction can be made between a 'Stage A' including the spatial planning processes and site-specific master-planning and risk-assessment, and separately a 'Stage B' which involves selection, operation and verification of remediation techniques. Decisions made at Stage A directly influence remedial works undertaken later. However, the opportunity for parties working solely in Stage B to influence the broader decisions made at Stage A may be limited or non-existent. Figure 2 illustrates this point with a vertical dashed line – it is important to understand what the boundary conditions are that frame a sustainability assessment.

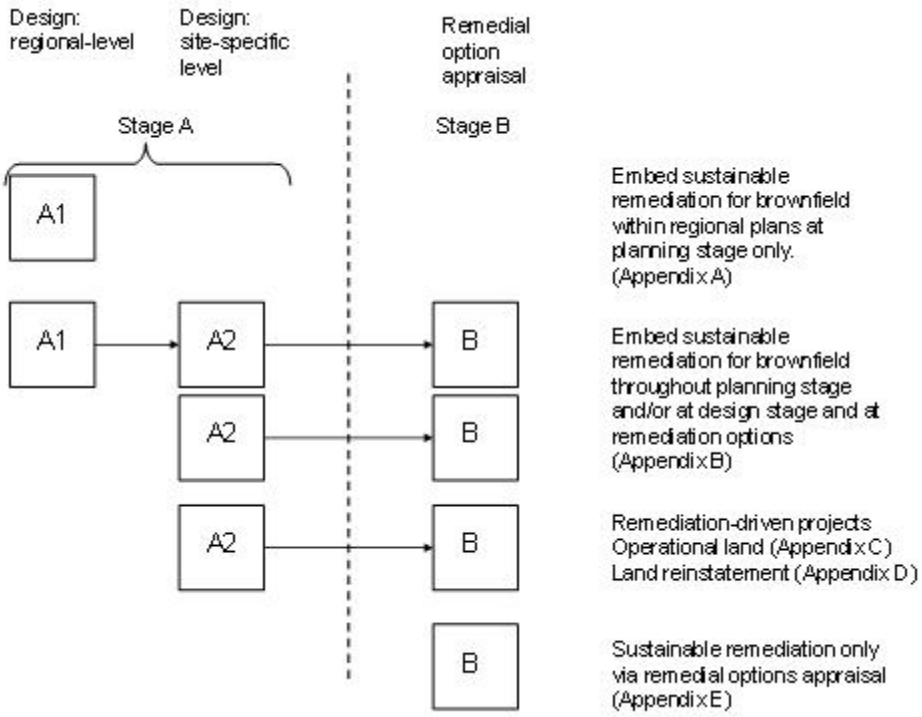

Figure 2. Use of the SuRF-UK framework for different remediation scenarios (after CL:AIRE 2009a)

At the highest level (A1), a sustainable remediation assessment requires inclusion of remediation consideration alongside other relevant criteria in policy formulation, regional spatial planning decisions and strategic environmental assessments. Inclusion of the benefits and impacts of remediation when allocating land-use in spatial plans is important to ensure the approach is sustainable at the broadest scale. If national strategy and regional spatial plans take account of remediation considerations the resulting influence on the contribution of remediation to sustainable development goals will be greatest – the overall development will be 'better by design'. At the next stage, A2, site-specific planning requires considerations of, for example, land-use allocation and site master-plan design, such as the mosaic of different end-uses across a previously contaminated site. Allocation of historically contaminated areas

to new low-sensitivity uses may minimise the requirement for remedial works. Where remediation is required, integration of remediation with other activities, such as earthworks or design of ground storage of heat systems, may bring about further benefits in terms of cost saving, or environmental and social improvement. Stage A2 also includes assessment of the remedial strategy, to ensure appropriate and achievable risk-management objectives are addressed.

Stage B is the selection of a remedial strategy and technique to achieve risk-management goals. This sequence of stages is presented as a framework in Figure 3.

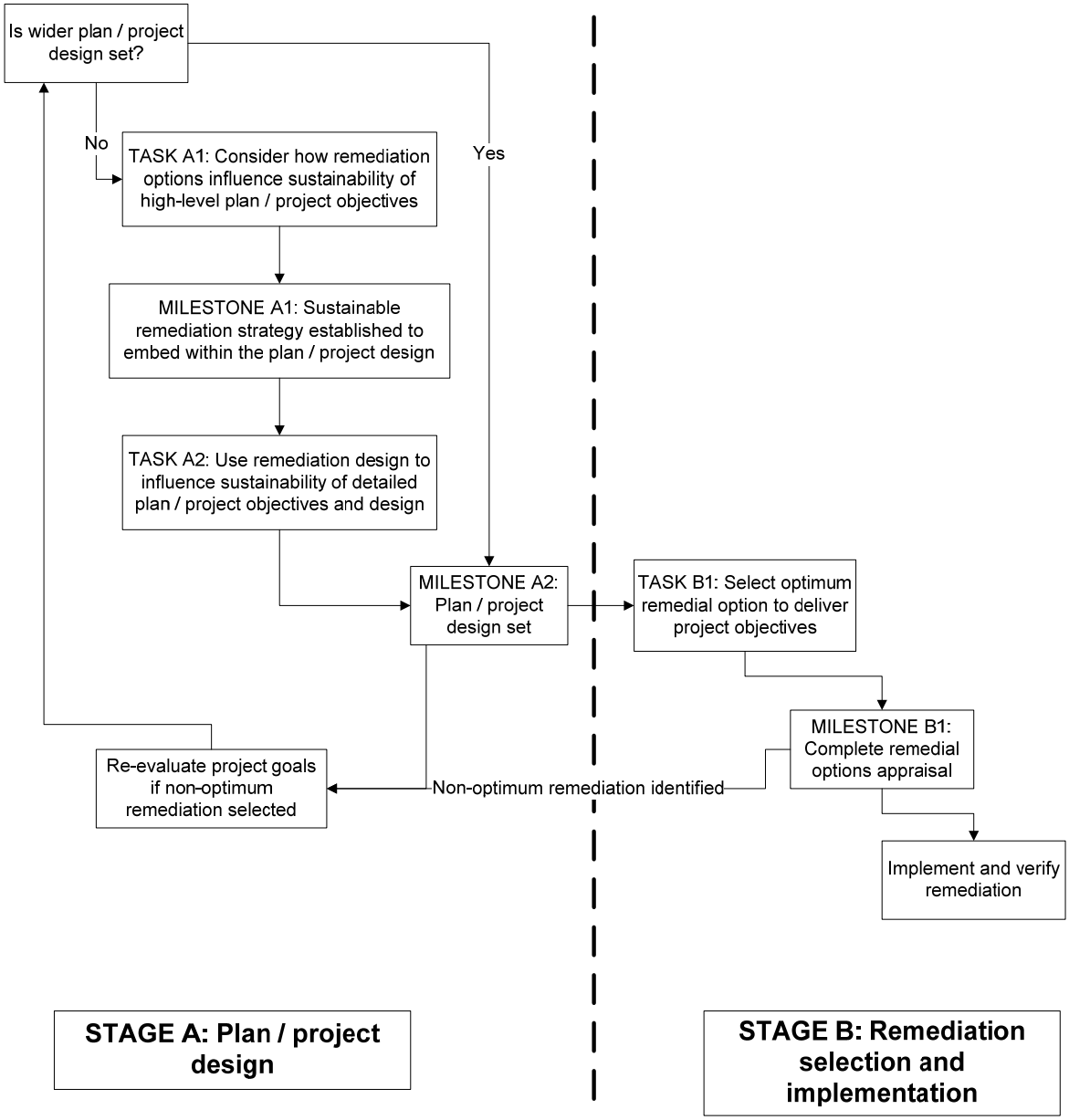

Figure 3. The SuRF-UK framework

TIERED APPROACH TO SUSTAINABLE REMEDIATION ASSESSMENT

Within each stage SuRF-UK have proposed a tiered approach to evaluating sustainable remediation, starting with simple qualitative methods, progressing through approaches such as multi-criteria analysis (MCA), and ultimately to cost-benefit analysis (CBA) (Fig. 4). At each tier a set of environmental, social and economic factors are considered as illustrated in Table 1. However the level of detail considered at each tier may also vary so that, for example, at the simplest tier an assessment of the impacts and benefits associated with 'environment', 'society' and 'economy' may be adequate, and the assessment may simply take the form of an informed discussion amongst the relevant stakeholders. In an MCA assessment the 18 categories (Table 1) may be initially considered, and during a CBA the monetised impacts and benefits associated with detailed sustainability metrics (e.g. impacts on air: CO_2 and NOx emissions, Impacts on water: consumptive water abstraction) are used (Environment Agency, 1999b; Hardisty et al. 2009). The assessment tier used should reflect the project complexity and be the minimum assessment required to make a robust and reasonable management decision.

Table 1. Possible categories of indicators for use in sustainable remediation assessment

Environmental	Social	Economic
1. Impact on air 2. Impact on water 3. Impact on soil 4. Impact on ecology 5. Natural resource use and waste generation 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.

APPLICATION IN THE UK AND EU

The framework was designed to complement the existing UK government policy on sustainable development (ODPM, 2005a, 2005b) and good practice for contaminated site management, which is risk-based (EA/Defra, 2004), and to provide guidance on selection of sustainable solutions within business and regulatory processes that are already familiar to those who operate in the UK environment. Figure 5 illustrates how the SuRF-UK framework interfaces to the existing structure of CLR11 (EA/Defra, 2004).

Guidance already exists on methods for undertaking assessment of the costs and benefits of soil and groundwater remediation (Environment Agency, 1999a, 1999b, 2000a, 2001), which may be appropriate at the higher tiers of the SuRF-UK framework. Formal CBA assessments have been used to successfully inform remediation decision making in the UK by a number of landowners, representing different industrial sectors. Furthermore a review of the wider

environmental benefits of remediation (Environment Agency 2000b) presents information that may be used to frame discussions and identify boundary conditions for a sustainability assessment at the lower tiers.

In a wider European context the SuRF-UK framework is applicable to any assessment of sustainable remediation, and it was drafted to be consistent with the requirements of the most recent draft (spring 2009) of the EU Soil Protection Framework Directive, which required an assessment of environmental, social and economic considerations in selecting a sustainable remedial solution.

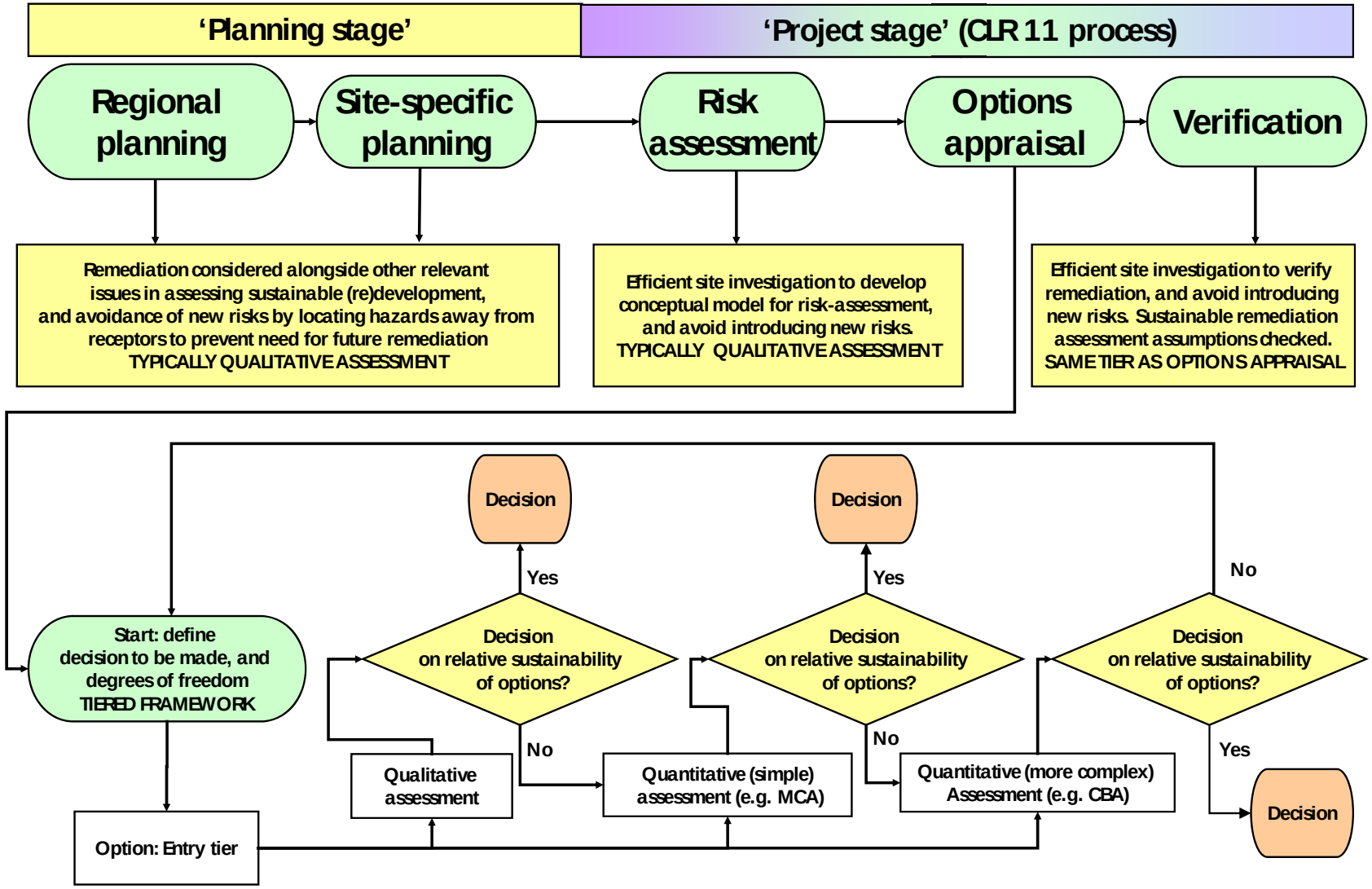

Figure 4. Tiered approach to assessing the sustainability of remediation in spatial planning decisions and risk-assessment/management stages. CLR11 refers to Contaminated Land Report 11 (Environment Agency/Defra, 2004), which describes UK government good practice for contaminated site management.

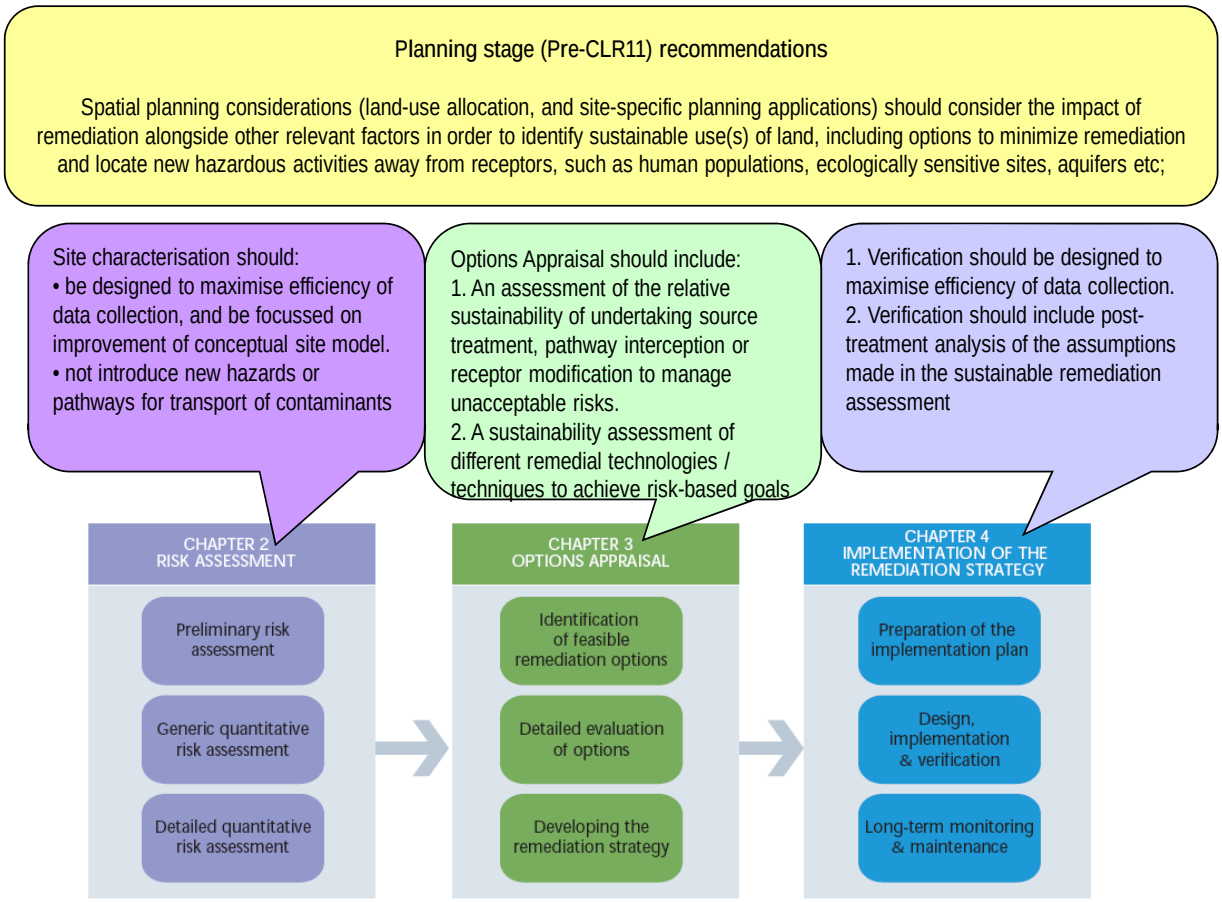

Figure 5 SuRF-UK sustainable remediation assessment points aligned to planning decisions and the CLR11 process

CONCLUSIONS

The first phase of SuRF-UK activity is drawing to an end with consultation and publication of a framework document (October 2009). Future work is likely to concentrate of development of sustainability indicators and metrics (to supplement or replace those in table 1), and collation of data on the performance of a range of remediation techniques against those metrics. Further detail will be posted at www.claire.co.uk/surfuk, and it is hoped that publication and use of the framework will help the remediation industry in the UK (and elsewhere) to more directly contribute to achieving sustainable development.

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