Developments in Sustainability Assessment within Contaminated Land Management, and Perspectives from SuRF-UK and NICOLE

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Abstract: Since the end of the last century there has been a general international consensus that the basis of decision making for the management of the problems of historically contaminated land should be on the basis of assessment of risks to human health and environmental receptors. More recently there has been an increasing interest in including sustainability as a decision-making criterion, in particular to consider the impacts of a risk management processes themselves, but also to explore wider opportunities for benefit by integrating remediation with other desirable activities. Sustainable remediation has come to exist as a popular term used to describe contaminated site management that is demonstrably sustainable, i.e. where some form of sustainability appraisal has been used in decision making to identify the "most sustainable" approach for any particular management intervention required. The "most sustainable" approach is one that, in the view of the stakeholders involved in making or considering management decisions, has the optimal balance of effects and benefits for each of the three elements of sustainability: environment, economy and society. This chapter describes how the Brundtland Report concept of sustainable development can be linked with risk based land management as a tool in decision making.

INTRODUCTION

Contaminated land management on a global scale is an enormous undertaking, both in terms of the amount of land under or requiring management, and also as an economic activity. In August 2007 the European Environment Agency - EEA (EEA 2007) concluded that soil contamination requiring clean up is present at approximately 250,000 sites in the EEA member countries. The data is very variable from country to country, and numbers may increase. "Potentially polluting activities are estimated to have occurred at nearly 3 million sites. The market for remediation services was estimated to be US$30 billion worldwide in 2002 (U.S. International Trade Commission 2004). The US Market was valued at $12.1 billion in 2002 and the EU market at $7.9 billion in 2000. The EEA, although it does not have UK data, suggests that some European economies are spending 0.5 to 3% of GDP on contaminated land management –based on 2004 - 2006 data (EEA 2007). Consequently the way in which contaminated land is managed cannot be immune from having impacts on environment, economy and society: the three *elements* of sustainability.

This paper briefly reviews "Brundtland" definition of sustainable development and how this notion is linked to an ethical framework. The paper goes on to describe how sustainable remediation has evolved as an idea from the general European consensus on risk based land management. It argues that different types of stakeholder may want to use sustainability arguments for differing purposes, but that a unifying concept is necessary, based on a common purpose if sustainability is to have any value as a criterion in contaminated land decision-making that all people can understand. The paper goes on to set out a general approach for the use of sustainability in contaminated land management decision making. An important element in using sustainability as a decision-making criterion in a rational way is to have some kind of a framework which identifies the decision points at which sustainability assessment should be used to maximise its effectiveness. This framework has to link with contaminated land management practice and regulatory, planning and policy frameworks. Equally important is a process or procedure for carrying out sustainability assessment in a

reproducible way, that ensures both that all relevant considerations are undertaken; and that engagement with stakeholders takes place. A good example of a framework has been developed in the UK by the Sustainable Remediation Forum in the UK - SuRF-UK (CL:AIRE 2009b). An emerging assessment process or "road-map" has been developed by the Sustainable Remediation Working Group (SRWG) of the Network for Industrially Contaminated Land in Europe[1] - NICOLE (Maurer 2009).

HISTORICAL PERSPECTIVE

It had long been assumed that contaminated land risk management was by its nature intrinsically sustainable because, for example, it controlled risks from pollutants and facilitated the re-use of brownfield land so reducing greenfield redevelopment processes. However, it has increasingly been realised that this simple assumption may not always be true. For example, increasing concerns about fossil carbon use have led to questioning whether it is truly sustainable to apply energy intensive remediation processes to relatively low levels of contamination and increasing interest in using natural capacities to effect remediation (Vegter *et al.* 2002).

However, sustainability concerns, although not always explicitly referred to as such at the time, have already had a major influence on contaminated land management policy across Europe. It was argued in some countries that the aim of any remediation that took place should always be to make the treated land suitable for any purpose no matter how sensitive from a risk management point of view, the so-called "multi-functionality" approach. Many countries believed that it was questionable whether the more stringent treatment required was environmentally beneficial from a holistic point of view taking into account the requirements and emissions of the treatment. However, ultimately it was the economic and social costs of multi-functionality that were found to be politically unsustainable, and in fact an obstacle to the re-use of brownfield land (Denneman 1999, Harmsen and Hoeks 1998). Hence these major sustainability flaws with multi-functionality led to its abandonment as a policy by the end of the century.

Both the use of risk-based decision making and questions of sustainability were crystallised in 2002 by the European project CLARINET: the Contaminated Land Rehabilitation Network For Environmental Technologies in Europe (Vegter *et al.* 2002), in its seminal work on Risk Based Land Management (RBLM) described below. CLARINET was a "Concerted Action" of the European Commission's Environment and Climate Research and Development Programme. The project ran from 1998 to 2002 and was funded and supported by the European Union and by national agencies and regulators. Its primary objectives were to develop technical recommendations for sound decision making on the rehabilitation of contaminated sites in Europe and to identify research and development needs. Some of these ideas were transmitted by wider international networks and meetings established under the NATO Committee for Challenges to Modern Society (US EPA 2000) and ultimately began to influence thinking in the US EPA. It may be a stretch to assume that the US EPA concept of "green remediation" (US EPA 2008) had its origins in NATO/CCMS, but the Pilot Studies can only have helped!

Interestingly, the same point of view was emerging in industry, both amongst site managers and the service providers. NICOLE, the Network for Industrially Contaminated Land in Europe, held a workshop in Barcelona, Spain in 2003 on the "Management of Contaminated Land towards a

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Sustainable Future: Opportunities, Challenges and Barriers for the Sustainable Management of Contaminated Land in Europe" (Bardos 2003). This meeting concluded that the meanings ascribed to terms such as "sustainable" or "sustainable development" vary widely. It also concluded that there was no common language for discussing contaminated land management in the context of sustainable development. "Without clear definitions everybody can claim that they are acting sustainably when sometimes perhaps they are not". NICOLE decided that it would be both a major challenge, and also a major achievement, for NICOLE to catalyse the development of a common framework, widely used across Europe in the same way that risk based decision making has become used.

Hence discussions of the role of sustainability in contaminated land remediation have been long-standing in Europe. However, it is a US development that has catalysed the debate in recent years. The Sustainable Remediation Forum (SURF) was initiated by a company, Du Pont, and rapidly grew into a cross-sectoral network that attempted to define concepts of sustainability from the bottom up, i.e. from the standpoint of remediation practioners (SURF 2009). This has led to a flurry of similar cross-sectoral sustainable remediation networks, most notably SURF-UK, and the NICOLE SRWG and SURF Australia. The SURF-UK approach was different to that of the original USA SURF organisation, in that it attempted to place sustainable remediation in a broader context, linking it to broader definitions of sustainable development in policy, spatial planning, the land development cycle and last but not least existing approaches to risk based contaminated land management decision-making. This is essentially what the SURF-UK framework achieves (CL:AIRE 2009b). This is currently out to public consultation and will be finalised by the end of 2009. NICOLE SRWG's perspective has been different again. Being an international group, it quickly realised that a single one size fits all framework for Europe like that developed by SURF-UK was not only unlikely to be achievable, but would probably be detrimental given the diversity in policy, economy, society and environments across Europe. However, what NICOLE did conclude was feasible was a discussion of common principles that might underpin the use of sustainability assessment in contaminated land management decision making, independent of particular national regulatory or policy contexts. It will be producing a first draft of guidance that reviews these principles, and a process or "road map" for applying them, at the end of 2009 (*see Maurer paper in these proceedings*). What is interesting, but actually unplanned, is how these different initiatives are complementary, but taken together begin to delineate an overall system for achieving sustainable remediation.

The importance of this work has been highlighted by the inclusion of this definition of remediation in the November 2008 draft text for the emerging European Soil Framework Directive: "Remediation shall consist of sustainable actions on the soil aimed at the removal, control, containment, reduction of contaminants, natural recovery or any other appropriate means, so that the contaminated site, taking account of its current use or approved future use, no longer poses any significant risk to human health or the environment". While the drafting has changed, and political agreement for the draft Directive was not secured, negotiations are likely to begin again in 2010 and sustainability will be important in the future Directive. It is therefore timely that a range of cross-sectoral working parties are producing their first outputs now, and important that these are used to find an overarching consensus that can influence any future drafting of the proposed Soil Framework Directive, to make sure that Europe-wide legislation does indeed meet the needs of the stakeholders it will affect and will truly contribute to sustainable development.

ETHICS AND SUSTAINABLE DEVELOPMENT

At the 2009 NICOLE Leuven meeting on sustainable remediation Prof John Handley applied concepts of environmental ethics to the management of land affected by contamination (Bardos 2009). Environmental ethics has been described as being *concerned with the moral relations that hold between humans and the natural world. The ethical principles governing those relations determine our duties, obligations and responsibilities with regard to the Earth's natural environment and all the animals and plants that inhabit it"* (Taylor 1986). These considerations can be seen from different perspectives which affect which actions are seen as most appropriate, for example, a utilitarian perspective such as maximising business welfare, or a duty-based perspective related to some moral imperative. Duty based perspectives can be further subdivided, for example, should remediation be done to fulfil anthropocentric (for human benefit) or eco-centric (Nature benefit) objectives? Remediation from an anthropocentric perspective is carried out because humans benefit from a better environment. Remediation from an ecocentric position would be carried out for the benefit of the conservation of Nature, with human benefit being one aspect of that wider Nature. Handley proposed a classification of ethical approaches (which he adapted from: Beatley 1994).

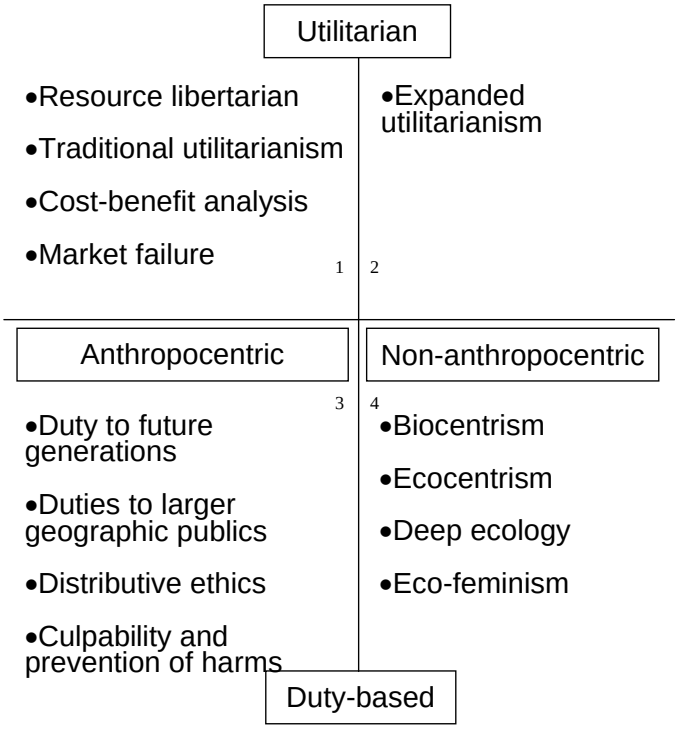

Figure 1 Classification of ethical approaches

Sustainable development as a concept was defined in the 1987 "Brundtland Report" by the World Commission on Environment and Development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland 1987). This would place it in the left had bottom quadrant of the chart in Figure 1: as being something that is "duty based", but also anthropocentric (as it explicitly considers effects on society and economics). There are other concepts of sustainability that are more eco-centric, for example the maintenance of ecosystem services, although even in this case these services may often be seen in

the context of their value to human society (Stratton and Pearson 2008). The current sustainable remediation debate is framed in the context of the Brundtland definition of sustainable development, which is integrated in a wide range of environmental policy making in the European Union.

Using the Brundtland definition, SURF-UK and the NICOLE SRWG define 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 that those activities will deliver* (CL:AIRE 2009b). Sustainable development in these terms is wide ranging in its scope across environmental, economic and social factors. SURF-UK has grouped these factors in a number of overarching categories for each of the three elements of sustainability, as set out in Table 1. It has carried out a preliminary assessment of the wide ranging factors considered different sustainable development based policies and consultations (CL:AIRE 2009a), and is developing a "checklist" approach to assist mediation practioners in identifying individual sustainability factors in collaboration with NICOLE SRWG .

Table 1 Overarching Categories of Sustainable Development Considerations

Environmental	Social	Economic
• impacts on air – incl climate change • 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

RISK BASED LAND MANAGEMENT AND SUSTAINABLE DEVELOPMENT

In its influential report (Vegter *et al.* 2002) CLARINET concluded that contaminated land management decision making needs to consider three main broad issues: (1) fitness for use, (2) protection of the environment and (3) long-term care. The first two describe goals for safe use of land, including prevention of harm and resource protection. The third allows for a more rigorous assessment of the way in which these goals are achieved, to ensure that it is a sustainable way. The three components need to be in balance with each other to achieve an appropriate solution. CLARINET called this concept Risk Based Land Management (RBLM). RBLM is primarily a framework for the integration of two key decisions for remediation of contaminated land:

1. The time frame: this requires an assessment of risks and priorities, but also the consideration of the longer term effects of particular choices.
2. The choice of solution: this requires an assessment of overall benefits, costs and environmental effects, value and circumstances of the land, community views and other issues.

These two decisions have to take place at both an individual site level and at a strategic level, especially as the impact of contaminated land on the environment can have not only a large scale regional dimension but also potentially wide ranging long term impacts.

RBLM emphasised the importance of sustainable development for contaminated land management. Risk based decision making in contaminated land management was seen as consistent with sustainable development because it provides a scientific rationale for the costs of remediation that society has to bear. But furthermore CLARINET suggested that where possible the "natural capacities" of soil and water should be used to effect risk management (e.g. through the exploitation of natural attenuation). However, CLARINET pointed out that not all remediation projects are necessarily sustainable development. Remediation processes themselves will have economic, environmental and social burdens. For example, removal of contaminated soils to landfill may only represent a transfer of contamination from one place to another, even if it does facilitate a redevelopment, and that transfer has economic, environmental and social costs associated with lorry movements, which may outweigh the benefits arising from any risk reduction on the contaminated site. CLARINET suggested that considering the true contribution of remediation work to sustainable development is an emerging challenge at least as great in its difficulty as the development of risk based decision making, and with the same capacity to profoundly change how we manage contaminated land in the future.

SURF-UK and NICOLE SRWG and the other international initiatives have begun the response to this challenge.

SUSTAINABILITY DECSION MAKING AND THE PROJECT MANAGEMENT PROCESS

Remediation is a process that takes place after a chain of decisions that set its *scope*. Very often the remediation work is part of a larger initiative, for example the redevelopment of a former industrial site, which will include a wide range of other decisions related to feasibility of developing a site and financing the project, and hence their consequent Risk management requirements. These project based decisions are affected by higher level decisions such as: setting national and regional spatial policies, and indeed Risk management priorities, and local level decisions such as a municipality's development zoning requirements. Each of these decisions might be subject to its own sustainability appraisal and sustainable development context. Hence, remediation decision making is one segment of a broader framework of decision making.

The benefits of considering "sustainable remediation" depend on where in the decision making process this consideration takes place. Sustainable remediation may be seen purely as an aspect of selecting the optimum remediation strategy for a project after all land use and site development decisions have already been made. This may often be the scenario that is faced by contaminated site management service providers. However, in this situation, the impact of adopting a sustainable remediation approach may well be less than if remediation options and their impacts had also actively considered as part of the land use and overall project planning stages when greater sustainability "gains" might have been possible (Bardos *et al. in prep*). Consequently the SuRF-UK framework identifies two fundamental stages at which sustainability can be considered: firstly plan/project design stage and, secondly, remediation implementation, as illustrated in a general way in Figure 2. The range of options available to optimise sustainability of remediation work is likely to be greater if it is a consideration at the design stage: "better by design". However, in practice the

project design and contracting of a redevelopment site may mean that a wide range of design decisions will have been agreed before remediation is even considered. In this situation, the extent to which sustainability can be optimised will be limited to the choice of remediation option for a set of fixed remediation objectives. Clearly, the type of land use affects this decision-making. For example, for operational industrial land where risk management has been triggered by a potential environmental impact, the remediation operations will represent the bulk of the project carried out. For a brownfield redevelopment, remediation will be one of a wider set of processes going on a site, for example including the development of infrastructure and buildings.

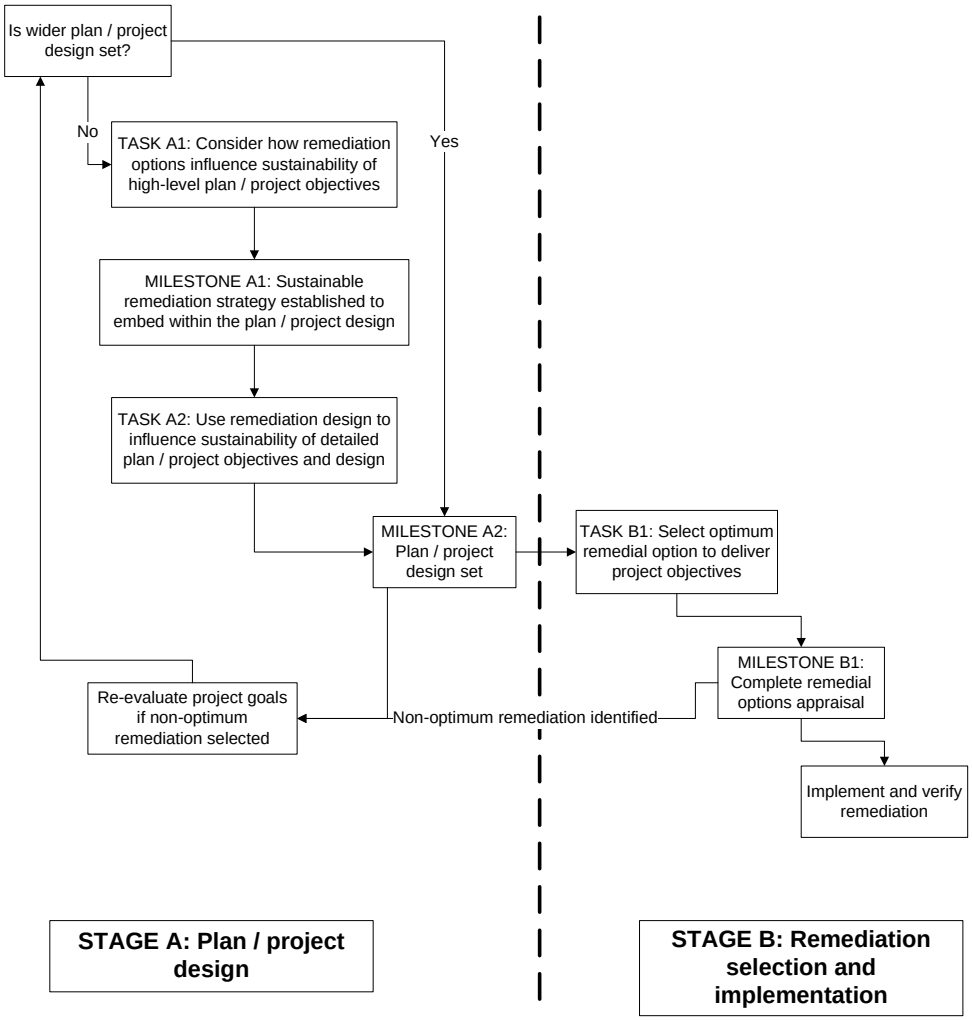

Figure 2 The general SuRF-UK sustainable remediation framework

In many countries the sustainability (and the costs versus benefits) of remediation has become an important consideration in the choice of remediation approach. As yet limited questioning of the sustainability of the risk management objectives themselves has taken place. The conventional wisdom is that the protection of human health and the wider environment is the driver for remediation, and consideration of sustainability relates to the process of meeting these needs. However, the NICOLE SRWG has posed the question, are risk management objectives intrinsically "sustainable"? At a recent NICOLE workshop on sustainable remediation (Bardos 2009) it was pointed out that the impacts of reaching a very conservative risk management target may be

substantial, a case of the cure being worse than the illness. For example, a risk management objective may be based on a desire to reduce excess cancer risks to a level of one in a million, but what if the risk of death to those carrying out the remediation earth moving and construction was say one in ten thousand over the lifetime of a project. Not only are the risks to human health greater from the remediation process itself, but those construction risks are probably also more reliably quantified. This is a very sensitive debate, and one in which NICOLE is not anxious to participate.

A CONSISTENT APPROACH TO "MEASURING" SUSTAINABILITY

A wide range of tools and techniques that might be used in sustainability assessment have been produced, although each has its strengths and weaknesses (Bardos *et al. in prep*). However, for a sustainability appraisal to be transparent and capable of scrutiny there are a number of key steps that need to be undertaken. NICOLE has summarised these in a draft "road map", reproduced in Figure 3. In the first instance the organisation wishing to undertake a sustainability appraisal needs to have a clear view of its purpose, and what options are being compared. The "purpose" of the sustainability appraisal within the SURF-UK framework would be to either identify best options at the design stage or remedy selection stage (shown in Figure 2). NICOLE recommends that the next step should be to identify all of the parties who will need to understand the sustainability appraisal, and who will have to support any choice of option made on the basis of sustainability appraisal. This may include people at the heart (or at the core) of decision making such as the site owner, the consultant, the regulator and other authorities. There may also be a wider group of parties with a legitimate interest, for example campaigning organisations. The project manager should decide which parties he will engage with as early as possible and involve them in both the design and the execution of the sustainability appraisal.

Engagement of stakeholders is important not just because it is seen as part of sustainable development policy in many countries, but also for a very practical reason. Sustainability is not a quantitative measurement like a cost or a number of kilograms of carbon equivalent, it is essentially a distillation of a wide range of individual assessments; and it is intended to be a persuasive argument for a choice of a particular approach. That argument cannot be made if all of the stakeholders who need to be "persuaded" have not been engaged in the assessment process. Indeed, there may be great controversy arising from the sustainability appraisal process itself. The most efficient way to avoid this controversy is to engage with the stakeholders around a particular contaminated land management project at an early stage, so that a consensus can be found for the framework and for the sustainability appraisal process before any comparison of options even takes place.

The next step of the process is to agree what will be considered as "sustainability", which individual factors will be assessed to draw up an overall picture of sustainability. There is a range of views about this debate. The US EPA "green remediation" approach (US EPA 2008) identifies five or six parameters strictly within the environmental element of sustainability which should be considered for all decisions. SURF within the USA also suggests a limited range of factors should be considered for all projects. NICOLE SRWG and SURF-UK are more *inclined* to the view that sustainability assessment is a process that helps decision making on a site by site or project by project basis, and that the factors which will be important will therefore vary accordingly. These might include local area spatial planning considerations, impact on neighbourhoods and communities, and corporate sustainability reporting needs as well as a more *technical* assessment of likely suspects for environmental, economic and social benefits of impacts. Hence, NICOLE

SRWG and SURF-UK are collaborating to develop a *check-list* of sustainability indicators that can be considered by individual projects to identify those seen as relevant, and perhaps combine them with indicators seen as important for policy and corporate reasons. A key point is that the final set of attributes of sustainability that will be considered must represent a consensus view of all of those who will be considering the outputs of the sustainability appraisals. If you cannot agree what sustainability is with your stakeholders, you are probably not going to agree on the findings of the sustainability appraisal!

It is also possible that some attributes will be seen as more important than others, so some form of prioritisation or weighting may be used. Again this has to reflect a consensus for the sustainability appraisal process to be acceptable.

The final preparatory step is to find a common understanding of the boundaries of the sustainability appraisal that is to be undertaken. Again, it is important to aim for consensus at this stage as well. There are four broad categories of boundaries that should be considered:

- the "system boundary, which is the boundary affected by the framework within which contaminated site decision making is made and includes the scope for remediation set by preceding management decisions;
- the "life cycle" - while Life Cycle Assessment focuses only on a range of environmental impacts, "Life Cycle Thinking" may also be appropriate for a wider range of sustainability indicators (Koneczny *et al.* 2007);
- geographical boundaries; and
- the duration over which effects are to be considered.

At this point the following are known, and hopefully agreed: the aims and scope of the sustainability assessment; what is being compared; what the basis of comparison is (i.e. what "sustainability" will be assessed by); any weightings and the boundaries for the assessment. The final choice to be made is to identify the technique that will be used to distil a sustainability assessment. SURF-UK suggest that it makes sense to begin with a qualitative technique to reduce decision-making costs. Quantitative assessments can then focus on the areas of the qualitative sustainability appraisal where consensus could not be reached (CL:AIRE 2009b). It is possible that a further checklist, comparing techniques, might be offered by NICOLE to support this stage of the process as well.

The final stage of the process is interpretation, and this may include the use of sensitivity analyses to see how robust any conclusions made really are, for example where there is some uncertainty over any particular assessments, or to – say – compare the outcome of considering only "very important" factors against the outcome of considering all of the sustainability attributes identified. Once an option has been chosen it may also be a requirement that the aspects of its performance that led to its selection on sustainability grounds are monitored in some way to verify that "sustainable remediation is really taking place.

What is evident about this "road-map" is that it is also a kind of a framework, a framework for reaching consensus in the sustainability based decision-making. Perhaps such consensus may not always be possible, but in that case carefully recording where the points of disagreement have occurred, or are taking place, will allow a clever project manager to understand where the greatest efforts to provide more convincing information such as quantitative measurements, need to be made; and also the degree to which arguments against any particular option are truly rational.

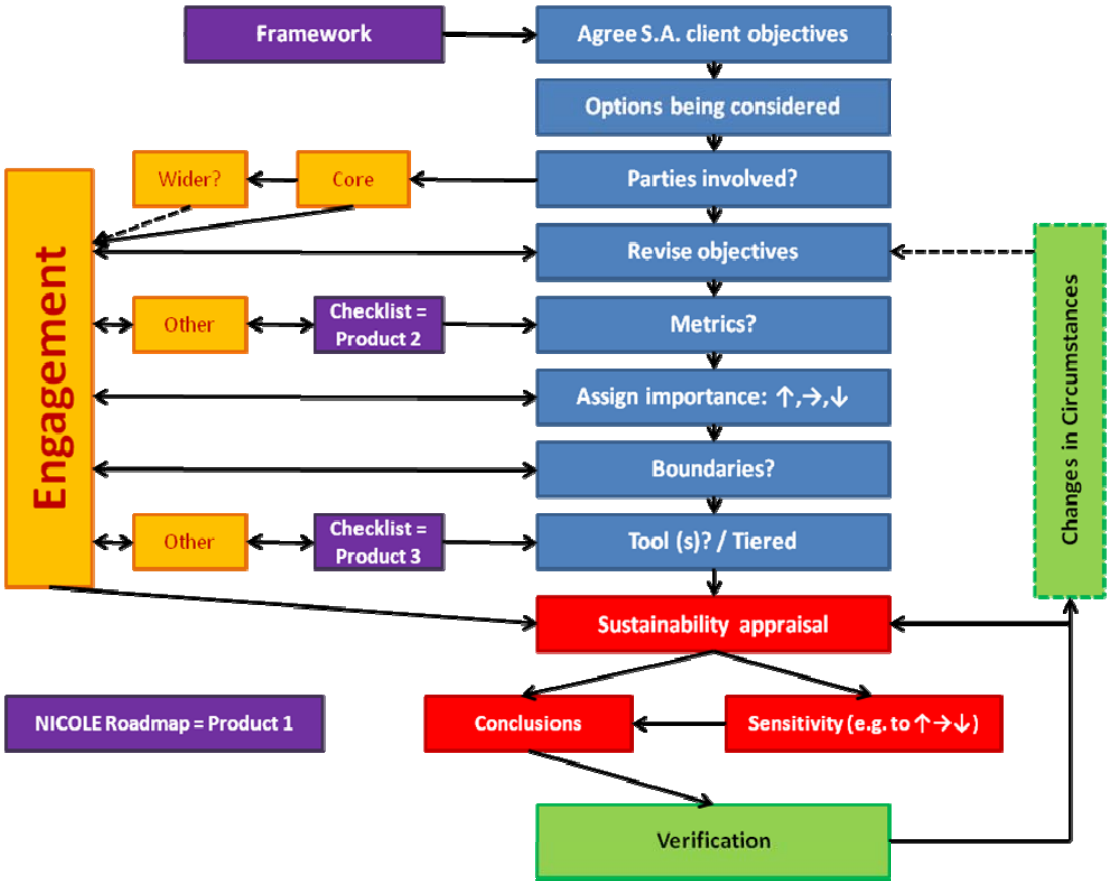

Figure 3 Draft NICOLE Road Map for Using Sustainability Assessment in Remediation Planning

DISCUSSION

Consideration of sustainability has already had an enormous influence on land remediation if the multi-functionality debate is taken into account. .However, it is increasingly a material consideration in remediation planning for individual projects, in much the same way as risk assessment and risk management. Over the last ten years, and particularly over the last three years, concepts and approaches to sustainable remediation decision making have developed rapidly. These are rooted in the Brundtland definition of sustainable development, and it is evident that an international consensus is emerging, illustrated for example by the developing collaboration between NICOLE SRWG and SURF-UK, as well as convergence with ideas being presented at this meeting from the US about sustainable and green remediation. The major differences in approach between these initiatives are related to execution, in two ways:

1. the extent to which an overarching framework is deemed necessary to achieve sustainability benefits from better practise in remediation; and
2. the breadth and scope of factors which should be considered – some argue that sustainability appraisal should be wide ranging, and others argue that it should be constrained to a limited number of readily quantifiable metrics.

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