

Waste Protocols Project

Uncontaminated topsoil

A technical report on the use of both naturally occurring
and manufactured uncontaminated topsoil

Contents

Executive summary	01
1. Introduction	03
2. Process description	05
3. Current legislative and policy positions	06
4. The British Standard for topsoil	09
5. Main markets for topsoil	10
6. Risk assessment	12
7. Potential safeguards to allow removal of waste controls	14
8. Findings and recommendations	16
Appendix A: Technical Advisory Group (TAG) membership	18
Appendix B: Terms of reference	19
Appendix C: Summary of market survey	20
Appendix D: Definitions	22
Appendix E: Topsoil production process	23
Appendix F: References and bibliography	24
Appendix G: Proposals for development of the risk assessment	25

Executive summary

Background

The Waste Protocols Project aims to provide guidance to business on various waste streams that will:

- define the point of full recovery back into a product or material that can either be reused by the business or industry, or sold into other markets; or
- confirm to the business community what legal obligations remain to control the reuse of treated waste material.

The Environment Agency currently considers that all *uncontaminated topsoil*, other than topsoil used where it was produced without needing further treatment, remains 'waste' until the point at which it is fully recovered and is suitable for an agreed use without posing a risk to the environment.

The project board asked a Technical Advisory Group (TAG) to consider the feasibility of producing a Quality Protocol that would enable the point of recovery of topsoil to be moved closer to the point of its production. This would mean a site-specific assessment would not be needed to demonstrate that the topsoil could be used on any site.

This report is an output of the discussions held by the TAG between July 2007 and February 2008.

Methodology

The TAG's remit was to produce a technical report setting out sufficient information to determine the point at which uncontaminated topsoil might be considered to have ceased to be waste. In doing so, the TAG:

- sought to identify and quantify the major markets and appropriate end uses for topsoil;
- identified the current legislative framework that governs the production, handling, storage, transportation and use of topsoil;
- sought to identify and quantify the relative risk to human health and the environment from using topsoil in its main markets; and
- considered the safeguards against such risk already included in BS 3882:2007: Specification for topsoil and requirements for its use and the additional protective measures that might need to be addressed by a Quality Protocol.

The TAG agreed that both naturally occurring and manufactured topsoil would be considered under the title of 'uncontaminated topsoil'.

Findings

- The TAG concluded that there is a continuing and growing market for both naturally occurring and manufactured good quality uncontaminated topsoil. Introducing a Quality Protocol would be likely to lead to further growth in the market, particularly for manufactured topsoil, by increasing confidence in product quality, increasing the market value of compliant topsoil, and reducing regulatory compliance costs.
- The market survey the TAG commissioned added more general knowledge of this market, but there is a lack of detailed, systematic information about the content of topsoil products, their input materials, and about how they are used. Efforts to obtain more of this information from industry met with disappointing results. The lack of a single trade association covering the topsoil industry and the low level of awareness in parts of the industry that topsoil is currently regarded as waste may have contributed to the difficulties encountered.
- The TAG recognised that in principle, BS 3882:2007 *Specification for topsoil and requirements for use* is an appropriate publicly available standard even though on a practical level, it is very difficult to assess compliance with the standard due to the lack of UK limit values for the protection of human health and the environment. Topsoil, which complies with BS 3882:2007, can be used for the specific application on the specific site to which its compliance has been demonstrated without further processing. The reliance on a site-specific assessment is a shortcoming of BS 3882:2007 means that the standard cannot be used 'off the shelf' and must be tailored to each site.

- The shortage of relevant information has severely limited the scope of the risk assessment work that could be done for the TAG, for example, the lack of data prevented any assessment of potential microbiological risks in relation to any of the input materials.
- The TAG concluded that the lack of data prohibited the development of a Quality Protocol in the short term. The TAG believe that whilst individual companies may hold data, this information is not available to the wider industry and that they need to work together to identify and collect adequate data in the future.

Recommendations

The TAG identified a number of issues that need to be addressed to resolve the lack of data, which has stopped a Quality Protocol being developed at the current time. Issues identified by the TAG include:

- developing a list of chemical data requirements for each of the topsoil inputs to provide a minimum base set of data for a risk assessment;
- identifying a methodology for sampling each of the inputs;
- identifying likely costs for sampling and analysis; and
- developing a semi-quantitative approach to persistent organic pollutants (POPs) analysis and interpretation.

The TAG recommends that the proposals for addressing these issues, set out in Appendix G, should be taken as the starting-point for discussions within industry about how progress might be made towards completing the risk assessment.

The TAG considers that resolution of these issues would help inform the requirement of potential safeguards such as input and process controls, product content tests, designation of market sectors in which quality topsoil could be used, precautions for the application of quality topsoil and certification arrangements.

If these safeguards are assessed to be less burdensome to the industry than site-specific assessment, a generic Quality Protocol approach may be appropriate to be adopted. The Waste Protocols Project is funded on a yearly basis, therefore if this conclusion is found; the development of a quality protocol may have to be industry led.

In the meantime, the current regulatory position remains and site-specific assessments will have to be carried out to determine when topsoil ceases to be waste in line with the Environment Agency's guidance document 'Definition of Waste: Developing Greenfield and Brownfield Sites'.

1. Introduction

- 1.1. The Waste Protocols Project is a Department for Environment, Food and Rural Affairs (Defra) funded business resource efficiency activity run as a joint initiative between the Environment Agency and WRAP (Waste & Resources Action Programme).
- 1.2. Uncertainty over the point at which waste has been fully recovered and ceases to be waste within the meaning of Article 1(1)(a) of the EU Waste Framework Directive (WFD) (2006/12/EC) has inhibited the development and marketing of materials produced from waste which could be used beneficially without damaging human health and the environment. In some cases, this uncertainty has also inhibited the recovery and recycling of waste and its diversion from landfill.
- 1.3. Interpretation of EU legislation is ultimately a matter for the European Court of Justice and there is now a substantial body of case law on the interpretation of the definition of waste in Article 1(1) (a) of the WFD. Drawing on the principles established in this case law, it is possible to identify the point at which certain wastes cease to be waste, and thus when the WFD's waste management controls no longer apply. This identification is the purpose of the waste protocols project.
- 1.4. More specifically, depending on the circumstances of the waste stream concerned, the project seeks to achieve the following outcomes:
 - to produce a Quality Protocol identifying the point at which waste, having been the subject of a complete recovery operation, may become a non-waste product or material that can be either reused by business or industry, or supplied into other markets, enabling such fully recovered products to be used without the need for waste management controls; and
 - to produce a statement that confirms to the business community what legal obligations they must comply with to use the treated waste material.
- 1.5. Uncontaminated topsoil is one of the areas of waste addressed by the Waste Protocols Project. A Technical Advisory Group (TAG) was set up to consider this, bringing together representatives from the Environment Agency, WRAP and industry. Appendix A contains a list of TAG members and Appendix B gives its terms of reference.
- 1.6. The TAG agreed to look at both manufactured and naturally occurring topsoil.
- 1.7. The report assumes that both manufactured and naturally occurring topsoil, that is moved off site, are waste.
- 1.8. In order for uncontaminated topsoil to be considered as having ceased to be waste, it is necessary to demonstrate that it has been fully recovered, suitable for an agreed use and there is no further need for waste management controls.
- 1.9. To investigate this, the TAG considered, in particular, whether the waste is being made into a distinct product that:
 - has a market and certainty of use;
 - meets a standard (an identified specification) and needs no further processing before it can be used;
 - is capable of being used without undermining the Waste Framework Directive and Water Framework Directive's aims of protecting human health and the environment.
- 1.10. To consider this last point the TAG has, where applicable, considered whether the waste-derived product could be used in the same way as the virgin material it replaces and with no detrimental environmental effects subject to existing pollution prevention guidance.

- 1.11. The objectives of this report are to:
- describe the TAG's progress on this topic;
 - set out the TAG's findings; and
 - provide recommendations to the Waste Protocols Project Board and the Environment Agency on what steps are needed to meet one of the project aims, stated in point 1.3.
- 1.12. In developing the technical report, the TAG:
- sought to identify and quantify the major markets and appropriate end uses for topsoil;
 - identified the current legislative framework that governs the production, handling, storage, transportation and use of topsoil;
 - sought to identify and quantify the relative risk to human health and the environment from using topsoil in its main markets; and
 - considered the safeguards against such risk already included in BS 3882:2007 and the additional protective measures that might be included in a Quality Protocol to allow the removal of waste controls.
- 1.13. This report is an output of the discussions held by the TAG between July 2007 and February 2008.

2. Process description

- 2.1. Topsoil can occur naturally or be manufactured.
- 2.2. Natural topsoil is the result of dynamic chemical, physical, and biological processes acting on weathered mineral material. Its properties vary greatly because of local variations in geology, topology, and climate. These variations affect, positively or negatively, its suitability for particular uses. Its composition may also be affected by previous agricultural use, inappropriate handling or by contamination with other materials if carelessly stored.
- 2.3. *Natural topsoils* are generated from the stripping of the upper layers of previous undeveloped sites. In many cases, some or all of the material is re-used on site for landscaping. Where there is more topsoil than a development needs, the development company will transport it to another local development. Where transport costs or other difficulties make this uneconomical, the company may sell any surplus topsoil to a topsoil producer, directly or through a broker or send the topsoil to landfill.
- 2.4. As natural topsoils are liable to change their characteristics according to different conditions, in order to be certain the products are of a suitable quality and composition, it may be necessary to apply testing and analysis at the destination site or input source controls.
- 2.5. *Manufactured topsoils* are produced by blending other materials. Suitable materials may include (for example) natural topsoil, *subsoil*, compost, sand, *overburden*, *quarry fines*, recycled soil from for example vegetable washing, and (if effectively source-segregated and quality controlled) soil reclaimed from inert development sites and *utility works*. Waste from the excavation industry, selected under strict quality control, may also be suitable.
- 2.6. However, unsuitable material such as waste from construction and demolition, untreated waste from contaminated *brownfield* sites, fines from construction and demolition recycling and waste, and fines from waste transfer stations and waste processing facilities should be excluded from manufactured topsoil products. Waste from these activities is often used, but this results in the production of very poor quality soils, which have, for example, a high pH level and often contain high levels of potentially toxic organic and non-organic elements.
- 2.7. Depending on the nature of the input materials to the topsoil manufacturing process, it may be necessary to apply input controls to ensure that the products are of a suitable quality and composition.
- 2.8. A process diagram is attached at Appendix E.

3. Current legislative and policy position

3.1. Current legislative controls

3.2. The following provisions apply throughout the processes of collecting, handling, and storing input materials; topsoil manufacture; and handling, storing and using topsoil, both natural and manufactured:

- Environmental Protection Act 1990 and Environmental Permitting (England and Wales) Regulations 2007: relevant provisions within the Act relate to waste deposits and to disposal and recovery operations. A permit is generally needed to carry out waste operations. Some operations however are exempt from the need for permitting and these are set out in the EPR Schedule 3. Exemptions must be registered with the appropriate authority, usually the Environment Agency.
- The Environment Agency may consider a waste operation to be 'low risk'. If that is the case, it may decide that it would not be in the public interest to expect the operator to obtain a permit. Operations considered to be "low risk" are set out in a list available on the Environment Agency's website.
- The Environmental Protection Act 1990 s.34, together with the Environmental Protection (Duty of Care) Regulations, 1991 and the Controlled Waste (Registration of Carriers and Seizure of Vehicles) Regulations 1991, place duties on all people who handle waste. They make sure that waste is properly handled in accordance with the law until it is completely recovered or disposed of. Waste may only be transferred to certain authorised people, and waste management contractors involved in transporting waste must be registered with the Environment Agency as waste carriers. Waste transfer notes must be completed and kept.

The following table summarises the current legislative controls:

Activities	Current legislative control
Delivery of input materials	<p>In the case of soil manufacturing, most input materials will be classified as waste.</p> <p>Compost produced and handled in accordance with the <i>Quality Protocol for the production and use of quality compost from source-segregated biodegradable waste</i> is an exception, as it is classified as a non-waste.</p> <p>Waste must be handled according to the Environmental Protection (Duty of Care) Regulations 1991. The waste materials must be transported by a person who is registered as a waste carrier.</p>
Storage of waste material	<p>Storage requires an environmental permit unless any of the exemptions (e.g. Para 7, Para 8, Para 9 and Para 13) provided for under Schedule 3 of the EPR apply or unless it is considered 'low risk'.</p> <p>Relevant 'low risk' activities include:</p> <ul style="list-style-type: none"> ■ the storage of <i>uncontaminated</i> soil at garden centres (activity LRW 059). <p>This is subject to change and must be checked with the Environment Agency.</p>
Process of manufacturing topsoil	<p>The manufacture of soil or soil substitutes from certain waste may be exempt from permitting under paragraph 13 (construction and soil materials) of Schedule 3 of the EPR, if the conditions specified are met, such as:</p> <ul style="list-style-type: none"> ■ the manufacture is carried out at the place where either the waste is produced or the manufactured product is to be applied to land; and ■ the total amount manufactured at that place on any day does not exceed 500 tonnes. <p>If the conditions are not met, an environmental permit is required.</p>

continued

Activities	Current legislative control
Delivery of topsoil to end user	Topsoil, which is manufactured from waste input materials (or from non-waste mixed with waste inputs), is considered waste, and must be handled according to the Environmental Protection (Duty of Care) Regulations 1991 and transported by a person who is registered as a waste carrier.
	In some circumstances, for example when moved off-site, natural topsoil will be considered a waste and must be handled according to the Environmental Protection (Duty of Care) Regulations 1991 and transported by a person who is registered as a waste carrier. More detail on this is provided in the Environment Agency guidance <i>Definition of Waste: Developing Greenfield and Brownfield Sites</i> .
Use of topsoil by the consumer	<p>Where the topsoil received is a waste, its use requires an environmental permit unless the activity is exempt, or if it is considered 'low risk'.</p> <p>Relevant exemptions include:</p> <ul style="list-style-type: none"> ■ Use in restoration sites – spreading waste soil for restoring sites for agricultural benefit or ecological improvement may be exempt from permitting under paragraph 9 of Schedule 3 of the EPR; ■ Use in agriculture – spreading waste soil for agricultural benefit or ecological improvement may be exempt from permitting under paragraph 7 of Schedule 3 of the EPR. <p>Relevant low-risk activities include:</p> <ul style="list-style-type: none"> ■ using uncontaminated soil in domestic gardens and public open spaces (LRW 059); and ■ using topsoil made from blending water treatment sludges and quarry by-products in the final restoration layer of the quarry where it is produced (LRW 064). <p>These are subject to change and must be checked with the Environment Agency.</p> <p>Use of natural topsoil on site – clean, natural topsoil that is excavated and used on the same site may not be a waste and waste management controls will not normally apply.</p> <p>The Environment Agency guidance <i>Definition of Waste: Developing Greenfield and Brownfield Sites</i> states that:</p> <p><i>'Where uncontaminated materials produced on site during construction works (including excavated soils and materials resulting from demolition) are used on site, particularly where the use is in accordance with the planning permission, the Environment Agency would not generally regard them as being discarded, provided:</i></p> <ul style="list-style-type: none"> <i>(i) they are suitable for that use and require no further treatment,</i> <i>(ii) only the quantity necessary for the specified works is used (otherwise it becomes a disposal activity), and</i> <i>(iii) their use is a not a mere possibility but a certainty.'</i> <p>Use of natural topsoil off site – if natural topsoil is removed and used off site, waste management controls (as above) may apply. More detail is provided in the Environment Agency guidance <i>Definition of Waste: Developing Greenfield and Brownfield Sites</i>. This guidance is scheduled for review in late 2008.</p>

- 3.3. The Environmental Permitting (England and Wales) Regulations 2007 (EPR) was implemented on 6 April 2008. These regulations combine the regulation of PPC permits, waste management licences, and registered exemptions into a single, simplified permitting and compliance regime. The new regime will enable regulation to be carried out in a consistent and risk-based way.

3.4. REACH Regulation

- 3.4.1. The REACH (Registration, Evaluation, Authorisation and Restrictions of Chemicals) Regulation¹ came into force in the EU on June 2007. It aims to improve protection of human health and the environment by making more information available about materials and products. It applies to 'substances', 'preparations' (mixtures of substances), and 'articles' which are defined in Articles 3(1), (2) and (3) of the Regulation as:

- " 1) Substance: means a chemical element and its compounds in the natural state or obtained by any manufacturing process, including any additive necessary to preserve its stability and any impurity deriving from the process used, but excluding any solvent which may be separated without affecting the stability of the substance or changing its composition;
- 2) Preparation: means a mixture or solution composed of two or more substances; and
- 3) Article: means an object which during production is given a special shape, surface or design which determines its function to a greater degree than does its chemical composition."

- 3.4.2. All of these exclude waste as defined in the Waste Framework Directive (WFD). It follows that compliance with a Quality Protocol will potentially bring the material or product concerned within the scope of the REACH Regulation.
- 3.4.3. The main effect is that, unless the material is specifically exempted from REACH, it will need to be registered by its manufacturer or importer, or else the material will no longer be able to be marketed in the EU. Certain substances are eligible for phased registration over an 11-year period (if they were on the market before 1981). But to qualify for this they must be pre-registered with the new European Chemicals Agency between 1 June and 1 December 2008. Otherwise, substances new to the market will be required to be registered after 1 June 2008.
- 3.4.4. Further information on this and other processes relating to REACH is available from the UK REACH Competent Authority website at www.hse.gov.uk/reach or specific advice can be available from the Competent Authority Helpdesk on 0845 408 9575 or email ukreachca@hse.gov.uk.

3.5. Policy position and guidance

- 3.6. The Environment Agency has produced a guidance document *Definition of Waste: Developing Greenfield and Brownfield Sites*. This document sets out when the Environment Agency considers uncontaminated and contaminated soils, excavated in the course of the development of a site, to be waste.
- 3.7. The Environment Agency are working with industry to produce a Code of Practice that sets out the requirements that developers have to follow when assessing whether excavated material is waste or has ceased to be waste. A copy of the draft document can be found on the CL:AIRE website.

4. The British Standard for topsoil

- 4.1. For many years, there has been a British Standard for topsoil. A new edition (BS 3882:2007) was published in November 2007. Its main intention seems to be to ensure that the product will sustainably support either a wide range of vegetation (multi-purpose topsoil) or the particular type of vegetation for which it is intended (specific-purpose topsoil).
- 4.2. The standard:
- prescribes characteristics (mostly quantified) for multi-purpose topsoil and for specific-purpose acidic, low-fertility and calcareous topsoils;
 - sets out sampling and analysis requirements for testing against these, and advises (but does not require) users to consider using a laboratory that complies with the MCERTS (Monitoring Certification Scheme) performance standard; and
 - prescribes good practice to be followed in sourcing, handling, storage, preparation of the receptor site, and spreading.
- 4.3. The standard does not make provision for any independent compliance certification regime, but suppliers wishing to declare their compliance to customers are required to give specified details of analysis against the parameters, and of the source of the topsoil (location and its land use history if natural topsoil, maker if manufactured).
- 4.4. The quantified content parameters give (according to the case) permitted ranges, covering:
- texture (clay, silt and sand content);
 - organic matter;
 - coarse fragments;
 - pH level;
 - nutrients;
 - carbon/nitrogen ratio;
 - exchangeable sodium;
 - phytotoxic contaminants; and
 - visible contaminants.
- 4.5. There is also a general requirement that concentrations of chemical contaminants should not exceed levels that would represent a risk to human health or the environment. The standard says that the list of contaminants to be analysed should be based on the history of the source(s) of materials that make up the topsoil, and the intended use of the site(s) where the topsoil is to be used. The concentrations of concern depend on the end use of the topsoil. Where this information is not available, appropriate conservative assumptions should be made, for example using the Environment Agency's Contaminated Land Exposure Assessment model (CLEA). Attention is drawn to the need for the concentrations of contaminants not to exceed those permitted by the current UK legislation.
- 4.6. The TAG recognises that, in principle, compliance with BS 3882:2007 may make material suitable for use, but because of the site specific nature of its approach, compliance with the standard may not be sufficient to demonstrate that the material ceases to be waste in every case. A *Quality Protocol* for topsoil, which provides measures to protect human health and the environment, could be used to demonstrate a generic approach so that the material has ceased to be waste in most cases.
- 4.7. Watts & Crane, the consultants preparing the risk assessment (section 6), identified a further difficulty in assessing topsoil against the BS 3882:2007 criteria for protecting human health and the environment. They indicated that there are no published UK limits for metals in soil so phytotoxic limits from the Code of Practice for Agricultural Use of Sewage Sludge are used to assess chemical contaminants. Although these limits aim to protect soil and water quality the levels are known to be under-protective in some circumstances for example, microbial soil function. In addition, bioavailability of metals is not determined just by their concentration in soil; factors such as soil pH and texture are important too.

5. Main markets for topsoil

- 5.1. When it began its work, the TAG could find little systematic data on the market for uncontaminated topsoil. It, therefore commissioned RPS Planning and Development Ltd to carry out a survey of uncontaminated topsoil producers and users, to inform the preparation of the financial impact assessment and this report. The survey work was carried out in autumn 2007.
- 5.2. The TAG provided an initial list of contacts within the topsoil industry, which was supplemented through relevant trade organisations. The list was not necessarily fully representative of either producers or users, but can be taken to broadly represent the industry. A questionnaire was designed by RPS in consultation with the TAG. 127 copies were sent out, with 29 direct responses were received (23 per cent response rate). A further 10 responses were received as a result of trade associations circulating the questionnaire to their members. A summary of RPS' report is at Appendix C. Some relevant findings from their work, drawing also on the professional knowledge of TAG members, are set out below.
- 5.3. Compost conforming with PAS 100, and recycled soil, were the two components of manufactured soil reported most frequently by respondents. There were a number of mentions also for mineral materials, non-PAS 100 compost, 'other soil', and (particularly) 'other'; it is unclear what particular materials respondents included in the last two categories.
- 5.4. The great majority of producers reported growth in the amount of topsoil they had supplied over the last five years, though a quarter said that the volume supplied had not changed over the period. Similarly, a majority expected volumes supplied to continue to grow, particularly in the case of manufactured soil. Users tended to agree, though not to the same degree, citing reasons such as a decrease in *greenfield* development sites, and an increase in brownfield development resulting in restricted availability of natural topsoil.
- 5.5. Commercial landscaping and use in housing developments were the two high-volume uses most commonly reported by both producers and users. Use on sports pitches and in gardens was also widely reported, but quantities involved were smaller. Landfill and brownfield restoration were mentioned by some, and agriculture only by a few. For most applications, use of natural topsoil substantially exceeded use of manufactured topsoil.
- 5.6. These findings on usage generally correspond well with TAG members' experience. They are aware of a wide range of landscaping and related uses. Examples include providing a new covering for the sub-soil on reclaimed and restored sites, creating or improving parks, laying the base and providing dressings for grass playing surfaces in sports grounds, providing a root zone medium for (for example) turf production, and domestic use in gardens. The product characteristics required for different activities may vary in detail. For example, blends with a high proportion of sand may be needed for high-grade sports grounds, whilst blends with higher acidity or alkalinity than usual may be needed to support the growth of particular plants. TAG members believe that uncontaminated topsoil is not frequently used in commercial horticulture or agriculture. An example might be ad-hoc repair work to a field damaged by a contractor's heavy machinery. In their experience, for most of these uses, uncontaminated soil tends to be applied to a site just once rather than a number of times. However, maintenance and repair of sports grounds may require repeat applications.

- 5.7. A majority of producers responding to the survey said that they applied the BS3882 standard for topsoil (discussed in section 4) in their production or supply of topsoil. They did not think that the market would be significantly affected by the recent release of the 2007 edition of BS3882. Around a quarter said they did not use any quality standard. Others reported that they had developed their own specification, or used one stipulated by the client. The proportions of users responding to the survey who said that they used BS3882, or none, or their own specification were broadly similar.
- 5.8. The TAG concluded that there is a lack of clarity over the types of input materials used to produce manufactured topsoil. There is however, a continuing and growing market for good quality uncontaminated topsoil, both naturally occurring and manufactured. The availability of this market helps to satisfy the 'certainty of use' criteria. Development of a Quality Protocol would be likely to lead to further growth in the market, particularly for manufactured topsoil, by increasing confidence in product quality, increasing the market value of compliant topsoil, and reducing regulatory compliance costs.

6. Risk assessment

- 6.1. To consider what protection for human health and the environment might be included in a Quality Protocol, a risk assessment for using naturally occurring and manufactured topsoil was commissioned. A report on the assessment is published separately alongside this technical report. An outline of the approach and its findings is given below.
- 6.2. The main stages of the process were to seek out and consider data on input materials, to assess the hazards that might be posed by each of these, to identify the key receptors (areas affected) of topsoil in its various uses, to establish worst-case risk scenarios, and to consider possible options for managing and reducing these.
- 6.3. The risk assessment consultants considered the following list of input materials, identified by the TAG:
- topsoils and subsoils from sites with no prior history of development;
 - off-specification mineral waste from the production of primary aggregates;
 - primary aggregates;
 - fines from the quarrying of hard rock;
 - sand waste from china clay extraction;
 - micaceous waste from china clay extraction;
 - off-specification mineral waste from the extraction of ball clays;
 - compost complying with the Quality Protocol for quality compost;
 - anaerobic digestates, of a quality likely to satisfy emerging proposals for a Quality Protocol for quality digestates;
 - aged forestry materials from the storage and processing of untreated wood only;
 - sawdust resulting from the processing of untreated wood only;
 - spent mushroom compost; and
 - treated sewage sludge.
- 6.4. The results of the topsoil survey indicated 'other' as inputs to manufactured topsoil. It is unclear what materials respondents included in this category so it is possible that some input materials are missing from this list.
- 6.5. TAG members attempted to obtain data on the characteristics of these input materials from suppliers but with disappointing results. Some data was provided, but for only five types of material: natural topsoil, quality compost manufactured from green waste, anaerobic digestates, spent mushroom compost, and sewage sludge.
- 6.6. For each of the five input materials where data was provided, the risk assessment consultants considered the available data on concentrations of metals and persistent organic pollutants (POPs) and other physico-chemical characteristics affecting the fate, behaviour, and subsequent impact of these substances.
- 6.7. Key receptors, exposure pathways, and reasonable worst case exposure scenarios**
- 6.7.1. Key receptors identified were water and land habitats, plant, and animal life in these habitats, human health, air, and groundwater. Worst-case scenarios identified were:
- i) a child consuming topsoil in a domestic garden (human health);
 - ii) humans consuming domestically grown produce (human health);
 - iii) organisms living in topsoil (plants and animals);
 - iv) leaching or run off of contaminants from topsoil into surface and groundwaters (human health, water-based plants and animals); and
 - v) leaching or run off of nutrients from topsoil, into surface and groundwaters (water-based plants and animals).
- 6.7.2. Due to a lack of information about topsoil products and how they are used, each scenario was considered in relation to the input materials for which information was available. It was assumed that each input would be applied without mixing or dilution, and in a single application. Highly precautionary assumptions about material characteristics and soil parameters affecting the toxicity of chemicals were adopted, to account for the lack of detailed use or site information.

- 6.7.3. Because the metals and persistent organic pollutants (POPs) considered are relatively immobile in soils, and leaching is therefore very unlikely to be a significant migration pathway for these, scenario v. was not examined further.
- 6.7.4. The other scenarios, for each input material, were considered in relation to current UK limit values for soil concentrations or loadings of specific chemicals, where these were available (for example in sewage sludge regulations and Soil Guideline Values), the outputs from Environment Agency research on the bioavailability of metals in different soil types and, for POPs, limit values from non – UK jurisdictions.

6.8. Risks identified

- 6.8.1. natural topsoil potential risks from:
- cadmium under scenarios i. and iii. in acid soil;
 - zinc under scenario iii. in sandy soil; and
 - PAHs, dioxins, and furans in both urban and rural soils.
- 6.8.2. compost, anaerobic digestate and spent mushroom compost – potential risks from using these inputs from:
- zinc under scenario ii. in sandy soils; and
 - phosphorus under scenario v. when mushroom compost used in agricultural use.
- 6.8.3. sewage sludge: potential risk:
- to human health and soil dwelling organisms from nickel, and to soil dwelling organisms from zinc (regardless of pH and soil texture); and
 - from copper, cadmium and lead under scenario iii.

The approach taken for sewage sludge was particularly precautionary because of the very small dataset provided. Risks might have appeared lower had a larger and more representative dataset been used.

- 6.9. The risks identified from metals were relatively low, even under precautionary conditions, apart from in the case of sewage sludge. They could be expected to be further reduced if different inputs were combined to form topsoil products. However, the risk evaluation could only be carried out in a general way, given the lack of product and use information. The lack of data also prevented any assessment of risk in relation to nine of the input materials listed by the TAG, or assessment of potential microbiological risks in relation to any of the input materials.

6.10. Conclusions from the risk assessment

- 6.10.1. The TAG concluded that due to a lack of data the risk assessment findings could not be used to develop a Quality Protocol in the short term.
- 6.10.2. The lack of data may reflect the fragmented nature of the topsoil industry, the lack of a single trade body, the relatively low level of awareness amongst producers and users of the relevance of waste controls to topsoil production and use. This lack of data and the reasons for it may remain an obstacle to the future development of a Quality Protocol.
- 6.10.3. The risk assessment sets out some proposals for further development. These are included at Appendix G. The TAG suggests that these should be taken as the starting-point for industry led discussions about how progress might be made towards completing the assessment.

7. Potential safeguards to allow removal of waste controls

- 7.1. Although it will not be possible to consider preparing a Quality Protocol until a comprehensive risk assessment has been produced, the TAG has given some preliminary thought to its possible content. The intention would be to include in the Protocol a range of safeguards, which could adequately protect human health and the environment without having to carry out a site-specific assessment.
- 7.2. As well as the risks discussed in the risk assessment section, these safeguards would have to include the risks associated with topsoil being a dynamic and fragile material. For example, natural topsoil is liable to change its characteristics according to the prevailing topography and types of local vegetation and transportation itself may disturb the material so that it loses its ability to be acceptable in its destined location.
- 7.3. The following safeguards have been suggested by the TAG but have not been explored in detail due to the risk assessment proving inconclusive meaning that a Quality Protocol cannot be developed at this time.

7.4. Input controls

- 7.4.1. There are no specific restrictions in BS 3882:2007 on the types of input materials that may be used to produce compliant topsoil. However, for an approach that removes the need for a site-by-site risk assessment, the TAG considers that it would be necessary to include some input restrictions. These could be of several kinds:
- A list of *permitted input materials*. The starting point for this would be the list that the TAG provided to the risk assessment consultants. This would need to be reviewed in light of the completed comprehensive assessment, when available. An incremental approach could perhaps be taken, adopting a relatively short list for the first edition of the Protocol, with the possibility of adding to it as the assessment of other materials was completed.
 - A list of *permitted input sources*, limited to sources that were thought likely to pose low risks of contamination. So, for example, previously developed sites that had been used in specified ways judged likely to have resulted in significant pollution might be excluded from the list, as could those materials sourced from geological areas known to result in high concentrations of metals in the topsoil.
 - Requirements on *inspection, record-keeping etc* for incoming consignments of input materials.

7.5. Process controls

- 7.5.1. Some other Quality Protocols have required producers to adopt hazard analysis and critical control point planning (HACCP) and quality management systems (QMS). The TAG is doubtful whether these would be necessary for a simple process like topsoil manufacture. However, it will consider whether any of the basic principles of these systems should be applied, in a simplified way.

7.6. Product testing

- 7.6.1. It would be possible, in principle, to include in the Quality Protocol product testing parameters related to health and environmental risks as well as the specific ones included in BS 3882:2007. The range of potential contaminants could, however, be very wide and testing requirements could be very burdensome even if limited to a selection of 'indicator' species, at least unless permitted input types and sources were severely restricted.

7.7. Designated market sectors

- 7.7.1. The Protocol would need to designate the market sectors to which it applied. It would be possible to exclude any particular uses of topsoil which were judged to pose an unacceptable risk, or in which risk could not yet be assessed with sufficient certainty.

7.8. Further precautions on application of topsoil

- 7.8.1. Some guidance on application and spreading of topsoil is already given in BS 3882:2007. Additional guidance could be provided in the Protocol to protect health and the environment, for example guidance on suitability for application to particular types of soils, on testing of recipient soils, or on information and guidance to be provided by the producer to the user.

7.9. Certification

- 7.9.1. The Quality Protocol would need to include credible arrangements for monitoring the performance of producers claiming to comply with the Protocol. In the case of some other Quality Protocols, trade associations have taken a leading role in designing and operating these arrangements. However, there is no single trade association covering topsoil producers and this remains a difficulty in moving forward.
- 7.10. To a considerable extent, these various possible elements of a Quality Protocol are inter-dependent. For example, restricting permitted inputs, sources, and/or designated markets would help to reduce the number of additional product testing parameters that might be required. On the other hand, the narrower the scope of the Protocol, the smaller its potential benefits in growing the market and encouraging materials to be reused, which might otherwise go to landfill.

8. Findings and recommendations

8.1. Findings

- 8.1.1. The TAG concludes that there is a continuing and growing market for good quality uncontaminated topsoil, both naturally occurring and manufactured. Development of a Quality Protocol would be likely to lead to further growth in the market, particularly for manufactured topsoil, by increasing confidence in product quality, increasing the market value of compliant topsoil, and reducing regulatory compliance costs.
- 8.1.2. The market survey that was commissioned added more general knowledge of this market, but there is still a lack of detailed, systematic information about the content of topsoil products, their input materials and how they are used. Efforts to obtain more of this information from industry met with generally disappointing results. The lack of a single trade association covering the topsoil industry and the low level of awareness in parts of the industry that topsoil is currently regarded as waste are likely to be relevant factors on this issue.
- 8.1.3. The TAG recognises that, in principle, BS 3882:2007 is an appropriate standard although given the lack of UK limit values for protecting human health and the environment on a practical level; it is very difficult to assess compliance with the standard. Topsoil, which complies with the standard, will require no further processing before it is used for the specific application and the specific site in relation to which its compliance has been demonstrated. The standard's reliance on site-specific assessment of protection of human health and the environment is however a shortcoming that a Quality Protocol could address.
- 8.1.4. The shortage of relevant information has severely limited the scope of the risk assessment work that could be done for the TAG, for example, the lack of data prevented any assessment of potential microbiological risks in relation to any of the input materials.
- 8.1.5. The TAG concluded that the lack of available data means that the findings of the risk assessment could not be used to develop a Quality Protocol in the short term. The TAG felt that industry need to co-operate if adequate data was to be provided in the future.
- 8.1.6. If a comprehensive risk assessment were produced, it might be possible to prepare a Quality Protocol that adequately protected human health and the environment. The TAG identified potential safeguards for inclusion within a Quality Protocol that may allow the removal of waste controls. These include;
- input controls (type, source, inspection and record-keeping requirements);
 - process controls (but proportionate to the simplicity of the topsoil manufacturing process);
 - additional product content tests;
 - designation of particular market sectors in which quality topsoil could be used safely;
 - further precautions in the application of topsoil; and
 - certification arrangements.

- 8.1.7. Even though these potential safeguards have not been assessed in detail, it is thought that they could be very burdensome on the topsoil industry.
- 8.1.8. In light of the conclusions reached by the TAG and the lack of development of a Quality Protocol for topsoil, the current regulatory position remains and site-specific assessments will have to be carried out to determine when topsoil ceases to be waste.

8.2. Recommendations

- 8.2.1. The TAG identified a number of issues that need to be addressed if a reasonable and proportionate way forward in developing a Quality Protocol for topsoil is to be found. These include:
- producing a list of chemical data requirements for each of the topsoil inputs to provide a minimum base set of data for a risk assessment;
 - identifying a methodology for sampling each of the inputs
 - identifying likely costs for analysis; and
 - a semi-quantitative approach to POPs analysis and interpretation.
- 8.2.2. The TAG recommends that the proposals for addressing these issues provided by the risk assessment and set out in Appendix G should be taken as the starting-point for discussions within industry about how progress might be made towards completing the risk assessment.
- 8.2.3. The completion of the risk assessment will then give industry the opportunity to assess the potential safeguards needed in order to move from site-specific risk assessment to a generic approach. If these safeguards are then thought not to be too burdensome to the industry there may be potential for a Quality Protocol approach to be adopted.

Appendix A Technical Advisory Group (TAG) membership

Organisation	Representative	Type of member
Baileys of Norfolk	John Farrell	Attending
British Sugar	Andy Spetch	Attending
Cass Associates	David Hackett	Attending
Defra	Judith Stuart	Attending
Environment Agency	Claire Hamilton	Correspondence
	Kathryn Harriss	Correspondence
	Rebecca Favager	Correspondence
	Clare McCallan	Correspondence
	Steve Moss	Correspondence
National Grid	Frank Evans	Correspondence
NIEHS (Policy Rep - Northern Ireland)	Jim Wright	Correspondence
Reading University	Stephen Nortcliff	Attending
Remade Essex	Ben Dyson	Attending
Rio Soils	Darren Sharpe	Attending
RSK Group Plc	Peter Witherington	Correspondence
The Soil and Groundwater Technology Association (SAGTA)	Doug Laidlar	Correspondence
Scottish Environment Protection Agency (SEPA)	Mark Heggie	Attending
Shanks	Nigel Wellsbury	Attending
Tarmac	John Halfpenny	Attending
The Composting Association (TCA)	Emily Nichols	Attending
Tim O'Hare Associates	Tim O'Hare	Attending
Waste Protocols Project Team	Laura Battle-Welch (technical secretary)	Attending
	Suzanne Laidlaw	
	Sarah Clayton	
WRAP	David Tompkins	Attending
Independent	Peter Bird (Chair)	Attending
Michael Faulkner Consultancy	Michael Faulkner (technical writer)	Attending

Appendix B Terms of reference

1. Mission statement

- 1.1. To produce a technical report, recognised by (and produced with the support of) industry. The technical report will contain enough information to determine when uncontaminated topsoil has been reprocessed to such a level that it can be considered to be fully recovered and no longer subject to the requirements of the regulatory waste regime.
- 1.2. If this is unachievable, the technical report will contain enough information so the Environment Agency can:
 - determine whether uncontaminated topsoil is recovered to a state where its use is acceptable in accordance with their low risk regulatory principles; or
 - confirm to businesses the laws covering the re-use of treated waste material.

2. Desired outcomes/outputs

- 2.1. The Technical Advisory Group (TAG) will produce a technical report that will identify:
 - suitable input/source controls to eliminate contaminants such that their presence is immaterial.

The technical report will also establish the point at which:

- there is a market for the recovered product and it is certain to be used; and
 - the use of the recovered product will not result in harm to human health or the environment.
- 2.2. To do this, the TAG will consider:
 - the current or future markets for recovered uncontaminated topsoil;
 - whether there are any existing industry standards and specifications which recovered topsoil can meet;
 - existing standards and specifications. If they do not exist, the TAG will identify alternatives and/or scope out a project for producing a new standard or specification;
 - the potential human health and environmental impacts associated with the use of the recovered products and identify any necessary methods of reducing these;
 - existing thresholds and guidance values;
 - augment/develop existing standards if required; and
 - the requirement for certification and auditing/monitoring.
 - 2.3. The TAG will provide input into a financial impact assessment (FIA) that will determine the costs and benefits of a change in the point that waste ceases to be waste (with the help of the project economist).
 - 2.4. The TAG will also help to implement a communications plan.

3. Limitations

- 3.1. Knowledge from the industry is vital in producing the technical report and financial impact assessment. By being a member of the TAG, it is expected that participants will willingly share information from their sector and be prepared to participate in writing and reviewing elements of the report. If this help is not forthcoming, it may not be possible to fully develop a technical report in the timescale available.
- 3.2. The technical report will provide enough evidence to the Environment Agency to support moving the point at which waste ceases to be waste. However, ultimately the Environment Agency will decide this point.

Appendix C Summary of market survey

Summary

The objective of this market survey was to gather market data from the topsoil industry that will be used to inform the financial impact assessment and subsequently, the Quality Protocol for topsoil. A series of questions were developed to identify what information would provide the necessary market data. These questions and accompanying answers are presented below. Where possible, we have distinguished between natural and manufactured/blended topsoil.

In our interpretation of the results, we applied the assumption that both types of topsoil were supplied to/used in the different applications/end uses as listed in Figure 3.2 and Figure 3.4 unless otherwise specified by the respondent.

Table C.1 What are the main types of topsoil produced/supplied and used?

Producer/Supplier	User
43 per cent handle only natural topsoil	22 per cent use only natural topsoil
33 per cent handle both natural as well as manufactured/blended topsoil	74 per cent use both natural as well as manufactured/blended topsoil
24 per cent handle only manufactured/blended topsoil	4 per cent use only manufactured/blended topsoil

Table C.2 What are the main sources and inputs of topsoil?

Producer/Supplier	User
76 per cent source their natural topsoil from groundwork contractors – four of these respondents also use other sources	61 per cent purchase their topsoil from local or specific/specialist suppliers
PAS-100 compost and recycled soil are the most common components in topsoil	

Table C.3 What tonnages of topsoil supplied are supplied/used a year?

Producer/Supplier	User
61 per cent of respondents supply between 10,000 and 50,000 tonnes of topsoil a year	Approximately 43 per cent use more than 6,000 tonnes a year

Table C.4 What are the main outlets and end uses for topsoil?*

Producer/Supplier		User	
Natural	Manufactured/blended	Natural	Manufactured/ blended
Commercial landscaping (2,000-20,000t/yr)	Commercial landscaping (10,000-20,000t/yr)	Commercial landscaping (100-350,000t/yr)	Commercial landscaping (100-350,000t/yr)
Housing developments (2,000-25,000t/yr)	Housing developments (10,000t/yr)	Housing developments (3,000-100,000t/yr)	Housing developments (50-10,000t/yr)
Sports pitches (1-15,000t/yr)			

* Please note that the volume ranges reflect the responses provided in the survey rather than the industry as a whole.

Table C.5 Has the volume of topsoil supplied/used increased/decreased or stayed the same over the last five years?

Producer/Supplier	User
70 per cent increased the volume they supplied	45 per cent increased the volume used
25 per cent volume remained the same	41 per cent volume remained the same
5 per cent decrease in volume they supplied	14 per cent decreased the volume used

Table C.6 What is the potential for growth in the volumes supplied/used?

Producer/Supplier		User	
Natural	Manufactured/blended	Natural	Manufactured/ blended
63 per cent predict an increase in supply	80 per cent predict an increase in supply	40 per cent predict an increase in amount used	57 per cent predict an increase in amount used
31 per cent predict same level	20 per cent predict same level	33 per cent predict same level	36 per cent predict same level
6 per cent predict a decrease	0 per cent no answer	27 per cent predict a decrease	7 per cent predict a decrease

Table C.7 What are likely to be the main drivers for change?

Producer/Supplier	User
Customers demanding high quality products	Increased redevelopment of brownfield sites
Increased redevelopment of brownfield sites	Limited availability of natural topsoil
Greater activity in new markets	

Table C.8 What are the sale costs/purchase prices?

Producer/Supplier	User
£5-10/tonne	£10-15/tonne

Table C.9 What quality standards are used?

Producer/Supplier	User
64 per cent use BS3882	61 per cent use BS3882
9 per cent use their own/client specification	22 per cent use their own/client specification
27 per cent don't use any quality standard	17 per cent don't use this standard

Appendix D Definitions

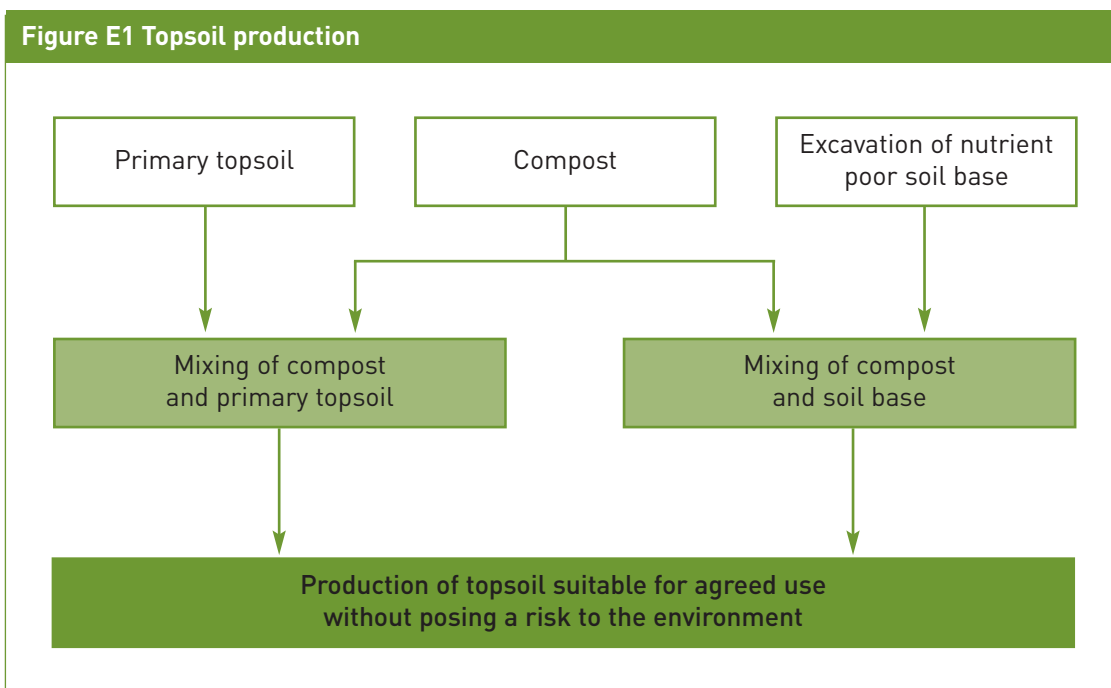
Terms used in this document have the following meaning as agreed by the members of the TAG. They do not constitute the Environment Agency's interpretation of these terms.

Term	Description
BREW	Business Resource Efficiency and Waste – a programme set up and administered by central government. It is funded via the Landfill Tax and is currently used to support environmental initiatives and projects seeking to maximise resource efficiency and minimise waste within England and Wales.
Brownfield	Site upon or within the boundary of which development has previous occurred, where development constitutes the erection of a permanent structure (including agricultural and forestry buildings) and associated fixed surface infrastructure.
Contaminated	A site where there is significant harm to human health or the environment due to the presence of harmful substances in or under that land, or where there is high possibility of significant harm or there is pollution of controlled waters.
Controlled waste	Controlled waste is household, commercial, and industrial waste. Controlled waste is defined in section 30 of the Control of Pollution Act 1974, section 75 of the 1990 Act and the Controlled Waste Regulations 1992 (as amended). Paragraphs 9(2) and 10(3) to Schedule 4 of the Waste Management Licensing Regulations 1994 provide that any reference to 'waste' in Part I of the 1974 Act or Part II of the 1990 Act includes a reference to Directive waste.
Greenfield	Site upon or within the boundary of which development has never occurred, where development constitutes the erection of permanent structure (including agricultural and forestry buildings) and associated fixed surface infrastructure.
Manufactured topsoil	Material produced by combining mineral matter and organic matter of suitable quality (and, where appropriate, fertiliser and lime) and which provides the same function as topsoil.
Natural topsoil	Upper layer of an in situ profile, usually darker in colour and more fertile than the layer below (subsoil), and which is a product of the natural biological and environmental processes.
Overburden	Rock and soil cleared away before mining.
Permit	<p>Environmental permits or exemptions issued under the Environmental Permitting (England and Wales) Regulations 2007, which came into force on 6 April 2008, or low risk waste activities in accordance with Environment Agency guidance.</p> <p>From 6 April 2008, the following automatically become environmental permits:</p> <ul style="list-style-type: none"> ■ PPC permits issued under the Pollution Prevention and Control (England and Wales) Regulations 2000 (as amended); and ■ Waste Management Licences (WMLs) issued under the Environmental Protection Act 1990 (as amended). <p>Exemptions from the need for a Waste Management Licence, registered under Regulation 18 and Schedule 3 of the Waste Management Licensing Regulations 1994 (as amended) will now come under schedule 3 of the Environmental Permitting (England and Wales) Regulations 2007.</p>
Quality Protocol	A Quality Protocol sets out criteria for producing a product from a specific type of waste. Compliance with these criteria is considered sufficient to ensure that the recovered product may be used without risk to the environment or harm to human health, and therefore without the need for waste regulatory control. In addition, the Quality Protocol indicates how compliance may be demonstrated and points to best practice for using the recovered product.
Quarry fines	Finely crushed or powdered material as ore, rock or stone
Subsoil	Soil directly under the humus or topsoil
	continued

Term	Description
TAG	Technical Advisory Group. The TAG is a group of representative experts from industry, trade bodies, publicly funded and regulatory authorities. The role of the TAG is to input their expertise into discussions regarding the technical, economic, and environmental feasibility of developing and implementing the Quality Protocol.
Topsoil	Natural or manufactured topsoil in which plants can grow healthily.
Uncontaminated	Not contaminated (see above).
Utility works	Works involving excavations to install or maintain utility supply infrastructure.
Waste management controls	Controls under legislation that govern the treatment, handling, containment, and storage of waste.
WRAP	WRAP helps individuals, businesses and local authorities to reduce waste and recycle more, making better use of resources and helping to tackle climate change.

Appendix E Topsoil production process

The process of topsoil production and application is summarised in the diagram below. For simplicity, the diagram refers to only a selection of the more commonly used input materials.



Appendix F References and bibliography

Legislation

European Union legislation

Available from <http://eur-lex.europa.eu>

- The Waste Framework Directive: Council Directive of 15 July 1975 on waste, as amended (consolidated text CONSLEG: 1975L0442 – 20/11/2003).
- The REACH Regulation: Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC.

England and Wales legislation

Available from www.opsi.gov.uk

- The Environmental Protection Act 1990
- The Waste Management Licensing Regulations 1994 (SI1994/1056)
- The Waste Management Licensing (England and Wales)(Amendment and Related Provisions)(No.3) Regulations 2005 (SI 2005/1728)
- The Pollution Prevention and Control (England and Wales) Regulations 2000 (SI 2000/1973)
- The Environmental Protection (Duty of Care) Regulations 1991 (SI 1991/2839, as amended by SI 1996/972 and as further amended, as they apply to England and Wales, by SI 2000/1973 and 2002/1559)
- The Environmental Permitting (England and Wales) Regulations 2007 (SI 2007/3538)

Guidance etc

Available unless otherwise specified from www.defra.gov.uk

- *Codes of Good Agricultural Practice (England and Wales): Air Code, Soils Code and Water Code* (Defra, revised 1998). *Addenda to Air Code and Water Code* (Defra 2002).
- *Code of Good Agricultural Practice to Protect Water, Soil and Air Quality* (consultation draft of revised version for England: Defra, August 2007).
- *Fertiliser Recommendations for Agricultural and Horticultural Crops* (RB 209) (7th edition, MAFF, 2000).
- *Code of Practice for the Agricultural Use of Sewage Sludge* (2nd edition, (Department of the Environment).
- *Performance Standard for Laboratories Undertaking Chemical Testing of Soil*. Version 3. (Environment Agency, March 2006) (available from <http://publications.environment-agency.gov.uk>).

Other references

Environment Agency, 2006 *The Definition of Waste: developing greenfield and brownfield site*.

Available from www.environment-agency.gov.uk/commondata/acrobat/dowv10506_1386151.pdf

WRAP and Environment Agency, 2007 *The Quality Protocol for the production and use of quality compost from source-segregated biodegradable waste*. Available from:

www.environment-agency.gov.uk/subjects/waste/1019330/1334884/1713670/?lang=_e

WRAP and Environment Agency, 2008 *The Quality Protocol for the production and use of quality outputs from anaerobic digestion of source-segregated biodegradable wastes*. Available from:

<http://qpyr1.dialoguebydesign.net/bgo/documents.asp>

Environment Agency, 2007, Low Risk Waste Position LRW059 *Using uncontaminated soil in domestic gardens and open spaces*.

Environment Agency 2007, Low Risk Waste Positions LRW064 *Using topsoil made from blending water treatment sludges and quarry by-products in the final restoration layer of the quarry where it is produced*.

Appendix G Proposals for further development of the risk assessment

A key goal of the TAG is to provide a 'topsoil input' driven approach, which means to assess the risks of an input in terms of its physico-chemical properties without reference to site-specific information. This approach requires an understanding of the intra-sample variability of the input and the range of potential contaminant concentrations present. It has not yet been possible to consider such a suitably broad dataset for any of the inputs to manufactured topsoils.

The TAG identified a number of issues that need to be addressed if a reasonable and proportionate way forward in the developing a Quality Protocol for topsoil is to be found. These issues and options for moving forward are set out below.

1. Produce a list of chemical data requirements for each of the 13 topsoil inputs to provide a 'minimum' base set for a risk assessment

There are few input materials for topsoils for which organic chemicals data are available. With such a potentially diverse source of input materials to manufactured topsoil, providing an exhaustive list that covers all of the possible organic micropollutants that may be present from each input needs to be balanced against the probability and consequence of them occurring, and the practicalities and costs of producing such data. Furthermore, without considering site or source specifics for the input materials (BSI 2007) uncertainties will remain about how representative sub-samples from one location are for the same topsoil input material sampled from another location.

Several existing organic determinand lists are available which are used to provide data to assess human health and environmental risks associated with soils and materials recycled to land. Table G1 provides a selection of these lists, including one derived by the Environment Agency for a project on organic material for recycling to land (ADAS 2007). An input-specific organic micropollutant list such as this, informed by an understanding of the source and characteristics of the material, could represent a pragmatic and proportionate way forward.

Table G1 clearly shows that some organic determinands are common across the lists, including halogenated organic compounds, PCBs, dioxins, furans, and polycyclic aromatic hydrocarbons. Despite this limited similarity, without considering input characteristics there is a distinct possibility that an ever-extending list of organic analytes could be selected. A compromise could be to develop an extended version of the Environment Agency recommended list, to include selected pesticides and total petroleum hydrocarbons (TPHs). However, such a compromise would be based on limited evidence and would likely represent a financial and analytical burden disproportionate to the potential risks associated with the selected topsoil input materials.

Table G1. List of potential organic determinands and respective limit values (given in parenthesis) from selected sources. Units are mg kg⁻¹ dm, unless otherwise stated. Ticks represent determinands that are present and crosses represent those that are absent.

Table G1. Potential organic determinands			
Organic determinands	EU 3rd working draft of Sludge Dir. (2000)	Environment Agency recommended list for other waste projects [#]	CLR8 List [*]
Sum of halogenated organic compounds	✓ (500)	✓	✓
Linear alkylbenzene sulphonates	✓ (2600)	✓	✗
Dimethyl-, diethyl-, dibutyl-, diisobutyl-, butylbenzyl-, dioctyl-, di(ethylhexyl)-, dinonyl- and didecyl- phthalates	✓ (100 for DEHP)	✓	✗
Penta-, Octa- and Deca- bromodiphenylethers	✗	✓	✗
Hexabromocyclododecane (HBCD)	✗	✓	✗
Tert-dodecylmercaptan	✗	✓	✗
Perfluorooctane sulphonate (PFOS)	✗	✓	✗
Triclosan	✗	✓	✗
TBT	✗	✓	✓
Pentachlorophenol	✗	✓	✓
Nonylphenol	✓ (50)	✓	✗
Polycyclic aromatic hydrocarbons (PAHs; viz the 16 USEPA PAH)	✓ (6)	✓	✓
PCDD/F (ng TE/Kg dm)	✓ (100)	✓	✓
Polychlorinated biphenyl's (PCBs) ≈ 18 congeners	✓ (0.8)	✓	✓
Mineral Oils	✗	✓	✓

ADAS (2007)
* Table 2.2 in CLR8 (Defra and the Environment Agency 2002)

Three categories of determinands are shown in Table G2 that may be considered as the 'minimum' base set of physico-chemical data. Many of these determinands are listed as requirements for other specifications, protocols and codes of practice (BSI 2007, WRAP 2007, DoE 1996)

- Metals – total Cd, Cu, Cr, Ni, Pb, Se, Hg, Mo, As, F, Zn.
- Organic micropollutants – the Environment Agency list as given above, including key pesticides and TPHs
- Physical characteristics – texture, maximum coarse fragment content, visible contaminants.

In addition to these three categories data on pH, EC, organic C, and macronutrients, including a measure of available (Olsen) P, would also be required. The first three determinands have a significant bearing on contaminant behaviour and availability in soils, and macronutrient concentrations are key to understanding the potential for impacts upon water quality and habitat diversity.

Table G2. Input-specific physico-chemical data made available to the risk assessment.* Ticks represent determinands which are present and crosses represent those which are absent.

Table G2. Input-specific physico-chemical data made available to the risk assessment			
Inputs	Determinands		
	Metals	POPs	Physical
Topsoils and subsoils from sites with no prior history of development.	✓	✓	✓
Non-specific mineral wastes from the production of primary aggregates	✗	✗	✗
Primary aggregates	✗	✗	✗
Fines from the quarrying of hard rock	✗	✗	✗
Sand wastes from china clay extraction	✗	✗	✗
Micaceous wastes from china clay extraction	✗	✗	✗
Non-specific mineral wastes from the extraction of ball clays	✗	✗	✗
QP composts	✓	✗	✓ [†]
QP anaerobic digestate outputs	✓	✗	✓ [†]
Aged forestry materials from the storage and processing of untreated wood only	✗	✗	✗
Sawdust resulting from the processing of untreated wood only	✗	✗	✗
Spent mushroom compost	✓ [#]	✗	✓ [†]
Treated sewage sludge	✓ [#]	✗	✓ [†]

* Microbiological data have not been selected as a key requirement for the assessment, although the Environment Agency has recently identified such information as potentially being important (Environment Agency 2007b)

This dataset is limited to seven samples or less.

† This dataset is incomplete, with not all the required determinands covered

2. Likely methodology and sampling methods for each of the inputs

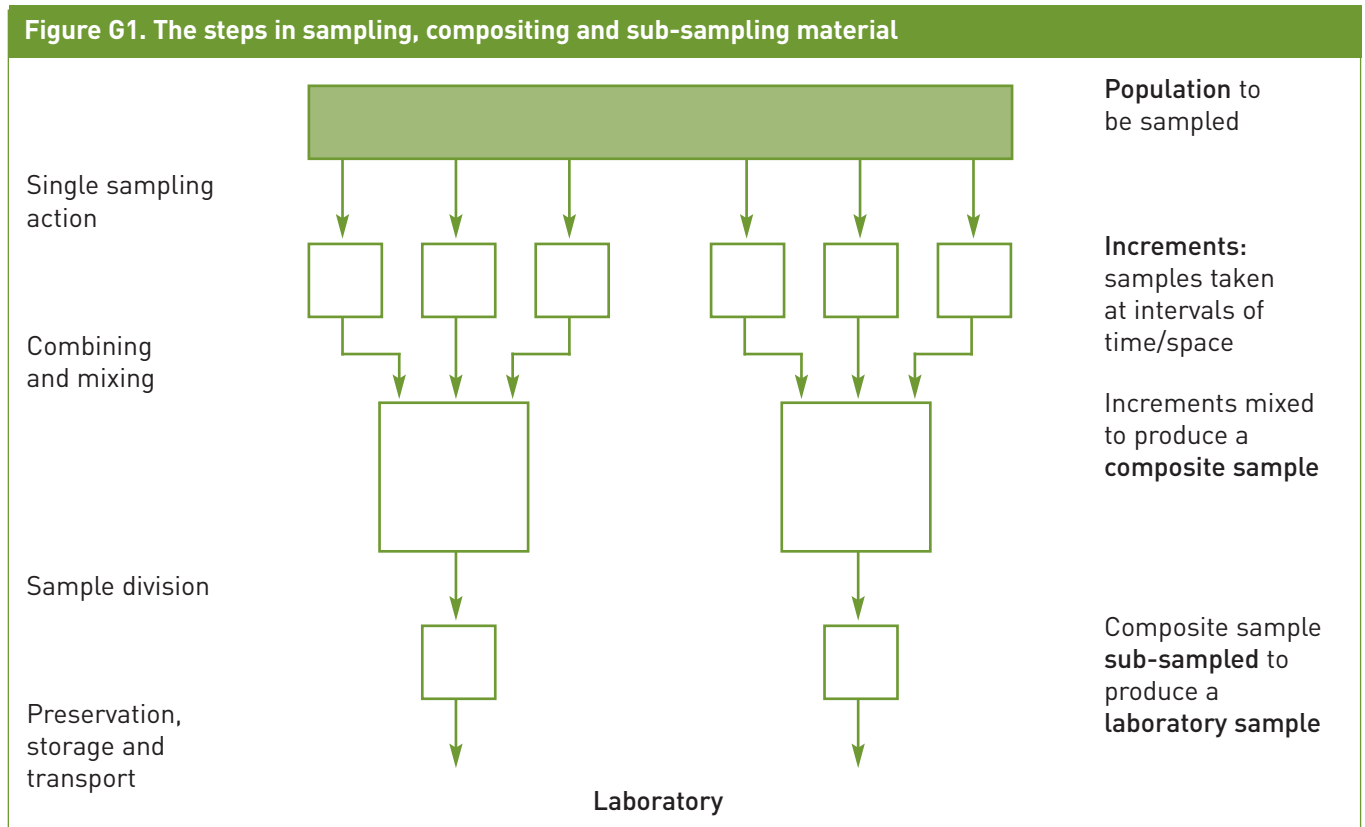
Without considering site or source specifics for the input materials (BSI 2007) uncertainties will remain about how representative the samples taken are in describing that input. Definition of an appropriate sampling regime with sufficient power to detect a determinand of interest depends upon site- and source-specific knowledge of the temporal and spatial variation of determinand concentration.

There is no straightforward answer to the question 'how many samples need to be collected to provide an accurate physico-chemical assessment?' Nevertheless, some key steps should be taken, as outlined by Lambkin et al. (2004) if the best practicable efforts are to be made in obtaining a representative sample. These will include:

- identifying the population to be sampled, which means the material and, as far as possible, its characteristics;
- defining an adequate number of samples – dependent on the accuracy required, the homogeneity of the feedstock, and the degree of mixing during processing/excavation; and
- determining the sampling pattern and sub-sampling procedure before sampling, and recording this.

The importance of the characteristics of the input material to be sampled is likely to be well understood by the producers and manufacturers of topsoil. A schematic of the process from Lambkin et al. (2004) is given below in Figure G1. This outlines the steps in collecting material through to providing a suitable sample for laboratory analysis.

Figure G1. A schematic showing the steps in sampling, compositing and sub-sampling material (from Lambkin et al. 2004).



3. The range of likely costs for these analyses

Generally, the costs of the metals and physical analyses, as given above, are relatively low when compared to the organic chemicals analyses. Table G3 provides indicative total costs from a range of commercial laboratories in the UK.

Table G3. Indicative costs from commercial laboratories carrying out organics analyses for the lists of organic determinands given in Table G1*. Ticks represent determinands which are present and crosses represent those which are absent.

Table G3. Indicative costs from commercial laboratories			
Organic determinands	EU 3rd working draft of Sludge Dir. (2000)	Environment Agency recommended list for other waste projects [#]	CLR8 List*
Sum of halogenated organic compounds	✓ (500)	✓	✓
Linear alkylbenzene sulphonates	✓ (2600)	✓	✗
Dimethyl-, diethyl-, dibutyl-, diisobutyl-, butylbenzyl-, dioctyl-, di(ethylhexyl)-, dinonyl- and didecyl- phthalates	✓ (100 for DEHP)	✓	✗
Penta-, Octa- and Deca- bromodiphenylethers	✗	✓	✗
Hexabromocyclododecane (HBCD)	✗	✓	✗
Tert-docecylmercaptan	✗	✓	✗
Perfluorooctane sulphonate (PFOS)	✗	✓	✗
Triclosan	✗	✓	✗
TBT	✗	✓	✓
Pentachlorophenol	✗	✓	✓
Nonylphenol	✓ (50)	✓	✗
Polycyclic aromatic hydrocarbons (PAHs; viz the 16 USEPA PAH)	✓ (6)	✓	✓
PCDD/F (ng TE/Kg dm)	✓ (100)	✓	✓
Polychlorinated biphenyl's (PCBs) ≈ 18 congeners	✓ (0.8)	✓	✓
Mineral Oils	✗	✓	✓
Range of costs (£)	450–600	941–600	380–540

* Quotes obtained between August 2007 and March 2008, based on a sample size of >5.

4. Semi-quantitative approach to POPs analysis and interpretation

The potential determinand list for POPS could become too long and a balance needs to be struck between the feasibility/costs of analysis and the probability that this will result in identifying an important risk (a risk-benefit analysis).

As well as the large cost per sample, there will be a number of analytical challenges associated with some of the determinands in the topsoil matrices – among these are the lack of validation data, the lack of currently available routine methods for many of the determinands in the matrices, and the extensive clean-up required to analyse some of the determinands.

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While such methods could be developed using currently available analytical equipment, the costs associated with method development and validation would be large and the on going costs to apply these to all of the matrices would be substantial. A more practical approach is therefore required that looks for the toxicologically important compounds that are most likely to be present and that have readily achievable limits of detection.

Depending on the characteristics of the input material (and, of course, source information), a wide range of analyses may be considered to be necessary, such as for speciated PAHs, Total Petroleum Hydrocarbons (TPHs), Solvent Extractable Matter, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), speciated TPHs, PCBs, and pesticides to provide basic information for risk assessment. These are all organic parameters providing information on specific organic compounds and can provide a very good indication of the degree and nature of contamination of the material. For topsoil that has probably been prepared from (proven) relatively uncontaminated inputs, even this relatively limited degree of analysis could be considered excessive. However, it would be prudent to carry out some selective screening for as wide a range of organic compounds as possible to provide suitable assurance that the topsoil is fit for purpose. A suitable organics screening approach would be to analyse the topsoil for two well known parameter groups, namely VOCs and SVOCs. Used together, these methods can indicate the presence (or absence to a defined level) of a very wide range of organic compounds in topsoil. In addition, they have already been well developed, validated and applied to soil matrices and have been subject to an analytical performance standard – the Environment Agency's MCERTS.

The VOC analysis would typically use a modern headspace GCMS with a high sensitivity MS that allows full scan and SIM data to be produced. This analysis can cover a very wide range of volatile organics including BTEX, MTBE, halogenated and other solvents. If greater sensitivity (lower detection limits) is required, purge and trap can be used instead of headspace, but headspace probably provides sufficient sensitivity for a screening method and is simpler and cheaper to apply. The presence of other compounds not on the list of specific VOC target compounds can also be identified if the GCMS analytical method is of the SIM/scan type. Samples for analysis of VOCs need to be stored in small containers filled to the brim with topsoil and sealed as soon as they are collected and should be transported and stored at sub-ambient temperatures prior to analysis. The less volatile compounds present can be determined by SVOC analysis using solvent extraction of the topsoil followed by analysis of the concentrated extract using SIM/scan or equivalent GCMS. The SVOC method can determine a wide range of compound types including PAH, aliphatic hydrocarbons, phthalates, and certain pesticides. Once again, if a SIM/scan GCMS method is used then the presence of other compounds not on the list of specific SVOC target compounds can also be identified.

Such a combination of analytical methods would provide a practical approach to screening topsoils for organics for risk assessment purposes. The methods will not provide the highest specificity or the lowest limits of detection, but should provide a sufficiently detailed picture to decide whether further, more detailed analysis is required or that the topsoil is relatively uncontaminated. The methods should also provide quantitative data of reasonable (and known) quality for risk assessment for the specific compounds and qualitative data for other compounds that can guide the need for further information.

A similar approach is already used to provide an initial indication of the level of contamination, if any, of land prior to sale or development. This provides a balance between using several methods of analysis at huge expense and using a very simple, non-specific screening method based on total extractable organic matter. If any compounds are found to be present, the data produced is of good enough quality to be used in a risk assessment model to determine the level of risk.

Costs for carrying out these analyses are in the region of £77.50 – £100.00 per sample, as obtained from two commercial laboratories in March 2008. Turnaround times for the samples are typically around 8-10 days.

This methodology would likely represent a practical way forward for some of the input materials assessed in the risk assessment report, for which risks were identified as being low for metals and for which similar results are thought probable for the organic micropollutants. These input materials include spent mushroom compost, green waste compost, and anaerobic digestate outputs.

5. A possible way forward in relation to exposure scenarios and end uses

A range of assumed or default exposure scenarios were used to develop the risk assessment. However, it was not clear how close these assumed exposure scenarios were to reality. The TAG proposed that a number of scenarios used in the market survey could be further developed through industry input to more closely represent the priority uses for topsoils, both natural and manufactured. Table G4 gives the scenarios, prioritised by use (but not necessarily volume), from the market survey.

Table G4. Main uses for topsoils, both natural and manufactured from the market survey (Environment Agency and WRAP 2007c).

Table G4. Main uses for topsoils	
Scenario	Number of respondents
Commercial landscaping	22
Housing developments	18
Sports pitches	12
Brownfield restoration	12
Domestic gardens	8
Landfill restoration	5
Other	4
Agriculture	2

Further details on the scenarios, as supplied by industry could be used to develop a range of reasonable standard scenarios rather than the 'worst case' scenarios which were used but which may not represent realistic uses. The priority scenarios in Table G4 in terms of data requirements are those that have the greatest use, such as commercial landscaping and housing development.

Information to help develop standard scenarios for topsoil use could include typical tonnage ranges, conditions, and methods of application, drainage, and planting regimes. These scenarios could be developed through an ongoing process between industry and regulator to ensure that each one represents current practice.

6. The limitations associated with lack of guideline values for POPs for human health and environmental assessment

There are currently few limit values for the assessment of human health and ecological risks in the UK, especially for organic micropollutants. Therefore, routine practice as indicated by a significant amount of anecdotal evidence, suggests that when limit values for human health or environmental risk evaluation are not available (not derived under any UK regulations) limit values from other jurisdictions are 'cherry picked' on an ad hoc basis.

However, the Environment Agency has developed several new limit values, called Soil Screening Values (SSVs) for assessing ecological risks, which are likely to be released for consultation in summer 2008. Furthermore, a range of information sources has also been recommended in the consultation for situations when no UK limit values are available. This will provide guidance to practitioners and regulators and reduce the use of *ad hoc* limit values from other international jurisdictions.

For human health, the derivation of Soil Guideline Values is a relatively slow process and few are currently available, especially for POPs. The UK Government does not recommend the use of limit values from other jurisdictions as assumptions about exposure and toxicity may not be the same as those currently in line with UK policy. Under EU REACH regulations (Registration, Evaluation and Authorisation of Chemicals, estimates of Derived No Effect Levels (DNELs) for humans will need to be provided by chemical manufacturers and importers for all chemicals currently in use in the European Union (estimated to be ~30000). DNELs for many of the most important substances will be provided by the first REACH deadline of 2010, with DNELs for most of the remaining substances provided by the final deadline of 2018. It is likely that these DNELs could be used quite effectively as screens for substances found in topsoils.

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