REPORTS OF THE TECHNICAL WORKING GROUPS

ESTABLISHED UNDER THE THEMATIC STRATEGY FOR SOIL PROTECTION

VOLUME - IV

CONTAMINATION AND LAND MANAGEMENT

Editors

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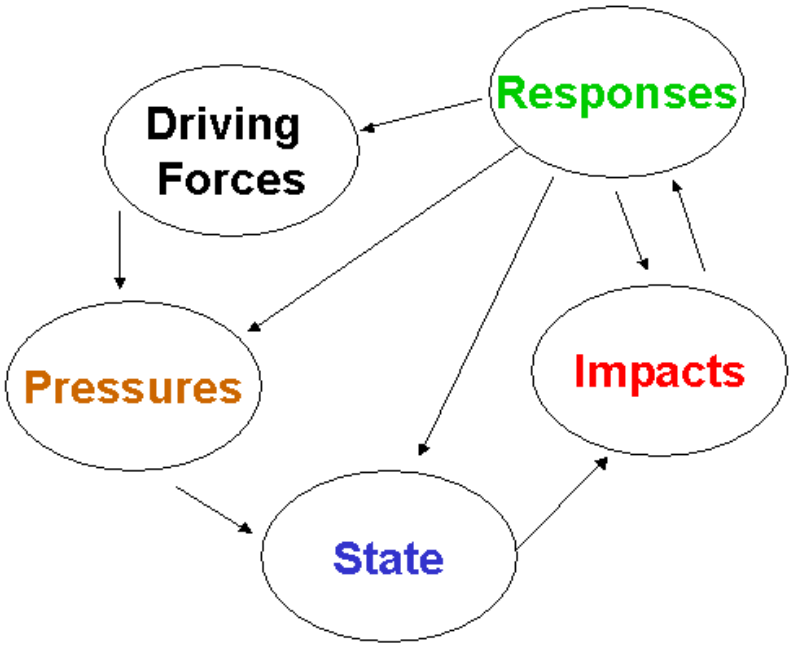

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CONTAMINATION AND LAND MANAGEMENT

Task Group 1 on
STRATEGIC OVERVIEW AND STATUS OF CONTAMINATION

Joop Vegter, Sigbert Huber, Anna Rita Gentile

Executive Summary

1.1 General introduction

Contamination is one of the main threats to soil identified in the EU soil communication (COM(2002) 179 final). Prevention of soil contamination has strong links with policies on chemical substances and with environmental protection policies for water and air. It has also strong links with policies concerning certain land uses, for instance agriculture.

The relation between soil contamination and waste management is obvious as well. Bad waste management has led to a large number of contaminated sites. Better waste management has led to recycling of waste as construction products, or as composts and sludges that can be used as fertilisers. Both ways of recycling may positively or negatively affect the quality of the soil. Waste disposal by landfilling is now subject to environmental regulations which protect soil and groundwater.

In fact many policies have significantly contributed to the protection of soil. However soils are still subject to many pressures leading to soil degradation, which calls for a policy which addresses soil in it's own right. Such a policy should not replace current regulations which already contribute to soil protection but act as an umbrella. It may be described in a policy document aiming at the coordination of the implementation of regulations already in place and at improving current regulations if soil is not addressed sufficiently. The legal basis for such a strategy document is implicit in EU treaties and the proposed directive on environmental liability (COM(2002) 17 final). There is also political commitment from the European council (CO-DBP (2003) 10) and European parliament (2002/2172(COS)).

The discussions in the TWG contamination have strengthened the above point of view. Specific policy strategies have been designed for local sources of contamination, for agricultural soil uses, for management of contaminated land and for large scale diffuse pollution. The strategies, which form the basis of the policy recommendations of the working group, are tightly linked to the way the land is used and identifies the owner/user of the land as the primarily responsible party for soil protection. For agricultural land the farmer has to treat the soil in a balanced way in order to save the soil quality for future generations. This should be supported by production of high quality products and proper information on usage. For land of local sources the owner has to prevent soil contamination by safeguarding avoidance of release of substances to soil as much as possible. For contaminated land the owner of the land is responsible for managing and improving the situation only if the polluter cannot be legally addressed. A policy approach for large-scale diffuse pollution however requires large-scale integration of soil protection, air and water policies and land use policies. The water framework directive provides opportunities for management of water quality and quantity at the river basin scale and will become an important vehicle for soil and sediment protection and further integration of environmental management. The abatement of large-scale diffuse contamination problems will for long be the task of public authorities and EU wide coordination is necessary due to the transboundary nature of the environmental problem and its economic repercussions. It is also clear that the classical generic tools in environmental policies for contaminating substances like state-of–the-art emission reduction techniques and the setting of (eco)toxicological quality standards fall short in view of the large-scale diffuse soil contamination. For soil protection we need to put the uses and functions of the soil-(ground)water-sediment system upfront and not the individual contaminating substances. The generic tools have to be adapted to fulfil their role as decision-making tools within a system-oriented management framework.

The analysis of regulations already in place that can contribute to soil protection against contamination has been the starting point for the working group and its task groups. Before any additional regulations or measures are proposed better implementation of existing ones or amendments concerning soil contamination are recommended. The reporting obligations at the EU level associated with these regulations already provide information that can be used for "action-driven" soil monitoring, but may have to be extended if necessary. For the further development of action-driven monitoring a scheme has been proposed for monitoring and assessment, based on indicators and a tiered approach. The working group discussed in depth the usefulness of classical soil monitoring to improve our insights in diffuse contamination. It proposed to start with an aggregation of the results of national monitoring approaches for heavy metals and POP's as listed by the Stockholm convention on POP's. However the need for new monitoring schemes is obvious in view of the large-scale diffuse pollution problem, in relation with monitoring requirements of the water framework directive and the groundwater directive.

A large input of the working group to the TWG Research was based on the RTD needs identified by the concerted actions CARACAS and CLARINET and the networks SEDNET and NICOLE. Concerning agricultural land uses many research questions are inspired by the lively discussions on compost, sewage sludge and fertiliser applications and more generally by discussions about Good Agricultural Practice, sustainable agriculture and the reform of the EU Common Agricultural Policy.

1.2 Organisation of the work

The general approach for discussion of soil contamination makes a distinction between source-oriented soil protection and contaminated land management. Source-oriented soil protection is aimed to prevent (further) contamination of the soil, while contaminated land management deals with the clean-up, remediation and reuse of soil which is already contaminated, often as a result of past activities.

Within this strategy framework, four workpackages and related task groups were established:

1) Policy, strategy and integration of issues (PSI), providing the common ground for the task groups and covering general policy requirements and cross-cutting issues;

2) Local sources (LS), dealing with prevention of contamination at the single site scale;

3) Diffuse inputs (DI), including agricultural sources, dealing with prevention of contamination due to diffuse inputs at the large and farmland scale;

4) Contaminated land management (CLM), dealing with remedial actions.

Common objectives of the task groups were the following:

a) Draw a general picture of the extent of soil contamination in the enlarged EU;
b) Describe strategies and technologies solutions;
c) Identify the added value of action at the EU level;

d) Define what should be monitored;
e) Make a research agenda.

The following sections will summarise the policy recommendations (based on objectives a, b and c), the monitoring recommendations (d) and the research recommendations (e) based on the work done by the task groups.

1.3 Main conclusions

1.3.1 Mandates and cross-cutting issues

The working group analysed all relevant mandates, identified the issues that are to be covered by the group and divided the work into work packages (see chapter 2). Most of the issues have been covered (see this report and task group reports), but a few have not been addressed due to time constraints, lack of expertise or low relationship with soil contamination.

The issue that could not be addressed in a quantitative way from the specific mandate was to assess the consequences of soil contamination hindering the achievement of sustainable development by addressing the impacts on economy, employment and social welfare.

Concerning the general mandate for all working groups, the basic principles (like polluters pay and precautionary principle) have been addressed by the working group and are reflected in the task group reports. Regarding policy needs a European soil policy should not replace current regulations, which already contribute to soil protection or duplicate these efforts but amend and complement these where required and act as a coordinating umbrella. The main philosophy of the working group is to stress the responsibility for soil protection and liability for soil contamination of the owner and/or user of the land. If soil users need to contribute to the improvement of soils contaminated by others, it will be obvious that some additional incentives will be needed. The role of agriculture and forestry in revitalising soils has to be seen in this light.

Concerning cross-cutting issues the following rough conclusions have been drawn in relation to soil contamination:

- Basic definitions: Protection against the threat of contamination has to consider the whole soil-water-sediment system and all kinds of (past and present) land use have to be addressed for the definition of appropriate measures.

- Climate change: Effects of climate change on the impacts of soil contamination, will be caused by changes in the water flow and organic matter status of soils. This will in turn influence the fluxes and the bioavailability of contaminants. The conclusions from the EU funded Chemical time bomb project (1991) are still relevant in this respect and need to be further explored to yield reliable scenarios in view of decision making.

- Environment and health: Apart from the clear human health risks associated with heavily contaminated areas the relation between soil contamination and human health is rather vague. In view of the uncertainties of the cause-effect relationships between soil health and human health a strong link between the Soil Thematic Strategy and the Strategy on Health and Environment is recommended.

- Biodiversity: There is clear evidence of adverse effects of soil contamination on soil biota and plants. Methods for ecological risk assessment should be further developed and further research is needed for implementation of specific indicators concerning the protection of biodiversity.

- Role of land use planning policy: Land use planning should consider soil contamination, in particular in urban areas showing the need for consideration of soil degradation in the urban thematic strategy.

- Role of agriculture and forestry in revitalising soils: Guidelines and regulations for materials applied to agricultural are useful and further needed in order to avoid contamination, but also incentives are suitable to enhance soil protection, e.g. by reducing input of pollutants into soils.

- Co-ordination of the world-wide dimension: Regarding large-scale diffuse contamination it is strongly recommended to develop synergies between the soil strategy and the Convention on Long-Range Transboundary Air Pollution.

- Awareness, communication and participation: Awareness raising on soil issues is very important in order to avoid soil contamination. Therefore provision of information is recommended using different tools adapted to the audience to be addressed.

- Property rights related to soil and soil data: Data owned by public administrations has to be made publicly available, but also private data in case they are getting of public interest due to risk of damage to the environment.

<u>Issues that have not been addressed from the general framework:</u>

- Impact Assessment
- Socio-economic aspects
- Gender mainstreaming
- Basic typology and characterisation across European soils
- EU soil conservation service

1.3.2 Task group Local Sources

The **task group Local Sources** focussed on recommendations for preventing soil pollution from point sources. These sources only need the soil for support. Introduction of contaminants in the soil system can be avoided so the phrase “no added pollution” can be used to describe the strategic policy objective. The task group also provided an overview of major point sources contributing to local soil contamination.

The **main conclusions** of the task group are:

1. In most cases soil pollution from point sources is unintended and happens due to handling spills or accidents or insignificant but continual losses/emissions. In contrast to air emissions and wastewater discharges, the principle of “controlled emissions” can not be applied and appropriate measures need to focus on pollution prevention.

2. Soil pollution deriving from point sources shall be avoided as far as reasonably achievable whatever the state of soil might be at the beginning of an operation ("no added/increasing contamination").

3. Prevention of soil pollution from point sources is not sufficiently addressed in current EU policy (in contrast to emissions to air and water). Environmental liability in the case of pollution is weak and legally binding financial security of potential polluters is entirely lacking.

4. Point source safety for potentially soil polluting activities from industry, waste deposits, buildings, and extractive industries needs to be reviewed. In this respect special provisions to prevent emissions to soil need to be defined and the progress of their implementation needs to be surveyed.

5. Monitoring of soil pollution from point sources can only be based on assessing policy efficiency in the sense of surveying the progress and efficiency of implementing measures intended to increase point source safety related to soil protection. Appropriate "policy monitoring" can only be implemented after implementation of appropriate policy adjustments at EU level and at Member State level.

1.3.3 Task group Diffuse Inputs

The **task group diffuse inputs** discussed two classes of soil contamination which are generally labelled as diffuse contamination:

1] Contamination that may arise from current agricultural practices and related soil uses such as forestry, managed nature reserves, reclamation areas, landscaping, gardens and parks where the user of the land modifies ecological processes in soil with additions of nutrients, exogenous organic matter and pesticides to increase productivity or to protect the current state of the land.

2] Contamination that enters the soil system by natural pathways like atmospheric deposition and sedimentation from surface waters (in the case of sediments).

These two classes have in common that the input from contaminants cannot be avoided like for local sources that only use the soil for support. In order to formulate adequate soil protection policies for diffuse contamination one has to address the interaction of the contaminants with the complex living soil system and its heterogeneity in space and time. Moreover contaminants enter the soil system by multiple pathways. Agricultural land may become contaminated through atmospheric deposition, through certain trace elements in fertilisers, through the application of pesticides, manure, slurries, sludges and compost or applied soil material. Another complication is the fact that many substances may contaminate the soil simultaneously and can interact, which may lead to additional adverse effects on some receptors.

The **main conclusions** from the task group are:

1. Given the complexity of the diffuse input problem a strategic approach is needed that gives some indication how to consider the different inputs and their relations and how to pave the way to sustainable land use and soil conservation as a resource for future generations. European Parliament stressed the importance of preventing the accumulation of hazardous substances in soils, but the task group could not agree on the basic principles to turn this EP statement into a policy.

2. Preventing accumulation of harmful substances by balancing inputs and outputs was considered a too simple "arithmetic" approach by some. According to them it is not the accumulation of the substance as such but the accumulation of risk for human health or ecosystems that should be the key issue. Others considered that focussing on (short-term) risk and current land uses is not preventive enough, in particular in relation to the Water Framework Directive. Risk assessments must be sufficiently knowledge-based and detailed to take into account future land uses and potential impacts in the long term in order not to be in conflict with sustainability. We should not want to endow future generations with risky soils and limit their freedom of choice to use the land differently.

3. In view of the lack of consensus for a strategic approach, the group decided to use a bottom up approach, because they felt that was the most practical when discussing inputs of contaminants in agriculture. Materials like composts, manures, lime, fertilizers, sludges and pesticides can be assessed according to agronomic value, the impurities and potential pollutants can be identified, the pathways of exposure can be tracked and the risks for soil functions, water resources, plants animals and man can be assessed. This discussion automatically led to the question whether we should protect the multifunctionality of soils together with applying the precautionary principle, or whether we should make a differentiation between different types of land uses according to their sensitivity for pollution. Some favoured the long-term goal of preserving soil as a multifunctional resource for future generations, others favoured the more short-term risk based point of view related to the current use of the land.

4. The weighing of agricultural benefits versus environmental impacts of each product proved also to be a controversial issue. This weighing is dependent on several political value judgements. Moreover the merger of the discussion about the sludge and biowaste from a waste management point of view with the discussion about soil protection did not contribute to the consensus in the group. One option is to define treated (e.g. composted) waste materials as product which is put on the EU market to be used for the improvement of nutrient status or organic matter content of soils. This strategy is applied in a number of Member States for composted biowaste (Austria, Italy, The Netherlands etc.). Another option as known from the Sewage Sludge Directive and national regulations is the strategy of waste recycling with the possibility to follow and control the recycling path until the application on a specific plot. In both cases agriculture must not be urged to serve as principle receptor of certain waste streams, but a distinct and comprehensive material and quality definition of waste derived soil amendments must ensure an environmentally sound beneficial use. In addition it has to be noted that, by definition, if a material is a waste does only depend on the fact, if someone wants to discard a material. On the first hand this is no matter of quality definition. The answers to these questions seem to require some general policy guidance. The more so because the added value of intervention at the EU level in regulations concerning waste, especially sewage sludge seems to be based on different arguments than for regulations

concerning soil. Sewage sludge is produced locally and should be dealt with close to the source (it is not an example of transboundary pollution). Generally sludge is not exported as a recycled product to other countries (though it is sometimes transported over long distances), and whether sludge is burnt, landfilled or applied as organic fertilizer does not affect the performance of the internal market in EU or the balance of competition between Member States. However, organic waste recycling to the benefits of the environment must go hand in hand with the needs of agriculture and more specifically the demands of soil protection.

1.3.4 Task group Contaminated Land Management

The **task group Contaminated Land Management** focuses on a risk based and sustainable management of land that has already been contaminated (= "historical pollution"). This accounts for diffuse contamination as well as for contamination coming from point sources. It also covers what has been termed recently as "proximity pollution", wide-spread diffuse pollution originating from a single industrial source, outside the property boundaries of the industry.

The **main results** of the discussions in the task group are:

1. The following definitions are proposed:

   a. A *"potentially contaminated site"* is a "site where an activity is or has been operated that may have caused soil contamination".

   b. *"Land"* represents a geographical area (could be a single site, or it could be a region such as a municipality or larger area). However, it also includes the physical components of this spatial area, such as soil and groundwater beneath the surface of the land.

   c. *"Site"*: A particular area of land, usually related to a specific area of ownership or activity.

   d. *"Contaminated land"*: a geographical area with confirmed presence of "dangerous substances" caused by man in such a level that they may pose a significant risk to a receptor in such a way that action is needed to manage the risks. The risk is evaluated taking into account current and expected uses of the land."

   e. *"Contaminated site"*: a site with confirmed presence of "dangerous substances" caused by man in such a level that they may pose a significant risk to a receptor in such a way that action is needed to manage the risks. The risk is evaluated on a site-specific base taking into account current and expected uses of the site.

2. The management of contaminated land must follow the concept of Risk Based Land Management (as studied in the Clarinet-report) applied on a case by case approach. When a problem of new soil contamination is found immediate action is required.

3. Every MS should work out an action plan for contaminated land management.

4. Today, an EU-wide inventory has little relevance, because many Member States (MS) have a different understanding of what "contaminated site" means, and because the way and speed of building up inventories throughout the MSs differ greatly. That being said however, every MS (or county or region) needs information on potentially contaminated sites to be able to plan necessary management actions. This information can be grouped in an inventory. As decision for action can take into account other factors than contamination, it should be up to MS to fill it in depending on its own needs. EU-wide guidelines on how to build up an inventory of potentially contaminated sites as well as contaminated sites can be useful to exchange good practice in particular for MS not having such inventories.

5. Several Member States have carried out national action plans. Key principles and recommendations concerning such action plans are the following:

   a. A strategic approach at national level is very useful in particular to define priorities for action based on the risks and the impacts of the contaminated sites.

   b. An approach requiring a strong harmonisation of such plans at EU level is not appropriate. In particular MSs should have the freedom to decide whether the inventory or the plan should be carried out at national or regional level. MSs should also decide the type of inventory necessary to cover their territory (in particular a number of MSs have already developed such tools).

   c. An information exchange on strategic approach between MS would be highly beneficial and should be developed to define best practices; the already established EU Common Forum may serve as a useful starting point here.

6. Information on soil contamination is often owned by private parties (e.g. land owner or operator); this information should be made publicly available, at least when contamination has been proven. MSs should be able to decide that they want all information on possible soil contamination to be made publicly available.

7. Application of the "polluter pays"-principle is not always possible for historical contamination, as the polluter may not be liable for historical contamination, may not be able to pay for remediation or does not exist any more. The recent Directive on environmental liability deals differently w ith soil damage versus water and biodiversity damage. The liability directive might have been an opportunity to protect/restore soil and land to the same standards as water and biodiversity.

8. The Proposal of the Commission for a Directive on Groundwater gives no solution for large zones of contaminated groundwater (for instance compliance with certain limit values is required in all points of the water body regardless the technical and economical difficulties to manage historical contamination). The Proposal should be amended to ensure an appropriate management of historical contaminated sites. In particular, the preventive and limit clause in the Water Framework Directive (WFD) may hinder remediation activities and should be clarified.

9. A need exists for a better harmonisation of risk assessment concepts. Much research has been carried out on the issue, and within the Caracas project an effort has been made to bring together all information within MSs, but little has been done to really co-ordinate the concepts. Some scientific elements relevant to risk assessment should be harmonized (e.g. stepwise and scientifically coherent decisional procedure, tox/ecotox/chem. contaminant properties) while others should be optionally selected from jointly developed "toolboxes" (e.g. sampling/analytical procedures, fate and transport models), in order to allow for site-specific and regional variability. MSs should be encouraged to harmonize their acceptable human health risk level e.g. excess lifetime tolerable cancer risk because differences are hard to explain to the public.

10. The "Best Available Technology" (BAT)-principle is relevant to make sure that best technologies are being used for soil remediation, while taking into account also secondary effects and costs of a technology. Guidance documents on proven technology may be helpful, while a strict list is likely to stifle innovation and development of new technologies. Implementing "BAT" should more be about procedures to come to site specific BAT rather than a strict list of what technology should be used for what type of contaminant. Examples of guidance documents already exist in several MSs, while also Clarinet- and NATO/CCMS Pilot Study reports provide useful information. When EU-funds include soil remediation in certain projects (like in funds for regional development, Interreg, Life, etc.) building in the necessity to use site specific BAT could trigger technology development and knowledge dissemination.

11. Some MSs have got mechanisms to co-finance the remediation by the present owner of contaminated sites where responsible parties have failed. Some EC-funding mechanisms (such as Interreg or European Fund for Regional Development) may fund soil remediation; they are limited though to certain regions. Yet, the application of the "state aid" regulation on soil remediation is not always very clear and should be amended.

12. The rights of an owner can interfere with "public interest", where e.g. soil contamination poses a threat to human health, groundwater quality, ecosystems, etc. The rights of an owner should be of minor importance to the public interest. Anyhow, an owner is an interested party in the soil quality, so he should take part in the decision making process of a remediation plan. To make the market "work" on remediation, the responsibility for the remediation could be put with the owner of the land, as this will make a remediation most effective; this can be "softened" with co-financing when the owner is not the liable party. Financial guarantees could also be required to ensure that industrial operators have the necessary funds to rehabilitate their sites when the activities cease.

13. Generally, greenfield development is too easy, thus hindering brownfield redevelopment.

14. A report on land status is desirable when a "risk activity" has been carried out on a piece of land to inform a potential buyer about the risks. One might even think of creating a "financial guarantee" at the moment of transfer to avoid constructions in which a liable party "sells" the badly contaminated land to an insolvent third party. Such a land status report should also be required in case of land use change toward a more sensitive use.

1.4 Recommendations

1.4.1 Recommendations for Policy

1.4.1.1 LOCAL SOURCES

Main recommendations of the task group are:

1. A commonly recognised list of potentially soil polluting activities from industry, waste deposits, and extractive industries needs to be drawn up and a distinction shall be drawn between those activities that shall be subject to EU policy and those that shall be subject to national policy regimes. A list of major sources was set-up by the Task Group (see p. **Error! Bookmark not defined.**), which needs more detailed specifications.

2. In view of the enormous costs generated in the case of soil remediation, environmental liability needs to be strengthened. The Task Group recommends a regime of obligatory financial security, or insurances depending on the size and type of activity and the efficiency of implemented preventive measures.

3. Implementation of an obligatory soil assessment at the start and closure of potentially soil polluting activities.

4. Prevention of soil pollution from potentially soil polluting activities needs "tailor made" prescriptions and should be based on sector-specific or activity-specific precautionary measures. At EU level the Task Group considers IPPC BREF documents as the most suitable level to integrate soil protection measures in a sensitive way.

5. Consideration of early warning systems in landfills.

6. Consideration of soil pollution in mine waste management and reclamation of mining areas.

7. Incentives for operators → better insurance and liability conditions for proactive soil protection measures.

8. Improvement of point source safety at sites that are currently not covered by EU legislation, in particular small and medium sized enterprises (SMEs). Development of short guidance documents for prevention of soil pollution at potentially soil polluting SMEs.

9. Awareness raising at sites where potentially polluting activities are carried out.

10. Monitoring of point source safety with regard to soil pollution at EU level and Member State level.

1.4.1.2 DIFFUSE INPUTS

A general policy framework should be developed to address diffuse soil contamination resulting from atmospheric deposition, water pollution in the case of sediments, from agriculture and other activities like

reclamation, landscaping and building activities. This policy has to achieve the following:

1. Specification of (ultimate) long-term goals and (proximate) short-term goals.

   The long-term goal is related to sustainable land use and protection of natural resources. Balancing diffuse inputs with acceptable outputs of the soil and groundwater system in order to prevent a decline of soil functions seems to be the most appropriate long-term goal, whereas short-term goals can be based on the current risks of the contamination as related to land uses and functions and the bioavailability of the contaminants. Moderate surplus of diffuse inputs could be acceptable if the long-term goal is not endangered. The interaction between short-term and long-term goals need a thorough consideration, especially in relation to land use changes and cross-cutting issues like sustainable agriculture, mid-term beneficial aspects of certain soil management practices and climate change.

   Therefore function related soil quality definitions and investigations on critical concentrations of (potential) contaminants are an important pre-requisite and reference for addressing GAP related to land management.

2. Specification of the responsibilities of the users of the land.

   The user of the land should be addressed while taking into account that the user cannot be held responsible for all diffuse inputs. In the light of a "Good agricultural practice" a farmer should have the duty to be as eco-efficient as possible by minimising the flux of contaminating substances like heavy metals and organic pollutants coming from agricultural inputs and the flux of unused nutrients to groundwater and air. Suppliers and manufactures of products that are used on land and may impact on soil also have responsibilities to support the farmer in proper use of these products (quality assurance, guidelines for application).

   Abatement of air and water pollution contributing to non agricultural diffuse inputs is a task for society as a whole. The long-term goal is to achieve a balance between inputs and outputs to groundwater into balance without compromising the quality of soil and water resources for future uses and functions taking into account the requirements of the water framework directive.

3. Ensure a linkage between soil protection policies and other related policy areas

   Policy areas of relevance are policies approving chemical substances (including pesticides) for the market, policies concerning the quality of products applied on soils (fertiliser, compost) that may contain "unwanted" contaminating substances, policies for Good agricultural practices and policies concerning the use of organic waste on soil. Soil protection aspects should be taken into account, or enhanced where necessary, to ensure that there are no long- or short-terms threats.

   There should be a more direct feedback loop from diffuse contamination and agricultural practice to the approval policies for chemicals and pesticides so that sustainable use in agricultural practice and prevention from entering the large-scale diffuse pollution pathways (deposition and sedimentation) can be improved. A stronger emphasis on persistence of chemical substances and pesticides in soil may be necessary in view of soil protection. The EU regulations on chemical substances and on pesticides should solve that problem. Further discussion about this issue for pesticides should take place in the Thematic strategy on pesticides and the current revision of 91/414/EEC Regulation on pesticides.

Concerning waste the policy should specify whether recycled waste can be used as a product or if it should be recycled in the framework of waste regulations.

If an application regime under waste regulations controls is chosen possibilities of a proper use of products are limited. Therefore for products high level of quality assurance, product declaration and quality requirements must be applied together with more and more emphasising GAP.

Specific recommendations for manure and slurries

1. In the long term, sustainable land use planning could encourage a better distribution of animal breeding and production in EU countries. One possibility to reduce unwanted inputs to soils would be to adapt the husbandry density (livestock unit per hectare) according to the environmental sensitivity of each area. Further recommendations are the following:

- Substitute manures and slurries for mineral fertilizer according to the needs of crops (good agricultural practices) in intensive breeding regions

- Develop treatments like biogas production that, on the one hand, improves the fertilization capacities of manures and slurries and, on the other hand, makes it easier to store and to handle. Appropriate land use planning policies are needed to ensure its development.

- Compost manures and slurries, which increases the percentage of stable organic matter in these materials and sanitises the manure but loses nitrogen. The benefits have to be compared with negative impacts like emissions of ammonia to the air which needs more research work.

- Decrease (if feasible) the amount of Zinc and Copper in the feeding of animals to a necessary level taking animal welfare implications into consideration as well as increasing the digestibility of diets to limit excretion in excess of N and P in the faeces after evaluation of potential benefit.

Specific recommendations for sludges

1. It would be desirable to refine the current EU sludge directive to achieve a holistic approach to all organic resources that are applied to all types of land in order to have soil protection based, harmonized requirements for all of them.

2. It would be desirable to improve the definition of treatment and preferably to move to the protocol that has been adopted buy the food industry and that is progressively being required of farmers, i.e. Hazard Analysis and Critical Control Point (Codex, 1997; Evans, 2003). HACCP is equally applicable to chemical as well as to microbiological hazards.

Specific recommendations for compost

1. A positive list of high quality source materials for composting and anaerobic digestion intended for the processing of organic soil amendments would be essential to guarantee high quality compost. This should include source separated household waste and green waste as well as organic industrial waste (e.g. from food industries).

2. In order to bridge the gap between targets for the reduction of biodegradable municipal waste to landfill and a sustainable use of the biodegradable waste fraction incentives for the recycling of source separated biowaste are essential. Member States are encouraged to explore the best solution for implementation considering local conditions.

1.4.1.3 CONTAMINATED LAND MANAGEMENT

1. As a starting point for individual monitoring at risk activities, it is interesting to start with a soil quality monitoring duty for operators who already have an existing monitoring and reporting duty, such as IPPC. An amendment to the directive should be made to specifically reference soil monitoring activities in the duties for operators. To make sure that the activities with higher risks for soil contamination are covered, an investigation should be carried to define the main contaminating activities which are not yet covered by the IPPC-list.

2. It seems necessary to clarify “satisfactory state” in IPPC, as interpretations differ at the moment throughout MSs.

3. Every MS should work out national or regional action plans for contaminated land management.

4. Contaminated land policy comprises both soil and groundwater contamination. We need an integrated approach to soil and water.

5. Water-soil interaction is very important for dealing with sediment problems. Sediments should be included in soil strategy.

6. Create an incentive to the harmonisation process for risk assessment.

7. Promote the use of the RBLM concept to manage historically contaminated sites in an efficient and sustainable way.

8. Soil should be protected at the same level as other environmental compartments in the coming Directive on environmental damage.

9. The text of the “state aid” regulation should be amended or at least clarified to reduce uncertainties about possible public incentives which for instance aim to bring brownfield sites/regions back into the economic cycle, to solve urgent problems which pose a high risk, etc.

10. Create a legal basis for the public availability of aggregated data on soil quality of contaminated sites.

11. Create incentives for the redevelopment of brownfield areas; this implies often creating extra protection against greenfield development.

1.4.2 Recommendations for Monitoring

1.4.2.1 DEFINITIONS

The term “monitoring” is used in this report as general term covering classical soil monitoring, multi-purpose monitoring, action-driven monitoring and regular reporting using various indicators or other type of information across the whole DPSIR chain.

“Classical monitoring” is the measurement of concentrations of substances in soil (monitoring of state). Multi-purpose monitoring and action-driven monitoring are defined in the Monitoring mandate. We consider multi-purpose monitoring as the monitoring of the state of soil for all threats to fulfil different needs, whereas action-driven monitoring is focused on the evaluation of policy measures against soil degradation.

”Regular reporting” is the periodic communication of aggregated information resulting from national monitoring programmes, according to an agreed format.

1.4.2.2 GENERAL RECOMMENDATIONS

Classical monitoring is only useful in well-defined stratified approaches. The group recommends that detailed monitoring is carried out only in problem areas. Many parameters have to be measured in order to interpret the observed changes in the state of soil with respect to contaminants. There should be a recommendation for reference standard methods for sampling and analysis and for standard specification of what to report and how to report it. Monitoring of soil should be integrated with monitoring of sediments, groundwater and surface waters. A European approach should be based on information provided by the national monitoring programmes. Related to the different threats an explicit identification of problem areas or risk zones is needed. Criteria for identification of risk zones should be agreed with the Member States.

The following recommendations are mainly referred to ‘action-driven’ monitoring which is considered the most appropriate approach to monitoring and assessment of soil contamination. For this reason particular relevance is given to action and policy-relevant indicators, which are usually collected at a relatively high – i.e. by country - aggregation level. However a number of indicators and parameters might be considered in order to get less aggregated information needed to carry out a more detailed, and still action-driven, monitoring down to specific problem areas. Details on the choice of contaminants to be monitored are also provided.

1. The implementation of the soil information and monitoring system on soil contamination should follow a progressive upgrade in terms of quality and quantity of information collected. The system architecture and individual data collection items will

be updated along with the improvement of the information basis that will be available with the enforcement of a harmonized EU Soil Protection Policy.

2. The system should be built on systems already in place both at the European and national level.

3. The system design should be implemented following a dynamic and flexible nature and devised to fulfil short-term requirements, mainly based on a number of already available and comparable indicators and parameters at the different spatial scales. Long-term needs should also be identified.

4. The monitoring and assessment system of soil contamination should be based on the following elements:

   a. Action-driven monitoring
   b. Identification of relevant indicators and related data needs
   c. Integration with existing European monitoring and reporting activities
   d. Integration of local and diffuse contamination
   e. Streamlining (not extensive multi-purpose monitoring but based on specific policy needs)
   f. Tiered approach, according to the following geographical levels:
      i. Country
      ii. Catchment (regions of natural boundaries)
      iii. Site-specific-European Level (full EU coverage limited to pressures; detailed monitoring limited to problem areas)
      iv. Site-specific- national Level (limited to guidelines for national inventories))
   g. Step-by-step implementation and harmonisation (gradual implementation and learning by doing)
   h. Guidelines for national monitoring (data collections activities, national inventories, etc.).

5. The Driving Forces-Pressures-State-Impacts-Responses (DPSIR) assessment framework should be used to identify and prioritise the policy-relevant indicators to include in the system.

1.4.2.3 MONITORING OF LOCAL SOURCES

The measurement of concentrations of substances in soil and groundwater are planned to detect failure of the technical preventive measures as fast as possible. Therefore they are of little relevance in terms of providing an overview of the state of the soil (or groundwater) with respect to contamination.
For this reason, monitoring of local sources should make use of more aggregated information like failure frequency of specific preventive technologies or general policy performance indicators (see also monitoring recommendations from task group contaminated land management).

Main recommendations of the task group are:

1. Establishment of a European Point Source Assessment System (EPSAS). Safety conditions at defined point sources should be monitored on a regular basis. The system should cover activities included in an agreed common list of potential soil polluting activities. A distinction should be made between activities subjected to EU policies and activities subjected to national regimes. The system should be based as far as possible on existing activities.

2. At the European level, EPSAS should cover those installations that are currently obliged to report their environmental standards on a regular basis. These are industrial installations as defined by the IPPC directive, installations addressed by the regime of the Seveso II directive, exploratory industries addressed by the new BAT document of the IPPC directive, and landfills that come under the regime of the landfill directive.

3. At the national level, on the basis of an agreed list of potential soil polluting activities, Member States should be encouraged to monitor point source safety at other installations or activities which are currently not covered by EU legislation (i.e. small enterprises with relevance for soil pollution).

4. Existing information should be improved and expanded:

   - **Industry:** in the long term the European Pollutant Emission Register (EPER) should be extended to provide information on the efficiency of soil protection at IPPC sites

   - **Mining:** Member States should compile and report national overviews of sites which need to comply with new standards and progress in standard implementation.

   - **Waste management:** further development of the EEA electronic waste catalogue and integration in EPSAS of reporting under the hazardous waste directive and the landfill directive.

5. The EPER register should be extended to include emissions to soil.

6. The status of strategic industries (i.e. Seveso II) should be reviewed, including any installation and waste sites of the military sector

1.4.2.4 MONITORING OF DIFFUSE INPUTS

Sources of contamination from agricultural practices

The monitoring in farm systems of input-output balances of the concentration in soil of selected contaminants and nutrients may help the improvement of GAP (good agricultural practice). Given the large number of farms in the EU, information to be reported to the EU should be aggregated in policy-performance indicators or sustainability indicators.

It should be noted that plant protection products although applied to plants or soil are more often monitored in plants and groundwater than soil, as required by the Pesticide (91/414/EEC), Drinking water and Water Framework Directives. In some cases (risk areas) monitoring the amount applied to soil may be useful but additional information is required to relate this to potential environmental impacts, such as described in Directive

91/414/EEC. Hence it would be relevant to monitor certain of these products in soil solution as well.

Large scale diffuse pollution

This is the policy area where monitoring is of most importance and relevant at EU level because of the transboundary nature of large-scale diffuse pollution. Monitoring the fate and transport of contaminants through environmental media will help the choice of the best national and regional abatement strategies and their effectiveness. Because all environmental compartments are involved, soil and sediment monitoring should be linked to the monitoring of surface water, as required in the Water Framework Directive, to the monitoring of groundwater, as required in the Groundwater directive, and also linked to the monitoring of air pollution. The EU monitoring system could use already existing networks as a starting point. Even if the methods used differ between networks, the conclusions may still be consistent.

Substances to measure

Measurement of concentration of contaminants in soil should focus on the abatement of (current and future) effects due to diffuse inputs. It should also include the effects of measures to reduce inputs. Monitoring should only be done where there are real concerns (risk areas) rather than a routine grid sampling. The choice of substances should consider only those substances which may reach critical limits in soil in view of human health, food safety, soil fertility, ecological risks especially concerning biodiversity in soil, groundwater and surface waters. Those include the following:

- Heavy metals (Cadmium, Copper, Lead, Zinc, Mercury, Arsenic, Nickel and Chromium)
- Polycyclic aromatic hydrocarbons (PAHs)
- Dioxins, polychlorinated biphenyls (PCBs) and other dioxin-like substances
- Banned, persistent pesticides, such as hexachlorocyclohexane (HCH), dichlorodiphenyltrichloroethane (DDT) or DDE
- Nutrients (nitrogen and phosphates).

Use of the results of measurement of substances in soil

Results from a monitoring programme should enable the user to:

- Evaluate the impact (= quantity and quality) of diffuse inputs in relation to other inputs (e. g. what is the contribution of atmospheric inputs compared to inputs by manure?). This will, later on, steer the measures to be taken to reduce inputs according to relevance.
- Evaluate the future state of the system, i.e. how does the current land use (or changes thereof) affect soil quality. Again, soil quality in relation to crop growth, water quality, ecosystem etc. This means that input-output (balance) approaches are needed that are able to calculate fluxes into (inputs), within (processes) and out (outputs) of the system. Based on the outcome of these balance approaches, inputs can be reduced or effects can be reduced (accept a certain input but make sure effects are negligible, e.g. by additional liming).

Frequency

An average sampling interval of 5 to 10 years seems to be an adequate compromise to measure changes in the metals and organic contaminants listed above, which are likely to be slow as well as nitrogen, phosphorus and the inputs/outputs of contaminants to/of the soil system, which may change faster. If more knowledge of the dynamics of the various parameters is available, the sampling frequency could be adjusted accordingly for each parameter.

Representativity and spatial resolution

To be representative for EU soils, a monitoring network should cover the major forms of land use, climate, hydrological regime and soil type, as strata in a stratified sampling design. Although monitoring could be done on an arbitrary grid basis, it is not very efficient to consider soil as a black box system and ignore that land uses, soil types, climate and hydrological regimes are major factors determining the influence of diffuse inputs on the state of soils. Stratified sampling is much more powerful in this case because it addresses these factors explicitly and will make interpretation of data much easier. We need to take into consideration the distribution of driving forces/pressures and the receptors of contamination (not just the distribution of physical parameters).

Specific recommendations for (action-driven) monitoring of exogenous organic matter (EOM)

Due to the usually low quantity of pollutants and limited amount of material applied to land (following GAP) accumulation rates are generally low. If source materials as well as the gained exogenous organic materials (including manure) are of well defined quality (limit values) it would be fairly enough to monitor changes on pilot scale where pure modelling would still leave considerable uncertainties. In this way (as mentioned below) basic data taking into account the most important management and site conditions can be considered.

Collecting these data may be useful also for scientific purposes, to improve conceptual models of substance flows in agricultural systems. A number of farming systems maybe monitored through EU and such a monitoring system may help to improve GAP (good agricultural practice)

There exists research based evidence that the input of humified organic matter (compost) increases the sorption or fixation capacity for heavy metals in soil. So monitoring of heavy metal availability/solubility/mobilisation within *pilot schemes* with plots fertilised with EOMs would be an important tool for further evaluation of potential impacts due to the input of contaminants by fertilisation systems. Also persistent organic pollutants (POPs) and their breakdown/solubility behaviour which may be found in those EOMs could be considered to be monitored in this way. But currently this may rather be a matter of research than of regular monitoring system.

1.4.2.5 MONITORING OF CONTAMINATED LAND

Measurements of contaminant concentrations in soils are needed to assess the risks of contamination on a one-off basis or in relation to long-term management plans. In both cases monitoring will be specific for the site and of limited representativity, unless there is a larger number of similar sites. For these reasons, only for very large sites (megasites), where risk management plans are at the regional scale (like for instance "the Kempen" in the Netherlands and the Flemish region, the old coal and steel region in the North of France, or the Bitterfeld area in Germany), reporting of monitoring data may be of EU interest.
Data on concentrations of contaminants at individual sites (there may be 1.000.000 sites in EU) make little sense for EU policy discussions. Therefore, EU relevant information about contaminated land problems and solutions should be reported in the form of policy performance indicators.

The monitoring of contaminated land should have the following objectives:

1. gather data on the quality of soil according to risk-based principles, i.e. land use fitness and protection of resources
2. identify where action is needed
3. assess the efficiency of the actions undertaken and of the effectiveness of policy in place.

There is a strong need for tiered monitoring: at national or regional/catchment level a monitoring strategy is desirable to know where action is required, at EU-level it may be interesting to aggregate the collected data to give an idea about the effectiveness of the policy in place. The monitoring objectives are also linked to the discussion under "definition"; following that item, "aggregated parameters" or "indicators" might be:

1. Number of potentially contaminated sites
2. Number of sites that have been investigated
3. Number of sites where action is needed
4. Estimated amount of money needed to undertake action
5. Number of sites where action has been undertaken
6. Amount of money spent in action

Other interesting parameters/indicators (giving a broader view) might be:

1. Technologies used for remediation: this parameter gives an idea about the "sustainability" of remediation concept and may serve as a driver to initiate use of new technologies in other Member States.

2. Surface of brownfields known and dealt with: those parameters/indicators may serve as a signal for site remediation as driver for sustainable land use

3. Some sites may have such a serious impact on other relevant fields (so called megasites or problem areas), that reporting at EU-level on specific parameters for this site could be interesting. A definition of a megasite could be: "site where pollution is so bad that is has EU dimension (meaning that the site is relevant for existing EU-policy). Examples may be sites where the quality of a (ground or surface) water bodies is endangered, where food safety is endangered or a site that has a big social impact. A report on such a site could comprise parameters such as the location, kind of hazard (what EU dimension is "close") and the management concept for the site.

4. The main principles on monitoring could be in a directive, details on the monitoring scheme and on the reporting should be in a technical guideline.

1.4.2.6 EU INFORMATION MANAGEMENT FRAMEWORK: A STEP-BY STEP APPROACH

Monitoring and reporting approaches need to evolve into a more harmonised EU information management framework. EU Monitoring has to start with aggregating the already existing monitoring schemes and will identify the need for harmonisation and additional monitoring information for the interpretation of the results. Reporting has to start by using already defined program performance indicators and will have to accept some differences between Member States. As policy will become more uniform due to the EU soil strategy, policy implementation differences between Member States will gradually disappear and policy performance indicators will become more comparable.

So, both for monitoring and for reporting, we need to accept that the first results will give a rather blurred image of the DPSIR for soil contamination. But the quality of the information will improve gradually if information exchange and harmonisation of approaches is stimulated. There is a need to report aggregated information on agreed formats.

1.4.3 Recommendations for Research

1.4.3.1 LOCAL SOURCES

1. Further development of containment devices and techniques for safe storage, handling and transport of substances that may contaminate soil and groundwater.

2. Passive sampling technologies work contaminant specific and are a promising technology for early warning of soil pollution. However, absence of performance data from lengthy use and other uncertainties prevents their availability on the market. Further improvement on product development is needed to improve economy and reliability of such devices.

1.4.3.2 DIFFUSE INPUTS

General recommendations

1. The availability of substances (to plants, animals and soil micro-organisms) that reach the soil from either atmospheric deposition or agricultural activities, both chemical and biological, and changes therein with time. Specific issues that need to be addressed include P-availability in soils, change in heavy metal availability with time, effects of organic matter and pH on availability of metals and organic micropollutants in soils (link with organic matter group; specifically in relation to compost addition, see additional remarks on compost discussion)

2. Practical tools (i.e. measurement techniques) to assess the degree of biological availability of substances in the soil that can be used to assess the internal levels. Here especially crop uptake and exposure of toxic substances for soil organisms have to be addressed.

3. From 1 and 2 it is obvious that some degree of consensus on the concept of bioavailability is needed since it forms a crucial aspect. If bioavailability in some form or another is to be implemented in EU policy, there should be some agreement amongst scientists what is meant by bio-availability. Further on it is an important to take scientifically based steps for the definition of critical soil threshold concentrations. This cannot be done by setting one value of a contaminant for all soils, land uses and climates. But without such an orientation all technical debates on risk-based assessments and precautionary principles etc. become obsolete

4. Field based process studies that establish process information at the desired level. Often process knowledge obtained in laboratories is insufficient to explain the behaviour of substances under field conditions. Especially retention and transport of substances like P, metals and organics have to be addressed in order to be able to link levels in soils to those in ground- and surface waters.

5. Investigate feasibility of development of true Farm and Field gate balances that take into account all in- and outputs. Currently various outputs (crop uptake, leaching, gaseous emissions) are not properly quantified or even neglected.

6. Knowledge on long-term changes in soil in relation to changes in land use (conversion of arable land to forest or wetland, extensivation, changing groundwater tables, changes in salinity due to irrigation or intrusion of sea water)

7. An overview of effects of available and new management strategies on environmental impact. For example the change from low to high inputs systems of organic manure may result in higher nitrate losses to the groundwater.

8. The economic impact (both form farmers and governments) of changing regulations on the allowed content of unwanted substances. For example reducing the amount of cadmium in P-fertiliser will result in higher prices for fertiliser. What are economic consequences for this?

9. Organic matter decline can be compensated by organic fertilisers, like animal manure, sewage sludge or compost. How do these potential sources for soil organic matter compare to the real natural input (decomposition of the local vegetation)and what are the long-term consequences for the soil and the surrounding ecosystem?. How is the life support system and biodiversity affected by current "high input- high output" agriculture?

10. Establish long-term field scale experimental sites across the EU where EOM is used at controlled rates that approximate to GAP. The sites should span the breadth of climatic and soil types found in the EU. The sites can be a resource to experimenters wanting to research the long-term effects of EOM.

Specific recommendations for manure and slurry

1. Digestibility of diets of animals and more efficient use of Cu and Zn in the diet, according to the real needs of animals

2. Regarding management, plant nutrition and soil protection:

   - Mineralization kinetics of organic matter and organic N
   - Availability to crops and leaching to groundwater of N, P at field scales
   - Characterization of organic matter (easily degradable or stable fractions)
   - Effects of organic matter on soil (increase of microflora, stabilisation of soil structure…)
   - Development of models and software predicting the mineralization and availability of nutrients
   - Development of models predicting and quantifying the effects of organic matter on soil

3. Regarding the prevention of soil pollution and the protection of soil ecosystems:

   - Effect on soil ecosystems of N and P accumulation
   - Speciation of trace elements and links with bioavailability
   - Extraction, analysis, transfers and impacts of veterinary drugs
   - Characterization and behaviour of pathogens in manures and slurry

4. Regarding the socio economical aspects

   - How to change the regional distribution of animal production in EU?
   - How to de-concentrate animal breeding in EU countries?
   - How to incite such changes?
   - What will be the socio-economical and technical impacts of such changes?

Specific recommendations for EOM

The regular use of EOM on Agricultural land imposes 2 main challenges to be covered:

1. optimisation of OM and nutrient supply (=soil improvement)
2. diminishing potential adverse effects due to load with accompanying contaminants.

A lot of applied research has been conducted for a number of materials such as animal manure, sewage sludge and, recently since 10 to 15 years also for compost.
Especially for compost from source separated organic waste long-term impacts on the soil-plant-groundwater system (agro-ecosystem) are still missing and do not reflect all typical ranges of soil, climate and land management conditions. Therefore in order improve GAP (good agricultural practice) for the organic fertilisation systems specific networks should be established covering the use of exogenous organic matter (EOM, such as

compost and sludge). Existing mid and long-term field trials must be integrated in order to profit from the already existing data pool. Harmonisation of *what* is being measured and *with which methods* is needed as well as completion with missing soil, management and climate variations. Parameters identified as effective indicators for soil quality and function can easily be integrated in such a co-operative research/monitoring network.

Key parameters related to soil contamination would be:

1. Various forms of *nitrogen* (nitrogen pools)
2. the *emission of greenhouse gasses (N_2O)*
3. the impact of spreading EOMs on *phosphorus-fractions* and their mobilisation potentials
4. The long-term effects of increasing the *sorption or fixation capacity for heavy metals* in soil by humified organic matter and dynamics are not fully understood in the view of precaution.
5. Accumulation, decay and solubility of *persistent organic pollutants* (POPs).
6. Potential hygienic problems resulting from the use of "*fresh compost*"
7. Impacts of the one-time use of higher amounts of composts (100 to 400 t/ha) in *land reclamation*.
8. The above mentioned effects (point 1 to 9) of *digestate* as compared to compost.

1.4.3.3 CONTAMINATED LAND MANAGEMENT

Many issues related to risk assessment management have been identified in the CARACAS and CLARINET concerted actions and by the NICOLE industry network.

In view of the need to integrate water protection, soil protection and prevention of air pollution a system-oriented approach is required in contrast to approaches focussing on individual substances. Feasibility of a river basin scale system-oriented approach should be scientifically explored, including demonstration projects. The system approach will require the development of conceptual models of the system we need to manage. The conceptual model will suggest (among others):

- What to monitor and where,
- The most promising measures to improve the environmental quality of the system
- The best way to conserve the quality (e.g. protection of non-contaminated ecosystems)

In addition the Task group on Contaminated land management identified the following research needs:

1. There is a strong need for harmonised analysis and sampling procedures. If not enough political agreement can be found to achieve this in a short term, effort should be put in attaining common performance standards such as accuracy and precision of the processes. Sampling and analysing have to be oriented as much as possible to the objective of the monitoring: whether one is interested in concentrations or in possible effects may have a strong influence on the kind of analyses that have to be carried out. There is a strong wish for risk-oriented sampling/analyses to get a better understanding of the possible effects of a contamination, rather than getting an idea about concentrations of a certain substance, without any notion of possible risks and without any notion of the potential effect of a cocktail of hazardous substances.
2. Focus research on giving better estimations of transfer of contaminants to possible receptors via the different transfer routes.
3. Sustainability of remediation concepts: most remediation concepts have an environmental impact themselves: emissions of volatile compounds, traffic, energy consumption, while on the other hand some concepts require long-term (sometimes even eternal) management. Most often, information about those environmental impacts and impact of this long term care is very scarce.
4. Easy-entry decision support tools for BAT: a lot of research has been carried out already on remediation techniques, but the information is not easily accessible for the end-users. There is a strong need for a good instrument for information exchange on remediation technologies. Such an instrument should be created at an EU-wide level. Projects like Eugris offer a help, but have the disadvantage that they stop at a certain moment.

2 REFLECTIONS ON SOIL, SOIL PROTECTION AND SOIL CONTAMINATION

2.1 A definition of soil

The first question that is often raised in discussions about Soil protection is "the definition of soil". Soil is a complex issue. The soil environment is very heterogeneous, and may show delayed reactions on human impact. It is important for its support of many needs of society, it has a huge biodiversity, it's biological activity is essential for maintaining the conditions for life on earth and it has many relations with other environmental compartments like water and air. Complexity of soil and its relations with other parts of the environment tend to manifest themselves differently at different spatial scales from individual soil particles to regional landscapes.

The complexity of soil, which is briefly outlined above, is the complexity as perceived by scientists. But there are also many different perceptions of the "soil issue" in the policymakers community:

Soil as a part of "system earth": This is mainly the scientist's perception, soil as the upper part of the earth, with the geosphere below and intensive interactions with hydrosphere and atmosphere.

Soil functions: Soil is seen as a multifunctional unit. Ecological functions like buffering, filtering, decomposition, and gene reservoir. Human related functions like crop production, support of buildings, archaeological archive and so on.

Soil (=land) uses: This is the spatial planners perspective: agricultural land, industrial, residential, nature area and so on. Proponents of integration of

environmental policy with land use planning often propagate "Land use planners should take soil properties into account in land use planning".

Soil environmental problems: Soil is considered as a collection of problems like acidification, eutrofication, erosion, contamination, salinisation, desertification.

Soil policy: The response of society and its public administration to soil problems. It is often a reactive response, although 'sustainable development' implies a proactive approach.

Soil (=land) management: This perspective puts the soil in a wide sense, or land, upfront as a valuable and limited resource to be managed for the current and future generations. Often related to the wish to achieve sustainable land use. It is proactive and sees the need for integration with water management and spatial planning.

Ethical considerations/ cultural values: Environmental stewardship, opinions about the relation of man to nature: protect it, use it or restore it. Precautionary principle, how to deal with the many uncertainties in risk assessment.

Economy: Soil has great value (living space, agriculture), is owned and traded but cannot be produced. Contaminated and degraded land looses economical value.

Juridical aspects: Linked to economical and land use perspectives. The right to own and use the land. Problems with liabilities in case of land contamination or degradation. Is the right to use the land a permit to contaminate the land to a certain extent? Can landowners prevent public authorities to investigate the quality of their land?

The diversity of perceptions described above is not intended as a complete catalogue of opinions but to raise awareness of the complexity of the soil protection discussion. As the European commission aims at a holistic approach we need to take this complexity into account, without loosing ourselves in too much detail. There is probably not a single definition that will satisfy everybody so it is better not to waste too much time on the definition of soil and instead concentrate on soil protection.

2.2 The "soil system" approach

. . In developing soil protection we need to consider soil as a system that interacts with other parts of the environment and is therefore a sink and a resource of substances. If we take a narrow view of soil, for instance only the upper part as used in agriculture, we need to address many relations with other parts of the environment. If we take soil in a very broad sense like the ISO definition, including groundwater, sediments, subsoil and go as deep as human activities go, we have to address more internal complexity and less external relations. The system approach has the advantage that all important aspects will be addressed, either as internal to the system or as external relations to other systems, independent of the definition of soil.

The scope of the EU soil protection strategy is similar to soil as defined in ISO with one important difference. Groundwater is NOT part of the strategy, but soil water (percolation water) is part of the soil. The groundwater surface is the border. That means that we have to see groundwater as a target of concern, outside the soil system. It is also important to note that sediments (excluding the marine ones) are part of the Soil strategy.

We must realise that including or excluding certain parts of the environment from the soil strategy has administrative reasons, in the real world it is hard to separate groundwater from the soil. In the same way the separation of sediments from surface water seems to violate the aquatic ecosystem approach. But on the other hand, sediments share a number of characteristics with soil, especially when they are used as soil material in the terrestrial environment. They act as sinks for contaminating substances and can behave like 'chemical time bombs', which means releasing accumulated contaminants after a change in environmental conditions. Considering sediments as soil material may also help to solve administrative problems with reuse or disposal of dredged materials. At present, dredged material is not considered as contaminated soil, but as waste. Once a material has been labelled as waste it becomes very difficult to reuse it as soil material. Finally it is worth noticing that often the most productive agricultural soils are former sediments.

As the focus of the present TWG is on contamination a further distinction is useful between the sources of contamination on the one hand and the problems of already contaminated land on the other hand. Contamination refers to the present or past introduction of chemical substances in the soil system by human activities that may lead to adverse effects on soil uses and functions and/or adverse effects in other parts of the environment. Older publications used to make distinctions between contamination (concentration above background value) and pollution (concentration above background value with adverse effects on soil uses and functions or on other parts of the environment). Contamination and pollution are nowadays used more or less as synonyms. The discussions on contaminated land by networks like CARACAS, CLARINET and NICOLE were based on a risk based perspective and did not make a distinction between pollution and contamination.

2.3 Source-oriented soil protection

Source-oriented environmental protection usually makes a distinction between local (or point source) contamination and diffuse contamination. Local sources are generally associated with industrial facilities, waste landfills and other facilities both in operation and after closure. In addition leaching from materials used in constructions (especially in view of mineral wastes which are more and more recycled as construction products) is considered a local source. Other examples are improperly designed septic tanks and underground oil storage tanks in residential areas.

Diffuse sources are generally associated with atmospheric deposition, certain farming practices and inadequate waste and wastewater recycling and treatment. Atmospheric deposition is due to emissions from industry, energy production, traffic, households and agriculture. Farming production systems may result in the contamination of ground- and surface water. Additional problems relate to heavy metals (e.g. cadmium, copper) in fertilisers, manure and animal feed, to antibiotics and to pesticides.

Sewage sludge often contains a range of pollutants, poorly biodegradable trace organic compounds and eventually pathogenic organisms. The use of compost from recycled organic waste – if quality is bad and applied in large quantities- may result in diffuse contamination.

Apart from the direct toxic effects of certain substances, diffuse soil contamination may also eventually result in significant reduction of the buffering capacity of soil, which reduces soil fertility and soil biodiversity and results in additional costs for water treatment due to organic compounds, pesticides, plant nutrients and heavy metals released form soils to waters.

Although the traditional distinction between local and diffuse pollution seem to imply a difference in spatial scale, the main difference is the way the input of contaminating substances is related to the use of the land. Contamination from local sources corresponds to activities where it is not necessary to put (contaminating) substances into the soil. Oil tanks do not necessarily leak, properly designed waste dumps do not need to have substantial emissions to groundwater and leaching in construction materials can be reduced without affecting their functionality. Soil is only used for support or to provide space for these activities. On the other hand activities like agriculture do address the soil as an ecosystem. Agriculture takes space but in addition modifies the ecological cycles of energy and matter to adjust them to agricultural use. Sustainable agriculture is not possible without some input of fertilisers. However, to keep the soil in good shape we must avoid accumulation and balance the inputs to the soil system with its normal outputs without adversely affecting other parts of the environment. To stick with the agriculture example: in the long term input of heavy metals resulting from applications of manure and fertilisers must be balanced by the output, which is the amount leaving the system via crops and leaching to groundwater. The balance must be set in such a way that the ecological health of soil is maintained, concentrations of substances in crop or animal products do meet standards for food safety and the flux to groundwater does not lead to pollution of ground- and surface water. For pesticides the balance will also include biodegradation.

Discussions about local and diffuse sources easily lead to confusion. This can be avoided if we put more emphasis on the relation between soil protection and soil (or land) use. In line with the polluter pays principle and the principle that pollution should be preferably controlled at the source, it is obvious to state that the soil (land) user is responsible for protecting the soil that he uses (or actually rents from the next generations if we want to underline that uses should be sustainable). To put this into practice we must provide the users with the right tools and with some incentives to take care of the soil.

In the previous paragraphs discussing local and diffuse pollution two types of soil uses were introduced. Uses which use the soil as physical support only, and agricultural uses in which the ecological capacities of the soil are exploited. Although this distinction may ask for a new terminology, we may for the moment use ‘local soil uses’(local scale) to denote the use of soil as physical support and ‘agricultural soil uses’(farmland scale) to denote soil ecosystem uses.

Source-oriented soil protection related to the way the soil is used will contribute to the reduction of water and air pollution, by controlling the direct contamination of soil by the land-user. But the source-oriented soil protection will not be enough to prevent the contamination of soils and sediments and flooding areas coming from non-soil sources, by atmospheric deposition and by sedimentation in surface water. We may need a third group reflecting 'indirect soil contamination by atmospheric deposition and surface water'. Industry and energy facilities, traffic, households and agriculture affect soils by diffuse contamination also in far distances from the source. Air and water are actually to be considered as important contaminated pathways leading to soil and sediment contamination at a large scale, way beyond the scale of individual land uses. We will discuss this later on, after the discussions about contaminated land management. This seems logical since we will need to consider the management of the contaminated environment in general, not only in relation with the use of the soil as we do for those sources that affect soils directly.

Local soil uses.
A typical characteristic of local sources is that the source is close to the target (soil). These sources are related to activities that do not involve soil as an ecosystem but only use the support function.

The goal here is to prevent the contamination entering the soil system, for example through barriers between source and target.

<u>The tools to achieve this are:</u>

- Appropriate techniques that prevent leakages and spills. If the techniques fail the resulting soil pollution should be removed as soon, and as entirely as possible.
- Monitoring systems for early warning.
- Necessity of additional barriers.
- Quality control of materials used in the built environment. As more waste materials containing contaminating substances are recycled into construction material some quality requirements are necessary concerning leaching and reuse after demolishing.

<u>What are the incentives:</u>

Soil clean-up is generally known to be very expensive. Since the polluter has to pay there is a big incentive for preventive measures. Adequate prevention costs orders of magnitude less than a clean-up. It is important that some legal obligation /liability exists to remediate the damage caused by spills and leakages *or* to restore the previous condition.

Agricultural soil uses.

The long-term goal is to balance inputs of substances (nutrients, metals, pesticides) with natural outputs to prevent accumulation of hazardous substances and irreversible depletion of buffering capacity of soils.

<u>The tools to achieve this are:</u>

- Quality control of manure, fertilizers, sewage sludge, composts and plant (and animal) protection products
- Methods to keep track of the balance.

<u>What are the incentives:</u>

Soil contamination in agriculture will affect soil fertility. For adverse effects that show up within a few years there is a big incentive to change agricultural practice and avoid contamination. To take measures now to avoid adverse effects after a few generations is more difficult and some incentives should be created by governments in the form rewarding more sustainable and therefore soil protecting farming, or with legal obligations.

2.4 Contaminated land management

European soils contain many legacies from a less sustainable industrial past. Whereas water and air have much improved due to source-oriented measures, the soil does not (or very slowly) improve by itself after reducing or closing the sources. Soils and sediments are sinks for many contaminating substances and can only improve in a reasonable time if an active clean-up operation is performed. Active clean-ups are very expensive especially if the area to be decontaminated is large and the contamination is persistent. With the development of techniques that make use of the biodegradation potential of the soil decontamination of larger areas becomes feasible but the costs are still high, especially when spatial planning consequences and aftercare are considered: The land use must remain compatible with the biodegradation and the monitoring and management of this process for a few decades. Similar considerations apply for other extensive techniques like phytoremediation (for further discussions see CLARINET reports). If an area cannot be cleaned, one has to restrict the use of the land or adjust land use to the contamination. Sometimes immobilisation techniques can help to achieve this.

It is important to note that clean-up as a once and for all solution is only expedient if the sources of the contamination are no longer in operation. This situation is often referred to as “historical contamination” or “Altlasten”. However due to inadequate environmental controls in water and air land is still being contaminated. A clean-up, even using a long-term “ natural attenuation” technique, is only expedient if the situation really improves. If there is still a substantial input to the soil from atmospheric deposition or especially in the case of sediments, from water pollution a clean-up of soil or sediment will not be a long lasting solution. Air and water pollution should be addressed first.

Because soils and sediments (also groundwater) are sinks for many pollutants it is quite common to discuss polluted surface waters and air as “sources”. From an environmental policy perspective however we should go to the ultimate sources of the pollution, the human activities that give rise to the emissions. Air and surface waters are in fact contaminated pathways to soil and sediment. It is not easy to quantify the area of Europe of soil under “pressure” from the water and air pollution pathways. Some basic results regarding air pollution have been achieved by ICP Mapping and Modelling (critical load maps) and ICP Vegetation (moss monitoring) under the CLRTAP. In general the loading of soil and sediments with persistent pollutants is more intensive in areas with high air and water pollution. In order to set priorities it is also important to know the accumulation rates of the pollution (e.g. by monitoring of atmospheric deposition) and the risks associated with this (e.g. by ecological and human health risk assessment models, trend analyses, ecotoxicological tests). Moreover an analysis should be made of the ultimate sources of the pollution. Some sources may contribute more significantly to ‘diffuse’ water and air pollution than others, and pollution by some sources may be more avoidable than others in view of technical and socio-economic considerations. An efficient and effective policy should be based on the relative contribution of the source (or group or type of sources) and the “avoidability” of the pollution.

Estimates of the number of contaminated sites that could in principle be cleaned (historic pollution, sources no longer present, not too large) in the EU range from 300 000 to 1.5 million. The European Environment Agency has estimated the total costs for the clean-up of these sites in Europe to be between EUR 59 and 109 billion. Not included are the costs of not being able to use the soil as intended (planning damage), and all costs associated with the land that is still being contaminated. Contaminated sediments lead to considerable additional cost for dredging, to keep important harbours accessible and to maintain the flow in water systems.

There is a growing consensus among the EU member states how to manage contaminated land problems, as a result of networks like Common Forum and the concerted actions CARACAS, CLARINET and NICOLE. Co-operation with countries outside EU has also a long tradition in the adHoc Working group on Contaminated land and the NATO/CCCMS pilot studies concerning remediation technologies. Although most remediation technologies are only cost-effective at a local scale, the recent interest in Monitored Natural Attenuation and Risk Based Land Management opens possibilities for sustainable management of larger contaminated areas and regions. For the management of contaminated land in general managers have to take into account that the so-called “diffuse sources (pathways)” may still be present. Risk based land management as described in the CLARINET reports can be easily extended to cover also the diffuse pathways, if applied at a regional or river basin scale. River basin management as initiated by the EU Water Framework Directive could become a major vehicle for the abatement of these so-called diffuse sources, related to water pollution. The river basin scale may also be the right scale to bring sources of large scale diffuse air pollution under control. It needs further discussion whether the river basin is indeed the scale for the integrated management of all environmental compartments. Would emission trade of air pollution be acceptable at this scale? The EU funded project AgriBMPwater[1] has recently explored a system approach to environmentally acceptable farming based on emission trades for nitrate and phosphate between farmers affecting the same watershed.

If we state that contaminated land needs to be managed properly we may also mention the most important tools and incentives.

<u>The tools:</u>

- Contaminated land risk assessment.
- Clean up and risk control techniques (site specific decision making)
- Planning (spatial planning, water management)
- Adapted agricultural land uses

<u>The incentives:</u>

- Avoiding risk for human health
- Spatial planning, urban redevelopment need soils that are fit for their use (human health and ecological requirements)
- Policies favouring brownfield redevelopment and site recycling instead of the use of greenfields
- Policies concerning protection of biodiversity and the soil as a life support system (ecological services)
- Policies concerning the protection of soil as a production factor (agricultural needs)
- Policies concerning the protection of water resources.

[1] AgriBMPwater. http://alpha.bordeaux.cemagref.fr/adbx/agribmpwater/

We may observe that many incentives are expected to come from policy. Although in many cases contaminated land can be turned "from a threat into an asset" locally because private investors may make profits by decontaminating and redeveloping the land, there is still much contaminated land "that nobody wants unless……..there are some subsidies or legal obligations or….."

2.5 Soil contamination by atmospheric deposition and by surface water

To curb the ongoing "diffuse contamination" of soil and sediments through water and air is beyond the scope of most private parties interests. This is a task for governments which need to formulate policies, for the short term aiming at the implementation of better preventive technologies and for the long term aiming changing our socio economic environment (the drivers in the DPSIR framework which will be discussed in the next section) towards 'sustainable development'. Soil contamination by atmospheric deposition and water pollution should be reduced to acceptable limits which protect the soil functions, especially the ecological ones (including life support functions and soil fertility) , in the long term.

<u>The tools to achieve this are:</u>

- Quality control of emissions to air and surface water from industry and energy facilities, traffic, households and agriculture
- Definition of acceptable deposition limits (e.g. critical loads) for soil and water resources
- Adjustment of water quality targets to improve sediment quality
- Monitoring of atmospheric deposition and surface water quality
- Land use planning and water management

<u>What are the incentives:</u>

Atmospheric deposition does not only affect the soil, but also plants and biota and finally the whole ecosystem. Precautionary measures are necessary because restoration of soils needs long time (many decades to centuries). The need to protect different ecosystems, biodiversity, food production and nature reserve should lead to incentives to control and implement the tools. International conventions (e.g. Convention on Long-Range Transboundary Air Pollution - CLRTAP, Alpine Convention) could help to promote the formulation of policies to improve the situation and meet the goal in the long run. In order to encourage polluters to take measures now incentives should be created by governments in the form of funds or direct subventions or with legal obligations (e.g. Environmental Impact Assessment, Environmental Liability Directive). For diffuse contamination related to surface water the Water Framework Directive may become an important vehicle for quality improvement of soils and sediments.

3 THE STATUS OF SOIL CONTAMINATION IN EUROPE

In many areas of Europe, soil is being irreversibly lost and degraded as a result of increasing and often conflicting demands from nearly all economic sectors.

In Western Europe (WE), pressures result from the concentration of population and activities in localised areas, economic activities and changes in climate and land use. Air depositions and cultivation systems are among the most important influences on the quality of soils in agricultural and natural areas. Consumer behaviour and the industrial sector are contributing to the increase in the number of potential sources of contamination such as municipal waste disposal, energy production and transport, mainly in urban areas.

In Central and Eastern Europe (CEE), many of the problems stem from past activities and poor management practices.

The combined action of these activities affects quality and limits many soil functions including the capacity to remove contaminants from the environment by filtration and adsorption. This capacity and the resilience of soil mean that damage is not perceived until it is far advanced.
This partly explains the low priority given to soil protection in Europe until recently. Moreover, since soil is a limited and non-renewable resource, when it is damaged, unlike air and water, it is not easily recoverable.

The geographical distribution of soil degradation depends on several factors. Soil problems are influenced by the diversity, distribution and specific vulnerability of soils across Europe. They also depend on geology, topography and climate and on the distribution of driving forces. Better integration of soil protection into sectoral policies and better harmonisation of information across Europe are needed to move to more sustainable use of soil resources and promotion of sustainable models of its use. In particular, soil contamination from diffuse inputs and local sources can result in the damage of several soil functions and the contamination of surface water and groundwater.

In WE, soils in agricultural and natural areas are still in an acceptable state with respect to contamination but are under pressure. If pressures continue at the current level, as it is already evident in some problem areas, impacts will start to occur on a larger scale. Because the negative effects on the quality of soils are hard to remediate, these pressures should be addressed in time. On the other hand many urban soils and sediments are already heavily affected. Prevention should stop further deterioration and the risks of the currently contaminated land should be adequately managed.

Soil degradation problems in the CEE countries are quite similar to those in WE. Most of the problems are inherited from the time of the former USSR, when environmental issues were of minor concern.
Past agricultural policies that focused on increasing productivity led to often unsuitable use of mineral fertilisers and pesticides.
The combined effects of these resulted in pollution of groundwater and reduction of soil fertility. Increased awareness of environmental issues, the obligation to implement EU legislation upon accession and declining economies are reducing the pressures from agriculture (decreases in fertiliser and pesticide consumption).

In CEE soil contamination is, to a great extent, a result of the legacy of inefficient technologies and uncontrolled emissions.

Problem areas include some 3 000 former military sites, abandoned industrial facilities and storage sites which may still be releasing pollutants to the environment (DANCEE, 2000). One of the major impacts is groundwater contamination and related health problems. Major concerns are the long time needed to regenerate contaminated soil and the considerable investment required for remedial measures.

Contamination with radioactivity is also important as a result of nuclear weapons tests, improper radioactive waste disposal and the Chernobyl accident (UNEP, 1998).

Further information on the status of soil contamination in Europe is given in Part 2 (see separate document).

DPSIR as basis for the design of solutions

Up till now the two strategies for source-oriented soil protection, a contaminated land management strategy and an approach for indirect contamination have been discussed separately. Since they should be part of a general soil protection strategy they should be interlinked. The Driver – Pressure - State – Impact - Response framework may be used to achieve this. The diagram one the next page will show the DPSIR for soil contamination. We may start our discussion by looking at the response to impacts of soil contamination.

The need for an environmental protection policy for soil is only recently perceived in most countries. Soil and sediments are really slow reacting media, which means that there can be a long delay between the contaminating activity and the adverse effects on land uses and functions. Translated in DPSIR language: There is a long delay between pressures, changes in state (soils and sediment systems have a large buffering capacity and are - ecologically speaking - very resilient) and impacts. Response to impacts is always too late and very costly, as clean-up programmes in a number of member states have shown. Therefore prevention needs to move "upwards" in the DPSIR approach. In the ideal situation we should change the socio-economic drivers that lead to pressures on the environment. This process, which must lead to sustainable development, is slow due to many international aspects and the need of proactive planning of uses and functions of land and water resources. It should be the long-term goal in soil protection and indeed for general environmental policies as well.

In the meantime much progress can however be made if we could prevent pressures from ongoing activities altogether as described for the local sources strategy. In this strategy the pressure -for instance hazardous material handling at an industrial site- is prevented from affecting the state of the soil if leaking is prevented by appropriate techniques, safety plans and other measures. The focal point of this strategy is at the "pressure" level in the DPSIR framework.

This approach is not feasible for all land uses. Moreover sealing of large areas of soil has been identified as an adverse effect on its own. For land uses that require ecological interactions with the soil system like agriculture (input of nutrients, output of crops) it is not possible to avoid all pressures on the system. Even without contamination cropped soils can be demonstrated to be under some pressure[2]. For this type of land use it is important to address the state of the soil. The state under agricultural pressure should be reversible within reasonable time. From the 'problem of contamination' point of view a balance approach (input = output) is the best option under the condition that the output does not affect other targets, like food quality or water. On the DPSIR scale the balance approach is on step lower than the local sources approach, the focal point is "state".

For historically contaminated land (sources no longer present) the strategy is to reduce impacts by risk reduction, as described by the Risk based land management (RBLM) approach. Sometimes it is feasible to restore the multifunctional state of the soil and even in a risk based approach this could be cost effective since multifunctional soil does not require structural long-term care (administration and control of use restrictions, monitoring of residual contamination). On the DPSIR scale the focal point is "Impact". However RBLM also addresses issues related to the long term. For instance risk reduction by natural attenuation, which requires adjustments in spatial planning (no changes in land use) and in water management. But also long-term care, which is necessary if land is not "multifunctional" anymore, will reduce the flexibility in land use planning and water management and indirectly socio- economic development. The lesson to be learned is that soil and sediment contamination, even if today estimated to be harmless given the current use of soil and water resources, becomes a "driver" (actually a negative one, a "restrictor") for future developments.

Large areas of soil and sediments are still being contaminated. The strategic approach for these situations can be based on Risk based land management. Because the sources are still active management solutions for the short term may be different from historical pollution. Although it may be worthwhile to clean-up the soil to a certain extent, one has to anticipate on future pollution, because for some sources the source-oriented approach will only be effective in the long run. Optimisation of the overall approach becomes attractive then. We may clean the soil now to be fit for a certain land use taking into account that accumulation of contaminants will diminish only gradually. This means that we clean-up to a more stringent level than is strictly necessary, to accommodate some ongoing contamination for a limited amount of time.

This approach will only be sustainable if in the long run all pressures on the soil system can either be eliminated as proposed for the local source approach, or balanced with the regenerative capacities of the soil system, as proposed for land uses that do require an interaction with soil ecosystem processes. In addition contamination of air and water should decrease to reduce the pressure of indirect sources of soil contamination. This underlines the need for a long-term strategy for sustainable land use and water management, which can only be effective at the "driver" level of the DPSIR framework.

In view of the many pressures on soil and the long recovery time or very expensive remediations of affected soils, soil protection policies need to be more proactive than traditional water and air policies. A sound strategic management of soil requires the combination of a long-term vision and shorter-term actions. The balance approach for diffuse inputs to soil can be considered as long-term a strategic goal. Priority setting of short-term actions is based on already existing regulatory obligations and liabilities or on an assessment of the risks associated with contaminants entering or being present in the soil system.

3.1 Risk assessment

In our analyses of approaches to prevent or remediate soil contamination we may observe an important common question: How to assess the risk of a local activity, an agricultural practice, or a contaminated site? Although these questions can be labelled as 'risk assessment', the way these questions should be answered can be very different. There is no such a thing as 'universal risk assessment'. For local sources the risk to be assessed is

[2] soil compaction, less organic matter, less biological activity, less soil fungi and so on, see for instance recent publications of Sparling and Schipper, Performance of soil condition indicators across taxonomic groups and land uses, Soil Sci. Soc. Am 64, 1,(2000)

associated with certain activities and technological failures. The probability of a spill or leakage of a hazardous substance in soil and groundwater is the central question in the assessment. For agriculture the risk should be related to accumulation of persistent contaminants and to leaching rates of nutrients and pollutants to groundwater and surface water. In contaminated land management risk assessment is related to exposure of man and the ecosystem, in other words the impact of the contamination is assessed.

Contaminated land risk assessment should therefore not be confounded with other forms of risk assessment like Environmental impact assessment, risk assessment before introducing new chemicals on the market and assessments of the risk of failure of certain technologies. The different approaches in risk assessment of chemical substances and contaminated land risk assessment may illustrate this. Risk assessment for new chemicals applies the so-called EUSES model, which predicts the distribution of a substance over the different environmental compartments after a release. The main exposure routes to soil contamination (ingestion of soil, consumption of home grown crops and inhalation of indoor air) are not taken into account in EUSES. For the purpose of the assessment of new chemicals this is justified, because we take into account that dumping of the chemical in soil will be prevented by regulations. But one should never apply EUSES in risk assessment of soil contamination, because we have to answer a different question: What is the risk of this contaminant in soil even if it is not expected to be there according to the EUSES model.

Another important difference between risk assessment in a policy on chemicals and contaminated land risk assessment is the level of precaution in the assessment. It will be obvious that one should be more precautionary before allowing a new chemical on the market than one should be in a decision to remediate soil and groundwater at a certain site. In the latter case the risks can be evaluated on the basis of real site specific impacts. On the other hand, the decision to allow a new chemical on the market can only be made on the basis of predicted adverse effects. These predictions involve more uncertainties than site specific contaminated land risk assessment, which can be based on empirical data.

3.2 What type of soil policy do we need at the EU level

In the previous sections we related the strategies to various stages in the DPSIR framework. For policies focussing on the long-term socio-economic drivers a large EU wide effort will be needed. After all the EU is a socio-economic union of states. At the other side of the range are historically contaminated sites. These burdens from the past require very site-specific solutions, which have to fit in a local socio-economic context. If the subsidiarity principle applies in soil protection, it applies there. One must be aware that subsidiarity concerns decision-making. It should not become a barrier to international exchange of experiences in research, policy and practice. We should aim at combining international expertise with local decision-making.

Contaminated land management is primarily operating at the “Impact” level in the DPSIR framework. But it is also noted that there are some longer-term consequences that may remain a burden for future socio-economic development, especially in areas that are still being contaminated. These wider and longer-term issues are at the “Driver” level in the DPSIR framework. Moreover these areas are quite large, and are affected by transboundary air and water pollution. In the case of sediments one has to consider the international transport of sediments as well. It will be obvious that a strong commitment at the EU level is needed to tackle these large and long-term problems.

For source-oriented soil protection there seems to be an intermediate position between ‘subsidiarity’ and ‘EU driven’. The higher we are in the DPSIR framework, the more important EU will be. For agriculture for instance, for which soil protection is strongly related to the “State” level in DPSIR, there is a EU driven Good agricultural practice but there are also many local considerations (soil types are different throughout Europe, differences in climate, crops and culture).

For local sources, where the focal point of the strategy is at the ‘Pressure’ level, much can be done at EU in the IPPC context. This strategy is less dependent on soil type and climate and more dependent on state of the art techniques for prevention. Moreover the application of preventive techniques for industrial activities in EU may distort the balance in competition if the requirements in member state are very different

There has been some discussion about the nature of an EU policy strategy for soil. We will make a distinction between a “light strategy” and a “heavy strategy”. Both strategies should derive from some legal obligation to address soil as a target of concern in environmental policy. Although not mentioned explicitly such a “duty of care” for soil (and sediment) already exists in the EU (see for instance EU treaties and the liability directive) but the implementation is lagging behind.

The light strategy will correct this by screening relevant EU directives and add soil protection issues when appropriate. A politically endorsed strategic document is needed as a yardstick for this assessment. The light strategy will also stimulate member states to make a national contaminated land management program. In short the light strategy is only strengthening approaches that are already there.

One can also think about a heavy strategy. That is for instance drafting a Soil framework directive to achieve sustainable soil use and putting all measures related to soil protection which are already in force under this single legal umbrella. This will be a very long process and require tedious negotiations with stakeholders and member states. Moreover the problem of overlap with the WFD should be solved and the relation with spatial planning and water management should be clarified. For the short term the light strategy is clearly the best option and may, at least for local sources, lead to good results already. For agricultural land uses current discussions about Good Agricultural Practice are a good opportunity to implement measures against soil contamination.

A stronger legal basis for environmental protection (not necessarily in the form of a soil framework directive) may be needed to tackle problems with transboundary air and water pollution that leads to accumulation of contaminants in soil sediments and groundwater. Also the ultimate goal of achieving sustainable development by influencing the socio-economic drivers may need new legal instruments in the longer term.

4 MONITORING SOIL AND SOIL PROTECTION

4.1 Introduction

Monitoring schemes for soil contamination should keep track of the changes in drivers, pressures, state (soil

quality for uses and functions), the impacts on man and environment and the policy responses. Monitoring of responses should highlight the success of protection and restoration policies in avoiding pressures and negative impacts. This is not an easy task. Soil is a very slow reacting environmental compartment. But once the state of the soil has been changed and impacts become noticeable it is often too late to react. Many changes tend to become irreversible especially is they occur at larger spatial scales, as the many contaminated land problems in EU have shown. For soil the sequence in DPSIR may easily lead to the wrong perception that action (response) should only start if there is a clear impact or if a negative trend in soil quality has been demonstrated.

This approach may be adequate for faster reacting environmental compartments like air and surface water, but it is inadequate for soil protection. Emphasis of preventive policies and monitoring should be put on earlier stages in the DPSIR scheme like drivers and pressures. This is the reason why the TWG contamination has proposed various forms of action-driven monitoring (see the monitoring recommendations in the executive summary). These proposals are related to policy programmes for agriculture, for local sources and for contaminated land management.

This type of monitoring boils down to the reporting of programme performance indicators[3] on a regular basis by member states. Some people seem to prefer to label these activities as "reporting" and want to reserve the term monitoring for the measurement at regular time intervals of concentrations of chemical substances in soils and their impacts on man and the environment. One should realize however that this narrower view on monitoring seems to reduce a soil protection policy on soil contamination to a policy on chemicals. As monitoring of many substances will be required by the new EU policy on chemicals under the upcoming REACH program, there is no added value for a special soil monitoring program which only measures contaminants in soil. The added value of a soil monitoring program has to be found in it's relevance for soil protection, where soil is considered as a system where effects of many contaminants and pressures from other soil threats come together.

In addition, from a broader soil protection perspective, soil should be characterized by its functions as related to human land uses and its functions in ecological cycles that relate soil to air and water. Concepts like "Soil Quality" or "Soil Health" are providing an intellectual framework for discussion about this holistic and system-oriented view on the state of the soil (the S in DPSIR) and it's impact (I) on the three dimensions of sustainability (people, prosperity and environment) (see also the discussion on "soil health" and "soil quality" in the TWG research and on "soil as ecological capital" in the TWG organic matter). Unfortunately a fully operational set of indicators for Soil Health and Soil Quality is presently lacking, especially for the description of the state of the soil.

Concerning contamination and the evaluation or monitoring of the state of soil in terms of soil functions, measuring concentrations of contaminants in soil can only be a starting point. These measurements should at least be accompanied by measurement of the fluxes of the substances through the soil system in view of the system-oriented approach needed in soil protection. This means that inputs from atmospheric deposition, inputs from surface waters (sedimentation, flooding), inputs from land uses (agriculture) and outputs like leaching to groundwater, uptake by crop plants and if possible biodegradation should be measured. These accompanying measurements are also needed for practical reasons if we want to interpret the soil monitoring results. This will be described later. The approach should also be flexible enough to accommodate newer indicators based on the further development of soil heath or soil quality concepts.

4.2 Monitoring as perceived by the TWG contamination

TWG contamination has a broad view on monitoring as already expressed in their previous reports for the Advisory forum. The term "monitoring" is used in all reports as general term covering classical soil monitoring, multi-purpose monitoring, action-driven monitoring and regular reporting using various indicators or other type of information across the whole DPSIR chain.

"Classical monitoring" is the measurement of concentrations of substances in soil (monitoring of state). Multi-purpose monitoring and action-driven monitoring are defined in the Monitoring mandate. We consider multi-purpose monitoring as the monitoring of the state of soil for all threats to fulfil different needs, whereas action-driven monitoring is focused on the evaluation of policy measures against soil degradation. "Regular reporting" is the periodic communication of aggregated information resulting from national monitoring programmes, according to an agreed format.

The broader view on monitoring of the working group is not necessarily linked to the preparation of a directive but stems from the perception of the group about what a thematic strategy on soil protection should mean[4].
The development of a EU soil protection policy should be based on information about soils, about the impacts of human activities on soils and the success of policies to improve the situation. Some member states have soil protection policies in place and even specific soil protection acts are in force in Germany and the Netherlands. Experience in these states has shown that monitoring in the classical sense - the measurement at regular time intervals of concentrations of chemical substances in soils and their impacts on man and the environment - can be useful in the last stage of the policy life cycle[5].

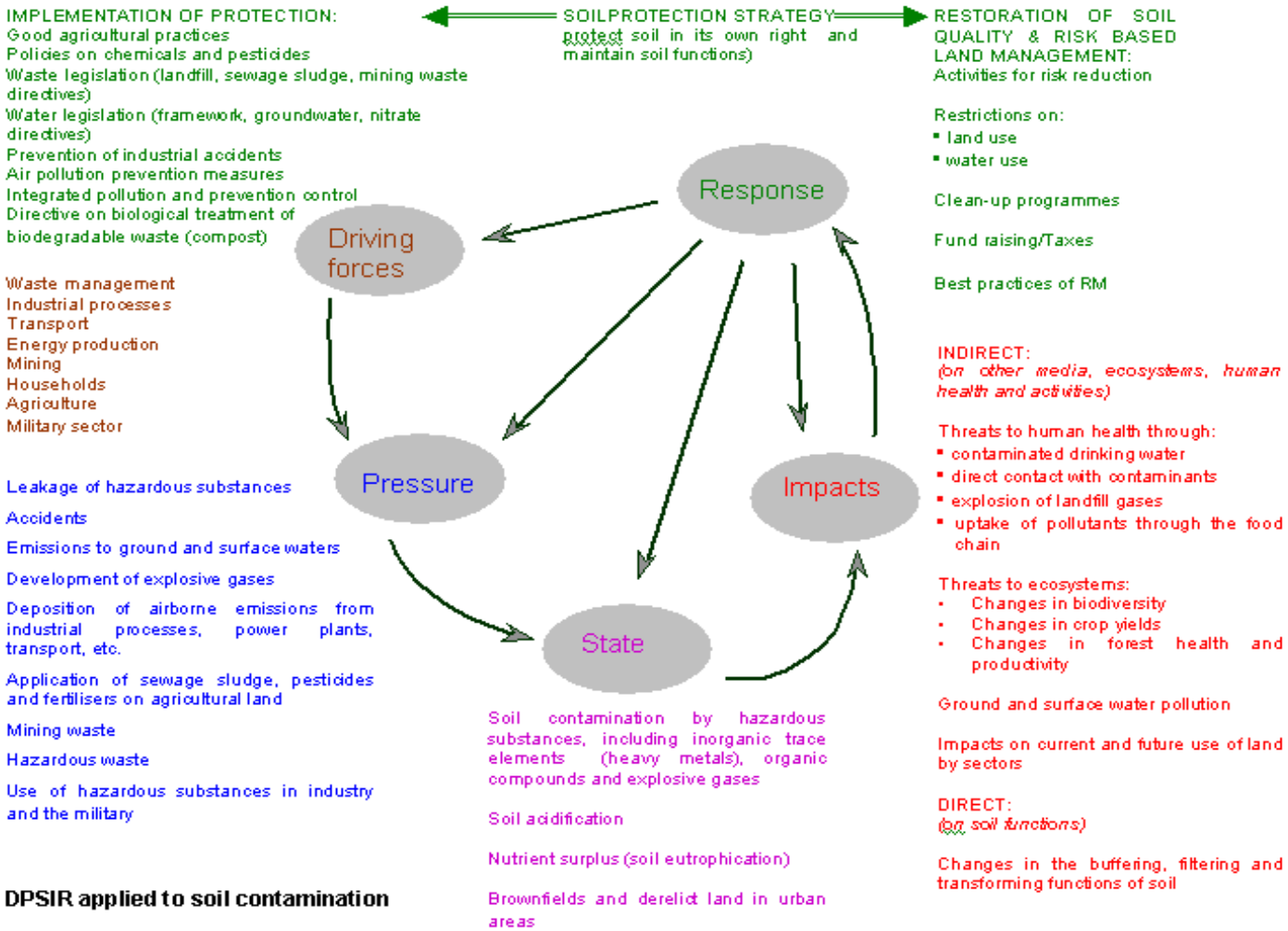
[3] This term is used in a general sense in this document. Programme effiency and cost benefit analyses and other indicators like the ones described in the EEA report "Environmental indicators, Typology and use in reporting" are considered to be covered by this term in the present document.

[4] According to this view the current discussion in the thematic strategy should result in a politically endorsed policy document describing the basic principles of EU soil protection in relation to the identified main soil threats. The main functions of such a document are:

- It serves as check for existing EU legislation to see whether it is protective enough for soil (and sediments) and may indicate the need for changes in this legislation
- It may indicate the need for new EU legislation in certain areas
- It provides a common basis for the development of national soil protection policies
- It provides guidance for setting priorities in policy related research
- It provides guidance for collecting and reporting and exchanging policy relevant soil information (inventories, monitoring, reports on policy performance indicators)

[5] The policy life-cycle. Generally the following stages can be distinguished:

1. Problem recognition
2. Policy formulation and implementation
3. Management and control


IMPLEMENTATION OF PROTECTION:
Good agricultural practices
Policies on chemicals and pesticides
Waste legislation (landfill, sewage sludge, mining waste directives)
Water legislation (framework, groundwater, nitrate directives)
Prevention of industrial accidents
Air pollution prevention measures
Integrated pollution and prevention control
Directive on biological treatment of biodegradable waste (compost)
SOILPROTECTION STRATEGY
protect soil in its own right and maintain soil functions)
RESTORATION OF SOIL QUALITY & RISK BASED LAND MANAGEMENT:
Activities for risk reduction
Restrictions on:
▪ land use
▪ water use
Clean-up programmes
Fund raising/Taxes
Best practices of RM
Response
Driving forces
Waste management
Industrial processes
Transport
Energy production
Mining
Households
Agriculture
Military sector
Pressure
Leakage of hazardous substances
Accidents
Emissions to ground and surface waters
Development of explosive gases
Deposition of airborne emissions from industrial processes, power plants, transport, etc.
Application of sewage sludge, pesticides and fertilisers on agricultural land
Mining waste
Hazardous waste
Use of hazardous substances in industry and the military
Impacts
INDIRECT:
(on other media, ecosystems, human health and activities)
Threats to human health through:
▪ contaminated drinking water
▪ direct contact with contaminants
▪ explosion of landfill gases
▪ uptake of pollutants through the food chain
Threats to ecosystems:
• Changes in biodiversity
• Changes in crop yields
• Changes in forest health and productivity
Ground and surface water pollution
Impacts on current and future use of land by sectors
DIRECT:
(on soil functions)
Changes in the buffering, filtering and transforming functions of soil
State
Soil contamination by hazardous substances, including inorganic trace elements (heavy metals), organic compounds and explosive gases
Soil acidification
Nutrient surplus (soil eutrophication)
Brownfields and derelict land in urban areas
DPSIR applied to soil contamination

It may have consequences for the adjustment or improvement of policies but it has never been used in the first stage of the policy life cycle, to convince politicians of the need for soil protection. The change of the state of soil over time is too slow, apart from changes resulting from changes in the use of the land or from sudden events like flooding. Significant and politically convincing changes may take half a century. Because many changes in soil due to contamination are very hard to reverse, we will have to conclude that prevention should have started 50 years ago. This is not a very effective way to raise the right awareness for the need of soil protection.

4.3 The need for information and monitoring in the EU thematic strategy for soil

In discussions about the Soil communication and the EU thematic strategy for soil the members of the European parliament stressed the need for general and policy relevant information on European soils. They asked for a catalogue of soil status, vulnerability, threats and pressures as a basis for future policy and decision-making. They also asked for a policy that prevents further loss of soil information for instance present in national institutes. Existing national soil maps should be harmonized and the use soil information for spatial planning and sustainable land use should be intensified. These are indeed the questions that are raised during the first stage of the policy life cycle.

The need of monitoring the state of soil has been mentioned in the TWG contamination report in relation with the management of large-scale diffuse pollution, as an element of the management and control stage of the policy life cycle, comparable to the national approaches. For such a management approach, which should address the soil-sediment-surface water and groundwater system, it is absolutely necessary that the fate and transport of the most important contaminants are known, and are followed in time. On the basis of this information models can be designed that permit the optimization of abatement scenarios for diffuse sources.

In contrast to national soil protection approaches that developed gradually and where the various stages in the policy life cycle do show a nice sequence, the development of EU soil policy appears to be a mixture of stages. There is a need for information from inventories and surveys to justify further actions at EU level (first stage in the policy life cycle). There is an existing body of EU legislation already addressing soils which may need fine-tuning (last stage) and new legislation is being formulated (intermediate stage in the policy life cycle). Because we have to address all stages simultaneously in the soil thematic strategy, there is a very large demand for all sorts of information, but this should not imply that the tools for the collection and management of information loose their original policy life cycle dependent purpose. Monitoring in the classical sense will always remain a tool for answering policy questions from the last stage almost exclusively.

Given the large demand for information to support an EU policy one may have different views on a monitoring directive:

1] A directive that forces the member states to monitor concentrations of contaminants at regular intervals in soil (monitoring in the classical, narrow sense of the word). This will be a technical directive.

2] A directive organizing the flow of all policy relevant information for an EU soil policy. This is a directive which sets rules for data ownership, describes competences for organizations involved in collecting, analysing and reporting information and provides a framework for further harmonization of national reporting of DPSIR for soils. It may (of course) also contain instructions for classical monitoring but the emphasis of the directive is on information management procedures.

A technical directive has the possible advantage of being very concrete in the sense that methods of measuring contaminants in soils are available and standardized. But the big disadvantage is that other DPSIR information on soils, which is needed for EU policy purposes, is not addressed and may be labelled as “less relevant” because it is not included in THE directive.

4.3.1 National inventories

The completion of national inventories follows today different approaches according to criteria and definitions established in national policies and to resource allocation strategies. As an example some legislative frameworks addressing soil contamination do not include sites used for agricultural use. In some Member states soil inventories are not explicitly focused on contamination, but e.g. on soil fertility or environmental status of soils due to different national priorities. Some soil inventories are established only at the regional level which is the effect of legal responsibilities.

In order to register suspected contaminated sites, affected by local contamination, it is a general policy to conduct a preliminary survey on existing soil polluting activities and activities that have taken place in the past, including an historical investigation on the site use. This activity may be performed at the regional scale and collected in the national register. The following step envisages the setting of priorities for selecting sites where a preliminary site investigation is needed. This investigation may lead to the definition of the site as contaminated. According to other policies only the following main site investigation and site-specific risk assessment decides upon the status of the site and its remediation requirements.
These two levels of inventories, suspected contaminated sites and confirmed contaminated sites, should generally be kept at the national level. More detailed inventories may record the different activities carried out on the sites and their abandoned/active state in the case of industrial or waste disposal sites.
Inventories of contaminated sites, generally do not include sites where naturally occurring substances are present at anomalous levels, except if they are concentrated by industrial activities, e.g. mining exploitation.

In order to get national information on soils affected by diffuse contamination, several approaches are used, direct and indirect ones.
Direct approaches are soil inventories based on systematic grids or representative site selection carried out once, often intended to be done more frequently in order to monitor the changes of soil conditions over time. Regarding diffuse soil contamination national or regional soil inventories across Europe are often focussing on soil properties like pH or base saturation and total contents of heavy metals, but less on organic compounds and bio-availability of these contaminants. Apart from these common objectives on the measured parameters, there are a lot of differences in the methodology. Indirect approaches to identify diffuse inputs to soil are necessary are to measure atmospheric deposition, e.g. with air monitoring or with moss monitoring technique. If lacking of

these measurements, deposition rates will be modelled using transfer functions based on emissions of contaminants.

4.3.2 Comparability of existing data

For soil contamination, work on development and population of indicators at the EU level has generally been limited to the collection of 'country level' information for local contamination. Several exercises have been carried out to define indicators and to collect data at 'regional' and 'province levels' (NUTS 3 level[6]), with the purpose to reach a higher detail, trace variations within countries and regional areas and to identify 'hot spots'.
Concerning data quality and comparability the results obtained so far show large heterogeneity (lack of comparability) in the gathered data at country level as well as at higher spatial detail. The major reasons are the following:

- Progress in the management of soil contamination, and the knowledge base, is very different among countries and, in some countries, among regions. This is mainly caused by the different start of relevant policies in the different countries: some countries have enforced relevant legislation one or two decades earlier than others. At a regional/provincial level larger variability is due to non homogeneous administrative procedures in place that may be highlighted whenever planning/remediation/and licensing rests on local authorities responsibilities.

- Different legal frameworks are adopted in the different countries. This means that policies may differ in many aspects, first of all by setting different political and environmental targets and as a consequence in different definitions of 'contaminated ' and 'cleaned-up or remediated site'. Different technical criteria used in site investigation and application of management solutions may also vary from country to country.

For these reasons indicators, even when derived by aggregated data, may give responses that are difficult to compare and perhaps of questionable use in policy making decisions.
There is then a general need to achieve a higher harmonization in the quality of the information provided by the indicators, and in the data collected behind. This can be achieved by using standardised definitions, specifying the data that are required and the standardised methods of sampling and analysis to be used for acquiring them. The following tools are recommended:

- provide guidance and relevant technical guidelines

- establishing an EU information and monitoring system able to trace soil contamination state and trends at different spatial levels.

Concerning monitoring of diffuse soil contamination we see that different sampling designs and methods as well as different analytical methods for the same parameters are used, even within a country (with regional inventories). Furthermore the monitoring frequency varies very much between the countries, but also within countries (different levels of monitoring or regional decisions). Further standardisation of methods would help to improve comparability but this is not so essential if monitoring schemes are designed to answer the same policy question. The methods used may be different but the conclusions reached on the basis of results from different monitoring schemes may still be consistent. It should be investigated whether the current national monitoring approaches can already lead to harmonised conclusion without complete harmonisation of the methods used.

[6] NUTS is the Eurostat nomenclature for the territorial unit

4.4 Monitoring proposals from TWG contamination

4.4.1 Action-driven monitoring - a general approach to monitoring and reporting of soil contamination

Use of indicators as aggregated information

Indicators simplify information that can help to reveal complex phenomena." Indicators should be related to policy-relevant questions and help evaluate specific measures by describing the situation at certain time intervals and showing changes over time. Indicators are usually based on a number of single parameters which are combined according to a specific methodology. [7]

The use of indicators at EU level for monitoring the state of the environment and temporal trends is a consolidated practice. It is used to assess the state and the trends in the environment, analyse the impacts of economic activities and provide information to help framing, implement and evaluate policies. Indicators are developed and data collected and updated on a regular basis for the major environmental areas or topics.

The design of a system of indicators should be implemented through a dynamic and flexible cycle. The system could be built on systems already in place both at the European and national level. It should fulfil known requirements, mainly based on a number of already available and comparable data at the different spatial scales. Long-term needs should also be identified to plan activities over a wider time scale. The use of the DPSIR assessment framework will be of great help to integrate information on all related soil threats and environmental media. It can be used not only to identify linkages between degradation of soil and its impacts on other media, but also identify the connections between different soil threats (e.g linkages between soil sealing, soil erosion and hydro-geological risk).

The main elements of a proposal on a general approach to the monitoring and reporting of soil in the EU, as applied to soil contamination in particular, are listed below.

1. The implementation of the soil information and monitoring system on soil contamination should follow a progressive upgrade in terms of quality and

[7] Example for an aggregated indicator: heavy metal load in agricultural areas due to application of sewage sludge application.
Policy question: How big is the extent of agricultural land treated with sewage sludge and how high is the heavy metal input in these areas. Necessary input parameters are:

- amount of sewage sludge used in agriculture
- amount of sewage sludge applied per ha
- heavy metal content in sewage sludge.

quantity of information collected. The system architecture and individual data collection items will be updated along with the improvement of the information basis that will be available with the enforcement of a harmonized EU Soil Protection Policy.

2. The system should be built on systems already in place both at the European and national level.

3. The system design should be implemented following a dynamic and flexible nature and devised to fulfil short-term requirements, mainly based on a number of already available and comparable indicators and parameters at the different spatial scales. Long-term needs should also be identified.

4. The monitoring and assessment system of soil contamination should be based on the following elements:

   a. Action-driven monitoring

   b. Identification of relevant indicators and related data needs

   c. Integration with existing European monitoring and reporting activities

   d. Integration of local and diffuse contamination

   e. Streamlining (not extensive multi-purpose monitoring but based on specific policy needs)

   f. Tiered approach, according to the following geographical levels:

      i. Country
      ii. Catchment (regions of natural boundaries)
      iii. Site-specific-European Level (full EU coverage limited to pressures; detailed monitoring limited to problem areas)
      iv. Site-specific- national Level (limited to guidelines for national inventories))

   g. Step-by-step implementation and harmonisation (gradual implementation and learning by doing)

   h. Guidelines for national monitoring (data collections activities, national inventories, etc.).

5. The Driving Forces-Pressures-State-Impacts-Responses (DPSIR) assessment framework should be used to identify and prioritise the policy-relevant indicators to include in the system.

4.4.2 Classical monitoring

The present section will provide some recommendations for classical monitoring and give further details on the choice of substances to be monitored. So in this section the term “monitoring” will refer to measurements of concentrations of substances in soils at regular intervals . If soil measurements are not intended to be repeated, we may use the terms ‘Inventory’ or ‘Survey’. Other policy relevant information which has to be provided at regular time will be denoted as “reporting”. In this terminology, “action driven monitoring of policy performance indicators” will be labelled as reporting. There is a strong relation between monitoring and reporting, because policy performance indicators may use information from local monitoring schemes. Indicators can also be used to combine and evaluate the data deriving from classical monitoring schemes and provide conclusions in a format more accessible to policy makers. To make this relation clearer, the use of monitoring in the basic soil protection strategies for soil contamination, which were introduced by the TWG contamination, as well as the needs for aggregated information, will be briefly described. This will lead to the conclusion that monitoring as defined above is only useful at the EU level for large scale diffuse inputs and contaminated regions (megasites).

4.4.2.1 Local sources

The preventive strategy aims at the application of technical measures that prevent contaminants from entering the soil system at sites where activities entail such a risk (like industrial facilities, underground storage, waste disposal sites, etc). Monitoring systems (measuring concentrations of substances that are relevant in view of the risk activity, in soil and groundwater) are designed to detect failure of the technical preventive measures as fast as possible. Results of this type of monitoring are very specific and less relevant for a general impression of the state of the soil (or groundwater) with respect to contamination. The data may be useful for some exploratory data analysis but not for reporting to EU and even national authorities. Reporting about local sources will make use of more aggregated information like failure frequency of specific preventive technologies or general policy performance indicators.

4.4.2.2 Contaminated land management

Measurements of contaminant concentrations in soils are needed to assess the risks of contamination. These measurements are not intended to be repeated in most cases, so they should be considered as local inventories. These local inventories may be used to draw soil contamination maps, which may be useful for local spatial planning in view of land use restrictions due to contamination. Sometimes it is not possible to restore a contaminated site for some intended use. Risk management plans will promote measures and actions suitable for improving the situation gradually and for avoiding unacceptable human health and ecological risks. Long-term risk management plans often require monitoring. The monitoring will be specific for the site and of limited representativity, unless there are a larger number of similar sites. Only for very large sites (megasites), where risk management plans are at the regional scale (like for instance “the Kempen” in NL and the Flemish region, the old coal and steel region in the North of France, or the Bitterfeld area in Germany), reporting of monitoring data may be of EU interest. EU relevant information about contaminated land problems and solutions will be reported in the form of policy performance indicators. Data on concentrations of contaminants at individual sites (there may be more than 1.000.000 sites in EU) make little sense for EU policy discussions.

4.4.2.3 Sources of contamination resulting from agricultural practices

The preventive strategy for contamination from agricultural land use should be based on a long-term balance approach. To balance inputs and outputs at a

farm scale, some information on the concentrations of contaminants in soil and the nutrient status of soil is useful for managing purposes. Sometimes a soil investigation is required before the application of organic waste as fertilizer, like sewage sludge. Collecting these data may also be useful for scientific purposes, to improve conceptual models of substance flows in agricultural systems. A number of farming systems maybe monitored through EU and such a monitoring system may help to improve GAP (good agricultural practice).

Given the large number of farms in EU it will be expedient to aggregate all information in policy performance indicators or sustainability indicators for reporting to EU.

It should be noted that plant protection products although applied to plants or soil are more often monitored in plants and groundwater than soil, as required by the Pesticide (91/414/EEC), Drinking water and Water Framework Directives. In some cases (risk areas) monitoring the amount applied to soil may be useful but additional information is required to relate this to potential environmental impacts, such as described in Directive 91/414/EEC. Hence it would be relevant to monitor certain of these products in soil solution as well.

4.4.2.4 Large-scale diffuse pollution

This is the policy area where monitoring is of utmost importance and relevant at EU level because of the transboundary nature of large scale diffuse pollution. Monitoring the fate and transport of potential contaminants through environmental media will help us to find the best national and regional abatement strategies. These integrated environmental assessments will also indicate our success. Because all environmental compartments are involved, soil and sediment monitoring should be linked to monitoring of surface water as required in the Water Framework Directive, monitoring of groundwater, as required in the Groundwater directive and also linked to air pollution monitoring. A number of soil monitoring networks already exist in member states. The EU monitoring system could use already existing networks as a starting point. Even if the methods used differ between networks, the conclusions may still be consistent.

4.4.2.5 Which substances should be monitored?

In order to specify the requirements of monitoring in relation to diffuse inputs the task group on Diffuse Inputs of the TWG contamination defined monitoring as follows:

Monitoring should focus on the abatement of (current and future) effects due to diffuse inputs, but should include effects of measures to reduce inputs as well.

It will be clear that monitoring a few thousands of substances that may enter the soil system by diffuse contamination is not feasible. Even the selection of high production volume chemicals by OECD covers 4000 substances. We need to set priorities and consider only those substances which may reach critical limits in soil in view of human heath, food safety, soil fertility, ecological risks especially concerning biodiversity in soil, groundwater and surface waters. Monitoring should only be done where there are real concerns (risk areas) rather than a routine grid sampling. The following paragraph will list the choice of high priority substances for monitoring diffuse soil contamination and will give some justification for their choice. The substances listed are minimum requirements for consideration. More substances may be added if they are of general interest but these will increase the costs of the monitoring. Furthermore parameters related to acidification, like pH, cation exchange capacity and base saturation should be considered. These parameters are also relevant for other threats and give some information on bioavailability of substances.

Cadmium

This contaminant is often discussed in relation with food safety issues. It readily accumulates in crops especially in acidic soils with low binding capacity. Exposure risk due to soil ingestion is less critical although recent investigations in the Kempen area (NL and Flemish region) indicate that exposure through indoor dust (soil related) is as high as exposure due to consumption of homegrown vegetables. In slightly acidic soils with low binding capacity there is a high risk of leaching to the subsoil and the groundwater.

Copper

Copper is an essential element for life but it is also very toxic. Ecological risk assessment is difficult for this element since generic safe levels derived from toxicity tests are below the levels necessary to sustain life in less sensitive organisms. Experience with the assessment of ecological impacts may improve if copper is monitored in soil in conjunction with biodiversity indicators. There is some concern of acute toxicity in children due to ingestion of soils containing only moderate levels of copper contamination[8].

Lead

Although emissions from lead to soil are decreasing, it is still a substance of concern given the amounts of lead stored especially in organic layers of topsoils. Effects associated with soil ingestion by children are well known. Critical levels in soil (based on total concentrations) for long-term exposure are often exceeded in urban areas, although bioavailability may be low. There is some concern of acute toxicity in children due to ingestion of soils containing only low levels of lead contamination [4].

Zinc

Zinc is an essential element for life but it is also very toxic for micro-organisms leading to a decreased decomposition of organic matter. Ecological risk assessment is difficult for this element since generic safe levels derived from toxicity tests are below the levels to sustain life in less sensitive organisms and even lower than background levels. Experience with the assessment of ecological impacts may improve if zinc is monitored in soil in conjunction with biodiversity indicators and assessments of soil decomposition processes. Also zinc deficiencies related to crop production could be identified.

[8] Calabrese, E.D., Stanek, E.J., James, R.C. & Roberst, S.M. (1997). Soil Ingestion: A Concern for Acute Toxicity in Children. Environmental Health Perspectives, 105, 1354-1358.

Mercury

Mercury is very toxic, mainly accumulates in soils and sediments, but can be transformed into mobile fractions (e.g. methyl mercury). Hg is prioritised in many environmental programmes at EU level (Heavy metal protocol of CLRTAP, Sewage sludge directive, proposal for biowaste directive, strategy for health and environment) and also national level. Unfortunately it is difficult and expensive to measure.

Arsenic

In many areas in the EU natural high concentrations of arsenic exist in soils. Arsenic accumulates in soils (mainly linked to iron oxides). The risk of leaching to groundwater is usually low, as is bioavailability. This may change however after a change in soil conditions or after ingestion by humans (especially children) [8] and grazing animal. Arsenic is to be considered as a priority element within the strategy for health and environment.

Nickel and Chromium

Although these metals are less "critical", they can be included in routine monitoring since they can be measured together with the metals mentioned above in an ICP scan.

PAH

This group contains a number of known carcinogens. PAH concentrations do show a long term upward trend in soils since the beginning of the previous century according to results obtained at Rothamsted in UK. Human health risks associated with soil ingestion already occur at moderate contamination levels (above 40 mg/kg for the sum of 10 PAH in the NL).

Dioxins, PCB and other substances with dioxine-like behaviour

Dioxins are considered the most dangerous substances. Many other substances like some PCB's have a similar mode of action. PCB's are a burden of the past and especially of concern in sediments. Measuring dioxins (including furans) in soil is expensive but individual substances relevant according to WHO guidelines should be considered.

Other PCBs

PCBs related to certain products should also be considered. Combustion of these products may cause emissions of PCB's, which can accumulate in the environment. Usually the 6 congeners of Ballschmiter are analysed. However they should be given less priority than the PCB's with dioxin-like mode or action.

HCH, DDT/DDE

These banned pesticides are very persistent and are now ubiquitous in soils. Monitoring will indicate whether biodegradation is occurring and whether further dilution of these substances does occur. DDT and DDE are also of concern since they are slowly transported by air and bioaccumulate in polar animals. Monitoring will also point out how much of these persistent substances have to be accepted as "background levels" for the next century.

The Nitrogen cycle

Various forms of nitrogen should be measured as input to soils and as concentrations in soil in view of prevention of eutrophication of surface water, prevention contamination of groundwater, acidification of soils. There is some concern about long-term health effect associated with changes in the global nitrogen cycle.[9]

Phosphate

In view of leaching of phosphate to groundwater and the risk of eutrophication of surface waters, it would be useful to monitor the degree of phosphate saturation and the water soluble fraction of phosphate which gives information on actual P availability in case of high P supply in soils used in agriculture. Because the impacts of high P supply are restricted to agriculture this monitoring can also be considered as "action driven".

4.4.2.6 Putting monitoring of substances of soil into practice

Results from a monitoring programme should enable the user to:

1. Evaluate the impact (= quantity and quality) of diffuse inputs in relation to other inputs (e. g. what is the contribution of atmospheric inputs compared to inputs by manure?). This will, later on, steer the measures to be taken to reduce inputs according to relevance.

2. Evaluate the future state of the system, i.e. how does the current land use (or changes thereof) affect soil quality. Again, soil quality in relation to crop growth, water quality, ecosystem etc. This means that input output (balance) approaches are needed that are able to calculate fluxes into (inputs), within (processes) and out (outputs) of the system. Based on the outcome of these balance approaches, inputs can be reduced or effects can be reduced (accept a certain input but make sure effects are negligible, e.g. by additional liming).

This calls for integrated monitoring where not only soil aspects are important but even more so, accurate measurements of quantity and quality of in- and outputs and processes in the soil system itself that affect the behaviour of substances. This is important because an increase or decrease of a concentration of a substance over time will not tell us much about the reasons behind this change. It will be clear that the interpretation of trends in the concentration of substances in soil indeed requires additional information.

It may be worthwhile then to measure total concentrations and bioavailable concentrations, and to measure concentrations in pore space water to assess the mobility of the identified substances. In addition a number of soil parameters should be measured which control the fate

[9] Townsend, A.R, et al. (2003). Human health effects of a changing global nitrogen cycle. Front Ecol Environ 2003 1(5): 240-246.

and transport of substances in soils and sediments. Soil Organic Matter (stable and dissolved), pH, CEC, soil texture and redox-potential are the most important ones.

As soil monitoring pertains to repeated measurements in time it is necessary to specify the frequency of the measurements. Concerning the metals and organic contaminants listed above most changes are likely to be slow. A sampling interval of 10 years and more seems adequate. On the other hand substances like N and P and the inputs or outputs of contaminants to the soil system may change faster. A sampling interval of 5 to 10 years may be a good compromise if all parameters need to be measured simultaneously. If more knowledge of the dynamics of the various parameters is available, the sampling frequency could be adjusted accordingly for each group of substance.

The extrapolation of observations at a single point to a larger area is an additional problem to consider. To be representative for EU soils, a monitoring network should cover the major forms of land use, climate, hydrological regime and soil type, as strata in a stratified sampling design. Although monitoring could be done on an arbitrary grid basis, it is not very efficient to consider soil as a black box system and ignore that land uses, soil types, climate and hydrological regimes are major factors determining the influence of diffuse inputs on the state of soils. Stratified sampling is much more powerful in this case because it addresses these factors explicitly and will make interpretation of data much easier.

Since several soil monitoring networks already exist within different countries, harmonisation of *what* and *how* is being measured seems a good start to use existing information at the EU levels. However the limitation of such a network is that the designated sites might diverge from the rest of the country.

4.5 Concluding remarks

Methods for measuring concentration of contaminants in soil and a number of important soil characteristics like CEC, organic matter content and pH are available and even standardized by ISO. CEN is in the process of adopting ISO standards for soil as European standards. However it should be noted the difficulty that in many cases there is more than one standard method for measuring a parameter. The interpretation of the results of this type of measurements in a monitoring program is less straightforward however. A large amount of additional information must be available to interpret the results in a meaningful way for policy making and policy evaluation. On the other hand, performance indicators used in “action-driven monitoring” or reporting (in the sense described in this paper) are less well standardized and may have different meanings in different countries. They are of interest since they reflect the political perception of certain soil problems by member states. They also have one big advantage over classical monitoring data: their ease of interpretation.

Monitoring and reporting approaches need to evolve into a more harmonised EU information management framework. EU Monitoring has to start with aggregating the already existing monitoring schemes as much as possible and will identify the need for harmonisation and additional monitoring information for the interpretation of the results. Reporting has to start by using already defined program performance indicators and will have to accept some differences between member states. As policy will become more uniform due to the EU soil strategy, policy implementation differences between member states will gradually disappear and policy performance indicators will become more comparable.

So, both for monitoring and for reporting, we need to accept that the first results will give a rather blurred image of the DPSIR for soil contamination. But the quality of the information will improve gradually if information exchange and harmonisation of approaches is stimulated.

5 CROSS-CUTTING ISSUES

According to the mandates cross-cutting issues are to be dealt with by all technical working groups. Due to this fact there may be some overlaps of the following with text of other working group reports, although here it was tried to focus only on issues linked to soil contamination.

5.1 Basic definitions

The TWG Contamination considers soils as a part of the soil-water-sediment system which requires an integrated approach concerning protection against the threat of contamination, towards a sustainable use of its resources and ecological services. There exist direct relationships between the compartments soil, water and sediment because of several fluxes of substances and energy. Processes like leaching and weathering are involving the whole system. Contaminants (heavy metals, POPs) deposited on soils are often accumulated, but under specific conditions they can be transferred through the whole soil-water-sediment system. On the other hand heavy metals naturally inherited in bedrock can be transferred into the soil compartment and released by leaching. Furthermore the process of erosion can contribute to contamination of water-sediment systems (e.g. in alluvial areas).

Soil contamination can occur under all land uses (due to atmospheric deposition), but most likely in soils under urban and industrial use. The timeframe of the process of contamination is very different depending on the land use (industrial accident vs. low atmospheric deposition in natural areas) and also its perception. Therefore all kinds of (past and present) land use have to be addressed when assessing soil contamination and defining appropriate measures to remediate or prevent contamination. Land use planning should take into account the status of soils and consider a suitable land use distribution at the local and regional level to avoid soil contamination in sensitive areas (e.g. no placement of potentially polluting industrial facilities near playing grounds or arable land). Already contaminated land should be used for specific land use for which contamination does not matter (e.g. reuse of brownfields for trade and industry areas) under the precondition that harm to the wider environment (e.g. groundwater) is not expected, or should be restored for intended uses and functions

Conclusions: Protection against the threat of contamination has to consider the whole soil-water-sediment system and all kinds of (past and present) land use have to be addressed for the definition of appropriate measures.

5.2 Climate change

Climate change will result in significant change of weather conditions (e.g. more often heavy rainfalls) which will have influence on run-off and consequently on soil erosion. Due to erosion of soil particles adhering nutrients and pollutants will be transported from one field to another

or even into nearby surface water. This movement can contribute to or cause eutrophication and contamination of soils and also water courses. It can be expected that distribution of precipitation will change spatially and temporally. This could affect the water flow through soils and change leaching conditions of pollutants.

Furthermore climate change will cause changes of land use which will have influence on the situation of soil contamination. Forests are filtering more airborne pollutants than agricultural vegetation does which are deposited on the soil. Agriculture requires fertilisation which can be achieved by application of different materials (mineral fertilisers, manure, slurry, compost, sewage sludge) containing certain amounts of contaminants. Their accumulation in the soil depend from various factors, among them the content of organic matter. This factor has a relationship to climate change because soils have a potential as a carbon sink and can therefore reduce the concentration of carbon dioxide in the atmosphere which contributes to the climate change.

Conclusions: Effects of climate change on the impacts of soil contamination will be caused by changes in the water flow and organic matter status of soils. This will in turn influence the fluxes and the bioavailability of contaminants. The conclusions from the EU funded Chemical time bomb project (1991) are still relevant in this respect and need to be further explored to yield reliable scenarios in view of decision making.

5.3 Environment and health

It is estimated that around 25-33% of the total burden of the diseases in industrialised countries can be attributed to environmental factors (WHO, 2002).

Health impacts derived from soil issues may occur in different ways. Exposure pathways are either directly through the ingestion of soil or indirectly via leaching through the soil into groundwater or surface water, release into the atmosphere or uptake by plants and animals causing an accumulation in the food chain. Especially children and vulnerable groups, such as poor and women in reproductive age are the critical population for environmental pollutant exposure.

Exposures to substances like lead, mercury can lead to mental or physical disabilities of infants. Chemicals like endocrine disruptors, can also act like hormones and disrupt the way of body functions with adverse effects a reproductive capacity.

Most examples of ill health associated with the soil are caused by concentrations of elements in food or water that are either deficient or toxic. Their concentrations might reflect the natural condition of the soil, or the effects of people's activities, such as pollution. In isolated subsistence communities distinct relations between elements and the aetiology of diseases can be identified. Examples include Keshan disease caused by selenium deficiency, and itai-itai disease caused by excess cadmium.

Even if people do not come in direct contact with soils dust particles due to wind erosion can also affected human health. The suspended particulate matter involved in dust contamination ends up making its way into the ambient air and other environmental media causing negative impacts to human health.

Some of the relations between soil and health are uncertain and the causes assumed, and they require further research to validate them. Currently a European Environment and Health Strategy is under development which aims to achieve a better understanding of the environmental threats to human health to identify the disease burden caused by environmental factors in the EU and to plan policy responses to the challenges that emerge. Although the cause-effect relationships are not all known a strong link between the two strategies is recommended, also concerning monitoring and information systems.

Conclusions: Apart from the clear human health risks associated with heavily contaminated areas the relation between soil contamination and human health is rather vague. In view of the uncertainties of the cause-effect relationships between soil health and human health a strong link between the Soil Thematic Strategy and the Strategy on Health and Environment is recommended.

5.4 Biodiversity

The biodiversity issue is mainly dealt with by the TWG Organic matter. As regards soil contamination this threat can have a significant influence on biodiversity, in particular soil biota. According to ecotoxicity tests specific species of micro-organisms and also plants show negative effects above a certain concentration of heavy metals in soil, especially in the soil solution. This NOEC toxicity data is used in eological risk assessment of soil contamination and in defining critical limits used for calculation of critical loads of heavy metals in order to protect the most of the ecosystems (Hettelingh et al., 2002). Also eutrophication and acidification can be assessed by a quite similar approach. Enhanced concentration of nitrogen and hydrogen protons respectively can change occurrence and abundance of plants and microbiota. This can have further implications on plant uptake of nutrients and pollutants as well as soil processes like mineralisation.

Conclusions: There is clear evidence of adverse effects of soil contamination on soil biota and plants. Methods for ecological risk assessment should be further developed and further research is needed for implementation of specific indicators concerning the protection of biodiversity.

5.5 Role of land use planning policy

As mention already before land use planning has an important influence on the soil status and consequently on the content of contaminants. For certain kinds of land (arable land, grassland, pastures, forest) suitable assessment methods on the status of soils have been developed and can be used to identify the suitability and capability of soils for these land uses. As regards urban areas and its specific land uses (e.g. infrastructure, trade and industry, playing grounds, recreation areas) and soil forming processes (e.g. refilling of excavated soils) such evaluation methods have been developed within the contaminated land risk assessment framework (See CLARINET and CARACAS reports, www.clarinet.at). Specific soil characteristics and functions (e.g. water retention capacity, compaction, stability, filtering capacity, soil biological processes) are relevant for these assessments and drive the suitability for certain soil uses. The need for land in urban areas is high and causes a high degree of competition. This situation requires a carefully land use planning based on appropriate methods. Synergies with the urban thematic strategy are needed in this respect. The role of land use planning in

contaminated land management has been intensively discussed during the CLARINET project. The CLARINET report contains many suggestions for improving the synergy between land use planning and environmental concerns.

Conclusions: Land use planning should consider soil contamination, in particular in urban areas which show the need for consideration of soil degradation in the urban thematic strategy.

5.6 Role of agriculture and forestry in revitalising soil

As regards soil contamination different measure for revitalising soils will have influence on the level of contamination in the soil. Application of different pesticides, soil improvers and fertilisers can cause accumulation of pollutants in the soil if no proper application is carried out. Guidelines and regulations are useful and further needed in order to avoid mismanagement with these materials (e.g. regulations and directives concerning pesticides, fertilisers, sewage sludge and biowastes). More general rules on agricultural management for the conservation of a good agricultural and environmental condition are given in EC Regulation 1782/2003 in order to receive direct financial support under the common agricultural policy. These rules should also consider best practices for avoiding soil contamination apart from the basic requirement to comply with the Sewage sludge and the Nitrate Directive (e.g. suitable application of manure and reduction of feed additives).

Beside regulations and directives there are other instruments like agri-environmental programmes in place which give incentives for certain soil conservation practices (e.g. promotion of organic farming, reduction of fertilisation, renunciation of pesticides). The acceptance of certain measures to avoid soil contamination could be promoted.

Conclusions: Guidelines and regulations for materials applied to agricultural are useful and further needed in order to avoid contamination, but also incentives are suitable to enhance soil protection, e.g. by reducing input of pollutants into soils.

5.7 Co-ordination of the world-wide dimension

Due to the fact that contamination is mainly caused by localised input of contaminants into soils, there is no big need for co-ordination of the world-wide dimension, except for large-scale diffuse contamination due to atmospheric deposition. In relation to the latter there exists the Convention on Long-Range Transboundary Air Pollution (UN-ECE CLRTAP). According to its protocols for heavy metals and persistent organic pollutants the member states have committed themselves to reduce emissions of these pollutants in order to protect ecosystems. Relevant data have to be provided on a regular basis. Currently the discussion on which organic pollutants should be included in the reporting obligations is ongoing. The evaluation is based on a comparison of calculated depositions and critical loads which would protect certain ecosystems by 95% of the area. It is strongly recommended to develop synergies between the soil strategy and this convention. This can help to reduce diffuse inputs, but also to avoid repetitions and double national reporting (i.e. ask countries to provide same information twice or more).

Conclusions: Regarding large-scale diffuse contamination it is strongly recommended to develop synergies between the soil strategy and the Convention on Long-Range Transboundary Air Pollution.

5.8 Awareness, communication and participation

Awareness raising on soil issues is very important in order to avoid soil contamination. Often there is a big delay between occurrence of contamination and perception of it. Awareness helps to implement regulations and encourage landowners to protect their soils. In case of historical contamination awareness and information by local authorities can be very helpful, in particular if buildings for living are erected on contaminated land. Mediation processes can help people to cope with the situation and their fears. Furthermore consideration of soil issues in processes of the local agenda 21 would give citizens the possibility to actively participate in soil protection.

Due to the fact that all people are in contact with soils in some way (e.g. landowners, recreation areas) and many of them can cause contamination, education in soil issues is needed. Education can be achieved by integration in lessons at school or adult education, by internet platforms or more specific by training courses for entrepreneurs and its employees.

In urban areas there is a high competition for the available land and also a lot of contaminants are produced or imported from other areas. Sustainable and efficient use of soils is therefore necessary. Urban administrations should perceive this and set some supporting measures (e.g. sealing tax, guidance for proper treatment of private gardens) and incentives (e.g. reuse of derelict land). At European level an initiative called European Land and Soil Alliance has been founded already with the aim of making an active contribution to sustainable soil use in communes.

In order to derive the information for dissemination a lot of detailed data are needed, in particular concerning soil contamination. Often the data gathering is time consuming and costly. So the data should be available for multi-purpose use, but the dissemination has to be carried out in a differentiated way according to the audience. Meta information and aggregated information should be made accessible for a wider audience, but site-specific information (raw data) should be restricted to experts because otherwise there is a high risk of misinterpretations. Furthermore the problem of data comparability from different data sources has to be taken into account and tried to be solved as much as feasible. In this context the requirements for INSPIRE need to be defined.

Conclusions: Awareness raising on soil issues is very important in order to avoid soil contamination. Therefore provision of information is recommended using different tools adapted to the audience to be addressed.

5.9 Property rights related to soil and soil data

Data on soil contamination are mainly sensitive information and can have negative implications on landowners and are therefore often under restrictive accessibility. On the other hand potential buyers of land

want information on it in advance. It is recommended that a report on land status should be drawn by the landowner (or his expert consultant) for the new owner and the competent public authority upon any transaction of land property according to requirements and instructions of the competent authority. According to the Aarhus Convention the public should have the right to have access to environmental data. Therefore data should be available to the public if a contamination becomes public interest (e.g. contamination of playing grounds, groundwater). Accessibility of data owned by the private sector should be regulated at the national or regional level.
Another fact that affects data accessibility in practise is costs that have been spent to gather data and the administration of soil data in Member States depending on their structure (responsibility for soil issues at national, regional or local level). Nevertheless data owned by public administrations has to be made publicly available (Directive 2003/4/EC). Soil information systems accessible by internet can provide such services.

Conclusions: Data owned by public administrations has to be made publicly available, but also private data in case they are getting of public interest due to risk of damage to the environment.

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CONTAMINATION AND LAND MANAGEMENT

Task Group 1 on
THE STATUS OF CONTAMINATION IN EUROPE

1 EXECUTIVE SUMMARY

In many areas of Europe, soil is being irreversibly lost and degraded as a result of increasing and often conflicting demands from nearly all economic sectors.

In Western Europe (WE), pressures result from the concentration of population and activities in localised areas, economic activities and changes in climate and land use. Air depositions and cultivation systems are among the most important influences on the quality of soils in agricultural and natural areas. Consumer behaviour and the industrial sector are contributing to the increase in the number of potential sources of contamination such as municipal waste disposal, energy production and transport, mainly in urban areas.

In Central and Eastern Europe (CEE), many of the problems stem from past activities and poor management practices.

The combined action of these activities affects quality and limits many soil functions including the capacity to remove contaminants from the environment by filtration and adsorption. This capacity and the resilience of soil mean that damage is not perceived until it is far advanced.
This partly explains the low priority given to soil protection in Europe until recently. Moreover, since soil is a limited and non-renewable resource, when it is damaged, unlike air and water, it is not easily recoverable.

The geographical distribution of soil degradation depends on several factors. Soil problems are influenced by the diversity, distribution and specific vulnerability of soils across Europe. They also depend on geology, topography and climate and on the distribution of driving forces. Better integration of soil protection into sectoral policies and better harmonisation of information across Europe are needed to move to more sustainable use of soil resources and promotion of sustainable models of its use. In particular, soil contamination from diffuse inputs and local sources can result in the damage of several soil functions and the contamination of surface water and groundwater.

In WE, soils in agricultural and natural areas are still in an acceptable state with respect to contamination but are under pressure. If pressures continue at the current level, as it is already evident in some problem areas, impacts will start to occur on a larger scale. Because the negative effects on the quality of soils are hard to remediate, these pressures should be addressed in time. On the other hand many urban soils and sediments are already heavily affected. Prevention should stop further deterioration and the risks of the currently contaminated land should be adequately managed.

Soil degradation problems in the CEE countries are quite similar to those in WE. Most of the problems are inherited from the time of the former USSR, when environmental issues were of minor concern.

Past agricultural policies that focused on increasing productivity led to often unsuitable use of mineral fertilisers and pesticides.

The combined effects of these resulted in pollution of groundwater and reduction of soil fertility. Increased awareness of environmental issues, the obligation to implement EU legislation upon accession and declining economies are reducing the pressures from agriculture (decreases in fertiliser and pesticide consumption).

In CEE soil contamination is, to a great extent, a result of the legacy of inefficient technologies and uncontrolled emissions.

Problem areas include some 3 000 former military sites, abandoned industrial facilities and storage sites which may still be releasing pollutants to the environment (DANCEE, 2000). One of the major impacts is groundwater contamination and related health problems. Major concerns are the long time needed to regenerate contaminated soil and the considerable investment required for remedial measures.

Contamination with radioactivity is also important as a result of nuclear weapons tests, improper radioactive waste disposal and the Chernobyl accident (UNEP, 1998).

Introduction

1.1 Structure of the report

The structure of this report follows the organization of the three thematic task groups established within the Working Group Contamination.
After a general introduction, where a geographic overview of the state of Europe's soils with respect to contamination is provided, specific sections analyse soil contamination issues related to diffuse inputs, local sources and contaminated land management, according to the DPSIR assessment framework.

Technical details on soil contamination by heavy metals in urban areas, the use of sewage sludge in agricultural areas and an assessment of background value for heavy metals in Europe are included in three Annexes.

This report was compiled from a variety of sources, in particular the latest EEA state of environment report. "Europe's environment: the third assessment", published in May 2003. Where possible, more recent data were used, such as for example the EEA 2003 fact sheets on management of contaminated sites and emissions of acidifying substances, the JRC report on background values of heavy metals in Europe (all currently under review) and several other reports published successively.

Box 1 provides information on country groupings used in the report. For practical reasons these groups are based on established political groupings rather than environmental considerations, and there can be large variations in environmental performance within the groups and substantial overlaps between them. Where possible this has been highlighted.

Box 1: Country groupings

EU 15: the 15 countries which were part of the EU before 1 May 2004. These include: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, United Kingdom

EFTA: Iceland, Liechtenstein, Norway, Switzerland.

New EU countries: the 10 countries which joined the EU on 1 May 2004. These include: Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovak Republic, Slovenia,

Candidate countries: Bulgaria, Romania and Turkey

Balkan countries: Albania, Bosnia-Herzegovina, Croatia, the Former Yugoslav Republic of Macedonia, Serbia and Montenegro

Western Europe (WE): EU 15 and EFTA, including the small states of Andorra, Monaco, San Marino.

Central and eastern Europe (CEE): the new EU countries; the candidate countries; the Balkan countries; Belarus, Republic of Moldova, Russian Europe, Ukraine.

Eastern Europe: Belarus, Republic of Moldova, Russian Europe, Ukraine.

1.2 Soil contamination and land use

The geographical distribution of soil degradation depends on several factors. Soil problems are influenced by the diversity, distribution and specific vulnerability of soils across Europe. They also depend on geology, topography and climate, and on the uses of the land. The latter determine the distribution of the driving forces and their impacts.

Due to the lack of data on many contaminants in many regions in the EU, it is not possible to give a complete geographical picture of the pressures, the state and the impacts associated with soil contamination. However, some general characteristics can be depicted, which can be considered representative for the EU in general with the exception of problem areas. A description of the specific situation in problem areas -such as the old coal- and steel- industry regions, the areas with large concentrations of contaminated sites or megasites, and the large regions affected by atmospheric deposition from zinc smelters is provided in the sections 2.1, 3 and 4. The situation in relation to contamination by heavy metals in urban areas is described in Annex I.

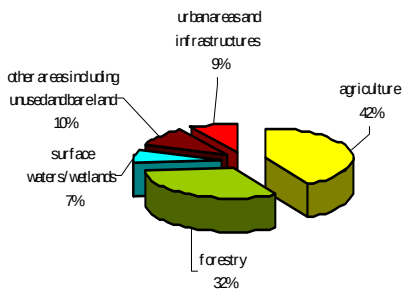
Soil conditions in the following broad categories of land uses have been considered to guide the general assessment provided in this section:

- Agricultural areas including areas with intensive forestry
- Natural areas including recreational areas and areas with extensive forestry
- Urban areas and infrastructures
- Soils under surface waters or sediments.

According to the most recent data on land use and land cover (Eurostat LUCAS survey, 2003), agriculture is the dominating land use in the EU15 (42%), followed by forestry (32%), urban areas and infrastructures (9%) and surface waters/wetlands (7%). Unused land and other land uses covers about 10% of the territory (Fig. 1).

An overview of soil conditions with respect to contamination for each of the land use categories mentioned above are described below.

Figure 1. Use of land in the EU 15



Source: Data elaborated from Eurostat, LUCAS survey 2003.

1.2.1 Agricultural areas

Soils in agricultural areas are under pressure from atmospheric deposition (acidifying substances, persistent organic pollutants or POPs, heavy metals), direct input of pesticides, manure and other biowaste.

These pressures may lead to the slow accumulation of heavy metals and POPs in topsoil and to accumulation of phosphates in areas with intensive animal farming.

The use of land for agriculture is only endangered in some problem areas because of safety of food crops. In general, agricultural soil is still fit for its use and for future land use changes for what concerns contamination, although a transition from eutrophic farmland to oligotrophic nature may take some time. It should be realised that also a natural succession towards mature terrestrial ecosystems will take its time.

1.2.2 Natural areas

Soils in natural areas share the same pressures from atmospheric deposition as agricultural soils. An additional concern in these areas is related to nitrogen deposition which may lead to eutrophication and acidification. Soils in natural areas may slowly accumulate POPs and heavy metals but are in general still in a reasonably good shape. Hence the quality of soil would not be a barrier for a change in land use.

1.2.3 Urban areas and infrastructures

Urban soils and soils close to infrastructures are generally polluted. The most important contaminants are polyaromatic hydrocarbons or PAHs, lead, copper and zinc from powerlines and masts, cadmium from transport, herbicides in the vicinity of roads and railways, asbestos from demolished buildings and mineral oil. These soils are often unfit for sensitive uses like playgrounds and vegetable gardens as observed in many urban areas in countries with a longer tradition in contaminated sites inventories. Contaminated soil may lead to contaminated indoor dust and thus to an increased human exposure. Apart from heavily contaminated sites, the impacts on human health are generally low if the soil is not used for vegetable gardens or as playground for children.

1.2.4 Sediments

Sediments are the major sinks for water pollution. They still reflect the former large-scale pollution of surface waters (metals, mineral oil, PAH, polychlorinated biphenyls or PCBs, old pesticides). The quality of the surface water has much improved due to more stringent emission controls, but now the sediments have become a threat for their ecological impacts in the cleaner waters. In many cases, sediments are generally unfit for use on land in agricultural and natural areas. Because river- and harbour- management often requires dredging, the polluted sediments are a big burden for society. In addition polluted sediments have impacts on terrestrial soils after flooding.

1.2.5 A general picture of soil contamination in the enlarged EU

The picture that emerges from the characterisations above is that soils in agricultural and natural areas are still in an acceptable state with respect to contamination but are under pressure. If pressures continue at the current level, as it is already evident in some problem areas, impacts will start to occur on a larger scale. Because the negative effects on the quality of soils are hard to remediate, these pressures should be addressed in time. On the other hand many urban soils and sediments are already heavily affected. Prevention should stop further deterioration and the risks of the currently contaminated land should be adequately managed.

Taking into account average land use distributions, it may be generally concluded that approximately 70% of EU soils are still in reasonable shape, with the exclusion of problems occurring in localised areas.

However, the situation may be different at the national level, because land use patterns may be different in each country. In the Netherlands, for example, agricultural and naturals areas cover approximately 75% of the territory and there is a large proportion of sediments (15%) and urban areas (10%)[1]; in Austria, agriculture and forestry cover more than 80 % of the total area (about 40% each), while urban areas and land covered by water amount to only 5% and less than 2% respectively; in Slovenia forests are the dominating land use (60%), and together with agriculture cover a large portion of the national territory (nearly 95%), while built-up areas and land covered by water account for only about 5 % and less than 1 % respectively[2].

2 DIFFUSE INPUTS

2.1 Overview

As already mentioned, there is no widespread pollution of European soils due to diffuse inputs, except for acidification and eutrophication. Pollution is rather localised in restricted areas, mainly urban areas and industrial compounds, where it may add to pollution coming from local sources.

The main diffuse sources of soil contamination are the atmospheric deposition of acidifying and eutrophying compounds or potentially harmful chemicals, the deposition of contaminants from flowing water or eroded soil itself, and the direct application of substances such as pesticides, sewage sludge, fertilisers and manure which may contain heavy metals and other pollutants. These pressures may lead to acidification, contamination by heavy metals and other persistent substances, and to a surplus of nutrients in the soil. The soil functions most affected by contamination are its buffering, filtering and transforming capacities.

Acidification is the most widespread type of soil contamination in WE and CEE, where vast areas have been affected, especially in Poland (10 million ha including natural acidification) and Ukraine (about 11 million ha of agricultural land). High content of heavy metals in soils is reported in Ukraine at the local level (about 5 million ha, mostly in human settlements and around the industrial factories) and in Lithuania (nearly 3 million ha) (van Lynden, 2000). However, the relatively high heavy metal concentrations in Lithuania can be partly explained by high natural background levels.

Acidification is not expected to increase further, due to the success of policy implementations in the past decades. However, it must be taken into account that soils under severely acidified conditions are difficult if not impossible to rehabilitate.

Nutrient surplus may occur in agricultural areas when not all the fertilizers and animal manure applied to the land are absorbed by the plants or removed during harvest. In the EU15, these areas are localised in Denmark, north-west France, the North Sea coast, and in the Rhine's water catchment.

Contamination by pesticides is common in Ukraine (more than 5 million ha) and Romania (more than 4 million ha), where the estimated degree of contamination is light to moderate (van Lynden, 2000).

The Chernobyl accident (1986) is still a major cause of contamination by radionuclides in Ukraine and some areas of the Russian Federation. Nuclear tests performed in the past, uranium mining and processing, and the manufacture of nuclear fuel affected some areas in Eastern Europe.

[1] Source: Joop Vegter, personal communication.
[2] Source: Joint OECD-EUROSTAT questionnaire on the state of environment, 2000

2.1.1 Problem areas of diffuse contamination in Europe (source EEA-UNEP, 2000)

Figure 2 shows areas with high probability of diffuse soil contamination and areas where actual contamination has been reported. For the EU 15 data on chemical use in agriculture has been used as a proxy for diffuse contamination in agricultural areas. In the new EU countries and in eastern European countries, an assessment of priority levels for soil contamination has been made using a subjective classification based on national State of Environment Reports (Denisov et al., 1997). Consequently all relevant "hot spots" may not have been identified.

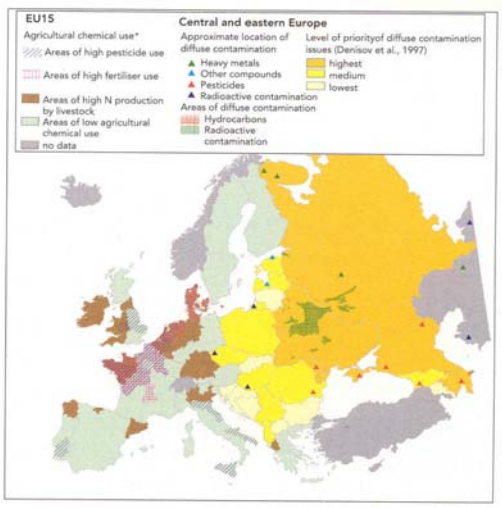
The intensity of agricultural chemical use is highest in the lowlands of Western Europe: Denmark, the Netherlands, Belgium, Luxembourg, and the north of France. Areas of high livestock manure production are distributed in a more patchy fashion, but the highest proportion is also in North-West Europe. In Eastern Europe, problems of diffuse soil contamination are greatest in Azerbaijan, Belarus, Moldova, Russia and Ukraine.

2.2 Deposition of acidifying and eutrophying substances (Most of the emission data contained in this sections have been extracted from the 2004 EEA facts sheet for indicator AP3b – EEA31 emissions of acidifying substances, prepared by ETC/ACC, currently under review)

Deposition of sulphur and nitrogen compounds contributes to acidification of soils and surface waters and may result in leaching of plant nutrition elements and damage to vegetation and water fauna.

Deposition of nitrogen compounds (from nitrogen oxide and ammonia emissions) can lead to eutrophication, resulting in disturbance of natural ecosystems and increased concentrations of nitrate in ground water. Much of the deposited nitrogen remains immobilised in the soil or taken up by vegetation but with continued deposition this will be mobilised and in the long run contribute further to the processes of acidification and eutrophication.

Fig.2 Probable problem areas of diffuse contamination in Europe



* Classification of intensity of agricultural chemical use for the EU15. These values are averages for region areas, and not actual spreading rates.

Notes:

Chemical type	'low'	'medium'	'high'
Fertilisers	< 50 kg/ha	50 – 100 kg/ha >	100 kg/ha
Pesticides	< 1 kg/ha	1 – 2 kg/ha	> 2 kg/ha
Nitrogen production	< 50 kg/ha	50 – 100 kg/ha	> 100 kg/ha

Data resolution:Eurostat NUTS2 (regional) level.
Sources: For EU15: New Cronos and Regio databases, EC (1997); FAO (1997). For eastern Europe: Denisov et al., 1997, Mnatsakanian (1992).

Combustion of fossil fuels is the key source of acidifying pollutants (58% stationary plus 13% mobile sources of total emissions). In 2001, the most significant emission sources in the EU15 were agriculture (31%), energy industries (26%), road transport (18%) and energy use in industry (11%). In the same year, the relative weighted contribution of sulphur emissions was 31%, while nitrogen oxides (NOx) emissions and ammonia (NH3) emissions counted for 37% and 32% respectively.

Data collection from 2003 shows that emissions of acidifying substances between 1990 and 2001 have been reduced by 41% in the EU 15, more than 58% in the new EU countries and 21% in the candidate countries.

Due to these reductions, the EU15 emissions as a whole are well below the linear target path to the 2010 target of the National Emission Ceilings Directive[3]. Nevertheless, substantial emission reductions are still needed by a number of countries to reach their specific 2010 national targets.

Most new EU countries and candidate countries are close, or have reached, their 2010 overall targets of the CLRTAP Gothenburg Protocol[4].
In the EU 15, this significant reduction is the result of the increased levels of pollution abatement equipment e.g. flue gas desulphurisation, together with the use of low-

[3] Directive 2001/81/EC, on national emissions ceilings (NECD) for certain atmospheric pollutants requires the introduction of national emission ceilings for emissions of SO2 and NOx in each EU 15 Member State, as well as setting interim environmental objectives for reducing the exposure of ecosystems and human populations to the damaging levels of acid pollutants and ozone are addressed by the NEC Directive and the Gothenburg Protocol under the UNECE convention on long-range transboundary air pollution (CLRTAP). The NEC Directive's emission reduction targets (calculated using an aggregated target for the three component pollutants) are slightly stricter than the targets set in the Gothenburg Protocol – a 57% and 56% reduction in acid equivalents from 1990 to 2010 respectively.

[4] The Gothenburg Protocol to the United Nations Economic Commission for Europe's (UNECE) Convention on Long-Range Transboundary Air Pollution (CLRTAP) to abate acidification, eutrophication and ground-level ozone (UNECE 1999). A key objective of the protocol is to regulate emissions on a regional basis and protect eco-systems from transboundary pollution by setting emission reduction targets for the pollutants NOx, (and SOx, NH3 and NMVOCs) to be reached by 2010.

sulphur fuels in power plants. In the new EU countries and in the candidate countries the reduction is mainly due to a combined effect of implementation of market economy principles, reduced energy consumption, closing inefficient plants, which were major sources of emissions, less use of sulphurous fuels and greater use of flue gas desulphurisation abatement.
The reduction of emissions of ammonia in the agricultural sector is the result of falling animal numbers rather than the implementation of abatement measures (EEA, 2003).

According to an assessment carried out by EMEP in 2000[5], while overall emissions of acidifying and eutrophying substances have fallen substantially since 1990 and policy targets are being met, the environment is still under risk as the deposition of these substances still exceeds the critical loads[6] of the ecosystems (see Fig. 3).

In fact, eutrophication remains a significant problem and ecosystems in large areas throughout Europe are unprotected from further damage. In addition, the percentage of ecosystems exposed to nitrogen deposition in excess of critical loads has increased since 1990 in several countries, thus reversing the downward trend in the area exposed to acidification observed earlier and increasing the area exposed to eutrophication (EEA, 2001; 2004a).

On the other hand, more than 90% of the ecosystem areas of Europe overall are estimated to have been protected against further acidification as a result of general emission control. However, many hot spot areas remain at risk especially in central Europe (EEA, 2003).

2.3 Inputs used in agriculture

Although there has been a general reduction of agricultural inputs in the past few years, especially in Central and Eastern Europe, the agricultural sector is still counting heavily on fertilisers and pesticides. Overuse and mismanagement of these products may have impacts on soil and water quality and on the safety of crops (Fig. 4 and 5; EEA, 2004b).

The over-application to soil of fertilizers with a high phosphorus and nitrogen content or livestock manure, together with acid depositions with a high content in these two elements, can have important effects on the environment. Here, the capability of soil to provide nutrients to plant growth is affected, and its buffering and filtering capacity plays an important role. Both nitrogen and phosphorous are essential elements for plant growth, but can become damaging when present in quantities excessive to plant requirements. The accumulation may lead to the soil becoming saturated and the excess may be leached from the soil, eroded or simply washed off into the groundwater, waterways and coastal systems, causing eutrophication.

In addition, the sewage sludge applied to agricultural land may contain heavy metals and other persistent pollutants, while overuse and mismanagement of pesticides may lead to ground and surface water pollution and have impacts on the safety of food crops. In CEE, the inadequate storage of old pesticides may be an additional source of contamination (see also section 2.4).

2.3.1 Fertilisers

The overall consumption of fertilisers has stabilised in recent years, following a significant decline during the first half of the 1990s in the CEE (EEA, 2003). See Fig. 4.

These reductions are the result of implementation of EU legislation, such as the Nitrate Directive (Directive EC 91/676), which seeks to limit nutrient losses from farming to freshwater bodies by restricting nutrient use in designated nitrate vulnerable zones.

However, more progress by the EU15 is required before this policy response can be considered fully satisfactory (EEA, 2002a).

The decline in fertiliser use in CEE countries, including the new EU countries, is more attributable to reduced market opportunities for agricultural products, the declining profitability of agriculture, reduced state support and the widespread reorganisation of farming in the region. However, inorganic fertiliser consumption in CEE is expected to increase as a response to expected new market opportunities and integration with the CAP (EFMA, 2000).

Despite these reductions, current fertiliser input both western and eastern Europe may be still too high to be environmentally sustainable in the longer term without appropriate management. Nutrient loads (nitrogen and phosphate) from diffuse agricultural sources remain high, with special reference to parts of north-western Europe where there is intensive livestock production. Phosphorus surpluses are also relatively high in southern Europe, due to low removal rates by harvested crops (EEA, 1999).

A 'nutrient surplus' occurs when not all the fertilizers and animal manure applied to the land are absorbed by the plants or removed during harvest. In the EU, the nutrient surplus runs to 7.1 million tonnes every year – and over 95% of it is at high enough levels to trigger eutrophication.

According to an EEA study[7], the total nitrogen surplus has not changed since 1990. Moreover, more than a quarter of this surplus comes from less than 10% of the regions examined. Focusing efforts on these regions, which are mainly located in Denmark, Brittany, on the North Sea coast, and in the Rhine's water catchment area, could therefore produce significant results.

[5] Calculated estimates of the transport and deposition of acidifying and eutrophying compounds have been obtained from the EMEP, with the disclaimer that current calculation routines are under further development and should be taken as only indicative of the actual situation.

[6] Critical loads have been defined under the CLRTAP as "a quantitative estimate of an exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge." Exceedance of critical loads is a complex function of deposition of various pollutants and soil properties. The area of exceedance of critical loads provides an indication of the ecosystem area in which damage could occur.

The size of ecosystem area exposed to exceedance of critical loads is determined by the sum of all ecosystem areas in grid cells where exceedances occur. Exceedance of critical loads for acidification are calculated by considering both sulphur and nitrogen deposition, while exceedances of the critical load of nutrient nitrogen are independent of sulphur deposition levels.

[7] EEA, 2001 signals 2001 http://themes.eea.eu.int/Sectors_and_activities/agriculture/indicators/nutrients/index_html

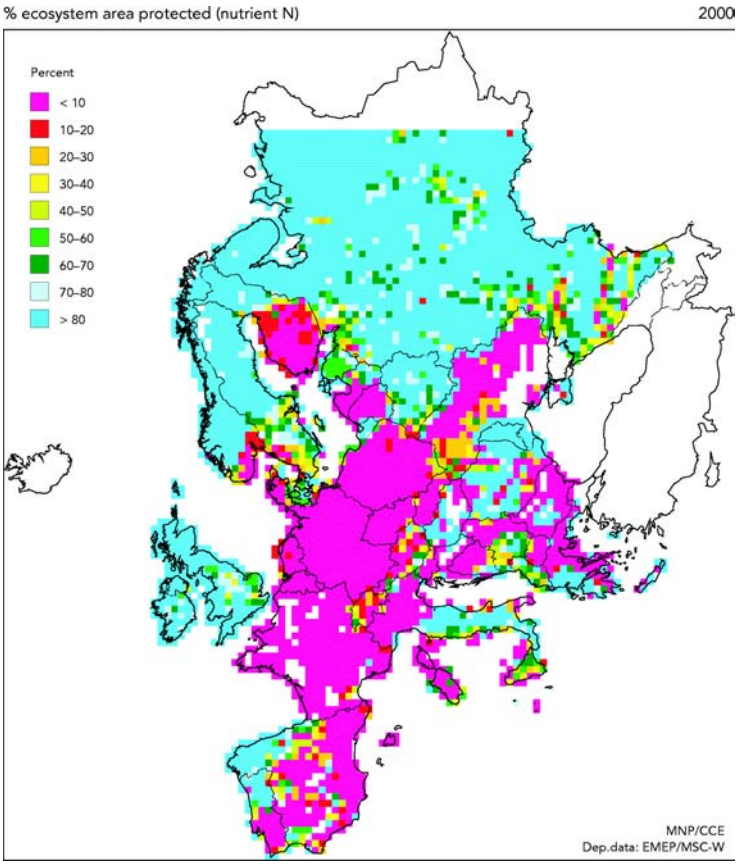


Fig. 3 Percentage of ecosystems protected from impact of eutrophication through atmospheric deposition of nitrogen
Source: EMEP MSC-W WGE/CCE

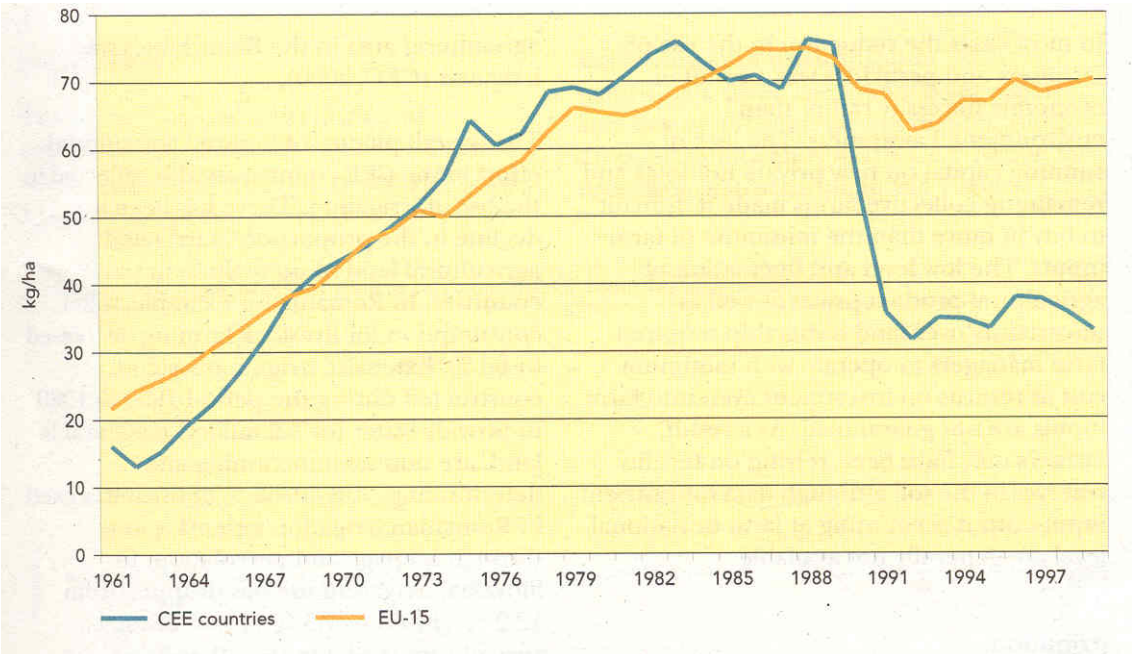


Fig. 4 N-fertiliser consumption in the EU15 and selected CEE countries
Source: FAOSTAT, 2002; EEA, 2004b

Note: Due to limited data availability, for CEE only 6 countries have been considered: Bulgaria, Czech Republic, Hungary, Poland, Romania and Slovakia. The graph indicates mean N-fertiliser consumptions per unit of agricultural land.

2.3.2 Pesticides

The intensity of pesticide use has declined in many countries as a result of public environmental concern, legislation, economic pressures and the introduction of active ingredients with lower dosage requirements. However, much agricultural production still relies heavily on pesticide application to achieve higher economic returns (EEA, 2003). See Fig. 5.

Pesticides may pollute drinking water, surface water and groundwater. Many groundwater supplies in the EU 15 exceed the Drinking Water Directive (Directive 98/83/EC) maximum of 0.1 µg/l for a single pesticide (EEA, 2002b). Soils can also be affected: in Ukraine more than 20 % of the investigated agricultural lands are polluted by DDT and its degradation products, about 4 % are polluted by hexachlorine-cyclohexane (Ukrainian NCP, 2002).

New management practices, such as integrated crop management (ICM), have evolved as a response to the need to reduce dependence on pesticides.

ICM aims at environmentally sensitive crop management, including a reduced use of inputs, while maintaining agricultural productivity and profitability. Although covering only about 3 % of utilised agricultural area (UAA) in the EU15, ICM encourages more targeted use and reductions in application rates of pesticides. In CEE countries, there are initial training programmes to support the uptake of ICM practices although the main reason for reduced pesticide use is economic restructuring.

However, there is a significant environmental legacy in many of the CEE countries where localised hot spots of contamination are commonly associated with the storage and disposal of pesticides. For example, there are estimated to be up to 60,000 tonnes of obsolete stocks of pesticides in Poland, 20,000 tonnes in the Russian Federation and 15,000 tonnes in Ukraine (IHPA, 2001; see also: Danish Environmental Protection Agency, 2001; SYKE, 2002).

Improved monitoring and disposal programmes for obsolete pesticide stockpiles are required to avoid significant environmental problems in the future.

2.3.3 Sewage sludge

In the EU, sewage sludge is applied only on a small percentage of agricultural land, but due to requirements of EU legislation (Urban Wastewater Treatment Directive, Landfill Directive) the percentage may increase significantly in the future. Across Europe the percentage of agricultural land treated with sewage sludge is less than 5 % except in a few regions in southern Scandinavia. In more than half of the area for which information is available, the percentage is even less than 0.5 %. In some countries sewage sludge is not used for agricultural purposes mainly because of national regulations[8].

The load of heavy metals on the treated agricultural land could lead to an accumulation of heavy metals in these soils in the long run.

According to a recent survey carried out from the European Environment Agency, the inputs of heavy metals by application of sewage sludge on agricultural land are lower in northern and central Europe than in Southern Europe. In all regions the calculated loads are less than the limit values of the EU Sewage Sludge Directive, but in a few regions they would exceed the limits proposed for the revision of the directive if the maximum permitted application rate with the given sewage sludge quality is applied (See Annex II - Table.1).

2.4 Emissions and concentrations of selected persistent pollutants

Environmentally persistent chemicals such as DDT, dioxines, heavy metals, PCBs, PAHs, etc have a range of diverse uses (insecticides, pesticides, solvents, plasticisers, etc.) and hence have the potential to be released into the environment (together with their degradation products) during production or product life cycles i.e. from raw material acquisition to final waste treatment and disposal. Actual emissions, concentrations and exposures of ecosystems, wildlife and humans, however, vary between chemicals.

2.4.1 Heavy metals

Among the many heavy metals released from various products and processes, cadmium, lead and mercury are of great concern to human health because of their toxicity and their potential to cause harmful effects at low concentrations and to bioaccumulate.
Significant progress has been made in reducing emissions to air of these metals in Europe with 1995 emissions being about 50 % of 1990 levels and decreasing further to 40 % by 1999. Lead emissions in 1999 were down to about 17,000 tonnes/year and mercury and cadmium to 200 and 400 tonnes/year, respectively (EMEP, 2002).

Although controlling diffuse emissions of cadmium and mercury remains problematic (e.g. batteries), point source emissions of these metals have declined as a result of improvements in sectors such as wastewater treatment, incinerators and the metals sector. Factors contributing to this include large decreases of lead emissions from the transport sector following the introduction of unleaded petrol in the early 1990s (EEA, 2003; chapter 2.6), continuing moves away from the use of lignite in the eastern European energy sector, and the introduction of improved pollution abatement technologies across a range of industrial and waste treatment sectors.

A number of recent policy initiatives have been introduced at the international level to address concerns raised by heavy metal emissions. The United Nations Economic Commission for Europe (UNECE) Convention on Long-Range Transboundary Air Pollution (CLTRAP) 1998 Aarhus protocol on heavy metals targets cadmium, lead and mercury and requires countries to reduce their emissions of these three metals to below their 1990 levels (or an alternative year between 1985 and 1995).

The need for further global initiatives on mercury has also recently been highlighted (TemaNord, 2002; UNEP, 2002). Some European countries have had success in reducing emissions of this metal (Table 1) through a combination of substitution, e.g. of mercury cells used in chlorine production, and improvement in abatement technologies especially flue-gas cleaning.

Positive effects from these reductions on European soils are expected, although methodological differences between countries preclude accurate quantitative assessment. Moreover, there are still major gaps in quantifying heavy-metal emission factors from industrial processes and in knowledge about the toxic effects of

[8] Source EEA, 2003 fact sheets on application of sewage sludge on agricultural land, not yet published; under review

heavy metal on ecosystems or the bearing capacity of different soils.

Table 1. Trend of mercury emissions in Nordic countries (tonnes)

Denmark	**1982–83**	**1992–93**		
Air		4.0-7.4		1.9-2.5
Water		1.4		0.25
Soil		1.4-1.6		0.2-0.3
Total		6.8-10.4	2.4-3.1	
Finland	**1990**		**1997**	
Air		1.1		0.6
Norway	**1995**		**1999**	
Air		1.1		1.1
Water		0.6		0.4
Soil		0.5		0.3
Total		2.2		1.8
Sweden	**1990**		**1995**	
Air		1.5		0.9
Water		0.2		0.6
Total		1.7		1.5

Source: TemaNord, 2002

2.4.2 Persistent organic pollutants

Persistent organic pollutants (POPs) are a group of specific chemicals regulated under international agreements to reduce or eliminate their use and release to the environment. The CLTRAP POPs protocol (UNECE, 1998) lists 16 substances as POPs, and the Stockholm convention on persistent organic pollutants (2001) identifies a subset of 12 of these substances targeted for release reduction or elimination.

POPs are released into the environment either as a result of their intentional use e.g. as pesticides such as lindane or DDT, as contaminants of other products, or as by-products from industrial processes e.g. dioxins, polyaromatic hydrocarbons (PAHs), hexachlorobemzene (HCB). The long-range transportation and transboundary distribution of POPs means that they pose an environmental threat not only within the country in which they are used but also to geographically distant countries (Swedish EPA, 1998). For example, residues from past global use of POPs are found in many remote regions of the Arctic, Baltic and other areas despite their use or emission never having taken place in these regions.

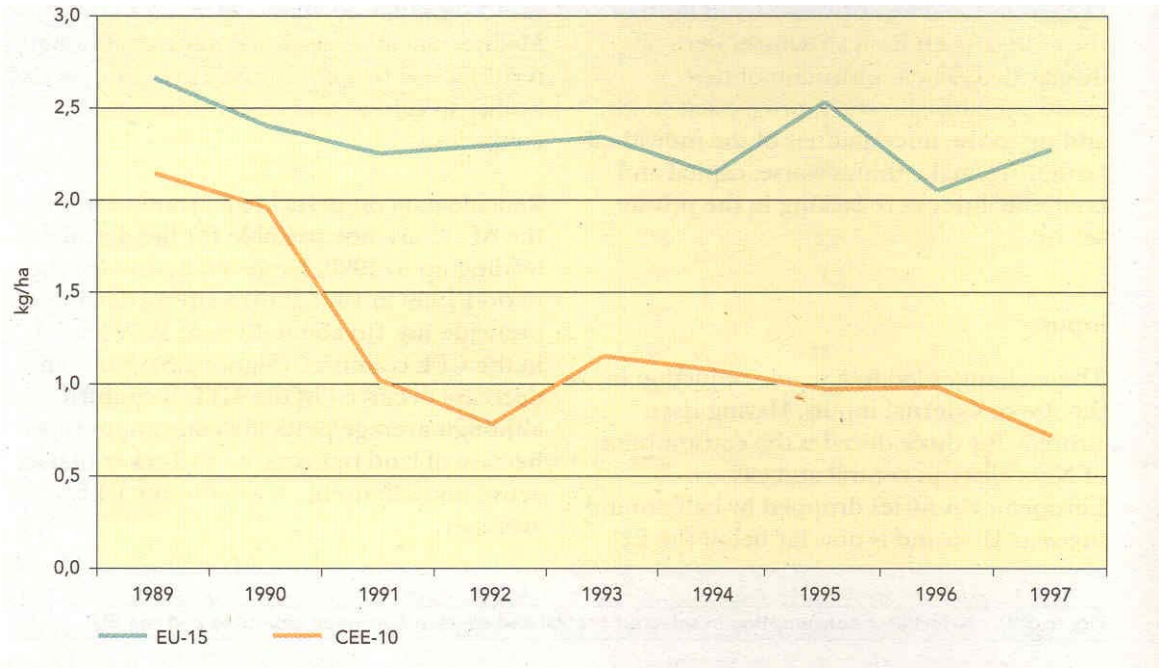
Concentrations of several of the priority POPs have decreased over recent decades due to a reduction in their production and use, accompanied by bans and other restrictions.
Hexachlorobenzene (HCB) provides one example of recent reduction-trends, and the link between decreased emissions.

HCB is a potential human carcinogen that was used as a pesticide/fungicide from the 1950s until the early 1980s. Its use as an agricultural chemical was banned in many European countries by the mid-1980s (Münch and Axenfeld, 1999).

However, although hexachlorobenzene emissions have decreased throughout Europe, the rate of decrease has slowed markedly since 1990. Further reductions in hexachlorobenzene emissions with its eventual elimination from use should be feasible.
Nevertheless, hexachlorobenzene remains widely dispersed throughout Europe due to long-range atmospheric transport processes and local 'hot spots' that reflect high levels of local use or contamination.

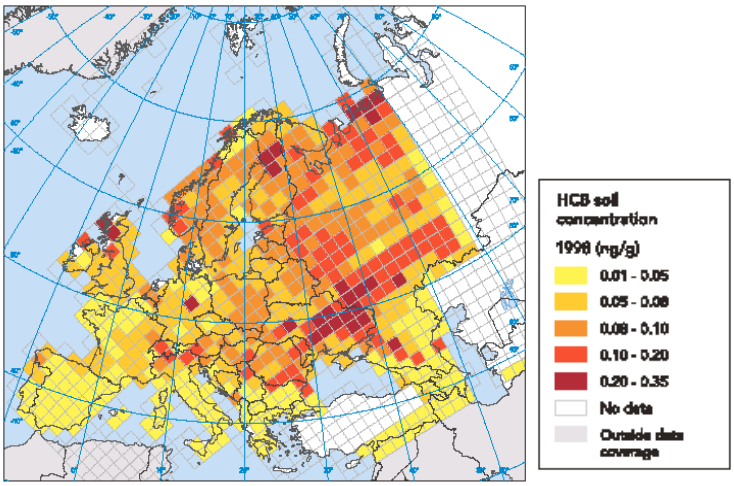
In fact, despite the banning of HCB as an agricultural chemical, it continues to be released via a number of other pathways e.g. via chlorinated solvent manufacture, as a contaminant in other pesticide formulations and from combustion processes, and therefore remains widely dispersed in the environment (Figure 6).

Fig. 5 Pesticide consumption in the EU 15 and CEE



Source: FAOSTAT, 2002; EEA, 2004b
Note: Data series on pesticides and land areas are incomplete for the EU 15 and the CEE. The graph shows mean consumption of pesticides (active ingredients classified as herbicides, fungicides and others per unit area of agricultural land.

Figure 6. Modelled HCB background soil concentrations in Europe, 1998



Notes: Concentrations represent the average soil concentration in a 150 x 150 km area. Localised areas having high HCB levels will exist within these larger areas. As a reference, the Dutch government has a target value for HCB in soil of 2.5 ng/g.

Sources: EMEP/MSC-East; UNECE Convention on Long-Range Transboundary Air Pollution programme

There is also concern about the wide dispersion and increasing environmental concentrations of persistent, bioaccumulative and toxic (PBT) chemicals that are not currently classified as POPs such as chlorinated paraffins and certain flame retardants.

Several bodies currently advocate the classification of these PBT substances as 'new' POPs under the POPs protocol and the Stockholm convention.

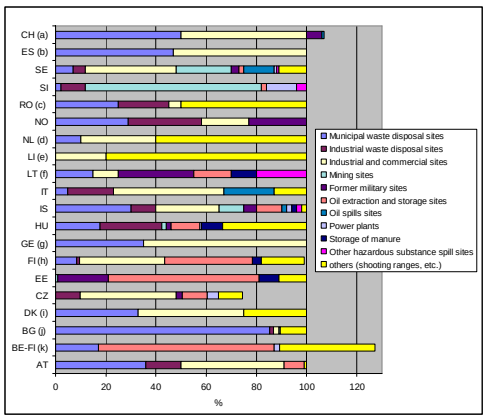
Another potentially significant environmental problem arises from the large quantities of old and out-dated pesticides (some of which are POPs) that are known to be stockpiled in many CEE countries. Storage facilities for these chemicals are frequently inadequate, ranging from simple holes in the ground and open sheds in fields to decomposing concrete bunkers. In many cases the poor storage facilities create high levels of potential risk to both the environment and humans (Klint, 2001).
Factors contributing to the build-up of unwanted pesticide stocks include poor stock management, inappropriate marketing, lack of adequate regulatory infrastructures, poor product packaging, purchases (or donations) of unsuitable products in impractical quantities, and prohibition of use (Jensen, 2000).

Progress in destroying stocks of unwanted pesticides is impeded by a lack of information on quantities and location.

3 LOCAL SOURCES

Soil contamination from localised sources is often related to industrial plants no longer in operation, past industrial accidents and improper municipal and industrial waste disposals. In addition, at industrial plants still operating, soil contamination often has its origin in the past, and current activities still have significant impacts (EEA-UNEP, 2000).
Effects of industrial activity (either historical or currently in operation) that pose a risk to soils and groundwater, and the spectrum of the various polluting activities, vary between countries. These variations may result in different classification systems and in incomplete information being available in some countries (Figure 7).

Figure 7. Percentage contribution to soil contamination from local sources



Source: EIONET priority data flow; September 2003. For DK, GE, LI, NL, ES: Pilot EIONET data flow; January 2002; for RO: data request new EEA member countries, February 2002. NB: 2003 data have not yet been published and are currently under review
Notes:(a) Switzerland: 'Municipal waste disposal' also include 'Industrial waste disposal'; 'former military sites' also include active military sites and shooting ranges.
(b) Spain: 'Municipal waste disposal' also include 'Industrial waste disposal'

(c) Romania: 'others' also include accidents
(d) Netherlands: 'others' also include accidents
(e) Liechtenstein: 'others' only refer to accidents; minor accidents are not included.
(f) Lithuania: petrol stations included in 'oil extraction'; pesticide storages included in 'other hazardous substances spill sites'
(g) Germany: 'Industrial activities' also include accidents and 'other'; 'Municipal waste disposal' also include 'Industrial waste disposal'
(h) Finland: service station, big fuel and heating oil storages included in 'oil extraction'
(i) Denmark: 'Municipal waste disposal' also include 'Industrial waste disposal'
(j) Bulgaria: 'others' are storages of forbidden (obsolete) pesticides
(k) Belgium-Flanders: 'oil extraction and storage sites' also include 'oil spills sites' several activities can occur together on 1 site (127%)

For DK, GE, LI, NL, ES and RO the category 'Industrial activities' was used instead of the here used 'industrial and commercial sites'.

Sites contaminated in these ways can pose serious threats to health and to the local environment as a result of releases of harmful substances to groundwater or surface waters, uptake by plants and direct contact by people, and following explosion of landfill gases.
The largest and probably most heavily affected areas are concentrated around the most industrialised regions in northwest Europe, from Nord-Pas de Calais in France to the Rhein-Ruhr region in Germany, across Belgium and the Netherlands and the south of the United Kingdom (EEA-UNEP, 2000).

Other areas where the probability of occurrence of local soil contamination is high include the Saar region in Germany, the Po area in northern Italy, and the so-called Black Triangle region located at the corner of Poland, the Czech Republic and the Slovak Republic. However, contaminated areas exist around most major cities and there are some individual contaminated sites in sparsely populated areas (EEA-UNEP, 2000).

A wide range of potentially harmful elements and chemical compounds is used in industry.

Handling losses, defects, industrial accidents and leaching of hazardous substances at waste disposal sites can cause soil and groundwater contamination. Major pollutants include organic contaminants such as chlorinated hydrocarbons, mineral oil and heavy metals. In some parts of Europe, soil is contaminated by artificial radionuclides. In the mining industry, which is a major driver of soil degradation in CEE countries, the risk of contamination is associated with sulphur and heavy metal-bearing tailings stored on mining sites, and the use of certain chemical reagents such as cyanide in the refining process. Acid mine drainage is a common long-term problem, as for example in the case of the serious incident at the Aznalcollar mine in Spain in 1998. The disaster affected a watercourse nearby for 63 km downstream and the adjacent land (Sol *et al*., 1999). Another recent accident was the cyanide spill in Romania from the Aurul tailings re-treatment plant at Baia Mare in 2000. This disaster affected plankton and fish in the upper reaches of the Tisza River in Romania and Hungary. The spill occurred in an area already contaminated by heavy metals from a long history of mining and metal processing. Upstream locations unaffected by this particular spill also contained high levels of some heavy metals. The accident occurred in a region with a number of poorly maintained and operated plants and flotation ponds containing cyanide and/ or heavy metals, many of which are leaking continuously (European Commission, 2000).

Waste landfilling is another important potentially contaminating activity. On average, 57 % of municipal waste generated in the EU is landfilled, 84 % in CEE (EEA, 2003, Chapter 7). Leachate from waste landfills can enter soil, groundwater and surface water. Particular concerns are related to landfills that operate or have operated in the past and that do not comply with the minimum requirements set by the Landfill Directive (Directive 1999/31/EC) (European Commission, 1999).

Contaminated land in CEE is the result of former military sites as well as industrial activities and waste management. Problem areas include some 3 000 former military sites, abandoned industrial facilities and storage sites which may still be releasing pollutants to the environment (DANCEE, 2000).

Inefficient technologies and production systems, in terms of raw material and energy consumption as well as waste production, were common in the past. Heavily contaminated sites covering several thousand square metres (e.g. in traditional large-scale industrial areas) may still represent a considerable risk to human health and the environment. However, the extent of the contribution of the military sector to soil contamination is not known, as data on contamination of military sites are not usually publicly available.

New legislative and regulatory frameworks at the national and EU level (Landfill Directive, Integrated Pollution and Prevention Control Directive, Water Framework Directive, Environmental Liability Directive) are based on the precautionary principle. Their application should result in fewer inputs of contaminants, as a result of fewer handling losses and accidents at industrial sites, and in better control of soil contamination (EEA, 2001). Nevertheless, much effort is still needed to characterise and remediate old contaminated sites.

4 CONTAMINATED LAND MANAGEMENT

The management of contaminated sites has the objective to remediate any adverse effects where impairment of the environment has been proved and to minimise potential threats. The whole process is carried out in several steps. Preliminary surveys provide a list of potentially contaminated sites and verify the existence of contamination and potential harmful effects to human health or the environment. The main site investigation focuses on the determination of the extent of the contamination. One of the next phases is the remediation plan, which includes a specific remediation investigation and measures to reduce adverse effects on human health or the environment.
Targets for remediation and/or safety measures can vary according to the proposed land use. The management scheme must take into account the risk of secondary contamination due to further retention of contaminants by the soil.

According to a recent EEA study[9], preliminary surveys are far advanced in most of the surveyed countries.

Further stages in management, such as detailed investigations and remediation activities are still progressing slowly. Surveyed countries are at different

[9] Management of contaminated sites is one of the EEA core set indicators. Data have been collected on a regular basis since 1997. Assessments of the data are included in fact sheets, used in EEA reports and regularly published on the EEA web site. Although there is no reporting obligation for these specific data flows, EEA member countries have officially committed themselves to deliver the data requested. Data related to 2002 have not been published yet and are currently under review. For further information, all published fact sheets (the latest were published in 2002) can be downloaded from: http://themes.eea.eu.int/Specific_media/soil/indicators

Methodology for data collection and assessment is validated and discussed with national experts through formal reviews and technical workshops.
In general it can be said that there is good availability of data at national level where contaminated sites management is centralised. However, there are still different and inconsistent definitions regarding site management steps in the various countries, different progress and level of prioritisation.

levels, while several countries have further advanced since the past few years.

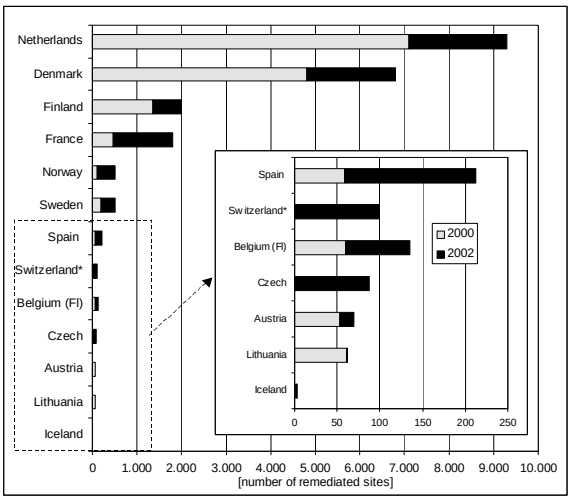
Figures 8 and 9 show the progress in site remediation for selected countries for the two years for which data are available, whereas Fig. 8 shows annual expenditures for contaminated site remediation for countries where data are available.

In general, there is scarce information on remediation measures available but improvement in data availability over the years has been observed.

Overall, all countries apply the 'polluter pays' principle, to differing extents. However, a considerable share of total remediation costs has been provided from public money. Many countries have developed special funding tools for the clean-up of contaminated sites. For example, in some countries there are voluntary agreements with the petrochemical and oil industries to fund the remediation of abandoned petrol stations, financed by a fee included in the petrol price. Estimates of public expenditure are available from many countries, but information on private expenditure is scarce and depends on approximate estimates.

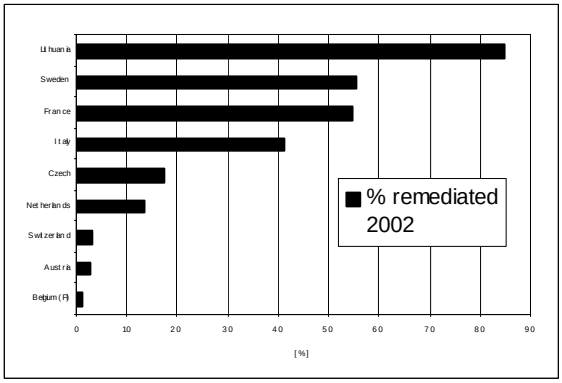
Although the "polluter-pays" principle is generally applied, a huge sum of public money - on average 25% of total expenses - has to be provided to fund necessary remediation activities, which is a common factor across Europe. Annual expenditures vary from 35 to under 2 Euro per capita in the various countries over the past four years.
In the EU, implementation of new regulations that reflect the precautionary principle should help to avoid local soil contamination in the future. In the EU countries where data are available, expenditures on clean-up have remained constant over recent years (1997– 2000). In future, expenditure will probably remain at a constant rate, except in countries that have only recently begun to address the problem, where an increase is expected. Many accession countries have started investigations, and the setting up of specific funding tools and cooperation with the EU are increasing.

Figure 8. Total number of remediated sites in selected countries in 2000 and 2002



Notes: * Switzerland: data refer to >100 sites
Source: For 2002: EIONET priority data flow; September 2003. For 2000: for EU countries and Liechtenstein: Pilot EIONET data flow; January 2002; for Accession countries: data request new EEA member countries, February 2002. NB: 2002 data have not yet been published and are currently under review

Figure 9. Progress in site remediation in selected countries in 2002 as % of estimated total number of sites needing remediation

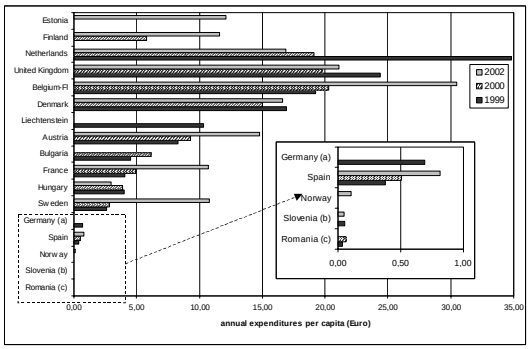


Source: EIONET priority data flow; September 2003. NB: 2002 data have not yet been published and are currently under review

Even though considerable amount of money has been spent on remediation activities already, the share compared to the total estimated remediation costs is relatively low over the last years (maximally 8 %). (Fig. 10)

In the CEE, most countries (e.g. Bulgaria) still do not have strategies and national policies for the management of contaminated sites or specific legislation regulating investigation and clean-up of contaminated land; others (e.g. Poland) have only recently introduced new laws on environmental protection. However, requirements for soil protection are generally included in several legislative acts (e.g. environment protection legislation and water, waste and mining legislation).

Figure 10. Annual expenditures for contaminated sites remediation in selected countries (Euro per capita and year), partly estimated



Notes: (a) Germany: projection from estimates of expenditures from some of the "Laender" , (b) Slovenia: data from 1999 and 2001, (c) Romania: data from 1997 and 2000

Source: 2002 data: EIONET priority data flow; September 2003. 1999 and 2000 data: for EU countries and Liechtenstein: pilot EIONET data flow; January 2002; for Accession countries: data request new EEA member countries, February 2002. NB: 2002 data have not yet been published and are currently under review

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ANNEX I SOIL CONTAMINATION IN URBAN AREAS

Soils in urban and industrial regions - conurbations in particular- show major differences as compared to soils in natural and cultural landscapes. Some have special characteristics, as a result of the application and mixture of natural and artificial substrates (waste, bricks, concrete, etc.), falling groundwater levels, excavation, compaction and sealing as well as the deposition of airborne pollutants.

In particular, the ecological functions of urban soils are severely restricted or even destroyed by these pressures. In the worst cases, urban soils have become a risk to human health on account of the accumulation and release of heavy metals, nitrates, pesticides and organic pollutants (DBG, 1997).

Contamination is particularly relevant in densely populated areas, where high competition of different soil and land uses exists and where access to resources such as clean drinking water is often seriously compromised. Except in perhaps a few cases, it is extremely difficult and practically or economically impossible to restore contaminated soil's multi-functionality in full. Current remediation strategies aim to restore soil to perform some of its functions. In Copenhagen, for example, the municipal authorities decided to remove soil from kindergartens due to its contamination from atmospheric depositions. In Helsinki, the municipally decided to gradually close down the Myllypuro suburb, erected on a former dump site, due to the threat posed by the presence of hazardous substances (EEA, 2000).

More details on the situation of urban soils are illustrated below, where the results of soil surveys aimed at investigating soil contamination by heavy metals in Austria and Germany are discussed.

Vienna

In Austria some surveys have been performed dealing with the condition of soil in urban areas, in particular pollution levels. For the industrial conurbation of Linz the pollution of soils with persistent pollutants, mostly caused by atmospheric depositions, was investigated. Whereas the load of heavy metals in arable soils showed only in individual cases increased concentrations of copper, lead, zinc, mercury and arsenic, half of the garden soils were polluted with heavy metals. The average concentration of lead, cadmium, mercury and zinc was more than two-fold above the average concentration of the same pollutants in the soils of the province of Upper Austria. (Magistrat Linz - Amt für Umweltschutz, 1989, 1990).

The department for environmental protection of the municipality of Vienna publishes every three years a Soil Report. This report include the results of soil surveys aimed at investigating heavy metal contamination at 286 sampling points located in specific areas in the municipality (playgrounds, public greens, greens along roads). The surveys show that no alarming heavy metal loads can be found in the surveyed areas and that lead concentrations in soils situated in the vicinity of roads are decreasing over time (Kreiner, 2001). Compared to grassland values of Austria, the concentrations of cadmium, copper, mercury, lead and zinc in public green areas of Vienna are clearly higher. This indicates that top soils in urban areas are 'usually' more polluted by certain heavy metals than soils in rural areas. This is most probably related to local emissions. Although these levels do not require remediation measures, reduction or prevention of further emissions should be considered.

Table 1 Ranges of heavy metal concentration in grassland soils of Austria as compared to public greens and parks in Vienna

10th – 90th percentile	**Cd**	**Cr**	**Cu**	**Hg**	**Ni**	**Pb**	**Zn**
Grass land * [1]	0,14 – 0,59	19,8 – 66,6	11,2 – 43,2	<dl° – 0,33	9,1 – 46,2	12,3 – 55,7	52,6 – 145,0
Public greens and parks Vienna ** [2 3]	0,33 – 0,88	16,4 – 40,3	22,6 – 81,1	0,14 – 0,96	22,2 – 34,5	37,2 – 143,7	84,2 – 269,6

Notes: * weighed mean values 0-20 cm, n= 753 up to 1172 ** 0 – 10 cm, n= 66 ° below detection limit

Sources:

1 Amlinger, F., Peyr, S., 2001.; soil data extracted from the soil information system BORIS of the Austrian Federal Environment Agency, based on provincial soil inventories of Burgenland, Carinthia, Lower and Upper Austria, Styria and Tyrol.

2 Kreiner, 2001

3 all parks with playgrounds

The comparison between public greens and parks (with playgrounds) show differences regarding some heavy metal concentrations between those two land uses (Table 2). For cadmium, lead, copper and zinc the concentrations are significantly higher in parks than in public greens (located in the outer districts of Vienna); the 90 percentile for lead is even more than 100 % higher. In relation to grassland and in particular arable land, the concentrations are much higher (three to six times for the 90 percentile). The most significant differences can be stated for mercury as all calculated percentiles for parks are more than twofold higher than in public greens. The reasons for the differences between those two land uses is most probably the distance to roads and human activities causing dust emissions. In relation to reference values for certain land uses (Eikmann & Kloke, 1993) no exceedances of BW III (concentration in soil which indicates damage to plants, animals and humans) could be observed. Exceedances would make some further investigations or even measures necessary. Regular monitoring programmes as those carried out in Vienna are needed to keep the situation in urban areas under control, where changes can happen faster than in rural areas.

Berlin

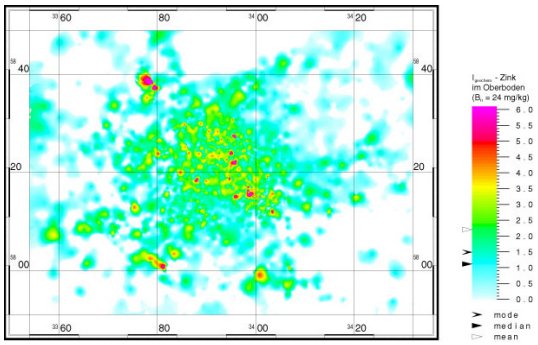
Results of a geochemical survey of the topsoils in the Berlin metropolitan area carried out in the late 1990's showed that heavy metal concentration varied considerably in the urban environment, reflecting land use

and the type and volume of industrial production in the area. (Birke and Rauch, 1997, 2000).

For example, high values of geo-chemical load index for zinc, measuring the level of contamination above geochemical background values, were found around sewage plants, hospitals and medical centres. Similar distributions have been observed for lead, mercury and copper.

Zinc concentration of up to 25% of Zn occurs near metal smelters and machine tool works with local maxima of up to 17% Zn in landfill areas near these sites (see Fig. 1).

Fig. 1 Distribution of the geochemical load index for zinc in topsoils of urban Berlin



Source: Birke&Rauch, 1997

Industrial and commercial areas in the Berlin metropolitan region often display considerable concentrations of heavy metals, especially lead and mercury, with respect to the natural background. Wooded areas show no great enrichments except for cadmium and zinc. Strong anomalies occur near iron and steel industries, construction material industries and in the vicinity of sewage farms. Local heavy metal pollution (mercury, cadmium, zinc) is associated with sewage plants in the northern and southern parts of the city.

Studies of Berlin and other German cities have shown that heavy metals concentrations (such as Cd, Cu, Cr, Hg, Ni, Pb, Zn and As) exceed 1.8 to 8.9 times the natural content (see Table 3).

Especially in the polluted soils of old industrial sites, peak values of 2050 times the geogenic background were measured for copper, 1780 for mercury and 1638 times for cadmium.

Table 3. Approximate heavy metal content in the Berlin topsoils, 0-20 cm (t)

Element	Total	geogenic	anthropogenic
As	834	620	214
Cd	74.0	21.8	52.2
Cr	5366	3869	1497
Cu	6660	1753	4907
Hg	40.6	8.5	32.1
Ni	1646	577	1069
Pb	16377	5366	11011
Sn	1283	428	855
Zn	27580	5153	22427
Zr	43829	43188	641

Source: Birke&Rauch, 1997, 2000

Method of calculation
Metal content (in t) = A * T * d * X /100
A = Berlin area in km^2 (890.85 km^2)
T = depth in cm
d = soil density in g/cm^3
X = element concentration in mg/kg

Table 2 Heavy metal concentration in arable and grassland soils of Austria as compared to public greens and parks in Vienna

Cadmium in soils [mg/kg]							
soil use	**horizon**	**N**	**Percentile**				
			10	**25**	**50**	**75**	**90**
arable land [1]	0 - 20 cm	2066	0,11	0,15	0,21	0,28	0,38
grass land [1]	0 - 20 cm	1172	0,14	0,18	0,24	0,35	0,59
grass land [1]	0 - 5 cm	1425	0,18	0,23	0,31	0,43	0,68
Vienna: public greens [2]	0 - 10 cm	28	0,30	0,37	0,50	0,62	0,78
Vienna: parks [2; 3]	0 - 10 cm	38	0,39	0,47	0,57	0,83	0,99
Chromium in soils [mg/kg]							
soil use	**horizon**	**N**	**Percentile**				
			10	**25**	**50**	**75**	**90**
arable land [1]	0 - 20 cm	2045	22,56	30,50	38,00	48,00	61,20
grass land [1]	0 - 20 cm	1106	19,78	27,80	36,16	47,23	66,64
grass land [1]	0 - 5 cm	1395	19,20	27,60	36,80	47,40	64,30
Vienna: public greens [2]	0 - 10 cm	28	15,54	19,58	26,39	38,89	46,16
Vienna: parks [2; 3]	0 - 10 cm	38	19,09	21,34	25,93	28,62	32,88
Copper in soils [mg/kg]							
soil use	**horizon**	**N**	**Percentile**				
			10	**25**	**50**	**75**	**90**
arable land [1]	0 - 20 cm	2066	12,30	16,30	21,20	27,62	37,90
grass land [1]	0 - 20 cm	1172	11,22	15,34	22,70	33,00	43,22
grass land [1]	0 - 5 cm	1425	11,60	15,70	22,40	31,50	40,90
Vienna: public greens [2]	0 - 10 cm	28	18,07	24,05	27,21	37,80	56,36
Vienna: parks [2; 3]	0 - 10 cm	38	29,29	35,17	46,28	59,40	96,37
Mercury in soils [mg/kg]							
soil use	**horizon**	**N**	**Percentile**				
			10	**25**	**50**	**75**	**90**
arable land [1]	0 - 20 cm	1728	< d.l.**	0,10	0,16	0,22	0,29
grass land [1]	0 - 20 cm	906	< d.l.**	0,07	0,14	0,23	0,33
grass land [1; *]	0 - 5 cm	1073	< d.l.**	0,09	0,13	0,20	0,30
Vienna: public greens [2]	0 - 10 cm	28	0,11	0,15	0,17	0,26	0,48
Vienna: parks [2; 3]	0 - 10 cm	38	0,27	0,33	0,55	0,75	1,06
Nickel in soils [mg/kg]							
soil use	**horizon**	**N**	**Percentile**				
			10	**25**	**50**	**75**	**90**
arable land [1]	0 - 20 cm	2045	10,40	18,40	23,70	30,00	38,20
grass land [1]	0 - 20 cm	753	9,09	16,45	24,10	32,88	46,17
grass land [1; *]	0 - 5 cm	1395	8,80	16,30	24,30	33,60	45,20
Vienna: public greens [2]	0 - 10 cm	28	18,81	23,80	27,38	31,38	34,52
Vienna: parks [2; 3]	0 - 10 cm	38	23,63	26,02	28,89	31,70	33,66
Lead in soils [mg/kg]							
soil use	**horizon**	**N**	**Percentile**				
			10	**25**	**50**	**75**	**90**
arable land [1]	0 - 20 cm	2066	5,48	11,60	17,20	23,20	32,13
grass land [1]	0 - 20 cm	1172	12,32	18,50	26,69	39,30	55,68
grass land [1]	0 - 5 cm	1425	15,82	21,50	28,40	42,70	67,04
Vienna: public greens [2]	0 - 10 cm	28	29,94	39,66	57,41	72,10	82,15
Vienna: parks [2; 3]	0 - 10 cm	38	47,84	73,97	85,70	123,11	185,26
Zinc in soils [mg/kg]							
soil use	**horizon**	**N**	**Percentile**				
			10	**25**	**50**	**75**	**90**
arable land [1]	0 - 20 cm	2066	54,17	63,10	73,89	92,00	112,87
grass land [1]	0 - 20 cm	1172	52,57	69,02	90,59	114,60	144,99
grass land [1]	0 - 5 cm	1425	56,46	73,20	96,00	119,43	144,42
Vienna: public greens [2]	0 - 10 cm	28	66,08	85,94	109,08	131,89	188,52
Vienna: parks [2; 3]	0 - 10 cm	38	96,19	123,04	155,85	213,51	304,10

Notes:

* without province Tyrol

** below detection limit

[1] Amlinger, F., Peyr, S., 2001.; soil data extracted from the soil information system BORIS of the Austrian Federal Environment Agency, based on provincial soil inventories of Burgenland, Carinthia, Lower and Upper Austria, Styria and Tyrol.

[2] Kreiner, 2001

[3] all parks with playgrounds

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ANNEX II HEAVY METAL LOADS IN EUROPE'S AGRICULTURAL AREAS DUE TO APPLICATION OF SEWAGE SLUDGE

Table 1: Loads of heavy metals in selected countries due to application of sewage sludge (mainly based on the national maximum permitted application rate)

Country	Year	Cd g/ha/a	Cr g/ha/a	Cu g/ha/a	Hg g/ha/a	Ni g/ha/a	Pb g/ha/a	Zn g/ha/a
AT	1995	3.20	143.93	639.71	5.60	93.29	266.54	3,331.80
AT	1998	3.18	143.24	636.64	5.57	92.84	265.27	3,315.84
AT	2001	3.29	147.86	657.14	5.75	95.83	273.81	3,422.62
DK	1995	1.77	31.37	269.75	2.14	26.84	68.02	957.16
DK	1996	1.33	26.86	262.54	1.23	21.59	51.86	712.51
DK	1997	1.32	25.11	244.51	1.11	18.16	49.45	664.18
DK	1998	1.37	25.47	246.35	1.00	20.54	50.64	697.94
DK	1999	1.45	25.61	229.62	0.95	21.34	49.25	678.00
DK	2000	1.15	23.87	214.76	0.94	21.46	49.87	649.31
DK	2001	1.29	23.18	221.62	0.94	26.23	46.83	702.34
GE	1998	2.34	81.83	482.63	1.67	45.09	105.21	1,394.45
GE	1999	2.17	78.49	490.98	1.50	46.76	101.87	1,369.40
GE	2000	2.17	68.47	504.34	1.50	46.76	100.20	1,379.42
HU	2002	9.65	330.13	-	7.11	154.34	256.18	4,744.33
IE	1999	5.20	330.00	666.00	1.20	66.00	212.00	1,136.00
IT	1998	16.94	486.96	1,472.41	8.37	315.88	560.92	4,347.04
IT	1999	16.60	437.17	1,609.62	7.66	226.25	515.38	4,471.79
IT	2000	14.82	611.08	1,424.88	5.67	318.66	503.73	4,312.49
LU	1999	5.10	189.00	900.00	5.70	153.00	387.00	5,004.00
NO	2001	2.00	49.60	488.20	1.80	29.00	41.20	634.00
PT	2000	20.40	660.00	3,072.00	31.20	276.00	630.00	10,020.00
ES	1999	47.30	2,992.22	6,782.38	30.58	1,096.70	2,575.98	21,098.44
ES	2000	49.60	2,888.20	6,051.00	42.60	916.20	2,058.00	18,034.60
ES	2001	76.50	3,001.80	7,994.70	33.90	1,236.00	3,747.00	21,995.10

Source: EIONET data flow, September 2003 (data not yet published)
Note: The table shows a worst case scenario, as for most countries data are based on maximum permitted application rather than actual application.

References

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ANNEX III BACKGROUND VALUES OF HEAVY METALS IN EUROPE'S SOIL

Heavy metal contents in European soils are varying according to soil parent material and land use (arable land, grassland, forest, other land use) and also due to heavy metal inputs. In order to assess soil contamination and its development it is essential to know the background level of trace elements in soils. Based on a study commissioned by the Joint Research Centre and DG Environment (JRC, 2004), ranges of background values of trace elements in European top soils in relation to parent material (including all land uses) are given in Table 1.

Table 1: Range of heavy metal contents (median) within the units of soil parent material considering all land use types [mg*kg-1], 11 countries included

Soil parent material*	Cd	Cr	Cu	Hg	Ni	Pb	Zn
Undifferentiated alluvial or glacial deposits	0.07 - 0.76	7 – 40	4 - 30	0.02 - 0.24	4 - 34	6 – 64	13 - 128
Calcareous rocks	0.26 - 1.23	10 – 56	12 - 24	0.06 - 0.23	13 - 39	16 – 63	49 - 100
Clayey materials	0.14 - 0.90	9 – 50	7 - 22	0.05 - 0.13	7 - 36	9 – 37	25 - 78
Sandy materials	0.09 - 0.30	5 – 37	2 - 21	0.04 - 0.18	3 - 22	9 – 39	6 - 62
Loamy materials	0.10 - 0.85	10 – 62	8 - 21	0.04 - 0.18	9 - 29	11 – 54	35 - 86
Detrital formations	0.18 - 1.23	16 – 49	12 - 24	0.10 - 0.13	21 - 32	17 – 46	52 - 107
Crystalline rocks and migmatites	0.11 - 0.94	8 – 43	11 - 31	0.04 - 0.20	10 - 38	15 – 73	40 - 101
Volcanic rocks	0.25 - 1.48	10 – 68	10 - 32	0.11 - 0.29	8 - 48	26 – 58	55 - 130
Other rocks	0.10 - 1.00	5 – 40	4 - 32	0.07 - 0.24	3 - 37	14 – 88	19 - 125

Note: * Mapping units of the European Soil Data Base
Sourcs: JRC, 2004

Maximum median values exceed the respective lowest median values 1.3 to 12.3 times. The highest median values can be found in the units "Volcanic rocks" and "Other rocks". They occur under grassland, forest or other land use but not under arable land. The lowest values are distributed to the units "Undifferentiated alluvial or glacial deposits", "Sandy material" and "Other rocks". They emerge either under forest or arable land. With regard to the limited data availability and comparability it must be pointed out that the given ranges of heavy metal contents are only in parts representative for the whole of Europe.

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CONTAMINATION AND LAND MANAGEMENT

Task Group 2 on
LOCAL SOURCES

Gundula Prokop, Andreas Bieber, Teija Haavisto, Tamás Hamor
Elisabeth Steenberg, Morten Brøgger, Marina Pantazidou

Executive summary and recommendations

The Task Group Local Sources focuses on preventing soil pollution from point sources. An overview of major point sources contributing to local soil contamination is provided by the Task Group.

Key conclusions of the Task Group are:

(1) In most cases soil pollution from point sources is unintended and happens due to handling spills or accidents or insignificant but continual losses/emissions. In contrast to air emissions and wastewater discharges, the principle of "controlled emissions" can not be applied and appropriate measures need to focus on pollution prevention.

(2) Soil pollution deriving from point sources shall be avoided as far as reasonably achievable whatever the state of soil might be at the beginning of an operation ("no added/increasing contamination").

(3) Prevention of soil pollution from point sources is not sufficiently addressed in current EU policy (in contrast to emissions to air and water). Environmental liability in the case of pollution is weak and legally binding financial security of potential polluters is entirely lacking.

(4) Point source safety for potentially soil polluting activities from industry, waste deposits, buildings, and extractive industries needs to be reviewed. In this respect special provisions to prevent emissions to soil need to be defined and the progress of their implementation needs to be surveyed.

(5) Monitoring of soil pollution from point sources can only be based on assessing policy efficiency in the sense of surveying the progress and efficiency of implementing measures intended to increase point source safety related to soil protection. Appropriate "policy monitoring" can only be implemented after implementation of appropriate policy adjustments at EU level and at Member State level.

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Key recommendations of the Task Group are:

(1) A commonly recognised list of potentially soil polluting activities from industry, waste deposits, and extractive industries needs to be drawn up and a distinction shall be drawn between those activities that shall be subject to EU policy and those that shall be subject to national policy regimes. A list of major sources was set-up by the Task Group (see p. 2), which needs more detailed specifications.

(2) In view of the enormous costs generated in the case of soil remediation, environmental liability needs to be strengthened. The Task Group recommends a regime of obligatory financial security, or insurances depending on the size and type of activity and the efficiency of implemented preventive measures.

(3) Implementation of an obligatory soil assessment at the start and closure of potentially soil polluting activities.

(4) Prevention of soil pollution from potentially soil polluting activities needs "tailor made" prescriptions and should be based on sector-specific or activity-specific precautionary measures. At EU level the Task Group considers IPPC BREF documents as the most suitable level to integrate soil protection measures in a sensitive way.

(5) Consideration of early warning systems in landfills.

(6) Consideration of soil pollution in mine waste management and reclamation of mining areas.

(7) Incentives for operators → better insurance and liability conditions for proactive soil protection measures.

(8) Improvement of point source safety at sites that are currently not covered by EU legislation, in particular small and medium sized enterprises (SMEs). Development of short guidance documents for prevention of soil pollution at potentially soil polluting SMEs.

(9) Awareness raising at sites where potentially polluting activities are carried out.

(10) Monitoring of point source safety with regard to soil pollution at EU level and Member State level.

Recommendations to the Working Group on Monitoring

Based on a commonly accepted list of potentially soil polluting activities, the progress of point source safety in Member States shall be measured at a regular basis - both at EU level for activities that are subject to EU policy and at the Member State level for those that are subject to national policy regimes.

The Task Group proposes to set up an information system on point source safety and to make use of already existing initiatives and databases as far as possible (i.e. EPER, EEA catalogue of waste facilities).

Recommendations to the Working Group on Research

(1) Structured information on pollution prevention devices (i.e. containment devices and techniques for safe storage, handling and transport of substances that may contaminate soil and groundwater) is needed in order to develop adequate BAT reference documents for defined potentially polluting activities.

(2) Passive sampling technologies, which in general are contaminant specific, are promising technologies for early warning of soil pollution. However, absence of performance data from lengthy use and other uncertainties prevent their availability on the market. Further improvement on product development is needed to improve economy and reliability of such devices.

Local sources: What are we talking about?

The current paper focuses on the prevention of future soil contamination deriving from local sources. It does not consider already existing or historic contamination from local sources, because this aspect is dealt with by the Task Group "Contaminated Land Management".

Major sources

The Task Group carried out a short survey of activities producing point source emissions with the potential to cause soil contamination, which are currently addressed in the Member States and in EU legislation (see also Annex, Reference 6). The list below is a summary of such activities.

In general, it can be said that there is no perfect categorisation of point sources. Point sources can be categorised according to economic sectors, contaminants, civil status etc. The above overview is a compromise of different methods. For further work, the Task Group decided that a distinction between civil and military activities was not opportune. Furthermore, the above categories are not all of major concern and, therefore, five major categories of potentially polluting activities were selected:

- Industry: accidents, spills, leaks, storage, and waste disposal
- Mining: the risk is often associated with storage or disposal of tailings, acid mine drainage and the use of certain chemical reagents. Pollution of groundwater is often associated with these processes
- Waste Management Activities
- Traffic: through gas exhaustion; oil and gasoline losses; rubber abrasion from tires; accidents with loss of oil, gasoline or load; other particles

- <u>Others</u>
  - Construction products used on or in the soil (concrete, paints, …)
  - Private and commercial storage and fueling facilities (tanks, gasoline stations)
  - Shooting ranges
  - Waste water systems

Major impacts

Soil can be seen as target for contamination but also as vehicle for the transport of contaminants to other targets. Looking at the relations "source → soil" and "soil → target", key pathways are direct input and indirect input through other media (air, water).
Soil contamination through local sources may have impacts on various targets, above all humans, nature and the water cycle. Impacts deriving from local sources can influence soil functions as such, affecting secondary targets but can also directly have an economic impact due to direct loss of values (see also Tab.2).

Local sources of soil contamination within the DPSIR cycle are presented in Figure 1, with regard to the DPSIR concept, which is briefly explained below

- **Driving Forces** refer to the permanent consumer demands. Consumer goods need to be produced and transported
- **Pressures** refer to local sources as such (see also Tab.1)
- **State** refers to the contaminant's content in the soil (primary target)
- **Impact** refers to the environmental targets (secondary targets), and
- **Responses** refer to measures to either prevent or repair contamination from local sources.

Tab.1: Major point sources according to activities

Category	Activities and facilities related to defined point sources
Industrial activities and waste management activities covered by the IPPC Directive[1]	(see also Annex, Reference 6)
Industrial activities not covered by the IPPC Directive	chemical laundries (dry cleaning), petrol stations, large car repair and maintenance facilities (also military and agriculture) , depots, scrap yards, agro-chemical storage, wood processing facilities, waste water treatment plants, electricity transformer stations
Production and use of materials for construction	asphalt production and processing, road construction, painting, etc.
Military activities	shooting ranges, airports, …
Sporting activities	shooting ranges, gulf courses, car racing places…
Transport	airports, railway stations and tracks, harbours, transshipment places, pipelines for materials (e.g. hydrocarbons), sewage (waste water), conveyors, traffic emissions (lead, hydrocarbons, rubber, …)
Storage of materials (not covered by the IPPC directive)	oil tanks, waste water,….
Mining activities	tailings ponds

[1] COUNCIL DIRECTIVE 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control

Tab.2: Soil functions affected by local contamination

Type of function (value)	Description
Natural soil functions	as a basis for life and a habitat for people, animals, plants and soil organ-isms, as part of natural systems, especially by means of its water and nutrient cycles, as a medium for decomposition, balance and restoration as a result of its filtering, buffering and substance-converting properties, and especially groundwater protection
Useful functions for humans	settlement and recreation, agricultural and silvicultural use, economic value

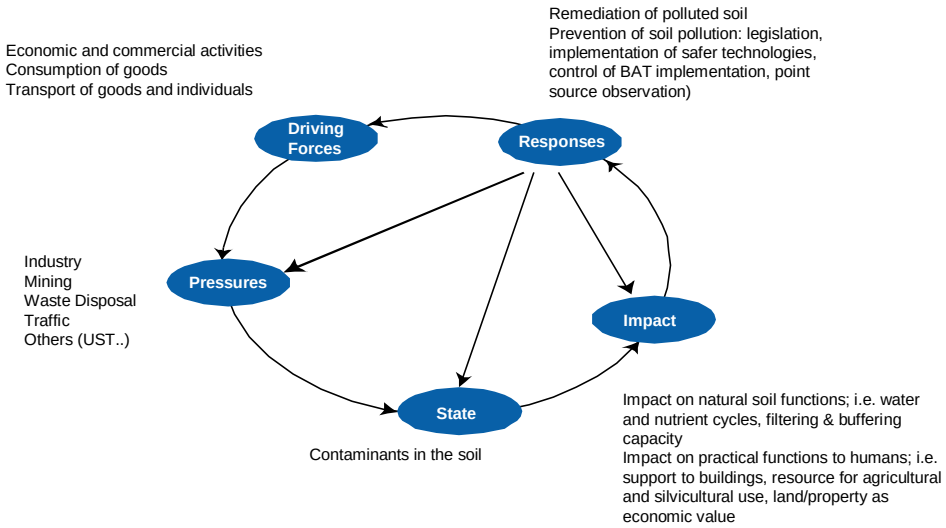

Fig.1.: Local sources of soil contamination within the DPSIR cycle.

Major contaminants involved

Major contaminant groups according to current EU research on soil and groundwater contamination are[2]:

- Fuel spills → hydrocarbons and MTBE
- Effluents from mines, combustion installations, transport → heavy metals
- Industrial spills
  - Decreasing agents, solvents → chlorinated hydrocarbons
  - Solvents, petroleum constituents → benzene, toluene, xylene, ethylene (BTEX)
  - Polymerisation starters → phenols
- Gas works and incomplete combustion processes → polycyclic aromatic hydrocarbons (PAHs)
- Residues from military activities → explosives

Other contaminant groups not included in the above list are anions (cyanides, nitrates, sulfates etc.) and cations (ammonia, sodium etc.). This group is linked to a sizeable variety of different activities.

Economic and social burden

Soil is the preliminary target of contamination from local sources. Once in the soil, contaminants can migrate and seep into the groundwater. Groundwater is still the major drinking water source in most European countries. If water resources or human health are at risk, remediation measures to cleanup soil and groundwater need to be implemented. Remediation measures involve enormous costs. In 1997 the European Environment Agency conducted a survey on expected total remediation expenditures in the EU and EFTA countries. Data for 68% of the surveyed area were obtained, indicating a figure of approximately 84 billion Euro. For the entire surveyed area, costs could be projected to be approximately 115 billion Euro or 490 Euro per capita[3].

Despite the magnitude of the problem as revealed by the estimates referring to total expected remediation costs, data on actual expenditures are very limited. Two surveys conducted by EEA refer to average annual expenditures of 10 Euro per capita (see Tab.3) in European countries

[2] IMAGE-TRAIN (2003), Newsletter no.3, Accompanying Measure of the 5th EU Framework Programme for RTD, available from http:www.image-train.net. see also Annex Ref. 3

[3] EEA (1999) Management of Contaminated Sites in Western Europe. Topic Report No.13/99. European Environment Agency, Kopenhagen, Denmark.

with a high GDP. It can be assumed that countries with a lower GDP spend less.

Tab.3: Annual expenditures on soil remediation (source: EEA[4], 2003)

Country	Million €	€ / capita	reference year of 1st survey
Austria			
Belgium-Fl*	96.5	16.3	2001
Finland			
France	76	1.3	2001
Netherlands*	332	20.8	2001
Norway	0.4	0.9	2002
Sweden			
UK	781.1	13.3	2002
Mean value		**10.3**	

Million €	€ / capita	reference year of 2nd survey
95	11.8	2002
122	20.6	2002
50-60	10.6	2002
101	1.7	2002
251	15.6	2002
1.1	0.2	2003
70	7.8	2002
812.3	13.7	2003
	10.3	

* including after-care measures

In most countries only the most urgent cases are remediated due to the enormous costs involved. The identification and remediation of already existing contamination is an enormous task consuming considerable financial recourses on a long term basis. EU Accession countries face the same burden as EU countries having less money to spend.

It can be concluded that already existing contamination inherited from the past is more than we can handle within this generation. Efforts and investments to prevent future local soil contamination will pay back firstly to maintain good soil quality and secondly to save enormous financial resources.

Measures to prevent soil pollution should not only be considered as financial burden. Their development and implementation yield a variety of benefits. Apart from the environmental benefits, export of know-how and technologies can be an opportunity for the European market. It should be noted that an EU action plan to boost environmental technologies with reference to venture capital and a clear time frame was recently published (ETAP[5]).

[4] EEA (2003), EIONET questionnaire carried out in 2003. Data were extracted from a fact sheet to be published on the EEA web site in 2004 after EIONET consultation

[5] COM(2004) 38 final, Communication from the Commission to the Council and the European Parliament Stimulating Technologies for Sustainable Development: An Environmental Technologies Action Plan for the European Union

Available data on local sources

An overview of European local sources of soil contamination does not exist so far. The European Environment Agency (EEA) has made first attempts to collect data. A generic questionnaire[6] used by EEA showed that, waste disposal and industrial activities were referred to as the most important local sources. Furthermore, EEA has drafted a map of European soil contamination based on potential polluters. The so called "hot spot map" distinguishes among regions with low, medium and high potential for soil contamination from local sources[7].

With regard to the major identified sources, available quantitative data on local sources were investigated. Furthermore, existing EU policy requirements have been checked as to whether or not they might provide information on local sources of soil contamination or include relevant reporting obligations.

Industry

With regard to the question which industrial activities are major contributors to local soil contamination, a questionnaire was used by EEA in 1998. Results reveal that the metal working, chemical, textile, leather,wood and oil industrie were ranked very high. In contrast the food industry and the glass, ceramics and stone processing operations were ranked very low[8].

Since June 2003 national governments of all EC Member States were required to maintain inventories of emission data from specified industrial sources and to report emissions from individual facilities to the European Commission. The reported data has been made accessible in a public register (**EPER**[9]), which provides air and water emission data from industrial installations that fall under the IPPC requirements. EPER can be considered as a first step towards the development of a fully integrated pollutant release and transfer register for Europe. From 2007 on EPER will be transformed into an international pollutant release and transfer register according to a UN protocol which was signed by all EU Member States (**PRTR**[10]). The new register intends to consider more pollutants, more activities and to include also waste streams and diffuse pollution. However, neither of them considers emissions to soil from point sources.

[6] EEA (2001) *Environmental Signals 2001 Report*, see also Annex Reference 2

[7] The source for the map was obtained through the CORINE land cover data base and ESRI population density data. The map is based on the assumption that for regions with higher urbanization and industrial density, the expectations for local soil contamination are higher. Thus the existence of sources for local contamination is highly correlated to populated and industrial areas.

Schamann M., Gentile A.R. et. al (2003) The European Environment Agency's Framework for the Development of Europe-wide policy relevant indicators on Local Soil Contamination. Proceedings of the 8th International FZK/TNO Conference on Contaminated Soil (CONSOIL 2003) from 12 to 16 May, 2003 in Gent – Belgium, p31; see also Annex Reference 4

[8] A list of 41 industrial activities was ranked based on expert judgement by 9 country experts; see Annex Reference 1

[9] Decision on the implementation of a European Pollutant Emission Register (EPER) according to Article 15 of Council Directive 96/61/EC concerning Integrated Pollution Prevention and Control (IPPC). http://www.eper.cec.eu.int/eper/default.asp

[10] United Nations (2003) *Draft Protocol on Pollutant Release and Transfer Registers*. Meeting of the Parties to the Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, Extraordinary Meeting in Kiev May 21, 2003

Mining

Mining activities have a wide range of environmental impacts at every stage of operation, of which management of tailings is one of the most significant environmental aspects. The mine accident in the Doñana National Park in Spain was a trigger to improve the safety of mining operations. Shortly after the accident, the World Wildlife Fund conducted a survey with specific emphasis on metal mining and processing activities[11] in EU countries. The report concluded that the EU is a major metal processing centre but only a small metal ore exploiter. At the time of the survey an overview of mining activities and tailings ponds was non-existent. The report lists larger metal mining activities with a capacity of more than 150,000 tons per year.

Further investigations related to point source data on mining activities led to a survey[12] carried out for DG Environment in 2001. A first attempt was made to compile an inventory of the European Union's mining sites. The inventory includes some 750 sites from 9 European countries and describes the type and the quantity of exploited material. Furthermore, the Joint Research Centre has initiated a project[13] which, among other objectives, includes the compilation of an inventory of toxic waste sites from mineral mining in Pre-Accession countries in relation to "sensitive" catchment areas, by combining an indicator approach according to the DPSIR framework and an analysis of satellite remote sensing.

Waste Management

The European Environment Agency started an initiative to set up an **electronic** catalogue of waste management facilities for all EEA member countries[14]. Basic data sets including address, regional code, and information on recovery and disposal types were entered into a central database. For hazardous waste management facilities data from all EU Member States were collected, whereas for non-hazardous waste management facilities only data from volunteering regions and countries were included. The electronic catalogue considered only those facilities which are relevant for the IPPC directive, i.e., only facilities of a certain size and/or capacity. A continuation of the electronic catalogue including regular updating is currently in the negotiation phase.

Traffic

As for other environmental issues, the European Council has described measures for the exchange of information and data on air pollution. These measures are decided in[15] the Council Decision of 27 January 1997 on establishing a reciprocal exchange of information and data from networks and individual stations measuring ambient air pollution within the Member States. The decision is made with reference to the 1996 Council Directive[16] on air quality.

The Council Decision on information exchange related to air pollution is not specifically addressing emissions deriving from traffic. However, pollutants like lead and poly-aromatic hydrocarbons, which are known to cause soil pollution, are included in the directive on air quality.
The Task Group concludes that specific soil polluting emissions from traffic are included in EU-wide air quality monitoring. However, data on air quality need to be further analysed in view of soil pollution. It has to be checked whether contribution from traffic can be specified from the existing data.

THE CURRENT SITUATION: WHAT IS BEING DONE TO PREVENT CONTAMINATION FROM LOCAL SOURCES

At EU level a variety of legislative regimes exist and are currently being developed to improve safe operation of local sources, mainly at installations that use dangerous substances or manage wastes. In the following section, existing EU legislation addressing local sources and prevention of soil pollution and its efficiency are analysed[17] (see also overview in Table 3).

Industry

Over decades industrial and commercial activities have contributed to local soil contamination due to spills, inappropriate waste management, leaking underground storage tanks, and accidents. In many cases contamination was due to non-existent safety standards.

Accident prevention

With regard to preventing major industrial accidents, the so called **Seveso II** Directive[18] was adopted in 1996, which aims firstly at the prevention of major-accidents hazards involving dangerous substances and secondly to limit the consequences of such accidents. Major requirements are to implement a major-accident prevention policy and a safety management system including safety reports and emergency plans involving a detailed risk assessment using accident scenarios. The directive applies to specified establishments where dangerous substances are present, however a variety of relevant activities and installations are excluded in particular military establishments, transport and temporary storage of dangerous substances, the mineral extractive industries, and waste land-fills. Hazards by ionizing radiation are also not addressed.

Despite its shortcomings, it was concluded that the Seveso II Directive introduces very intelligent measures that are worthwhile to be considered for a variety of other installations. In particular:

- Seveso II introduced an obligation for industrial operators to implement a major-accident prevention policy and a safety management system including

[11] WWF (1999) *Toxic Waste Storage Sites in EU countries. A Preliminary Risk Inventory*. Authors: Sol, V.M., Peters S.W.M. et al.; published by the Institute for Environmetnal Studies IVM report: R99/04, Amsterdam, The Netherlands.

[12] BRGM (2001) Management of Mining, Quarrying and ore processing Waste in the European Union, Study made for DG Environment, European Commission, BRGM/RP-50319-FR, p. 17.See Annex Reference 5

[13] PECOMINE, Inventory, Regulations and Environmental Impact of Toxic Mining Wastes in Pre-Accession Countries, A JRC Project in Association with Central and Eastern European Pre-Accession Countries; http://viso.ei.jrc.it/pecomines_ext/index.html

[14] EEA (2001) Waste Management Facilities – Electronic Catalogue (author: Thomas Weißenbach on behalf of the European Topic Centre of Waste), Technical Report 65, Copenhagen (Denmark).

[15] Council Decision of 27 January 1997 establishing a reciprocal exchange of information and data from networks and individual stations measuring ambient air pollution within the Member States (97/101/EC)

[16] Council Directive 96/62/EC of 27 September 1996 on ambient air quality assessment and management

[17] See also Annex Reference 7: Hamor Th. (2003) "The last environmental medium: A mapping of the European Union Community legislation with regard to provisions to soil" , Joint Research Centre (Review report prepared for WG Contamination)

[18] Council Directive 96/82/EC of December 9 1996 on the control of major accidents and hazards

safety reports and emergency plans involving a detailed risk assessment using accident scenarios.

Tab.3: Overview of EU legislation addressing prevention of soil pollution from local sources specifying positive aspects and gaps.

Issue addressed	Legal Document	Pro's	Gaps
Major industrial accidents	Seveso II	Land use planning aspects, safety management plan	Too many relevant activities are excluded
Industrial installations	IPPC Directive	Prevention of soil pollution is laid down. BAT documents are continuously revised; there is still room to add soil protection.	Specific prevention measures refer only to emissions to air and water (IPPC/Annex 3) Refers only to large industries Better consideration of GMP* and training in BAT documents currently under development
Mine Waste Management	Proposed Directive	Safe operation of mine tailings.	No specific reference to prevention of soil pollution
Waste Disposal	Landfill Directive	Control, monitoring and closure of landfills.	Early warning mechanisms in landfill design
Traffic	Directives on Motor Vehicles	Measures to be taken against air pollution by emissions from motor vehicles.	Soil pollution from vehicles not addressed
Liability	Proposal for Liability Directive	Prevention of environmental damage and obligation to remedy in case of pollution.	Financial security of entrepreneurs not obligatory Proposal focuses on env. damage to protected species and natural habitats, most cases of local soil contamination would not be covered.
Environmental Impacts	Environmental Impact Assessment Directive	Impact assessment of soil-relevant projects required.	Limited to a few large projects
Voluntary agreements	EMAS	Good instrument to improve "good management practices".	No reference to soil pollution, very flexible, not legally binding

* good management practices

- One of the major tools is prescribed in Article 12 "Land-use planning". The accidents in scope shall be taken into account in the land-use policies and/or other relevant policies through controls on the placing of new establishments; and new developments such as transport links, residential areas, etc. These policies and their implementation shall take into account the need to maintain appropriate distances between establishments and residential areas, areas of public use and areas of particular natural sensitivity or interest.

Pollution Prevention

Concerning pollution prevention from industrial facilities the **IPPC directive**[19] is currently the most important policy document. The Directive points out the needs for soil protection. However, specific measures are specified for emissions to water and air and not soil.

Installations of a specified production size of the energy, metal producing and processing, mineral and chemical industries, as well as waste management facilities (incineration plants, municipal land fills etc.) are required to obtain a permit based on Best Available Techniques (BATs). New installations are obliged to obtain a permit since 1999, existing installations until 2007. BATs include preventive measures against pollution as such, waste reduction and/or recovery measures, and prevention of accidents and limitation of consequences. The permit has to include suitable monitoring requirements for pollutant releases to air and water also specifying measurement technology, frequency, evaluation procedure and an obligation to supply the competent authority with data required for checking compliance with the permit.

- It has to be taken into account that the IPPC directive was not drafted in the context of soil protection. If the implementation of the IPPC directive shall be of value for soil protection, a few amendments need to be considered, in particular Annex 3, "Indicative list of main polluting substances to be taken into account if they are relevant for fixing emission limit values". The list contains substances

[19] Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control.

for air and water, substances for soil are not mentioned.

- For each industry, BAT reference (BREF) documents are drafted and revised on a five year basis ("Sevilla process"). BREF documents have already formally accepted for 15 industries, while others are at various stages of development. The Task Group on Local Sources has screened a variety of BREF documents and concluded that officially accepted documents include sections on Good Operating Practices and Management and Good Housekeeping. These sections cover the prevention of unintended pollution. However, they are relatively brief and they only make nominal references to BREFs for good management. The Task Group suggests to strengthen these sections, especially in those BREFs that are currently under development.

Voluntary agreements

EMAS[20] is a voluntary scheme designed to promote continuous improvements of the environmental performance and compliance with all relevant regulatory requirements regarding the environment. To achieve this aim, industrial sites are required to use an environmental management system to monitor efficiency and to report on their achievements regarding environmental performance. EMAS is targeted at the industrial sector at present. In the future, it will also be applicable to other sectors.

Conclusions

- The IPPC Directive does not explicitly regard soil pollution aspects; Annex 3 in particular needs to be revised in this respect.

- The IPPC Directive and the Seveso II Directive consider mostly large installations and do not cover small industries and commercial activities. Safe operation of small industries and commercial activities is surely a concern of national legislation. However, a survey on the different national regimes concerning "SME safety" and their efficiency should be carried out[21].

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REF documents currently under development should strengthen prevention of soil pollution in the sections "Good Operating Practices and Management" and "Good Housekeeping".

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o promote sustainable development in SMEs - both in terms of the pollution caused by their plants and in terms of the goods and services that they produce.

-

elated to the IPPC Directive, a register of point source emissions to air and water exists (EPER, see also page 4). However, the system ignores emissions to soil. It is recommended to establish a system to observe point source safety in particular in view of soil pollution.

-

nstallations that do not yet comply with IPPC but are of interest for soil pollution need to be identified.

-

pecific conclusions concerning Seveso II: The directive has too much exclusion. In particular the exemption of strategic industries (military activities) does not seem to be opportune.

- EMAS does not specifically address soil pollution. The instrument is very flexible and is implemented on a voluntary basis. However, EMAS is good instrument to improve good management practices.

Mining (Extractive Industries)

Exploitation of ores and minerals involves a variety of processes that can result in negative impacts on soil and other natural resources, in particular if operation standards do not correspond to the state of the art. Facilities that have ceased operations have usually more impact on the environment than active ones but are not dealt with in this paper.

Due to a variety of incidents in recent years (Baia Mare/Romania, Aznalcóllar/Spain) safe operation of mining activities became a big issue lately and problems deriving from mine wastes have been widely recognised. Wastes from extractive industries amount to 24% in the European Union and to 47% in Central and Eastern Europe[22] of annual waste production. Some of these wastes are inert and chemically neutral, whereas others contain large amounts of dangerous substances which can be extracted to the surrounding environment. The management of residual rock from extractive industries (tailings) is hence risky and requires widely agreed safety standards. In response to past incidents, the European Commission adopted a Communication on the *"Safe operation of mining activities: a follow-up to recent mining accidents"*[23] and defines three priority actions to prevent risks from mining activities:

- An amendment of the Seveso II Directive[24], which aims at contributing to the prevention of major accidents that involve dangerous substances. Seveso II requires specific Safety Management Systems to be put into effect and the performance of a detailed risk assessment considering possible accident scenarios. However, the directive excludes most activities of the extractive industries. Currently a proposal aiming at deleting this exclusion is under approval by the EU Parliament.

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[20] Regulation (EC) No 761/2001 of the European Parliament and of the Council of 19 March 2001 allowing voluntary participation by organisation in a Community eco-management and audit scheme (EMAS).

[21] To give an example: For Austria there are estimates that less than 500 installations will need a permit according to IPPC, whereas some 2,500 sites are estimated to have a severe impact on soil and groundwater.

[22] EEA (2003) Europe's environment: the third assessment; ed: European Environment Agency, Copenhagen, Denmark, pp 154.

[23] COM (2000) 664 final, Communication 2000/664 (final) from the Commission of October 23 2000 on *"Safe operation of mining activities: a follow-up to recent mining accidents"*.

[24] COM (2001) 624 final, Proposal for a Directive of the European Parliament and of the Council amending Council Directive 96/82/EC of 9 December 1996 on the control of major-accident hazards involving dangerous substances.

- Integration of extractive industries in the IPPC directive and production of a Best Available Technique Document Reference (BREF) document referring to waste management in the mining sector. A draft reference document[25] was issued shortly before the finalisation of this report. The draft BREF gives detailed guidance in how to design, build and operate both tailings and waste-rock disposal facilities in order to guarantee the safe disposal of mining waste. Special attention is given to facilities for the disposal of potentially Acid Rock Drainage (ARD) producing material and the management of cyanide. Short- medium- and long-term issues are addressed in order to obtain safe disposal of tailings and waste-rock and thereby minimise the risk for soil contamination. Special attention is given to the management of soil and its particular value in the reclamation of extractive activities.

- An initiative on the management of mining waste: A proposal for a Directive on the management of waste from the extractive industries[26] is currently under negotiation. The proposal focuses on the prevention of soil and water pollution deriving from mine tailings. Furthermore, the proposal states "Member States should require operators of the extractive industries to apply monitoring and management controls in order to prevent water and soil pollution ..." The directive proposal also calls for a waste management plan for which it is stipulated (article 5) how to manage any removed topsoil (5.2.4) and a description of measures applied for prevention soil and water pollution (5.3.f). In addition, there is a special article (article 13) which specifically addresses "Prevention of water and soil pollution". However, a final directive is non existent so far (May 2004).

Conclusions

Common European standards for the safe operation of extractive industries, in particular management of tailings are currently being prepared and will soon come into force. Implementation of the BREF document for extractive industries, the mine waste directive and the amended Seveso II Directive will clearly contribute to prevent future contamination from mining activities.

Waste Management

In the past landfills have very often been causes of soil contamination. This was mainly due to unsafe waste disposal and in particular due to the lack of leachate management, gas control and bottom sealing. In order to prevent soil pollution from landfills two strategies are opportune:

- Waste prevention through reduction of packaging, increase of recycling, and reuse of goods.
- Safe waste disposal.

In the past waste prevention was evidently not successfully realised at European level, as evidenced by the waste quantities that are still increasing in most European countries[27]. This need was realised at European level and recently a Communication on the prevention and recycling of waste was adopted by the European Commission[28]. The Communication can be considered as a starting point to improve waste prevention and recycling at European level. It includes an assessment of Community waste policy in relation to prevention and recycling, with a view to identifying means to further developing waste management policy in line with the hierarchy of objectives set out in the Community's waste strategy. It focuses on the means of promoting more sustainable waste management, by minimising the environmental impacts of waste while also taking into account economic and social considerations. However, it can be concluded that effective waste prevention is in the beginning phase. Clear regimes and targets have not been defined yet.

With regard to safe waste disposal, EU legislation is far more advanced. A variety of legislative regimes on safe waste disposal exist and some of them have already an implementation history.

(1) Already as early as 1975 the safety of **landfills was declared as common EU policy**[29] requiring the disposal of waste without risk to human health, water, air, soil, plants and animals. Furthermore, Member States were to designate competent authorities for supervision of waste management facilities and to issue permits for facility owners and managers.

(2) In 1991 a **directive on hazardous wastes**[30] was brought into force regulating the controlled management of hazardous waste. Since December 1994 Member States are obliged to send to the European Commission information *"for every undertaking which carries out disposal and/or recovery of hazardous waste"*, including name and address, the method used to treat waste and the types and quantities of waste which can be treated.

(3) In 1996 the **IPPC directive** was issued (see also "Industry"), which oblige the waste management facilities defined below to acquire a permit (new installations from 1999 on, existing installations until 2007) based on BREFs:

- Installations for the disposal of hazardous wastes (> 10t/d),
- Installations for the incineration of municipal wastes (> 3t/h),
- Installations for the disposal of non-hazardous wastes (> 10t/d), and
- Landfills (> 10t/d).

(4) In 1999 the **Landfill Directive**[31] was issued requiring

[25] European IPPC Bureau of the European Commission (2004) Draft Reference Document on best Available Techniques for Management of Tailings and Waste Rock in Mining Activities. Draft March 2004. available from http://eippcb.jrc.es/pages/FActivities.htm

[26] COM (2003) 319 final, Communication 2003/319 (final) from the Commission of June 2 2003 on the management of waste from the extractive industries.

[27] EEA (2003) Europe's environment: the third assessment; ed: European Environment Agency, Copenhagen, Denmark, pp 151.

[28] COM (2003) 301, Communication 2003/301 from the Commission of 27 May 2003 towards a thematic strategy on the prevention and recycling of waste.

[29] Council Directive 75/442/EEC of July 15 1975 on waste

[30] Council Directive 91/689/EEC of 12 December 1991 on hazardous waste

[31] Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste

- classification of landfills (hazardous, non-hazardous, inert waste),
- acquisition of a permit to be issued by the competent authority,
- control and monitoring procedures while operating the landfill, and closure and after care procedures, and
- that Member States send regular reports to the European Commission concerning the effective implementation of the Directive.

The relevant annex for soil protection is Annex III, which covers, under (4), protection of groundwater. This is achieved with periodic monitoring: the annex requires chemical analyses of groundwater samples obtained from one upgradient and two downgradient wells. The Task Group proposes the following changes in Annex III:

- "Protection of groundwater" becomes "Protection of soil and groundwater".

- To make reference to best available technologies (BATs) that can provide early warning signals if the soil is impacted, well before waste compounds are detected in groundwater (see below for further details).

- In order to achieve protection of soil specifically, it is suggested that early warning mechanisms are implemented in landfill design. Such best available technologies (BATs) may include:

- double-liner system, consisting of a leachate collection and a leachate detection system, whereby a leak is detected before it impacts the soil.
- lectrical, acoustic or magnetic sensors installed underneath and close to the landfill bottom liner, again providing an early signal of a leak.

- It will be also necessary to explore, in tandem with further development of soil protection BATs, incentives for the use of these extra-cost BATs. One possibility would be to reduce the required frequency of chemical analyses of groundwater samples (since groundwater sampling becomes, to varying degrees, redundant in the presence of the early warning signals).

Conclusions

Waste prevention. Waste prevention and recycling has only recently been recognised as a European issue. The development of a corresponding policy regime is currently in the beginning phase.

Safe waste disposal – efficiency of implementation at European level. Safe waste disposal is clearly regulated at European level. However, the progress of recent European policy regimes is difficult to measure. First progress reports of the EU Member States concerning their progress in implementing new policy requirements will be available by September 2004. With regard to hazardous waste management facilities, the European Commission has at its disposal disposes point source data, which are currently not further processed. Three years ago the European Environment Agency initiated a European catalogue on waste management facilities which is currently not further up-dated. It can be concluded that waste sites as potential point sources are very well regulated. However, existing policy regimes need to be better monitored and in particular existing data need to be updated and analysed.

Prevention of soil pollution. Prevention of soil pollution from landfills is not appropriately recognised. The landfill directive is based on the assumption that new landfill design is 100% tight and no leakages are to be expected. In fact no product lasts for ever and hence delayed leakages should be considered. In the current version of the directive, groundwater monitoring downstream of the landfill is the only early warning system considered, which might be a good solution for sites with shallow groundwater. However, at sites with deep groundwater this measure does not seem to be adequate and early detection of soil pollution should also be considered.

Traffic

Traffic causes a local soil pollution problem, especially in cities and towns, but also along larger roads. In particular polyaromatic hydrocarbons pose a serious problem to soil quality next to intensely frequented roads. Furthermore metals of the platinum group are contaminating soils near roads. Traffic increases continuously and so do emissions to soil.

Traffic is acknowledged as an air pollution problem and emissions from vehicles are regulated at EU level. Air emissions from light[32] and heavy[33] vehicles are regulated in two core directives that are continually amended to stepwise tighten air emission limit values. Emissions per vehicle are measurably falling because of these. However, traffic volumes continue to rise. Emissions to soil are not addressed in the aforementioned directives.

Conclusions

The impact of emission from traffic on soils has not been recognised yet. It has not been validated whether or not the prescribed emission reductions are sufficient to reduce the future pollution burden to soil.

Liability

At EU level a Directive for Environmental Liability is currently in the final stage of enactment. The current proposal[34] is an important step forward to regulating and establishing a framework of environmental liability based on the "polluter-pays" principle, to prevent and remedy environmental damage.

[32] Council Directive 70/220/EEC of 20 March 1970 on the approximation of the laws of the Member States relating to measures to be taken against air pollution by gases from positive-ignition engines of motor vehicles

[33] Council Directive 88/77/EEC of 3 December 1987 on the approximation of the laws of the Member States relating to the measures to be taken against the emission of gaseous pollutants from diesel engines for use in vehicles

[34] Common Position 58/2003/EC adopted by the Council, with a view to adopting a Directive of the European Parliament and of the Council on environmental liability with regard to the prevention and remedying of environmental damage

Annex III provides a list of the occupational activities which are within the scope of the proposal. It is not an item-wise catalogue but an almost complete list of potentially polluting activities on the basis of references with regard to the relevant pieces of the waste, water, chemicals acquis and the IPPC Directive. However, no references are made to the Seveso II Directive, the Environmental Impact Assessment Directive, and the European Waste Catalogue.

The core provisions of the proposal are rather standard regulatory tools (i.e. preventive measures, notification of the competent authority, remedial actions, risk assessment, etc.). The novelty is embedded in Articles 8, 9, 10, 14; in these articles, for the first time, Community legislation prescribes prevention and remediation costs, cost allocation in cases of multiple party causation, five years limitation for recovery of costs and financial security measures..

Financial security is addressed in Article 14. However, there is no clear legally binding obligation to provide financial security; i.e. *"Member States shall take measures to encourage the development of financial security instruments…"*.

Annex II provides more details on remediation measures, where a separate chapter deals with the remediation of land damage. Accordingly, as a minimum, the relevant contaminants have to be removed, controlled, contained or diminished so that the contaminated land, taking into account its current or future use, no longer poses any significant risk of adversely affecting human health. Risk-assessment procedures shall take into account the characteristics and functions of the soil, the type and concentration of the harmful substances, preparations, organisms or micro-organisms, their risk and the possibility of their dispersion. Use shall be ascertained on the basis of the land use regulations, or other relevant regulations in force. If such regulations are lacking, the nature of the relevant area, taking into account its expected development, shall determine the use of the specific area. A natural recovery option (i.e. natural attenuation) shall be considered.

Conclusions

Financial security of operators in the case of damage is only recommended and not legally binding. The proposed directive refers to severe damages with special reference to environmental damages to protected species and in natural habitats. The Task Group concludes that the majority of typical cases of local soil contamination would not be covered by the proposed directive.

Environmental Impacts

The Directive on Environmental Impact Assessment[35] (EIA) of the effects of projects on the environment was introduced in 1985 and was amended in 1997. The Directive lists which type of projects need an EIA, in particular waste water treatment plants, incineration plants, large roads, plants for the production of chemicals, refineries, smelter, pipelines, quarries and petroleum and gas abstraction. Among other requirements the EIA requires description, identification, and assessment of direct and indirect effects of a project on soil.

Conclusions

The directive seems to be a good instrument to assess impacts on soil of future projects. The directive is though limited to a number of large projects.

FUTURE NEEDS TO EFFICIENTLY PREVENT FUTURE SOIL CONTAMINATION FROM LOCAL SOURCES

In most cases soil pollution from point sources is unintended and happens due to handling spills or accidents or insignificant continual losses or emissions. In contrast to air emissions and wastewater discharges, the principle of "controlled emissions" can not be applied and measures need to focus on pollution prevention.

Soil pollution deriving from point sources shall be avoided as far as reasonably achievable whatever the state of soil might be at the beginning of an operation ("no added/increasing contamination").

In line with this conclusion the following measures are proposed:

Establishment of a commonly accepted list of potential polluters

The Task Group provided a rough overview of activities that are considered as potentially soil polluting activities (see also Table 1, page 2). However, the Task Group concludes that a detailed list of potentially soil polluting activities needs to be defined making a distinction between preventive measures to soil pollution that shall be regulated at EU level and measures that shall be implemented at the Member State level.

For regulation at EU level, it is recommended to consider those activities that are currently regulated by EU environmental permits and reporting obligations (i.e. IPPC installations, Seveso sites, Landfills regulated by the Landfill Directive)

Requirement of soil assessment at the start and end of defined activities

In line with the concept of *"no added contamination",* the Task Group concludes that sites where potentially soil polluting activities take place shall be subject to a soil assessment at the beginning and at the end of an operation. The detail of the assessment shall be adjusted to the size and type of activity.

Positive experience with start and end-point soil assessments has already been gained in the Netherlands, Belgium/Flanders and the UK, where such systems are already being implemented.

Strengthening of financial security to avoid soil pollution from local sources

The Task Group concludes that current EU policy does not require financial security from entrepreneurs responsible for potentially soil polluting activities. Furthermore, the proposed liability directive does not

[35] Council Directive 97/11/EC on 3 March 1997 amending Directive 85/337/EEC of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment.

foresee any legally binding guarantee either. Instead it "recommends" that Member States "encourage" the development of financial security instruments.

Comparable measures are already implemented in Denmark and Finland.

- In Finland "Environmental Damage Insurance" is laid down by national legislation since 1999[36]. The insurance is compulsory for companies whose activities cause a risk to the environment. Annual rates range between 250€ to 50,000 € and are on average 1,700 to 2,500 €.

- In Denmark the safety of installations is subject to regular inspections. Inspection fees depend on the type of activity and on the quality of implemented safety measures.

Recognition of soil pollution in BAT documents

Prevention of soil pollution from potentially soil polluting activities needs "tailor made" prescriptions and should be based on sector-specific or activity-specific precautionary measures. At EU level the Task Group considers IPPC BREF documents as the most suitable level to integrate soil protection measures in a sensitive way.

The Task Group has screened a variety of IPPC/BREF documents and concluded that officially accepted documents include sections on *"Good Operating Practices"* and *"Management and Good Housekeeping"*. These sections cover the prevention of unintended pollution. However, they are relatively brief and they only make nominal references to BATs for good management. The Task Group suggests to strengthen these sections, especially in those BREFs that are currently under development.

Strengthening prevention of soil pollution in SMEs

Small and medium sized enterprises (SMEs) contribute considerably to local soil contamination. The Task Group recommends the strengthening of preventive measures and their control; in particular:

- Start and end-point soil assessment for potentially soil polluting activities.
- Financial security for the case of soil pollution.
- Strengthening of the implementation of preventive measures and the development of "mini-BREFS" for potentially polluting activities.
- Provision of incentives for pro-active entrepreneurs.

Awareness raising

Typical pathways of soil pollution and their possible implications need to be communicated in a transparent way at sites that carry out potentially polluting activities.

Surveying Point Source Safety in view of soil pollution at EU and national level

The Task Group recommends regular control and observation of the safety of potentially soil polluting activities.

- **Scope of observation:** A commonly recognised list of potentially soil polluting activities from industry, waste disposal facilities and extractive industries needs to be drawn up and a distinction to be made between those activities that shall be subject to EU policy and those that shall be subject to national policy regimes.

- The European level. A European Survey of Soil Preventive Measures at Point Sources should cover those installations that are currently obliged to report their environmental standards on a regular basis. These are industrial installations as defined by the IPPC Directive, installations addressed by the regime of the Seveso II Directive, exploratory industries addressed by the new BAT document of the IPPC directive, and landfills that come under the regime of the Landfill Directive. In all cases the related technical guidance documents need to be amended and give clear guidance to efficient prevention of soil pollution.

- The national level. According to the common list of potentially soil polluting activities, Member States shall carry out surveys on point source safety at defined installations or activities which are currently not covered by EU reporting obligations (i.e. small enterprises with relevance to soil pollution).

- **Added value** of surveying point source safety:

- rovide information on pressures and driving forces for soil quality monitoring systems and for a variety of other monitoring systems (i.e. air and water).
- ffer overviews of the progress of efficient implementation of existing legislation (i.e. IPPC permits, landfill permits).
- elp prevent soil contamination and also avoid contamination to air and groundwater and to contribute to worker's safety.
- acilitate better understanding of contaminant transport mechanisms in extremely challenged regions where impacts on soil and/or groundwater quality are observed.

Needs to improve existing information sources

Industry: The European Pollutant Emission Register (EPER, see also page 4) provides information on annual air emissions and water discharges of IPPC industries. Data are available online. Information with regard to 50 key pollutants is available. Furthermore, infringements of emission permits are publicly available. The Task Group recommends that in the long term the EPER system be

[36] Environmental Damage Insurance Act (81/1998) Finland.

extended to provide information on the efficiency of soil protection at these sites.

Mining: For assessment of safe operation of mining activities reporting obligations at the Member State level need to be established; i.e. to compile national overviews of those sites/facilities which need to comply with the new standards and their progress in standard implementation.

Waste Management: The European Environment Agency started an initiative to set up an **electronic** catalogue of waste management facilities for all EEA member countries (EEA (2001) Waste Management Facilities – Electronic Catalogue (author: Thomas Weißenbach on behalf of the European Topic Centre of Waste), Technical Report 65, Copenhagen (Denmark).).

- The electronic catalogue of waste management facilities as compiled by EEA could be a good starting point for generic assessment of safe waste management. The catalogue includes basic information about hazardous (all EU countries) and non-hazardous (only selected EU regions) waste sites. Data are geo-referenced.

- For the assessment of point source safety, the Hazardous Waste Directive represents a good source for those sites which currently manage hazardous wastes. Geo-referenced data and basic qualitative information are already reported to the European Commission and could be integrated into a point source assessment system.

- The Landfill Directive would be a good source. By September 2004 first reports shall be submitted to the EU Commission. The current reporting regime does not foresee any geo-referenced data but only aggregated national data. In theory data about currently operating waste sites, their geo-reference, whether or not they comply with the requirements of the landfill directive, and their type (hazardous, non-hazardous, or inert waste) exist in each Member State.

Research needs

Structured information on pollution prevention devices (i.e. containment devices and techniques for safe storage, handling and transport of substances that may contaminate soil and groundwater) is needed in order to develop adequate BAT reference documents for defined potentially polluting activities.

Passive sampling technologies, which in general are contaminant specific, are a promising technology for early warning of soil pollution. However, absence of performance data from lengthy use and other uncertainties prevents their availability on the market. Further improvement on product development is needed to improve economy and reliability of such devices.

Questions to Advisory Forum and Received Response

The following questions were posed to the Advisory Forum. The received answers are summarised beneath.

Question 1: "Does the AF approve of the need to focus on pollution prevention and the principle of "no added contamination" as a basis for a common policy for "Local Sources of Soil Contamination"?

Response received from	Answer
Belgium	In principle we agree, but "no" does not exist in reality; a limited flux of pollutants is always present when polluting substances are used or stored; prevention should be based on a multifunctional approach and on the BAT-principle.
EUROFER	The ALARA principle should be applied for newly appearing contamination. But for contaminations that have possibly been present since a long time, even if it has not been detected before and hence not strictly falling under the "historical pollution" definition, the principle of "Risk Based Land management" should be applied.
Sweden	Yes
UEPC	Policy needs to be flexible as 'no added contamination' is an unrealistic idea, unless aver-aged across several case histories. We agree in principle that the current situation should not be made any worse. However consideration must be given to the use of 'ac-ceptable' herbicides, pesticides and fertilisers which may add additional chemicals (con-taminants) to the soil.
Austria	Yes
EUROMETAUX	Pollution prevention is a principle that should be striven for in respect to new activities to promote attention to the need for the proper protection of the soil compartment. The principle should, however, be applied with care and within a sustainable development framework. Indeed, prevention of input is an unrealistic option for aspects such as traffic, agriculture and use of certain products. "No added pollution" should preferably be changed into "no-added pollution as far as reasonably achievable".

Question 2: "Does the AF approve of the need to produce a commonly recognised list of potentially soil polluting activities from industry, waste deposits, and extractive industries and to distinguish between those activities that shall be subject to EU policy and those that shall be subject to national policy regimes?

Response received from	Answer
Belgium	Yes, furthermore potentially soil polluting activities related to transport and the domestic sector (incl. tourism) should be added.
Sweden	Yes. The relevant data is probably already available in various national reports to the Commission.
UEPC	Yes, provided these distinguish large and high risk activities and sites from activities and sites that are likely to have little cross border significance. (The UK currently makes use of industry profiles which list hazardous substances associated with 52 industries.)
Austria	Yes
EUROMETAUX	The soil prevention/rehabilitation requirements and conditions for industrial activities currently differ significantly among the EU countries, especially when considering the EU 25. The high costs associated with these preventive or aftercare actions may therefore result in competitive (dis)advantages for certain industries in certain EU countries, which is not a good basis for environmental policy since it would promote delocalisation. It is therefore suggested, in fact, to identify the sectors where the costs of soil prevention and rehabilitation are significant in order to evaluate the need for combined EU policy.

Question 3: "Does the AF approve of the conduction of obligatory soil assessments at the start and closure of potentially soil polluting activities?"?

Response received from	Answer
Belgium	Yes; this is the only way to have an idea of the impact of a certain operation on soil quality.
EUROFER	EUROFER supports this approach.
Sweden	In principle, yes. Especially at closure of the activities and on the condition that the demands on the soil assessment stay within reasonable limits. Under certain circumstances it might be suitable to include groundwater and surface waters in these assessments.
UEPC	Yes, provided these are limited to large and high risk activities and sites. There needs to be a cut-off threshold, so that burdens are not imposed on low risk activities such as building houses shops and offices.
Austria	Yes
EUROMETAUX	Yes, a baseline inventory at the start of activities is beneficial to all stakeholders: for society to establish the baseline of the natural or ambient background before the activity commenced and for the company to check the efficiency of the preventive measures after several years of activity. Moreover, the baseline assessment provides legal certainty for all parties concerning the baseline of the natural or ambient background before the activity commenced. To make this feasible, there is an urgent need for exhaustive, reliable, and economical measurement methods. Currently only a limited set of chemicals can be measured easily, reliably and economically.

Question 4: "Does the AF approve of the need to monitor point sources safety at EU level and Member State level?"

Response received from	Answer
Belgium	Yes, the obligation to monitor should be created at a EU and MS level, but this obligation should not imply that individual monitoring data should be reported at EU- (or even MS-) level. Reporting should happen at the appropriate level where measures can be taken.
EUROFER	Before taking any position on this question, EUROFER would be grateful to receive some clarification about the concept of monitoring point sources safety. In all circumstances, we would like to keep consistency with existing legislations such as IPPC Directive.
Sweden	In principle the need exists for both levels, but the level of ambition for the EU level must be discussed in more detail.
UEPC	At MS level.
Austria	Yes
EUROMETAUX	The answer to this question should not be seen in isolation. Indeed, any proper environmental management system will require safety to be monitored for the various environmental compartments if potential risks have been identified by the management system. The issue here is to whether or not to make it obligatory for certain potential high-risk activities. The answer to Question 2 is therefore also of relevance here.

REVIEWED EU LEGISLATION

Industry

Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control. **(IPPC)**

COM (2001) 624 final, Proposal for a Directive of the European Parliament and of the Council amending Council Directive 96/82/EC of 9 December 1996 on the control of major-accident hazards involving dangerous substances. **(Seveso II)**

Regulation (EC) No 761/2001 of the European Parliament and of the Council of 19 March 2001 allowing voluntary participation by organisation in a Community eco-management and audit scheme (**EMAS**).

Mining

COM (2000) 664 final, Communication 2000/664 (final) from the Commission of October 23 2000 on "Safe operation of mining activities: a follow-up to recent mining accidents". **(mining safety)**

COM (2003) 319 final, Communication 2003/319 (final) from the Commission of June 2 2003 on the management of waste from the extractive industries. **(mine waste)**

COM (2001) 624 final, Proposal for a Directive of the European Parliament and of the Council amending Council Directive 96/82/EC of 9 December 1996 on the control of major-accident hazards involving dangerous substances.

Waste Management

COM (2003) 301, Communication 2003/301 from the Commission of 27 May 2003 towards a thematic strategy on the prevention and recycling of waste. **(thematic strategy on waste)**

Council Directive 75/442/EEC of July 15 1975 on waste **(waste directive)**

Council Directive 91/689/EEC of 12 December 1991 on hazardous waste **(hazardous waste directive)**

Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste **(landfill directive)**

Traffic

Council Directive 70/220/EEC of 20 March 1970 on the approximation of the laws of the Member States relating to measures to be taken against air pollution by gases from positive-ignition engines of motor vehicles

Council Directive 88/77/EEC of 3 December 1987 on the approximation of the laws of the Member States relating to the measures to be taken against the emission of gaseous pollutants from diesel engines for use in vehicles

Environmental Liability

Common Position 58/2003/EC adopted by the Council, with a view to adopting a Directive of the European Parliament and of the Council on environmental liability with regard to the prevention and remedying of environmental damage.

ANNEX

Ref. 1: Assessment of relevance to soil and groundwater contamination of 41 industrial activities based on expert judgement

Source: EEA (2002) EEA Technical Report 76, p. 47, Copenhagen (Denmark).

Table 25: Assessment of relevance to soil and groundwater contamination of 41 industrial activities based on expert judgment

Industrial activity	Industrial sector	Average score
Metal casting	Metal working industry	27.8
Basic chemicals	Chemical industry	26.7
Paint and varnish	Chemical industry	26.7
Metal coating	Metal working industry	26.7
Storage of liquids and solid substances	Trade and traffic	25.6
Production of gas and coke	Energy production and mining	23.3
Mineral oil refining	Oil industry	23.3
Other chemical and technical products	Chemical industry	23.3
Metal forgeries	Metal working industry	23.3
Chemical weapons and pest control	Chemical industry	22.2
Wood industry	Textile, leather, wood and paper industry	22.2
Pharmaceutical industry	Chemical industry	21.1
Metal production	Metal working industry	21.1
Leather industry	Textile, leather, wood and paper industry	21.1
Scrap yards	Trade and traffic	21.1
Scrap oil recycling	Oil industry	20.0
Detergents	Chemical industry	20.0
Textile cleaning	Textile, leather, wood and paper industry	20.0
Synthetic fibre, plastic and glue	Chemical industry	18.9
Metal processing	Metal working industry	18.9
Textile industry	Textile, leather, wood and paper industry	18.9
Car maintenance	Trade and traffic	18.9
Transport industry	Trade and traffic	18.9
Chemical and technical aids	Chemical industry	17.8
Accumulator and battery	Electronic industry	17.8
Rubber	Chemical industry	16.7
Production of building material	Glass, ceramics, stone and soil industry	16.7
Pulp and paper industry	Textile, leather, wood and paper industry	16.7
Mining industry	Energy production and mining	15.6
Printing services and publishers	Textile, leather, wood and paper industry	15.6
Electrical industry	Electronic industry	14.4
Film-processing works	Textile, leather, wood and paper industry	14.4
Power plants	Energy production and mining	13.3
Electronic appliances devices and building components	Electronic industry	12.2
Glass industry	Glass, ceramics, stone and soil industry	12.2
Ceramic industry	Glass, ceramics, stone and soil industry	12.2
Exploitation of natural gas and mineral oil	Energy production and mining	11.1
Processing of plant products	Food industry, processing of agricultural products	8.9
Processing of animal products	Food industry, processing of agricultural products	7.8
Fatty acid and wax processing	Oil industry	6.7
Nuclear power plants	Energy production and mining	-7.8

Average scores deriving from eight test regions, scoring system: 30 = very relevant; – 10 = currently not regarded or included.

Ref. 2: Soil polluting activities from localised sources

Source: EEA (2001) Environmental Signals 2001, Copenhagen (Denmark).

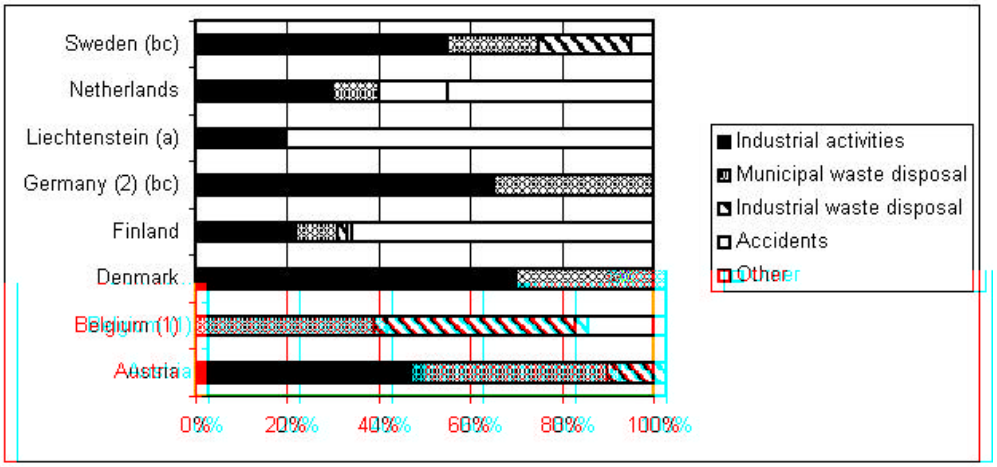


Fig.1 Soil polluting activities from localised sources as % of total

Source: EEA-ETC/S Data update request (August 1999, updated January 2001)

Notes: (1) Belgium: data refer to Flanders

(2) Germany: 'Industrial Activities' also include 'Accidents' and 'Other'; 'Municipal Waste Disposal' also includes 'Industrial Waste Disposal'

(a) minor accidents are not included

(b) the percentage share refers to the total number of identified suspected sites

(c) data refer exclusively to abandoned sites (not in operation)

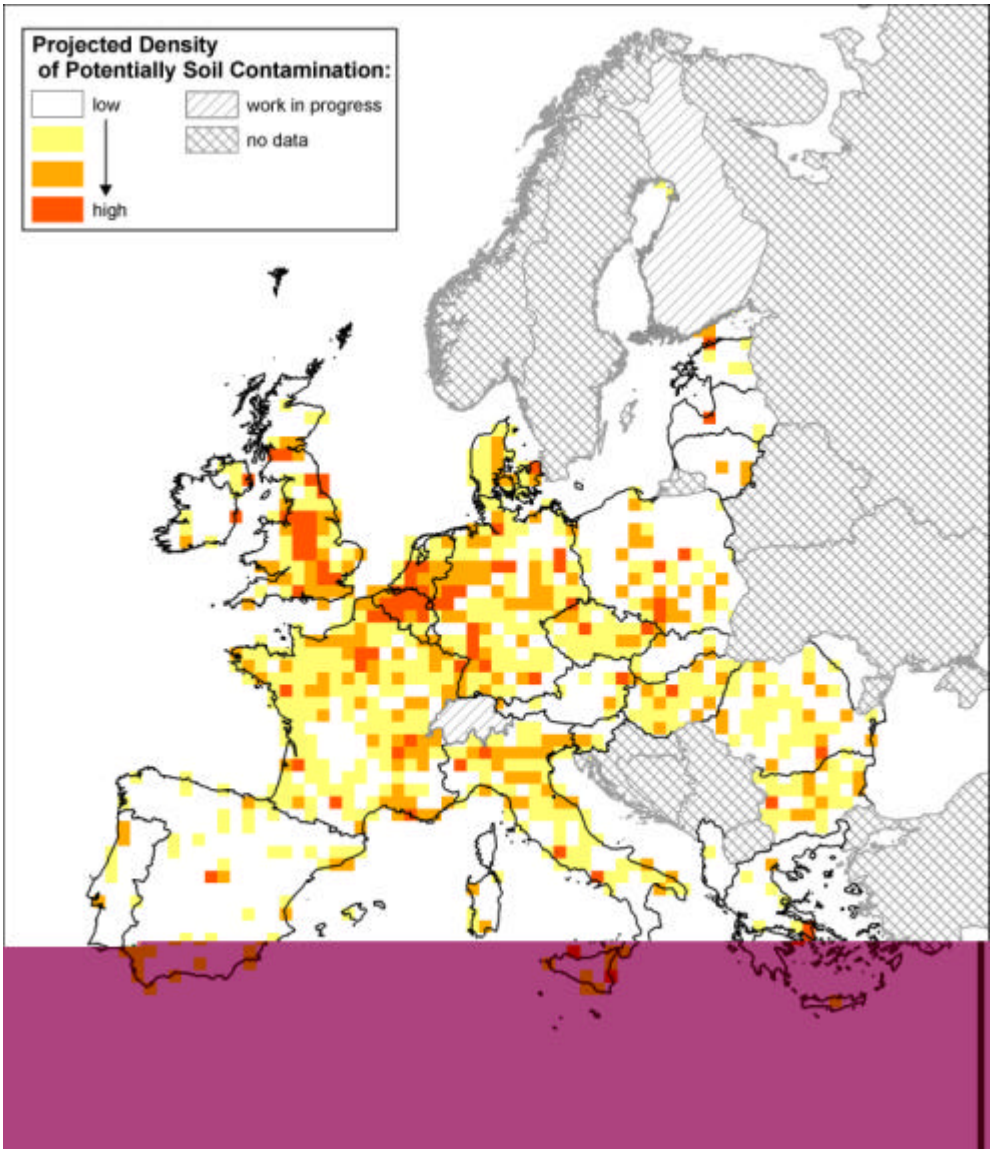
Ref. 3: Pollutant groups currently tackled in EU research projects

Source: IMAGE-TRAIN (2003), Newsletter no.3, Accompanying Measure of the 5th EU Framework Programme for RTD, available from http:www.image-train.net

Project	POPs	BTEX	Phenols	CHCs	MTBE	HC	PAH	heavy metals	explosives	
SOWA	■									contaminant behaviour
INCORE		■		■						investigation, plume modelling
TRACE-FRACTURE						■				monitoring, distribution in fractured media
GRACOS		■			■	■	■			contaminant behaviour
WATCH		■			■					monitoring & warning
DIMDES MOTOM								■		monitoring, sensor development
PIRAMID								■		remediation: passive in-situ rem.
PEREBAR		■				■	■	■		remediation: passive in-situ rem
MAROC				■						remediation: biodegradation
ORGONATE			■		■				■	remediation: adsorption
PHYTO-DEC								■		remediation: phytoremediation

Ref. 4: Areas with high expectation for local contamination

Source: Schamann M., Gentile A.R. er. al (2003) The European Environment Agency's Framework for the Development of Europe-wide policy relevant indicators on Local Soil Contamination. Proceedings of the 8th International FZK/TNO Conference on Contaminated Soil (CONSOIL 2003) from 12 to 16 May, 2003 in Gent – Belgium, p31



unit: area of urban and industrial areas per pixel [m²/km²]; pixel size: 50 x 50 k; source: EEA Corine Land-cover (industrially used land) and ESRI data (urbanised areas)

Ref. 5: Mining Sites in the EU

Source: BRGM (2001) Management of Mining, Quarrying and ore processing Waste in the European Union, Study made fort DG Environment, European Commission, BRGM/RP-50319-FR, p. 17

Country	Ferrous metals		Non ferrous metals		Industrial minerals		Coal	
	total sites	closed sites	total sites	closed sites	Total sites	closed sites	total sites	closed sites
Austria	2		1		>500 *		2	
Belgium	>500	all	>300	all	>4700	>4500	>4000	all
Denmark	local	closed	a few		Opencast pits		lignite	Closed
Finland	5	5	38	26	12	7		
France	17	17	160	158	119	77	81	77
Germany	3	1	3	3	105	1	44	2
Greece	3		6	1	15	1		
Ireland			21	17	6	4	4	4
Portugal	8	7	9	9			1	1
Spain	20	18	58	45	47	20	73	25
Sweden	3		20	14				
United Kingdom	35	35	31	29	22	?	23	?

* Most of those sites are related to aggregates production

Ref. 6: Overview of activitites producing point source emissions, which might cause contamination.

Compiled by Andreas Bieber, Federal Ministry of the Environment (Germany)

ANNEX Reference 6

Activities producing point source emissions, which might cause soil contamination:

Activities covered by the IPPC Directive

(COUNCIL DIRECTIVE 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control)

Activities not covered by the IPPC Directive

chemical laundries (dry cleaning)

petrol stations

car repairing facilities, depots

scrap yards

animal and plant farms

wood processing facilities

waste water treatment plants

electricity transformer stations

…

Production and use of materials for construction

Asphalt production and processing

road construction

painting

…

Military activities

Shooting ranges

Airports

…

Sporting activities

Shooting ranges

Gulf courses

car racing places

…

Transport

Airports

Railway stations and lines

Harbours

Transshipment places

Pipelines for materials (e.g. hydrocarbons)

Sewerage (Waste water)

conveyors

traffic emissions (lead, hydrocarbons, rubber, …)

…

Storage of materials (not connected with IPPC activities)

Oil tanks

waste water

…

Mining activities

tailings

ponds

…

IPPC-Directive

ANNEX 1

Categories of Industrial Activities

1. Installations or parts of installations used for research, development and testing of new products and processes are not covered by this Directive.

2. The threshold values given below generally refer to production capacities or outputs. Where one operator carries out several activities falling under the same subheading in the same installation or on the same site, the capacities of such activities are added together.

SOURCES
1. Energy industries
1.1. Combustion installations with a rated thermal input exceeding 50 MW
1.2. Mineral oil and gas refineries
1.3. Coke ovens
1.4. Coal gasification and liquefaction plants
2. Production and processing of metals
2.1. Metal ore (including sulphide ore) roasting or sintering installations
2.2. Installations for the production of pig iron or steel (primary or secondary fusion) including continuous casting, with a capacity exceeding 2,5 tonnes per hour
2.3. Installations for the processing of ferrous metals: a) hot-rolling mills with a capacity exceeding 20 tonnes of crude steel per hour; b) smitheries with hammers the energy of which exceeds 50 kilojoule per hammer, where the calorific power used exceeds 20 MW; c) application of protective fused metal coats with an input exceeding 2 tonnes of crude steel per hour
2.4. Ferrous metal foundries with a production capacity exceeding 20 tonnes per day
2.5 Installations a) for the production of non-ferrous crude metals from ore, concentrates or secondary raw materials by metallurgical, chemical or electrolytic processes b) for the smelting, including the alloyage, of non-ferrous metals, including recovered products, (refining, foundry casting, etc.) with a melting capacity exceeding 4 tonnes per day for lead and cadmium or 20 tonnes per day for all other metals
2.6. Installations for surface treatment of metals and plastic materials using an electrolytic or chemical process where the volume of the treatment vats exceeds 30 m^3
3. Mineral industry
3.1. Installations for the production of cement clinker in rotary kilns with a production capacity exceeding 500 tonnes per day or lime in rotary kilns with a production capacity exceeding 50 tonnes per day or in other furnaces with a production capacity exceeding 50 tonnes per day
3.2. Installations for the production of asbestos and the manufacture of asbestos-based products
3.3. Installations for the manufacture of glass including glass fibre with a melting capacity exceeding 20 tonnes per day
3.4. Installations for melting mineral substances including the production of mineral fibres with a melting capacity exceeding 20 tonnes per day
3.5. Installations for the manufacture of ceramic products by firing, in particular roofing tiles, bricks, refractory bricks, tiles, stoneware or porcelain, with a production capacity exceeding 75 tonnes per day, and/or with a kiln capacity exceeding 4 m3 and with a setting density per kiln exceeding 300 kg/m3
4. Chemical industry
Production within the meaning of the categories of activities contained in this section means the production on an industrial scale by chemical processing of substances or groups of substances listed in Sections 4.1 to 4.6
4.1. Chemical installations for the production of basic organic chemicals, such as: a) simple hydrocarbons (linear or cyclic, saturated or unsaturated, aliphatic or aromatic) b) oxygen-containing hydrocarbons such as alcohols, aldehydes, ketones, carboxylic acids, esters, acetates, ethers, peroxides, epoxy resins c) sulphurous hydrocarbons

	d) nitrogenous hydrocarbons such as amines, amides, nitrous compounds, nitro compounds or nitrate compounds, nitriles, cyanates, isocyanates e) phosphorus-containing hydrocarbons f) halogenic hydrocarbons g) organometallic compounds h) basic plastic materials (polymers synthetic fibres and cellulose-based fibres) i) synthetic rubbers j) dyes and pigments k) surface-active agents and surfactants
4.2.	Chemical installations for the production of basic inorganic chemicals, such as: a) gases, such as ammonia, chlorine or hydrogen chloride, fluorine or hydrogen fluoride, carbon oxides, sulphur compounds, nitrogen oxides, hydrogen, sulphur dioxide, carbonyl chloride b) acids, such as chromic acid, hydrofluoric acid, phosphoric acid, nitric acid, hydrochloric acid, sulphuric acid, oleum, sulphurous acids c) bases, such as ammonium hydroxide, potassium hydroxide, sodium hydroxide d) salts, such as ammonium chloride, potassium chlorate, potassium carbonate, sodium carbonate, perborate, silver nitrate e) non-metals, metal oxides or other inorganic compounds such as calcium carbide, silicon, silicon carbide
4.3.	Chemical installations for the production of phosphorous-, nitrogen- or potassium-based fertilizers (simple or compound fertilizers)
4.4.	Chemical installations for the production of basic plant health products and of biocides
4.5.	Installations using a chemical or biological process for the production of basic pharmaceutial products
4.6.	Chemical installations for the production of explosives
5. Waste management	
	Without prejudice of Article 11 of Directive 75/442/EEC or Article 3 of Council Directive 91/689/EEC of 12 December 1991 on hazardous waste:
5.1.	Installations for the disposal or recovery of hazardous waste as defined in the list referred to in Article 1 (4) of Directive 91/689/EEC, as defined in Annexes II A and II B (operations R1, R5, R6, R8 and R9) to Directive 75/442/EEC and in Council Directive 75/439/EEC of 16 June 1975 on the disposal of waste oils(2), with a capacity exceeding 10 tonnes per day
5.2.	Installations for the incineration of municipal waste as defined in Council Directive 89/369/EEC of 8 June 1989 on the prevention of air pollution from new municipal waste incineration plants(3) and Council Directive 89/429/EEC of 21 June 1989 on the reduction of air pollution from existing municipal waste-incineration plants (4) with a capacity exceeding 3 tonnes per hour
5.3.	Installations for the disposal of non-hazardous waste as defined in Annex II A to Directive 75/442/EEC under headings D8 and D9, with a capacity exceeding 50 tonnes per day
5.4.	Landfills receiving more than 10 tonnes per day or with a total capacity exceeding 25 000 tonnes, excluding landfills of inert waste
6. Other activities	
6.1.	Industrial plants for the production of: a) pulp from timber or other fibrous materials b) paper and board with a production capacity exceeding 20 tonnes per day
6.2.	Plants for the pre-treatment (operations such as washing, bleaching, mercerization) or dyeing of fibres or textiles where the treatment capacity exceeds 10 tonnes per day
6.3.	Plants for the tanning of hides and skins where the treatment capacity exceeds 12 tonnes of finished products per day
6.4.	a) Slaughterhouses with a carcase production capacity greater than 50 tonnes per day b) Treatment and processing intended for the production of food products from: - animal raw materials (other than milk) with a finished product production capacity greater than 75 tonnes per day - vegetable raw materials with a finished product production capacity greater than 300 tonnes per day (average value on a quarterly basis) c) Treatment and processing of milk, the quantity of milk received being greater than 200 tonnes per day (average value on an annual basis)
6.5.	Installations for the disposal or recycling of animal carcases and animal waste with a treatment capacity exceeding 10 tonnes per day
6.6.	Installations for the intensive rearing of poultry or pigs with more than: a) 40 000 places for poultry b) 2 000 places for production pigs (over 30 kg), or c) 750 places for sows

6.7.	Installations for the surface treatment of substances, objects or products using organic solvents, in particular for dressing, printing, coating, degreasing, waterproofing, sizing, painting, cleaning or impregnating, with a consumption capacity of more than 150 kg per hour or more than 200 tonnes per year
6.8.	Installations for the production of carbon (hard-bumt coal) or electrographite by means of incineration or graphitization

Ref. 7: European Union Community legislation with regard to provisions to soil

Hamor Th. (2003) "The last environmental medium: A mapping of the European Union Community legislation with regard to provisions to soil" , Joint Research Centre (Review report prepared for WG Soil Contamination)

"THE COUNCIL … RECALLS THE IMPORTANCE OF COHERENCE OF THE WHOLE SYSTEM OF COMMUNITY ENVIRONMENTAL LEGISLATION; INVITES THEREFORE THE COMMISSION TO STUDY THE OVERALL COHERENCE OF COMMUNITY ENVIRONMENTAL LEGISLATION … . IN THIS RESPECT, IT IS IMPORTANT TO TAKE INTO ACCOUNT THE INTERLINKAGE BETWEEN THE ENVIRONMENTAL MEDIA." /COUNCIL RESOLUTION OF 7 OCTOBER 1997/

THE LAST ENVIRONMENTAL MEDIUM: A MAPPING OF THE EUROPEAN UNION COMMUNITY LEGISLATION WITH REGARD TO PROVISIONS ON SOIL

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INTRODUCTION

This paper examines the acquis communautaire concerning direct references and indirect provisions relevant to soil protection and to soil management in general. It is intended to serve as a background document in order to supporting the work of the Technical Working Group on Soil Contamination and the legislative efforts of the Commission.

The study focuses on the primary and secondary legislation, and within these an emphasis was placed on the thematic, i.e. environmental medium-, or product-, or activity-specific legislation. The so-called horizontal legislation of generic scope and importance, e.g. on public participation, information access, reporting obligations of Member States are out of scope, as well as tertiary resolutions, recommendations, opinions, and communications or drafts. Nevertheless, a few important ones are cited. At the present phase the rulings of the European Court of Justice and the international conventions are not dealt with. The conclusions are very preliminary.

For easy reading the title of the legislation and the direct references on soil and related matters are in bold. The complete presentation of the cited regulations is not the task of this screening. The report follows the structure of the directory of the acquis and uses the EUR-Lex electronic edition of the legal texts, therefore for legislative and other official purposes the use of the original Official Journal version is strongly recommended.

PRELIMINARY CONCLUSIONS

The Community legislation contains numerous references on soil, most of which are found in the environment chapter of the acquis. Soil, one of the environmental media to be protected, is generally embedded in the statements of the preambulum and objectives of the legislation. Specific prescriptions on soil protection are relatively rare.

By tradition, there are certain strategic industries and potentially pollutant sectors (e.g. military, nuclear industry, mining industry) which are excluded from the scope of major environmental directives. When evaluating the risks that these activities impose on the soil, it is recommended to include these activities under the scope of the environmental acquis.

The terms in use are rather heterogenous (soil, land, terrestrial system, non-aquatic environment, area, site, subsoil, geological medium, geological formations), even within one particular legislation (e.g. IPPC Directive, Water Framework Directive). Future legislation shall provide clear definition and distinction on soil and geological formations. Most recent directives e.g. the Water Framework Directive, the Landfill Directive and their implementing pieces use both and treat them as major elements of the "earthborne" environmental media. The definition of other important terms such as "pollution" and "emission" is already available, which the soil legislation has to be in accordance with.

Whilst many emission limit values are set in the environmental acquis, in the water and waste chapters and by the IPPC Directive, the only list for some heavy metals concentration in soils is found in the Sewage Sludge Directive. Similarly, the dangerous substances acquis concentrates on the toxicological effects on aquatic systems with less focus on terrestrial systems. Nevertheless, the chemical legislation is ahead of the environmental acquis by regulating monitoring, sampling and analytical methods for soil in details (e.g. Directive 2001/59/EC on … classification, packaging and labeling of dangerous substances). The same statement holds true for the development and publication of common risk assessment methodologies. These have to be taken into account when drafting the legislation on soil monitoring.

There are voluminous references on soil management in a broad sense, associated with the common agriculture policy. The recent pieces of CAP contain numerous provisions on the agri-environmental measures. In a specific context, i.e. free movement of persons and capital, the ownership of land (incl. soil) is regulated on the Community level. This is an important momentum concerning the future legislative options on regulating liability of soil contamination.

THE LEGAL FRAMEWORK OF THE EUROPEAN UNION

Community law is an independent legal system which takes precedence over national legal provisions. **Primary legislation** includes the Treaties and other agreements having similar status. The Treaties define the responsibilities of decision-making bodies and the legislative, executive and juridical procedures which characterise Community law and its implementation. **Secondary legislation** may take the following forms: **regulations** which are directly applicable and binding in all Member States without the need for any national implementing legislation; **directives** which bind as to the objectives to be achieved within a certain time-limit while leaving the national authorities the choice of form and means to be used; **decisions** which are binding in all their aspects for those to whom they are addressed but do not require national implementing legislation. Recommendations, communications, opinions are not binding. **Case-law** includes judgements of the European Court of Justice and of the European Court of First Instance, which are directly applicable in the courts of all Member States. In this context, the role of the Court of Justice and the Court of First Instance is to provide the judicial safeguards.

The Treaties

The Treaty establishing the European Community declares twenty-one Community policies of which the Title XIX Environment and Title II Agriculture are the most relevant policies when considering soil management in general. Titles "Transport", "Public health", "Consumer protection", "Industry" contain relevant but less direct, conceptual declarations. Among the principles Article 6 stipulates that environmental protection requirements must be integrated into the definition and implementation of these policies, in particular with a view to promoting sustainable development. It implies that if the new Community soil protection regulations are set within the frame of the environment policy other policies and legislation have to be modified accordingly, if necessary.

The term "soil" appears in Title II Agriculture, Article 32(1) in the definition of agricultural products ("the products of the soil"). According to Article 33, among others, the objective of the common agricultural policy is: "(a) to increase agricultural productivity by promoting technical progress and by ensuring the rational development of agricultural production and the optimum utilisation of the factors of production". In working out this policy account shall be taken of: "(a) the particular nature of agricultural activity, which results from … natural disparities between the various agricultural regions". The Council may authorise the granting of aid "(a) for the protection of enterprises handicapped by … natural conditions" (Article 36).

In Title "Free movement of persons, services and capital" Article 44 says that in order to attain freedom of establishment as regards a particular activity, the Council and the Commission shall carry out duties by enabling a national of one Member State to acquire and use land situated in the territory of another Member State, in so far this does not conflict with the common agriculture policy. This is one of the very few provisions in the acquis with regard to the right of ownership of land.

According to Chapter 4 "Capital and payments" Articles 56 and 57, all restrictions on the movement of capital and payments between Member States and between Member States and third countries shall be prohibited. This provision shall be without prejudice to the application to third countries of any restrictions which exist under national or Community law in respect of the movement of capital to or from third countries involving direct investment — including in real estate — establishment, etc.. The Council may adopt measures on the movement of capital to or from third countries involving direct investment — including investment in real estate — establishment, the provision of financial services or the admission of securities to capital markets.
According to Title XIII Public health, Article 152(1) a high level of human health protection shall be ensured in the definition and implementation of all Community policies and activities. Community action, which shall complement national policies, shall be directed towards improving public health, preventing human illness and diseases, and obviating sources of danger to human health.

According to Title XIX Environment, Article 174 the Community policy on the environment shall contribute to pursuit to preserving, protecting and improving the quality of the environment, to protecting human health, and a prudent and rational utilisation of natural resources. This policy aims at a high level of protection taking into account the diversity of situations in the various regions of the Community. It is based on the precautionary principle and on the principles that preventive action should be taken, that environmental damage should as a priority be rectified at source and that the polluter should pay. In preparing its policy on the environment, the Community shall take account of the available scientific and technical data; the environmental conditions in the various regions; and the balanced development of its regions. Accordingly, the Council shall adopt measures affecting town and country planning, and land use, with the exception of waste management (Article 175(2)).

Articles 35 and 36 of the Euratom Treaty provided that Member States were to establish the facilities necessary to carry out continuous monitoring of the level of radioactivity in the air, water and soil and to communicate such information to the Commission so that it is kept informed of the levels of radioactivity to which the public is exposed.

03. Agriculture

Although the common agriculture policy is dedicated to regulate economic issues mainly, there are certain provisions in the agriculture chapter that refer to the sustainable use of land and soil. The preamble of Council Regulation No 1257/1999 on support for rural development from the European Agricultural Guidance and Guarantee Fund (EAGGF) and amending and repealing certain regulations contains several valuable policy statements reflecting the reform of the common agriculture policy with regard to environmental issues. The 1992 policy reform stressed the environmental dimension of agriculture as the largest land user (Rec. 4). Support for less-favoured areas should contribute to the continued use of agricultural land, maintaining the countryside, maintenance and promotion of sustainable farming systems (Rec. 24). The agri-environmental aid should continue to encourage farmers to use farming practices compatible with the increasing need to protect and improve the environment, natural resources, soil and genetic diversity and to maintain the landscape and the countryside (Rec. 31). Forestry measures should be based on schemes to develop and optimally utilise woodlands in rural areas (Rec. 37). The afforestation of agricultural land is especially important from the point of view of soil use and the environment and as a contribution to increasing supplies for certain forestry products (Rec. 38). Payments should be granted for activities to maintain and improve ecological stability of forests in certain areas (Rec. 39).

Article 9 provides details on the support of vocational training of farmers. Training topics include, inter alia, the application of production practices compatible with the maintenance and enhancement of the landscape, the protection of the environment, forest management practices to improve the economic, ecological or social functions of forests.

Among the objectives of the support for early retirement from farming there is the reassignment of agricultural land to non-agricultural uses where it cannot be farmed under satisfactory conditions of economic viability (Art. 10). Such uses are forestry or the creation of ecological reserves, in a manner compatible with protection or improvement of the quality of the environment of the countryside.

Support for less-favoured areas (e.g. mountain areas) and areas with environmental restrictions contribute to the following objectives (Art. 13):

(a) Compensation for naturally less-favoured areas

to ensure continued agricultural land use and thereby contribute to the maintenance of a viable rural community,

to maintain countryside,

to maintain and promote sustainable farming systems which in particular take account of environmental protection requirements;

(b) Compensation for areas with environmental restrictions to ensure environmental requirements and safeguard farming in areas with environmental restrictions.

Mountain areas are characterised by a considerable limitation of the possibilities for using the land and an appreciable increase in the cost of working it due to the existence, because of altitude, of very difficult climatic conditions; at a lower altitude, to the presence over the greater part of the area in question of slopes too steep for the use of machinery (Art. 18). Less-favoured areas which are in danger of abandonment of land-use and where the conservation of the countryside is necessary, comprise farming areas which are homogeneous from the point of view of natural production conditions and exhibit all of the following characteristics:

- the presence of land of poor productivity, difficult cultivation and with a limited potential,
- production which results from low productivity of the natural environment (Art. 19).
- Support for agricultural production methods designed to protect the environment and to maintain the countryside (agri-environment) shall promote:
- ways of using agricultural land which are compatible with the protection and improvement of the environment, the landscape and its features, natural resources, the soil and genetic diversity,
- an environmentally-favourable extensification of farming and management of low-intensity pasture systems,
- the conservation of high nature-value farmed environments which are under threat,
- the upkeep of the landscape and historical features on agricultural land,
- the use of environmental planning in farming practice (Art. 22).

Support for forestry shall contribute to the maintenance and development of the economic, ecological and social functions of forests in rural areas, in particular:

sustainable forest management and development of forestry, maintenance and improvement of forest resources, extension of woodland areas (Art. 29).

In the preamble of Commission Regulation No 445/2002 laying down detailed rules for the application of Council Regulation (EC) No 1257/1999 on support for rural development from the European Agricultural Guidance and Guarantee Fund according to recital (8) and (14), compensatory allowances payable

in less-favoured areas for land used jointly by several farmers should be paid to each farmer concerned. Detailed conditions should be laid down for support for afforestation of agricultural land and payments for activities to maintain and improve the ecological stability of forests. A tenant farmer may transfer the released land to the owner provided that the lease is terminated and the requirements relating to the transferee are complied with (Article 9). Released land may be included in a re-parcelling operation or in a simple exchange of parcels. In such cases, the conditions applicable to released land shall be applied to areas agronomically equivalent to the released land (Art. 10).

Article 13 concerns the agri-environment. Extensive livestock farming is to comply with, inter alia, that at least grassland management shall continue. The reference level for calculating income forgone and additional costs shall be the usual good farming practice in the area where the measure is applied. The economic consequences of abandoning land or ceasing certain farming practices may be taken into account where this is justified by the agronomic or environmental circumstances (Art. 18). Member States may authorise one agri-environment commitment to be converted into another during the period of its operation, on condition that any such conversion is of unquestionable benefit to the environment (Art. 21). It can be converted into a commitment for afforestation of agricultural land as well. The agri-environment commitment shall cease without reimbursement being required.

When improving the processing and marketing of agricultural products eligible expenditure may include, among others, the construction and acquisition of immovable property, with the exception of land purchase (Art. 22). The forests excluded from forestry support are:

(a) forest or other wooded land owned by central or regional governments, or by government-owned corporations;

(b) crown forest and other wooded land;

(c) forests owned by legal persons at least 50 % of whose capital is held by one of the institutions referred to in points (a) and (b) (Art. 25).

Agricultural land eligible for support for afforestation shall include in particular arable land, grassland, permanent pastures and land used for perennial crops (Art. 26). Where a beneficiary is unable to continue to comply with commitments given because the holding is reparcelled or is the subject of other similar public land-consolidation measures, the commitments can be adapted to the new situation (Art. 32). According to Article 33 a severe natural disaster seriously affecting the agricultural land on the holding is a category of force majeure.

Similar soil-related provisions are found in:

Commission Regulation 1444/2002/EC amending Commission Decision 2000/115/EC relating to the definitions of the characteristics, the exceptions to the definitions and the regions and districts regarding the surveys on the structure of agricultural holdings.

Council Regulation 2092/91/EEC on organic production of agricultural products and indications referring thereto on agricultural products and foodstuffs

Commission Regulation 1837/2001/EC amending Regulation 2237/77/EEC on the form of farm return

13. Industrial policy and internal market

13.30 Internal market: approximation of laws

13.30.18 Dangerous substances (15.10.20.50 Chemicals, industrial risk and biotechnology)

Council Directive 67/548/EEC on the approximation of laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous substances (last amended by 2001/59/EC) is one of the earliest pieces of the environment acquis, which has been amended twenty-eight times. For the purposes of this Directive "substances" means chemical elements and their compounds as they occur in the natural state or as produced by industry; "preparations" means mixtures or solutions composed of two or more substances. The originally eight dangerous characteristics were later extended and adopted by the waste legislation too as properties which render the waste hazardous. The amendments of the directive established the system of 68 risk phrases and 57 more combination risk phrases on the basis of physicochemical and toxicological properties, specific effects on human health, and environmental effects. The recent amendments introduced the category:

“5.2.2. Non-aquatic environment

5.2.2.1. Substances and preparations shall be classified as dangerous for the environment and assigned the symbol "N" and the appropriate indication of danger, and assigned risk phrases in accordance with the following criteria:

R54 Toxic to flora

R55 Toxic to fauna

R56 Toxic to soil organisms

R57 Toxic to bees

R58 May cause long-term adverse effects in the environment

Substances and preparations which on the basis of the available evidence concerning their toxicity, persistence, potential to accumulate and predicted or observed environmental fate and behaviour may present a danger, immediate or long-term and/or delayed, to the structure and/or functioning of natural ecosystems other than those covered under 5.2.1. Detailed criteria will be elaborated later.”

Although the last amendment by Directive 2001/59/EC presents a detailed description of adsorp-

tion/desorption batch method for soil, including sampling protocol, preparation and analytical techniques, in general it can be stated that the chemical legislation has much more provisions on the aquatic environment (e.g. ecotoxicology of aquatic ecosystems) than on terrestrial systems.

Commission Regulation (EC) No 1488/94 laying down the principles for the assessment of risks to man and the environment of existing substances in accordance with Council Regulation (EEC) No 793/93 defines "exposure assessment" as the determination of the emissions, pathways and rates of movement of a substance and its transformation or degradation, in order to estimate the concentrations/doses to which human populations or environmental spheres (water, soil and air) are or may be exposed.

According to the Commission Directive 93/67/EEC laying down the principles for assessment of risks to man and the environment of substances notified in accordance with Council Directive 67/548/EEC the first stage of the risk assessment shall be hazard identification. Having conducted the hazard identification, the competent authority shall proceed to the following sequence of actions:

(a) (i) dose (concentration)-response (effect) assessment, where appropriate;

(ii) exposure assessment for the environmental compartments (i.e. aquatic environment, terrestrial environment and air) likely to be exposed to the substance;

(b) risk characterization.

In Annex III of Council Regulation No 793/93 on the evaluation and control of the risks of existing substances among the information required for the export-import of existing substances above a certain volume, there are:

3.1. Stability

…3.1.3. Stability in soil

4. Ecotoxicity

…4.4. Toxicity to bacteria

4.5. Toxicity to terrestrial organisms

4.6. Toxicity to soil dwelling organisms

Council Directive 91/414/EEC concerning the placing of plant protection products on the market defines numerous information requirements for the dossier to be submitted for the inclusion of an active substance and for the authorization of a plant protection product, among which there are many items relevant to soil:

Annex II, Active substances, Part A, Chemical substances

4.2. Analytical methods including recovery rates and the limits of determination for residues:

4.2.2. Soil

7. Fate and behaviour in the environment

7.1. Fate and behaviour in soil

7.1.1. Rate and route of degradation (to 90 % degradation) including identification of the processes involved and identification of metabolites and breakdown products in at least three soil types under appropriate conditions.

7.1.2. Adsorption and desorption in at least three soil types and where relevant adsorption and desorption of metabolites and breakdown products

7.1.3. Mobility in at least three soil types and where relevant mobility of metabolites and breakdown products

8.3. Effects on other non-target organisms

8.3.2. Toxicity to earthworms and to other soil non-target macro-organisms

8.3.3. Effects on soil non-target micro-organisms

Part B, Micro-organisms and viruses

4. Analytical methods

4.4. Methods to determine viable and non-viable (e.g. toxins) residues in or on treated products, foodstuffs, feedingstuffs, animal and human body fluids and tissues, soil, water and air

7. Fate and behaviour in the environment

7.1. Spread, mobility, multiplication and persistence in air, water, soil

8. Ecotoxicological studies

8.9. Extent of indirect contamination on adjacent non-target crops, wild plants, soil and water

Annex III, Plant protection products, Part A, Chemical preparations

5. Analytical methods

5.2.2. Soil

9. Fate and behaviour in the environment

9.1. Testing for distribution and dissipation in soil

10. Ecotoxicological studies

10.3. Effects on other non-target organisms

10.3.5. Effects on earthworms and other soil non-target macro-organisms, believed to be at risk

10.3.6. Effects on soil non-target micro-organisms

Part B, Preparations of micro-organisms or viruses

10. Ecotoxicological studies

10.2. Effects on beneficial and other non-target organisms

10.2.3. Effects on earthworms

10.2.4. Effects on other soil fauna

10.2.6. Effects on soil microflora

Numerous and similar provisions concerning the testing of biocides in soil environment are provided by Directive 98/8/EC of the European Parliament and of the Council concerning the placing of biocidal products on the market.

There are other substance- or activity-related directives which contain emission limit values and/or limited references to soil:

Directive 2001/82/EC of the European Parliament and of the Council on the Community code relating to veterinary medicinal products

Directive 2001/18/EC of the European Parliament and of the Council on the deliberate release into the environment of genetically modified organisms and repealing Council Directive 90/220/EEC

Regulation 1774/2002/EC of the European Parliament and of the Council laying down health rules concerning animal by-products not intended for human consumption

Directive 2002/69/EC laying down the sampling methods and the methods of analysis for the official control of dioxins and the determination of dioxin-like PCBs in foodstuffs

Directive 2002/70/EC establishing requirements for the determination of levels of dioxins and dioxin-like PCBs in feedingstuffs

Directive 87/217/EEC on the prevention and reduction of environmental pollution by asbestos

Directive 82/176/EEC on limit values and quality objectives for mercury discharges by the chlor-alkali electrolysis industry

Directive 83/513/EEC on limit values and quality objectives for cadmium discharges

Directive 84/156/EEC on limit values and quality objectives for mercury discharges by sectors other than the chlor-alkali electrolysis industry

Directive 84/491/EEC on limit values and quality objectives for discharges of hexachlorocyclohexane

Directive 86/280/EEC on limit values and quality objectives for discharges of certain dangerous substances included in List 1 of the Annex to Directive 76/464/EEC, subsequently amended by Directives 88/347/EEC and 90/415/EEC amending Annex II to Directive 86/280/EEC

Directive 89/369/EEC on the prevention of air pollution from new municipal waste-incineration plants

Directive 89/429/EEC on the reduction of air pollution from existing municipal waste-incineration plants

Directive 94/67/EC on the incineration of hazardous waste

Directive 92/112/EEC on procedures for harmonizing the programmes for the reduction and eventual elimination of pollution caused by waste from the titanium oxide industry

Directive 88/609/EEC on the limitation of emissions of certain pollutants into the air from large combustion plants, as last amended by Directive 94/66/EC

Directive 76/464/EEC on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community

Directive 79/117/EEC prohibiting the placing on the market and use of plant protection products containing certain active substances (last amended by 807/2003/EC)

Directive 75/439/EEC on the disposal of waste oils

13.30.99 Other sectors for approximation of laws

For the purposes of Council Directive 89/106/EEC on the approximation of laws, regulations and administrative provisions of the Member States relating to construction products (amended by 93/68/EEC) "construction product" means any product which is produced for incorporation in a permanent manner in construction works, including both buildings and civil engineering works. Among others, the possible differences in geographical or climatic conditions as well as different levels of protection that prevail at national, regional or local level are to be taken into account when establishing the document of requirements and the technical specifications (Art. 3). The essential requirements (Annex I) involve that the construction work must be designed and built in such a way that it will not be a threat to the hygiene or health of the occupants or neighbours, in particular as a result of any of the following:

- the giving-off of toxic gas,

- the presence of dangerous particles or gases in the air,

- the emission of dangerous radiation,

- pollution or poisoning of the water or soil,

- faulty elimination of waste water, smoke, solid or liquid wastes.

The Directive is the most relevant in the sense that it acknowledges the fit for use concept for construction products, which concept is in the focus of debate for decontamination standards.

14. Regional policy and coordination of structural instruments

14.10 General principles, programmes and statistics

14.20 European Regional Development Fund (ERDF)

The aim of the Regulation No 1783/1999 of the European Parliament and of the Council on the European Regional Development Fund is to contribute towards the financing of assistance to promote economic and social cohesion by correcting the main regional imbalances and participating in the development and conversion of regions suffering from a structural handicap because of their insular, landlocked or peripheral

status. Among others, it is to finance the renewal of depressed urban areas and the revitalisation of and improved access to rural areas; the protection of cultural and natural heritage; the protection and improvement of the environment, in particular taking account of the principles of precaution and preventative action in support of economic development, the clean and efficient utilisation of energy and the development of renewable energy sources.

According to Commission Regulation No 16/2003 laying down special detailed rules for implementing Council Regulation No 1164/94 as regards eligibility of expenditure in the context of measures part-financed by the Cohesion Fund Article 16, the cost of the purchase of land not built on is eligible only if the purchase of the land is indispensable to the implementation of the project; the purchase of land does not exceed 10 % of the eligible expenditure for a project; a certificate confirms that the purchase price does not exceed the market value; the purchase is approved by the Commission. Expenditure on the purchase of land which, after completion of the project, remains in forestry or agricultural use is not eligible unless otherwise specified in the Commission decision. Expenditure on site preparation and construction which are essential for implementation of the project are eligible.

In the indicative list measures eligible for ERDF funding (Annex I) of Communication from the Commission to the Member States of 28 April 2000 laying down guidelines for a Community initiative concerning economic and social regeneration of cities and of neighbourhoods in crisis in order to promote sustainable urban development appears the mixed use and environmentally friendly brownfield redevelopment, which, among others, are the reclamation of derelict sites and contaminated land, and the rehabilitation of public spaces including green areas.

15. Environment, consumers and health protection

15.10 Environment

15.10.10 General provisions and programmes

The chapter "Environment, consumers and health protection", and especially subchapters "Water protection and management", "Chemicals, industrial risk and biotechnology", "Waste management and clean technology" contain the most numerous direct provisions relevant to soil management. Besides the sectoral-, and product-specific or emission-oriented legislation there are a few "horizontal" directives which regulate general environmental management issues.

Council Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment (last amended by 2003/35/EC) requires an environmental impact assessment of economic activities, which are likely to have significant effects on the environment. By definition projects are the execution of construction works, other installations, other interventions in the natural surroundings and landscape. Environmental impact assessments identify, describe and assess direct and indirect effects on human beings, fauna, flora, soil, water, air, climate, landscape, the inter-action between these factors, material assets and the cultural heritage.

According to Annex III the characteristics of projects must be considered having regard, in particular, among others, to the use of natural resources. When locating projects the environmental sensitivity of geographical areas likely to be affected must be considered, having regard, in particular, to:

the existing land use,

the relative abundance, quality and regenerative capacity of natural resources in the area,

the absorption capacity of the natural environment, paying particular attention to:

(a) wetlands;

(b) coastal zones;

(c) mountain and forest areas;

(d) nature reserves and parks;

(h) landscapes of historical, cultural or archaeological significance.

All of the projects of obligatory assessment (Annex I) likely have impacts on soil. Item 19. is perhaps the most directly soil-related activity:

"Quarries and open-cast mining where the surface of the site exceeds 25 hectares, or peat extraction, where the surface of the site exceeds 150 hectares."

Among the projects for which Member States have the freedom to judge whether to prescribe the assessment (Annex II) there are numerous which involve direct interaction with soil:

1. Agriculture, silviculture and aquaculture

(a) Projects for the restructuring of rural land holdings;

(b) Projects for the use of uncultivated land or semi-natural areas for intensive agricultural purposes;

(c) Water management projects for agriculture, including irrigation and land drainage projects;

(d) Initial afforestation and deforestation for the purposes of conversion to another type of land use;

(g) Reclamation of land from the sea.

2. Extractive industry

(c) Extraction of minerals by marine or fluvial dredging;

(d) Deep drillings with the exception of drillings for investigating the stability of the soil;

10. Infrastructure projects

(a) Industrial estate development projects;

(f) Inland-waterway construction not included in Annex I, canalization and flood-relief works;

(k) Coastal work to combat erosion and maritime works capable of altering the coast through the construction, for example, of dykes, moles, jetties and other sea defence works;

As required by Directive 2001/42/EC of the European Parliament and of the Council on the assessment of the effects of certain plans and programmes on the environment an environmental assessment shall be carried out for all plans and programmes, which are, among others, prepared for agriculture, forestry, and country planning or land use and which set the framework for future development consent of projects listed in Annexes I and II to Directive 85/337/EEC. Among others, the environmental report shall cover the likely significant effects on the environment, including on issues such as biodiversity, population, human health, fauna, flora, soil, water, air, climatic factors, material assets, cultural heritage including architectural and archaeological heritage, landscape and the interrelationship between the above factors (see Annex). The monitoring of the significant environmental effects is prescribed by Article 10 but existing monitoring arrangements may be used to avoid duplication.

Regulation No 761/2001 of the European Parliament and of the Council allowing voluntary participation by organisations in a Community eco-management and audit scheme (EMAS) is designed for the evaluation and continual improvement of the environmental performance of organisations. Annex VI lists the necessary information for the identification and evaluation of the environmental aspects in the certified environmental management system. Among others, direct environmental aspects (6.2.) may include, but not limited to:

(a) emissions to air;

(b) releases to water;

(c) avoidance, recycling, reuse, transportation and disposal of solid and other wastes, particularly hazardous wastes;

(d) use and contamination of land;

(e) use of natural resources and raw materials (including energy);

(f) local issues (noise, vibration, odour, dust, visual appearance, etc.);

(g) transport issues (both for goods and services and employees);

(h) risks of environmental accidents and impacts arising, or likely to arise, as consequences of incidents, accidents and potential emergency situations;

(i) effects on biodiversity.

Commission Decision 2001/688/EC establishing ecological criteria for the award of the Community eco-label to soil improvers and growing media is aiming at promoting the use and/or re-use of organic matter derived from the collection and/or processing of waste material and therefore contributing to a minimisation of solid waste at the final disposal, and at the reduction of environmental damage or risks from heavy metals and other hazardous compounds in soil improvers and growing media. Soil improvers are materials to be added to the soil in situ primarily to maintain or improve its physical properties, and which may improve its chemical and/or biological properties or activity. Growing media are materials, other than soils in situ, in which plants are grown. The environmental performance of the product group shall be assessed by reference to the specific ecological criteria set out in the Annex. In the Annex limit values for hazardous substances and nutrients (N, P, K) are provided as well.

Commission Decision 2002/272/EC establishing the ecological criteria for the award of the Community eco-label to hard floor-coverings uses an assessment system through the weighting of different factors in order to arrive at the least impact on the environment. One element of the system is the soil protection. According to the Technical Appendix:

W2. Soil protection/land capability classification

According to the European Soil Bureau's indication, land is graded on the basis of its potentialities and the severity of its limitations for crop growth into eight capability classes. An indicative description of the classes is as follows:
Class I soils have slight limitations that restrict their use,

Class II soils have moderate limitations that reduce the choice of plants or require moderate conservation practices,

Class III soils have severe limitations that reduce the choice of plants or require special conservation practices, or both,

Class IV soils have very severe limitations that restrict the choice of plants or require very careful management, or both,

Class V soils have little or no hazard of erosion but have other limitations, impractical to remove, that limit their use mainly to pasture, range, forestland, or wildlife food and cover,

Class VI soils have severe limitations that make them generally unsuited to cultivation and that limit their use mainly to pasture, range, forestland, or wildlife food and cover,

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use mainly to grazing, forestland, or wldlife,

Class VIII soils and miscellaneous areas have limitations that preclude their use for commercial plant pro-

duction and limit their use to recreation, wildlife, or water supply or for aesthetic purposes.

According to Article 2 of Directive 2003/4/EC of the European Parliament and of the Council 2003 on public access to environmental information and repealing Council Directive 90/313/EEC "environmental information" means any information … on, inter alia, the state of the elements of the environment, such as air and atmosphere, water, soil, land, landscape and natural sites including wetlands, coastal and marine areas, biological diversity and its components, including genetically modified organisms, and the interaction among these elements.

Proposal for a Directive of the European Parliament and of the Council on environmental liability with regard to the prevention and remedying of environmental damage /COM/2002/0017 final/ is an important step forward to regulating and establishing a framework for environmental liability. The draft operates with terms like "baseline condition" (the condition of the natural resources and services that would have existed had the damage not occurred, estimated on the basis of historical data, reference data, control data, or data on incremental changes …), "damage" (a measurable adverse change in a natural resource and/or measurable impairment of a natural resource …), "natural resource" (biodiversity, water and soil, including subsoil). A significant part of the bill addresses "soil and subsoil contamination" (direct or indirect introduction, as a result of human activity, of substances, preparations, organisms or microorganisms harmful to human health or natural resources into soil and subsoil), which is either recovered (the return of damaged natural resources and/or services to baseline condition) or restored (action, or combination of actions, to restore, rehabilitate or replace damaged natural resources and/or impaired services, or to provide an equivalent alternative to those resources or services…). The detailed introduction of the draft is out of our scope.

The discussion of the following horizontal environmental legislation is out of our scope:

Regulation 1980/2000/EC of the European Parliament and of the Council on a revised Community eco-label award scheme;

Communication from the Commission on "Environmental agreements" (COM(96) 561);

Community Mechanisms for the co-ordination of the Civil Protection Interventions in case of Emergencies (COM(2000) 593);

15.10.20 Pollution and nuisances

15.10.20.10 Nuclear safety and radioactive waste

Council Directive 96/29/Euratom laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionizing radiation applies to all practices which involve a risk from ionizing radiation emanating from an artificial source or from a natural radiation source in cases where natural radionuclides are or have been processed in view of their radioactive, fissile or fertile properties. The only land use related provisions is found under Article 53: Where the Member States have identified a situation leading to lasting exposure resulting from the after-effects of a radiological emergency or a past practice, they shall ensure, among others, that the area concerned is demarcated; arrangements for the monitoring of exposure are made; access to or use of land situated in the demarcated area is regulated.

15.10.20.20 Water protection and management

Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for Community action in the field of water policy (amended by 2455/2001/EC). The purpose of this Directive is to establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater which, among others, (a) prevents further deterioration and protects and enhances the status of aquatic ecosystems and, with regard to their water needs, terrestrial ecosystems and wetlands directly depending on the aquatic ecosystems;…(e) contributes to mitigating the effects of floods and droughts. "Inland water" means all standing or flowing water on the surface of the land, and all groundwater on the landward side of the baseline from which the breadth of territorial waters is measured. "Direct discharge to groundwater" means discharge of pollutants into groundwater without percolation throughout the soil or subsoil. "Pollution" means the direct or indirect introduction, as a result of human activity, of substances or heat into the air, water or land which may be harmful to human health or the quality of aquatic ecosystems or terrestrial ecosystems directly depending on aquatic ecosystems, which result in damage to material property, or which impair or interfere with amenities and other legitimate uses of the environment.

The novel and essential tool invented by the Directive is the river basin management plan. In this plan, among other environmental objectives, Member States may designate a body of surface water as artificial or heavily modified, when, inter alia, the changes to the hydromorphological characteristics of that body which would be necessary for achieving good ecological status would have significant adverse effects on water regulation, flood protection, land drainage, etc.. Member States are required to set a register of protected areas, to monitor the chemical and quantitative status of groundwater, to apply a combined approach for point and diffuse sources (Articles 6, 8, 10).

Member States may authorise (Art. 11):

reinjection into the same aquifer of water used for geothermal purposes;

injection of water containing substances resulting from mining activities, and injection of water for technical reasons, into geological formations from which hydrocarbons or other substances have been extracted or into geological formations which are unsuitable for other purposes;

reinjection of pumped groundwater from mines or associated with the construction or maintenance of civil engineering works;

injection of natural gas or liquefied petroleum gas for storage purposes into geological formations which are unsuitable for other purposes;

construction, civil engineering and building works and similar activities on, or in the ground which come into contact with groundwater;

- *discharges of small quantities of substances for scientific purposes for characterisation.*

The characterization of surface waters (Annex II Chapter 1), among others, requires the presentation of ecoregions, including altitude and size typology, and geology of the catchment area. Among the identification of pressures the estimation of land use patterns, including identification of the main urban, industrial and agricultural areas and, where relevant, fisheries and forests is prescribed. The characterization of groundwaters may employ existing hydrological, geological, pedological, land use, discharge, abstraction and other data but shall identify:

- the location and boundaries of the groundwater bodies,

- the pressures to which the groundwater bodies are subjects including diffuse and point sources of pollution, abstraction, artificial recharge, the character of the overlying strata from which the groundwater body receives its recharge, groundwater bodies for which there are directly dependent surface water or terrestrial ecosystems.

Further characterisation include relevant information on the impact of human activity and on:

geological characteristics of the groundwater body including the extent and type of geological units,

hydrogeological characteristics of the groundwater body including hydraulic conductivity, porosity and confinement,

characteristics of the superficial deposits and soils in the catchment from which the groundwater body receives its recharge, including the thickness, porosity, hydraulic conductivity, and absorptive properties of the deposits and soils,

stratification characteristics of the groundwater within the groundwater body,

an inventory of associated surface systems, including terrestrial ecosystems and bodies of surface water, with which the groundwater body is dynamically linked,

The review of the impact of human activity on groundwaters involve, among others, the land use in the catchment, including pollutant inputs and anthropogenic alterations to the recharge characteristics such as rainwater and run-off diversion through land sealing, artificial recharge, damming or drainage. When reviewing the impact of changes in groundwater levels it is to identify bodies of groundwater for which lower objectives are to be specified under Article 4 including surface water and associated terrestrial ecosystems, water regulation, flood protection and land drainage, human development.

Annex VI lists the measure to be included within the programme of measures. The non-exclusive list of supplementary measures which Member States within each river basin district may choose to adopt are legislative, administrative, economic or fiscal instruments, environmental agreements, emission controls, codes of good practice, recreation of wetlands areas, abstraction controls, demand management measures (e.g. promotion of adapted agricultural production such as low water requiring crops in areas affected by drought), efficiency measures (e.g. promotion of water-efficient technologies in industry and water-saving irrigation techniques), construction projects, desalination plants, etc..

Among many others, river basin management plans shall cover (Annex VII):

pressures and impact of human activity on the status of surface water and groundwater, including estimation of point and diffuse source pollution, including land use,

identification and mapping of protected areas;

a map of the monitoring networks and a presentation in map form of the results of the monitoring programmes carried out for the status of surface water (ecological and chemical); groundwater (chemical and quantitative); protected areas; a list of the environmental objectives for surface waters, groundwaters and protected areas, etc.

Council Directive 80/68/EEC on the protection of groundwater against pollution caused by certain dangerous substances. This Directive requires a prior investigation concerning the disposal or tipping of dangerous substances leading to indirect or direct discharges to groundwater. For the purpose of this Directive "groundwater" means all water which is below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil. "Direct discharge" means the introduction into groundwater of substances in lists I or II without percolation through the ground or subsoil. "Indirect discharge" means the introduction into groundwater of substances in lists I or II after percolation through the ground or subsoil. The prior investigations include examination of the hydrogeological conditions of the area concerned, the possible purifying powers of the soil and subsoil and the risk of pollution and alteration of the quality of the groundwater from the discharge and shall establish whether the discharge of substances into groundwater is a satisfactory solution from the point of view of the environment (Art. 7).

The objective of Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources is re-

ducing water pollution caused or induced by nitrates from agricultural sources and preventing further such pollution. For the purpose of this Directive "land application" means the addition of materials to land whether by spreading on the surface of the land, injection into the land, placing below the surface of the land or mixing with the surface layers of the land. "Vulnerable zone" means an area of land designated by Member States which contribute to pollution and which drain into the waters affected or waters could be affected by pollution if action pursuant Article 5 is not taken and identified in accordance with the criteria set out in Annex I. Member States are to establish a code of good agricultural practice to be implemented by farmers on a voluntary basis (Art. 4).

Action programmes in respect of designated vulnerable zones shall take into account available scientific and technical data, mainly with reference to respective nitrogen contributions from agricultural and other sources, and environmental conditions in the relevant regions. A suitable monitoring programme is required to assess the effectiveness of action programmes (Art. 5) by monitoring the nitrate content of waters (surface waters and groundwater) at selected measuring points. According to Annex II the following items shall be included of code of good agriculture practice:

1. periods when the land application of fertilizer is inappropriate;

2. the land application of fertilizer to steeply sloping ground;

3. the land application of fertilizer to water-saturated, flooded, frozen or snow-covered ground;

4. the conditions for land application of fertilizer near water courses;

5. the capacity and construction of storage vessels for livestock manures, including measures to prevent water pollution by run-off and seepage into the groundwater and surface water of liquids containing livestock manures and effluents from stored plant materials such as silage;

6. procedures for the land application, including rate and uniformity of spreading, of both chemical fertilizer and livestock manure, that maintain nutrient losses to water at an acceptable level.

7. land use management, including crop rotation systems and the proportion of the land area of permanent crops relative to annual tillage crops;

8. the maintenance of a minimum quantity of vegetation cover during (rainy) periods that will take up the nitrogen from the soil that could otherwise cause nitrate pollution of water;

9. the establishment of fertilizer plans and the keeping of records;

10. the prevention of water pollution from run-off and the downward water movement beyond the reach of crop roots in irrigation systems.

Annex III on the measures of the action programmes has many relevant items:

1. periods when the land application of certain types of fertilizer is prohibited;

2. capacity of storage vessels for livestock manure which must exceed that required for the longest period during which land application in the vulnerable zone is prohibited;

3. limitation of the land application of fertilizers taking into account the characteristics of the vulnerable zone:

(a) soil conditions, soil type and slope;

(b) climatic conditions, rainfall and irrigation;

(c) land use and agricultural practices, including crop rotation systems; and to be based on a balance between:

(i) the foreseeable nitrogen requirements of the crops,

(ii) the nitrogen supply to the crops from the soil and from fertilization corresponding to:

- the amount of nitrogen present in the soil at the moment when the crop starts to use it,

- the supply of nitrogen through the net mineralization of the reserves of organic nitrogen in the soil, etc…

The most relevant and recent piece of Community legislation on seabed pollution is the Decision 2850/2000/EC of the European Parliament and of the Council setting up a Community framework for cooperation in the field of accidental or deliberate marine pollution. The main objectives of the decision are, inter alia, to support the protection of the marine environment, coastlines and human health against

the risks of accidental or deliberate pollution at sea, excluding continuous streams of pollution originating from land-based sources;

accidental pollution risks including releases of harmful substances, whatever their origin, both from ships and from the shoreline or estuaries, including those linked to the presence of dumped materials (e.g. munitions) but excluding authorised discharges and continuous streams of pollution originating from land-based sources.

The major tool is a cooperation framework of the Member States set in three years rolling plan, and involving a common information system and financing scheme. The required information of the national home page(s) are, among others:

(i) a description of national structures and of links between national authorities, including focal points to be addressed in case of emergency;

(ii) information on teams and equipment for emergency response and clean-up, in particular:

- seaborne strike teams consisting of spill response vessels,

- land-based strike teams to combat shoreline pollution, to organise temporary storage, and to conduct actions for the rehabilitation of sensitive coastal areas,

- expert teams to carry out environmental monitoring of pollution and/or the impact of the combating techniques used, including chemical dispersion,

- other mechanical, chemical and biological means for combating pollution at sea and cleaning up coasts, including systems for lightening of oil tankers (Annex I).

The provisions of Council Directive 76/160/EEC concerning the quality of bathing water may be waived in the case of certain parameters marked (0) in the Annex, because of exceptional weather or geographical conditions; or when bathing water undergoes natural enrichment in certain substances causing a deviation from the values prescribed in the Annex. Natural enrichment means the process whereby, without human intervention, a given body of water receives from the soil certain substances contained therein, in case these exceptions disregard the requirements essential for public health protection (Art. 8).

Other important water legislation with no direct reference on soil are:

Decision 2455/2001/EC of the European Parliament and of the Council establishing the list of priority substances in the field of water policy and amending Directive 2000/60/EC

Regulation 2099/2002 of the European Parliament and of the Council establishing a Committee on Safe Seas and the Prevention of Pollution from Ships (COSS) and amending the Regulations on maritime safety and the prevention of pollution from ships

Decision 2002/915/EC concerning a request for derogation under paragraph 2(b) of Annex III to and Article 9 of Directive 91/676/EEC concerning protection of waters against pollution caused by nitrates from agricultural sources

Directive 91/271/EEC concerning urban waste-water treatment (as amended by 98/15/EC)

Directive 98/83/EC on the quality of water intended for human consumption

Directive 93/75/EEC concerning minimum requirements for vessels bound for or leaving Community ports and carrying dangerous or polluting goods

Directive 80/778/EEC relating to the quality of water intended for human consumption

Directive 79/869/EEC concerning the methods of measurement and frequencies of sampling and analysis of surface water intended for the abstraction of drinking water in the Member States

Directive 79/923/EEC on the quality required of shellfish waters

Directive 76/464/EEC on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community

Directive 75/440/EEC concerning the quality required of surface water intended for the abstraction of drinking water in the Member States

Decision 77/795/EEC establishing a common procedure for the exchange of information on the quality of surface fresh water in the Community

Directive 78/659/EEC on the quality of fresh waters needing protection or improvement in order to support fish life

15.10.20.30 Monitoring of atmospheric pollution

Atmospheric pollution is a typical diffuse pollution source on soil. This chapter of the acquis is rather developed by regulating certain emitters (e.g. vehicles), setting overall limit values of most hazardous pollutants, polluting activities (e.g. waste incineration) and regulating general horizontal issues like information transfer. Most recent pieces take into account an integrated approach to the protection of air, water and soil. For example Commission Regulation No 1091/94 laying down certain detailed rules for the implementation of Council Regulation No 3528/86 on the protection of the Community's forests against atmospheric pollution is the piece of legislation in the chapter which provides direct provisions on soil. As required by Article 1, a network of permanent observation plots shall be installed according to the common methods for the establishment of a network of permanent observation plots for intensive, continuous monitoring. For all plots the Member States shall forward to the Commission a review of the selection criteria and a complete list of the selected plots, including basic information such as location and species. The intensive and continuous surveillance of the forest ecosystems contains the inventory of the crown condition, the inventory of soil and foliar condition and measurements on increment changes, deposition rates and meteorology in accordance with established sampling and analytical methods. The annexes of the directive give exhaustive instructions for the soil sampling, analytics, and reporting categories.

The aim of Directive 2001/81/EC of the European Parliament and of the Council on national emission ceilings for certain atmospheric pollutants is to limit emissions of acidifying and eutrophying pollutants and ozone precursors (SO_2, NO_x, VOC, NH_3) in order to improve the protection of the environment and human health against risks of adverse effects from acidification, soil eutrophication and ground-level ozone (Art. 1). According to recitals (9) and (10) of the preamble transboundary pollution contributes to acidification, soil eutrophication and ground-level ozone formation. Reducing emissions of the pollutants causing acidification and exposure to ground-level ozone will also reduce soil eutrophication.

The national emission ceilings are designed with the aim of meeting the environmental objectives, which is expected to result in a reduction of soil eutrophication to such an extent that areas with depositions of nutrient nitrogen in excess of the critical loads will be reduced by ca. 30% compared to 1990.

The objective of Directive 2000/76/EC of the European Parliament and of the Council on the incineration of waste is to prevent or to limit as far as practicable negative effects on the environment, in particular pollution by emissions into air, soil, surface water and groundwater, and the resulting risks to human health, from the incineration and co-incineration of waste. The operator of the incineration or co-incineration plant shall take all necessary precautions concerning the delivery and reception of waste in order to prevent or to limit as far as practicable negative effects on the environment, in particular the pollution of air, soil, surface water and groundwater (Art 5). According to Article 8 "Water discharges from the cleaning of exhaust gases" incineration plant sites shall be designed in such a way as to prevent the unauthorised and accidental release of any polluting substances into soil, surface water and groundwater.

Commission Regulation (EEC) No 926/93 amending Regulation (EEC) No 1696/87 laying down certain detailed rules for the implementation of Council Regulation (EEC) No 3528/86 on the protection of the Community's forests against atmospheric pollution makes a statement in its preamble that the indirect effects of atmospheric pollutants through the soil are one of the main reasons for the deterioration of the condition of forest ecosystems. An examination of the soil of the forests provides basic information on the chemical condition of the soil and the nutrient supply to trees as well as the influence of pollutant inputs on the condition of the soil. In this way account would be taken of the increasing significance of soil for an improvement in the condition of forests.

There are numerous other legislation which have an indirect relevance to soil protection:

Directive 2002/3/EC of the European Parliament and of the Council relating to ozone in ambient air

Directive 2001/80/EC of the European Parliament and of the Council on the limitation of emissions of certain pollutants into the air from large combustion plants

Directive 2000/69/EC of the European Parliament and of the Council relating to limit values for benzene and carbon monoxide in ambient air

Directive 2000/25/EC of the European Parliament and of the Council on action to be taken against the emission of gaseous and particulate pollutants by engines intended to power agricultural or forestry tractors and amending Council Directive 74/150/EEC

Regulation No 2278/1999 laying down certain detailed rules for the application of Council Regulation (EEC) No 3528/86 on the protection of the Community's forests against atmospheric pollution

Directive 1999/96/EC of the European Parliament and of the Council on the approximation of the laws of the Member States relating to measures to be taken against the emission of gaseous and particulate pollutants from compression ignition engines for use in vehicles, and the emission of gaseous pollutants from positive ignition engines fuelled with natural gas or liquefied petroleum gas for use in vehicles and amending Council Directive 88/77/EEC

Directive 1999/32/EC relating to a reduction in the sulphur content of certain liquid fuels and amending Directive 93/12/EEC

Directive 1999/30/EC relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air

Directive 1999/13/EC on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain activities and installations

Directive 98/70/EC relating to the quality of petrol and diesel fuels and amending Council Directive 93/12/EEC

Directive 98/69/EC relating to measures to be taken against air pollution by emissions from motor vehicles and amending Council Directive 70/220/EEC

Directive 97/68/EC on the approximation of the laws of the Member States relating to measures against the emission of gaseous and particulate pollutants from internal combustion engines to be installed in non-road mobile machinery (last amended by 2002/88/EC)

Directive 97/20/EC adapting to technical progress of Council Directive 72/306/EEC on the approximation of the laws of the Member States relating to the measures to be taken against the emission of pollutants from diesel engines for use in vehicles

Directive 96/62/EC on ambient air quality assessment and management

Directive 94/63/EC on the control of volatile organic compound (VOC) emissions resulting from the storage of petrol and its distribution from terminals to service stations

Directive 94/12/EC relating to measures to be taken against air pollution by emissions from motor vehicles and amending Directive 70/220/EEC

Directive 93/12/EEC relating to the sulphur content of certain liquid fuels

Council Directive 92/72/EEC on air pollution by ozone

Directive 89/429/EEC on the reduction of air pollution from existing municipal waste-incineration plants

Directive 85/203/EEC on air quality standards for nitrogen dioxide

Directive 84/360/EEC on the combating of air pollution from industrial plants

Directive 82/884/EEC on a limit value for lead in the air

Directive 80/1268/EEC on the approximation of the laws of the Member States relating to the fuel consumption of motor vehicles

Directive 80/779/EEC on air quality limit values and guide values for sulphur dioxide and suspended particulates

Directive 77/537/EEC on the approximation of the laws of the Member States relating to the measures to be taken against the emission of pollutants from diesel engines for use in wheeled agricultural or forestry tractors

15.10.20.50 Chemicals, industrial risk and biotechnology

Council Directive 96/82/EC on the control of major-accident hazards involving dangerous substances (Seveso II Directive) aims at the prevention of major accidents which involve dangerous substances and the limitation of their consequences for man and the environment. It introduced an obligation for industrial operators to implement a major-accident prevention policy and a safety management system including safety reports and emergency plans involving a detailed risk assessment using accident scenarios. It applies to establishments where dangerous substances are present in quantities listed in Annex I. The Directive excludes from its scope

military establishments;

hazards by ionizing radiation;

the transport of dangerous substances and temporary storage by road, rail, internal waterways, pipelines, sea, air;

the mineral extractive industries;

waste land-fills.

One of the major tools is prescribed in Article 12 "Land-use planning". The accidents in scope shall be taken into account in the land-use policies and/or other relevant policies through controls on the siting of new establishments; and new developments such as transport links, residential areas, etc. These policies and their implementation shall take into account the need to maintain appropriate distances between establishments and residential areas, areas of public use and areas of particular natural sensitivity or interest.

ANNEX VI LISTS CRITERIA FOR THE NOTIFICATION TO THE COMMISSION OF MAJOR ACCIDENTS, AMONG WHICH :
DAMAGE TO REAL ESTATE (DWELLINGS OUTSIDE THE ESTABLISHMENT DAMAGED AND UNUSABLE) AND TO PROPERTY;
IMMEDIATE DAMAGE TO THE ENVIRONMENT:

- PERMANENT OR LONG-TERM DAMAGE TO **TERRESTRIAL HABITATS**,

≥0.5 ha of a habitat of environmental or conservation importance protected by legislation, ≥10 hectares of more widespread habitat, including agricultural land, significant or long-term damage to freshwater and marine habitats, ≥10 km of river or canal, ≥1 ha of a lake or pond, ≥2 ha of delta, ≥2 ha of coastline or open sea, significant damage to an aquifer or underground water.

According to the proposal (COM(2002) 340) for the amendment the following activities will be included in the scope:

chemical and thermal mineral processing and storage which involve dangerous substances;

tailings disposal facilities, including tailing ponds or dams, containing dangerous substances.

In addition, lower qualifying quantities for the category "Dangerous for the environment" are proposed.

Council Directive 96/61/EC concerning integrated pollution prevention and control (IPPC Directive, last amended by 2003/35/EC) provides the framework for the licensing and emissions of industrial installations to prevent or to reduce emissions in the air, water and land. Installations covered by Annex I are required to obtain an operating permit containing emission limit values or equivalent parameters based on the use of Best Available Techniques (BAT). In addition, permits must give provisions for other than normal operating conditions. The focus is on prevention rather than "end-of-pipe" abatement, therefore a distinction is made between new or substantially changed and existing installations. The preamble contains valuable statements like:

"6. … although Community legislation exists on the combating of air pollution and … of the discharge of dangerous substances into water, there is no comparable Community legislation aimed at preventing or minimizing emissions into soil;

7. … different approaches to controlling emissions into the air, water or soil separately may encourage the shifting of pollution between the various environmental media rather than protecting the environment as a whole;"

Among others, competent authorities shall ensure that:

all the appropriate preventive measures are taken against pollution, in particular through application of the best available techniques;

necessary measures are taken upon cessation of activities to avoid any pollution risk and return the site of operation to a satisfactory state. (Art. 3)

According to Article 6 permit applications shall include, among others, the conditions of the site of the installation, the nature and quantities of foreseeable emissions into each medium. All permits granted and modified permits must include details of the arrangements made for air, water and land protection (Art. 8). The permit shall include emission limit values for pollutants, in particular, those listed in Annex III, having regard to their nature and their potential to transfer pollution from one medium to another (water, air and land). The permit shall include requirements ensuring protection of the soil and ground water and measures concerning the management of waste. Limit values may be supplemented or replaced by equivalent parameters or technical measures.

The industrial activities in scope, listed in Annex I are not specific to soil management and soil conservation. The most relevant "soil-based" activities are perhaps the

installations for the disposal or recovery of hazardous waste with a capacity >10 t/day;

installations for the disposal of non-hazardous waste with a capacity >50 t/day;

- LANDFILLS RECEIVING >10 T/DAY OR WITH A TOTAL CAPACITY >25 000 T, EXCLUDING LANDFILLS OF INERT WASTE.

IN SPITE OF THE COMPLEX APPROACH DECLARED IN THE PREAMBLE OF THE DIRECTIVE, THE **INDICATIVE LISTS OF MAIN POLLUTING SUBSTANCES** TO BE TAKEN INTO ACCOUNT IF THEY ARE RELEVANT FOR FIXING EMISSION LIMIT VALUES BY ANNEX III ARE PROVIDED FOR AIR AND WATER BUT **NOT AVAILABLE FOR SOIL**. SIMILARLY, CONSIDERATIONS WHEN DETERMINING BEST AVAILABLE TECHNIQUES (ANNEX IV) DO NOT INCLUDE EXPLICITLY THE EVALUATION OF THE SOIL CONDITIONS AT THE SITE ("THE OVERALL IMPACT OF THE EMISSIONS ON THE ENVIRONMENT AND THE RISKS TO IT").

According to Commission Decision 2000/479/EC on the implementation of a European pollutant emission register (EPER) according to Article 15 of Council Directive 96/61/EC concerning integrated pollution prevention and control (IPPC) Member States shall report to the Commission on emissions from all individual facilities with one or more activities as mentioned in Annex I to the IPPC Directive. The report must include the emissions to air and water for all pollutants for which the threshold values are exceeded; both pollutants and threshold values are specified in Annex A1.

15.10.30 Space, environment and natural resources

15.10.30.20 Conservation of wild fauna and flora

The aim of Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (Habitats Directive) is to ensure bio-diversity through the conservation of natural habitats and of wild fauna and flora. Measures shall be designed to maintain or restore, at favourable conservation status, natural habitats and species of wild fauna and flora of Community interest, and shall take account of economic, social and cultural requirements and regional and local characteristics (Art. 2). Each Member States shall contribute to the creation of Natura 2000 network (Art. 3). By definition, natural habitats include terrestrial or aquatic areas distinguished by geographic, abiotic and biotic features, whether entirely natural or semi-natural (Art. 1).

Recital 13 of the preamble, and later Article 10 prescribes that Member States shall endeavour in their land-use planning and development policies, with a view to improving the ecological coherence of the Natura 2000 network, to encourage the management of features of the landscape which are of major importance for wild fauna and flora. Article 11 prohibits the deterioration or destruction of breeding sites or resting places of certain species. Annex I on natural habitat types of Community interest whose conservation requires the designation of special areas of conservation includes sand dunes, coasts, grasslands, heath and scrub, forests, bogs and fens, mudflats etc., which are commonly regarded as lands with soil cover.

According to Recital 8 of the preamble of Council Directive 79/409/EEC on the conservation of wild birds (last amended by Council Regulation No 807/2003) (Wild Birds Directive) conservation is aimed at long-term protection and management of natural resources as an integral part of Europe's heritage. It makes it possible to control natural resources and governs their use on the basis of the maintenance and adjustment of the natural balances between species. The directive relates to the conservation of naturally occurring birds including their habitats. The required measures include creation of protected areas, upkeep and management of habitats in accordance with ecological need, re-establishment of destroyed biotopes, and creation of biotopes (Art. 3). When creating protected areas the most suitable land areas are to be taken into account. A particular attention is to be given to the protection of wetlands (Art. 4). However, Member States may derogate from certain provisions (e.g. hunting, destruction of habitat) to prevent serious damage to crops, forests, etc. (Art 9).

According to Article 4 of Regulation (EC) No 2494/2000 of the European Parliament and of the Council on measures to promote the conservation and sustainable management of tropical forests and other forests in developing countries, countries shall address the conservation and restoration of forests which are considered to be of importance due to their high ecological value, in particular their value for the preservation of biodiversity, or due to their local and global impacts, such as the protection of hydrographic basins, the prevention of soil erosion, or of climate change. The development of appropriate national and international forest policy frameworks based on realistic valuation of forests, which, among others, include land use planning is required.

15.10.30.30 Waste management and clean technology

Council Directive 75/442/EEC on waste (as amended by 91/156/EEC, 96/350/EC) is the so-called Waste Framework Directive and as such it is one of the very first pieces of the environmental acquis. It defines waste as "any substance or object in the categories set out in Annex I which the holder discards or intends or is required to discard". Following the general requirements of Article 3, Article 4 presses measures to ensure that waste is recovered or disposed of

without making risk to water, air, soil and plants and animals, and without adversely affecting the countryside. The abandonment, dumping or uncontrolled disposal of waste is prohibited. Member States shall establish a network of disposal installations, taking account of the best available technology not involving excessive costs and geographical circumstances as well (Art. 5). Among other waste categories Annex I lists:

"Q5 Materials contaminated or soiled as a result of planned actions (e.g. residues from cleaning operations, packing materials, containers, etc.)

Q15 Contaminated materials, substances or products resulting from remedial action with respect to land".

Disposal operations (Annex IIA) include:

D1 Deposit into or onto land (e.g. landfill, etc.)

D2 Land treatment (e.g. biodegradation of liquid or sludgy discards in soils, etc.)

D3 Deep injection (e.g. injection of pumpable discards into wells, salt domes or naturally occurring repositories, etc.)

D4 Surface impoundment (e.g. placement of liquid or sludgy discards into pits, ponds or lagoons, etc.)

D5 Specially engineered landfill (e.g. placement into lined discrete cells which are capped and isolated from one another and the environment, etc.)

D7 Release into seas/oceans including sea-bed insertion

D10 Incineration on land

D12 Permanent storage (e.g. emplacement of containers in a mine, etc.)

Among the recovery operations Annex IIB acknowledges "R10 ***Land treatment*** *resulting in benefit to agriculture or ecological improvement".*
According to Council Directive 91/689/EEC on hazardous waste (last amended by 2001/118/EC) Article 2 on every site where tipping (discharge) of hazardous waste takes place the waste must be recorded and identified. The mixing of different categories of hazardous waste or hazardous waste with non-hazardous waste is prohibited. According to Annex IB. "23. soil, sand, clay including dredging spoils" are hazardous wastes if contain any of the constituents listed in Annex II and having any of the properties listed in Annex III.

Commission Decision 2001/118/EC amending Decision 2000/532/EC as regards the list of wastes (amended by 23001/119/EC) codifies all waste types according to generation source, waste composition and other criteria. The so-called European Waste Catalogue (EWC) lists seven soil related wastes, hazardous wastes and so-called mirror entries which require further investigation for qualification. In general wastes can be classified hazardous if they display one or more of the properties listed in Annex III to Directive 91/689/EEC and have one or more characteristics as listed in Article 2 of the EWC. These are the following:

170503* soil and stones containing dangerous substances

170504 soil and stones other than those mentioned in 170503

191301* solid wastes from soil remediation containing dangerous substances

191302 solid wastes from soil remediation other than those mentioned in 191301

191303* sludges from soil remediation containing dangerous substances

191304 sludges from soil remediation other than those mentioned in 191303

200202 soil and stones (as garden and park wastes, including cemetery waste).

There are numerous, otherwise not specified waste categories to which soil can fit, e.g. under the chapters mining wastes, or agriculture wastes, etc.

Regulation 2150/2002/EC of the European Parliament and of the Council of on waste statistics has several entries on soil:

04.4 Soils contaminated by radioactivity

12.31 Waste of naturally occurring minerals

0 Non-hazardous: soil and stones, soil from cleaning and washing beet

12.6 Contaminated soils and polluted dredging spoils

12.61 Polluted soils and rubble

The most relevant daughter regulation of the Waste Framework Directive is the Council Directive 1999/31/EC on the landfill of waste. It is the sophisticate piece of legislation that uses the terms soil, land, site and geology rather consequently, and which has an up-to-date scientific approach by discussing surface water, groundwater, soil, and geological formations in a complex manner and acknowledging the concept of multi-barrier protection through the combination of engineered and natural barriers. Recital 3 of the preamble says that waste recycling, recovery etc. should be encouraged so as to safeguard natural resources and obviate wasteful use of land. The requirements on landfill sites, must be complied with, to be taken against the pollution of groundwater by leachate infiltration into the soil (Recital 12). Accordingly, the major objective of the directive is, by way of stringent operational and technical requirements on the waste and landfills, to provide for measures, procedures and guidance to prevent or reduce as far as possible negative effects on the environment, in particular the pollution of surface water, groundwater, soil, etc. (Art. 1). By definition "landfill" means a waste disposal site for the deposit of the waste onto or into land (i.e. underground) (Art. 2(g)). Further-

more, the directive defines "underground storage" as a permanent waste storage facility in a deep geological cavity (Art. 2(f)). Among others, the following are excluded from the scope of the directive (Art. 3):

the spreading of sludges, sewage sludges, dredging sludges and similar matters on soil for the purposes of fertilisation or improvement;

the deposit of non-hazardous dredging sludges alongside small waterways from where they have been dredged out and of non-hazardous sludges in surface water including the bed and its sub soil;

the deposit of unpolluted soil resulting from prospecting and extraction, treatment, and storage of mineral resources as well as from the operation of quarries.

Among the general requirements of all classes of landfills (Annex I, 1.1.) the location must take into consideration:

(a) the distances from residential and recreation areas, waterways, water bodies and other agricultural or urban sites;

(b) groundwater, coastal water or nature protection zones;

(c) the geological and hydrogeological conditions;

(d) the risk of flooding, subsidence, landslides or avalanches;

(e) the protection of the nature or cultural patrimony.

A landfill must be situated and designed so as to meet the necessary conditions for preventing pollution of the soil, groundwater or surface water and ensuring efficient collection of leachate. Protection of soil, groundwater and surface water is to be achieved by the combination of a geological barrier, a bottom and a top liner. The geological barrier is determined by geological and hydrogeological conditions below and in the vicinity of a landfill site providing sufficient attenuation capacity to prevent a potential risk to soil and groundwater. The landfill base and sides shall consist of a mineral layer which satisfies permeability and thickness requirements with a combined effect in terms of protection of soil, groundwater and surface water. If, on the basis of an assessment of environmental risks, it has been established that the landfill poses no potential hazard to soil, groundwater or surface water, the requirements above may be reduced. The landfill shall be equipped so that dirt originating from the site is not dispersed onto the surrounding land.

Council Decision 2003/33/EC establishing criteria and procedures for the acceptance of waste at landfills has many references with regard to the geological environment, including soil. The list of wastes acceptable at landfills for inert waste without testing includes, among others, "170504 Soil and stones (excluding topsoil, peat; excluding soil and stones from contaminated sites)" and "200202 Soil and stones (only from garden and parks waste; excluding top soil, peat)". Selected construction and demolition waste is also acceptable with low content of unpolluted soil.

Appendix A on the safety assessment for acceptance of waste in underground storage places a high emphasis on the importance of the geological barrier. According to 1.2.1. the geological assessment requires thorough investigations and analyses of kind of rocks, soil, and the topography.

Council Directive 86/278/EEC of 12 June 1986 on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture is the piece of waste legislation which has the most relevant and direct provisions on soil. Its purpose is to regulate the use of sewage sludge in agriculture in a way to prevent harmful effects on soil, vegetation, animals and man. Values for concentrations of heavy metals in soil to which sludge is applied, concentrations of heavy metals in sludge and the maximum annual quantities of such heavy metals which may be introduced into soil intended for agriculture are given in Annexes (Art. 4).

Member States are to prohibit the use of sludge where the concentration of one or more heavy metals in the soil exceeds these limit values. They are also to regulate its use so that accumulation of heavy metals in the soil does not lead to those limit values being exceeded (Art. 5). Sludge is to be treated before being used in agriculture except where Member States authorise its injection or working into the soil (Art. 6). Member States are to prohibit the use of sludge on grazing grassland, forage crops, soil for fruit and vegetable crops (except fruit trees) and grounds for cultivation of fruit and vegetable crops that are in direct contact with soil (Art. 7). Sludge is to be used in such a way that the quality of the soil and of surface and ground water is not impaired (Art. 8). Annex IIB and IIC provide guidelines on sampling and analytical details.

Council Directive 75/439/EEC on the disposal of waste oils is aiming at ensuring the safe collection and disposal of waste oils. According to Article 4 Member States shall take the necessary measures to ensure the prohibition of any discharge of waste oils into internal surface waters, ground water, coastal waters and drainage systems; and any deposit and/or discharge of waste oils harmful to the soil and any uncontrolled discharge of residues resulting from the processing of waste oils. Undertakings collecting and/or disposing of waste oils must carry out these operations in such a way that there will be no avoidable risk of water, air or soil pollution (Art. 9).

The proposal for a Directive of the European Parliament and of the Council on the management of waste from the extractive industries /COM(2003) 319 final/ is an important effort in the waste legislation to regu-

late an industrial segment which enjoyed a distinguished status in the Community but generates ca. one-fifth of the overall waste stream in the EU. Besides the standard regulatory tools like permitting waste management and emergency plans, public participation, financial guarantee, reporting, penalties, etc. a separate article addresses the prevention of water and soil pollution through provisions on leachate and contaminated water treatment and by limiting the cyanide concentration in tailings ponds.

Commission communications have no legal outreach but Communication from the Commission on "Promoting sustainable development in the EU non-energy extractive industry" (COM(2000) 265) was the first document to tackle the problem of sustainable mining. In spite of its limited scope it gave a complex review of the mining industry and made valuable statements such as:

mining is increasingly influenced by other competing land uses, such as urban development, agriculture, nature conservation;

the balanced consideration of economic, environmental and social aspects to ensure the sustainable development of the industry is needed.

Other major product-specific waste legislation that have indirect relevance to soil contamination are the following:

Decision 2002/151/EC on minimum requirements for the certificate of destruction issued in accordance with Article 5(3) of Directive 2000/53/EC of the European Parliament and of the Council on end-of-life vehicles

Directive 2002/96/EC of the European Parliament and of the Council on waste electrical and electronic equipment

Directive 2000/59/EC of the European Parliament and of the Council on port reception facilities for ship-generated waste and cargo residues

Directive 2000/53/EC of the European Parliament and of the Council on end-of life vehicles

Directive 96/59/EC on the disposal of polychlorinated biphenyls and polychlorinated terphenyls (PCB/PCT)

Directive 94/62/EC on packaging and packaging waste

Directive 91/157/EEC on batteries and accumulators containing certain dangerous substances

Directive 78/176/EEC on waste from the titanium dioxide industry

19.30. Area of freedom, security and justice - Police and judicial cooperation in criminal and customs matters

Council Framework Decision 2003/80/JHA of 27 January 2003 on the protection of the environment through criminal law is an important step forward preventing soil contamination and sanctioning polluters. According to Article 2 the unlawful discharges, emissions, disposals of hazardous substances and waste or ionising radiation which causes substantial damage to the quality of soil are qualified as intentional offences and fall under the scope of the Directive.

JUDGEMENTS OF THE EUROPEAN COURT OF JUSTICE (TO BE CONTINUED…

INTERNATIONAL CONVENTIONS (TO BE CONTINUED…

Other quasi-legislation (to be continued….

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CONTAMINATION AND LAND MANAGEMENT

Task Group 3 on
DIFFUSE INPUTS

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Executive summary

General introduction

The **task group diffuse inputs** discussed two classes of soil contamination which are generally labelled as diffuse contamination:

1] Contamination that may arise from current agricultural practices and related soil uses such as forestry, managed nature reserves, reclamation areas, landscaping, gardens and parks where the user of the land modifies ecological processes in soil with additions of nutrients, exogenous organic matter and pesticides to increase productivity or to protect the current state of the land.

2] Contamination that enters the soil system by natural pathways like atmospheric deposition and sedimentation from surface waters (in the case of sediments).

These two classes have in common that the input from contaminants cannot be avoided like for local sources that only use the soil for support. In order to formulate adequate soil protection policies for diffuse contamination one has to address the interaction of the contaminants with the complex living soil system and its heterogeneity in space and time. Moreover contaminants enter the soil system by multiple pathways. Agricultural land may become contaminated through atmospheric deposition, through certain trace elements in fertilisers, through the application of pesticides, manure, slurries, sludges and compost or applied soil material. Another complication is the fact that many substances may contaminate the soil simultaneously and can interact, which may lead to additional adverse effects on some receptors.

The **main conclusions** from the task group are:

1] Given the complexity of the diffuse input problem a strategic approach is needed that gives some indication how to consider the different inputs and their relations and how to pave the way to sustainable land use and soil conservation as a resource for future generations. European Parliament stressed the importance of preventing the accumulation of hazardous substances in soils, but the task group could not agree on the basic principles to turn this EP statement into a policy.

2] Preventing accumulation of harmful substances by balancing inputs and outputs was considered a too simple “arithmetic” approach by some. According to them it is not the accumulation of the substance as such but the accumulation of risk for human health or ecosystems that should be the key issue. Others considered that focussing on (short-term) risk and current land uses is not preventive enough, in particular in relation to the Water Framework Directive. Risk assessments must be sufficiently knowledge-based and detailed to take into account future land uses and potential impacts in the long term in order not to be in conflict with sustainability. We should not want to endow future generations with risky soils and limit their freedom of choice to use the land differently.

3] In view of the lack of consensus for a strategic approach, the group decided to use a bottom up approach, because they felt that was the most practical when discussing inputs of contaminants in agriculture. Materials like composts, manures, lime, fertilizers, sludges and pesticides can be assessed according to agronomic value, the impurities and potential pollutants can be identified, the pathways of exposure can be tracked and the risks for soil functions, water resources, plants animals and man can be assessed. This discussion automatically led to the question whether we should protect the multifunctionality of soils together with applying the precautionary principle, or whether we should make a differentiation between different types of land uses according to their sensitivity for pollution. Some favoured the long-term goal of preserving soil as a multifunctional resource for future generations, others favoured the more short-term risk based point of view related to the current use of the land.

4] The weighing of agricultural benefits versus environmental impacts of each product proved also to be a controversial issue. This weighing is dependent on several political value judgements. Moreover the merger of the discussion about the sludge and biowaste from a waste management point of view with the discussion about soil protection did not contribute to the consensus in the group. One option is to define treated (e.g. composted) waste materials as product which is put on the EU market to be used for the improvement of nutrient status or organic matter content of soils. This strategy is applied in a number of Member States for composted biowaste (Austria, Italy, The Netherlands etc.). Another option as known from the Sewage Sludge Directive and national regulations is the strategy of waste recycling with the possibility to follow and control the recycling path until the application on a specific plot. In both cases agriculture must not be urged to serve as principle receptor of certain waste streams, but a distinct and comprehensive material and quality definition of waste derived soil amendments must ensure an environmentally sound beneficial use. In addition it has to be noted that, by definition, if a material is a waste does only depend on the fact, if someone wants to discard a material. On the first hand this is no matter of quality definition.[1]
The answers to these questions seem to require some general policy guidance. The more so because the added value of intervention at the EU level in regulations concerning waste, especially sewage sludge seems to be based on different arguments than for regulations concerning soil. Sewage sludge is produced locally and should be dealt with close to the source (it is not an example of transboundary pollution). Generally sludge is not exported as a recycled product to other countries (though it is sometimes transported over long distances), and whether sludge is burnt, landfilled or applied as organic fertilizer does not affect the performance of the internal market in EU or the balance of competition between Member States.
However, organic waste recycling to the benefits of the environment must go hand in hand with the needs of agriculture and more specifically the demands of soil protection.

The approach chosen by the task group was to write documents on all major diffuse inputs (see list below). Originally it was the intention to compile these contributions in one group report. However, in the end it was decided to include the separate reports as separate annexes. Major reasons for doing so were:

1. The structure and contents of the different contributions were found to be very different which made it difficult to write one overall report at the same level of information;

[1] Example: Austria produces ca. 2 Mio. tons of high quality excavated soil as waste. From a legal standpoint it is a waste. On qualitative level this soil should be reused in line with a environmentally sound material flow. At the end the question has to be solved based on proper quality definition.

2. Although there has been ample discussion on various issues (noticeably sludge, compost and pesticides), time was too short to reach consensus on all issues raised. Therefore, the documents still do not reflect the opinion of the group as a whole.

3. The data included in some of the reports are not always in agreement with data from other sources.

Nevertheless this approach and compilation of opinions resulted in a number of recommendations for policy, monitoring and research.

The following contributions were received and helped to formulate the recommendations for policy, monitoring and research.

1. Contribution of Manure and slurry to soil diffuse pollution. A. Bispo, C. Schubetzer and Isabelle Feix- ADEME

2. Inputs from Exogenous Organic Matter –Compost- Florian Amlinger- ECN, Claus Gerhard Bannick – UBA, Berlin; Sigbert Huber – UBA, Vienna

3. Cadmium input to soils – contributions from fertilizers Christian Palliere- European Fertilizer Manufacturers Association

4. Lime state of the art in relations with soil management (executive summary) Michel Givelet- European Lime Association EULA

5. Pesticides in soil Dave Riley - European Crop Protection Association (ECPA)

6. Report on Sewage Sludge -Tim Evans- CEN

7. Atmospheric deposition- Christos Vasilakos - METROPOLIS (Research Network)

Policy recommendations

General policy recommendations

A general policy framework should be developed to address diffuse soil contamination resulting from atmospheric deposition, water pollution in the case of sediments, from agriculture and other activities like reclamation, landscaping and building activities. This policy has to achieve the following:

A] Specification of (ultimate) long-term goals and (proximate) short-term goals.

The long-term goal is related to sustainable land use and protection of natural resources. Balancing diffuse inputs with acceptable outputs of the soil and groundwater system in order to prevent a decline of soil functions seems to be the most appropriate long-term goal, whereas short-term goals can be based on the current risks of the contamination as related to land uses and functions and the bioavailability of the contaminants. Moderate surplus of diffuse inputs could be acceptable if the long-term goal is not endangered. The interaction between short-term and long-term goals need a thorough consideration, especially in relation to land use changes and cross-cutting issues like sustainable agriculture, mid-term beneficial aspects of certain soil management practices and climate change.

Therefore function related soil quality definitions and investigations on critical concentrations of (potential) contaminants are an important pre-requisite and reference for addressing GAP related to land management.

B] Specification of the responsibilities of the users of the land.

The user of the land should be addressed while taking into account that the user cannot be held responsible for all diffuse inputs. In the light of a “Good agricultural practice” a farmer should have the duty to be as eco-efficient as possible by minimising the flux of contaminating substances like heavy metals and organic pollutants coming from agricultural inputs and the flux of unused nutrients to groundwater and air. Suppliers and manufactures of products that are used on land and may impact on soil also have responsibilities to support the farmer in proper use of these products (quality assurance, guidelines for application).

Abatement of air and water pollution contributing to non agricultural diffuse inputs is a task for society as a whole. The long-term goal is to achieve a balance between inputs and outputs to groundwater into balance without compromising the quality of soil and water resources for future uses and functions taking into account the requirements of the water framework directive.

C] Ensure a linkage between soil protection policies and other related policy areas

Policy areas of relevance are policies approving chemical substances (including pesticides) for the market, policies concerning the quality of products applied on soils (fertiliser, compost) that may contain “unwanted” contaminating substances, policies for Good agricultural practices and policies concerning the use of organic waste on soil. Soil protection aspects should be taken into account, or enhanced where necessary, to ensure that there are no long- or short-terms threats.

There should be a more direct feedback loop from diffuse contamination and agricultural practice to the approval policies for chemicals and pesticides so that sustainable use in agricultural practice and prevention from entering the large-scale diffuse pollution pathways (deposition and sedimentation) can be improved. A stronger emphasis on persistence of chemical substances and pesticides in soil may be necessary in view of soil protection. The EU regulations on chemical substances and on pesticides should solve that problem. Further discussion about this issue for pesticides should take place in the Thematic strategy on pesticides and the current revision of 91/414/EEC Regulation on pesticides.

Concerning waste the policy should specify whether recycled waste can be used as a product or if it should be recycled in the framework of waste regulations.

If an application regime under waste regulations controls is chosen possibilities of a proper use of products are limited. Therefore for products high level of quality assurance, product declaration and quality requirements must be applied together with more and more emphasising GAP.

Specific recommendations for manure and slurries

1] In the long term, sustainable land use planning could encourage a better distribution of animal breeding and production in EU countries. One possibility to reduce unwanted inputs to soils would be to adapt the husbandry density (livestock unit per hectare) according to the environmental sensitivity of each area. Further recommendations are the following:

- Substitute manures and slurries for mineral fertilizer according to the needs of crops (good agricultural practices) in intensive breeding regions
- Develop treatments like biogas production that, on the one hand, improves the fertilization capacities of manures and slurries and, on the other hand, makes it easier to store and to handle. Appropriate land use planning policies are needed to ensure its development.
- Compost manures and slurries, which increases the percentage of stable organic matter in these materials and sanitises the manure but loses nitrogen. The benefits have to be compared with negative impacts like emissions of ammonia to the air which needs more research work.
- Decrease (if feasible) the amount of Zinc and Copper in the feeding of animals to a necessary level taking animal welfare implications into consideration as well as increasing the digestibility of diets to limit excretion in excess of N and P in the faeces after evaluation of potential benefit.

Specific recommendations for sludges

1] It would be desirable to refine the current EU sludge directive to achieve a holistic approach to all organic resources that are applied to all types of land in order to have soil protection based, harmonized requirements for all of them.

2] It would be desirable to improve the definition of treatment and preferably to move to the protocol that has been adopted buy the food industry and that is progressively being required of farmers, i.e. Hazard Analysis and Critical Control Point (Codex, 1997; Evans, 2003). HACCP is equally applicable to chemical as well as to microbiological hazards.

Specific recommendations for compost

1] A positive list of high quality source materials for composting and anaerobic digestion intended for the processing of organic soil amendments would be essential to guarantee high quality compost. This should include source separated household waste and green waste as well as organic industrial waste (e.g. from food industries).

2] In order to bridge the gap between targets for the reduction of biodegradable municipal waste to landfill and a sustainable use of the biodegradable waste fraction incentives for the recycling of source separated biowaste are essential. Member States are encouraged to explore the best solution for implementation considering local conditions.

Monitoring recommendations

Sources of contamination from agricultural practices. The monitoring in farm systems of input-output balances of the concentration in soil of selected contaminants and nutrients may help the improvement of GAP (good agricultural practice). Given the large number of farms in the EU, information to be reported to the EU should be aggregated in policy-performance indicators or sustainability indicators.

It should be noted that plant protection products although applied to plants or soil are more often monitored in plants and groundwater than soil, as required by the Pesticide (91/414/EEC), Drinking water and Water Framework Directives. In some cases (risk areas) monitoring the amount applied to soil may be useful but additional information is required to relate this to potential environmental impacts, such as described in Directive 91/414/EEC. Hence it would be relevant to monitor certain of these products in soil solution as well.

Large-scale diffuse pollution. This is the policy area where monitoring is of most importance and relevant at EU level because of the transboundary nature of large-scale diffuse pollution. Monitoring the fate and transport of potential contaminants through environmental media will help the choice of the best national and regional abatement strategies and their effectiveness. Because all environmental compartments are involved, soil and sediment monitoring should be linked to the monitoring of surface water, as required in the Water Framework Directive, to the monitoring of groundwater, as required in the Groundwater directive, and also linked to the monitoring of air pollution. The EU monitoring system could use already existing networks as a starting point. Even if the methods used differ between networks, the conclusions may still be consistent.

Substances to measure. Measurement of concentration of contaminants in soil should focus on the abatement of (current and future) effects due to diffuse inputs. It should also include the effects of measures to reduce inputs. Monitoring should only be done where there are real concerns (risk areas) rather than a routine grid sampling. The choice of substances should consider only those substances which may reach critical limits in soil in view of human health, food safety, soil fertility, ecological risks especially concerning biodiversity in soil, groundwater and surface waters. Those include the following:

- Heavy metals (Cadmium, Copper, Lead, Zinc, Mercury, Arsenic, Nickel and Chromium)
- Polycyclic aromatic hydrocarbons (PAHs)
- Dioxins, polychlorinated biphenyls (PCBs) and other dioxin-like substances
- Banned, persistent pesticides, such as hexachlorocyclohexane (HCH), dichlorodiphenyltrichloroethane (DDT) or DDE
- Nutrients (nitrogen and phosphates).

Specific recommendations for (action-driven) monitoring –of exogenous organic matter (EOM)

Due to the usually low quantity of pollutants and limited amount of material applied to land (following GAP) accumulation rates are generally low. If source materials as well as the gained exogenous organic materials (including manure) are of well defined quality (limit values) it would be fairly enough to monitor changes on pilot scale where pure modelling would still leave considerable uncertainties. In this way (as mentioned below) basic data taking into account the most important management and site conditions can be considered.

Collecting these data may be useful also for scientific purposes, to improve conceptual models of substance flows in agricultural systems. A number of farming systems maybe monitored through EU and such a monitoring system may help to improve GAP (good agricultural practice)

There exists research based evidence that the input of humified organic matter (compost) increases the sorption or fixation capacity for heavy metals in soil. So monitoring of heavy metal availability/solubility/mobilisation within *pilot schemes* with plots fertilised with EOMs would be an important tool for further evaluation of potential impacts due to the input of contaminants by fertilisation systems. Also persistent organic pollutants (POPs) and their breakdown/solubility behaviour which may be found in those EOMs could be considered to be monitored in this way. But currently this may rather be a matter of research than of regular monitoring system.

The nitrogen and phosphor cycle. Various forms of nitrogen should be measured as input to soils and as concentrations in soil in view of prevention of eutrophication of surface water, prevention of contamination of groundwater and acidification of soils. Special emphasis should be given to mineralisation/solubility processes and potentials of N- and P-fractions due to the input of compost or sludge or any other exogenous organic material (EOM). This is of considerable importance in terms of long-term SOM management under different site and management conditions. It might be possible to evaluate different existing analytical methods in advance. However, all parameters relevant to nutrient and OM management should be measured on a regular basis in farm scale.

Monitoring sheet for compost as an example for EOM. The following sheet gives a detailed matrix for a practicable monitoring system as related to the use of compost. In principle it can be transferred to other EOM, when addressing specific needs according to the occurrence of specific elements and contaminants.
It has to be noted that the classical monitoring and regular approval and investigation of the EOM itself together with an external certification system classifying the EOM as *fit for purpose* when it complies with existing quality requirements is an important pre-requisite in safeguarding a soil protective application. Guaranteed product qualities and the application of GAP is a soil protection tool in itself.

Monitoring measures for COMPOST for integration in the Soil Strategy. It is not intended as a provision of the Monitoring Directive

Exemplary 10 t dm per ha and year of regular compost application is assumed as a maximum amount.

Main activity/ Source	Specification	QM of processes/ Materials	Soil survey grid based	Random	Pilot / demonstration field	Farm scale	Plot scale	Remarks/Explanations[2]
COMPOST **(from source separated and other "clean" organic industrial waste (e.g. food industry)**	PTEs [Cd, Cr, Cu, Hg, Ni, Pb, Zn]	√ 1)	-	-	√	√ 2)	-	1) Monitoring of final product quality on plant scale; random or stratified regular sampling 2) Only on sites with elevated background concentrations [to be defined by Member States]
	N total	√ 1)	-	-	√	-	After 50 t dm/ha	1) Monitoring of final product quality on plant scale; random or stratified regular sampling
	P total	√ 1)	-	-	√	-		
	K total	√ 1)	-	-	√	-		
	OM	√ 1)	-	-	√	-		
	N-mineralisation	-	-	-	√	-		
	C-pools/stability	-	-	-	√	-		
	PTE availability/sorption	-	-	-	√ 1)	-		To be included: Cd, Cr, Cu, Hg, Ni, Pb, Zn
	P/K availability	√ 1)	-	-	√	-		1) Plant available fraction depending of the use of the compost following standard methods (e.g. CAT-extraction)
	Organic pollutants	[√ 1)]	-	-	√ 2)	-		1) On individual suspect when uncertainty on potential contamination of input materials occurs or MSW is composted 2) OPs should only be monitored in pilot schemes where specific compounds are identified and in source materials and an accumulation due to persistence can be expected
	Pathogens	√ 1)	-	-	-	-	-	1) Monitoring of final product on plant scale; random or stratified regular sampling
	Input materials	√ 1)	-	-	-	-	-	1) Records of amount and type of used input materials
	Product specification	√	-	-	-	-	-	1) Monitoring of final product quality on plant scale; random or stratified regular sampling
	Process records	√	-	-	-	-	-	Batch specific records on time temperature regime

[2] Existing regulations and schemes on national and EU level; indicate the link between modelling and monitoring as related to precision/accuracy/performance/risks → bioavailability; indicate reporting level (on site; national; EU); give a ranking (priority for certain substances; developments!)

Research recommendations

General recommendations

1. The availability of substances (to plants, animals and soil micro-organisms) that reach the soil from either atmospheric deposition or agricultural activities, both chemical and biological, and changes therein with time. Specific issues that need to be addressed include P-availability in soils, change in heavy metal availability with time, effects of organic matter and pH on availability of metals and organic micropollutants in soils (link with organic matter group; specifically in relation to compost addition, see additional remarks on compost discussion)

2. Practical tools (i.e. measurement techniques) to assess the degree of biological availability of substances in the soil that can be used to assess the internal levels. Here especially crop uptake and exposure of toxic substances for soil organisms have to be addressed.

3. From 1 and 2 it is obvious that some degree of consensus on the concept of bioavailability is needed since it forms a crucial aspect. If bioavailability in some form or another is to be implemented in EU policy, there should be some agreement amongst scientists what is meant by bio-availability. Further on it is an important to take scientifically based steps for the definition of critical soil threshold concentrations. This cannot be done by setting one value of a contaminant for all soils, land uses and climates. But without such an orientation all technical debates on risk-based assessments and precautionary principles etc. become obsolete

4. Field based process studies that establish process information at the desired level. Often process knowledge obtained in laboratories is insufficient to explain the behaviour of substances under field conditions. Especially retention and transport of substances like P, metals and organics have to be addressed in order to be able to link levels in soils to those in ground- and surface waters.

5. Investigate feasibility of development of true Farm and Field gate balances that take into account all in- and outputs. Currently various outputs (crop uptake, leaching, gaseous emissions) are not properly quantified or even neglected.

6. Knowledge on long-term changes in soil in relation to changes in land use (conversion of arable land to forest or wetland, extensivation, changing groundwater tables, changes in salinity due to irrigation or intrusion of sea water)

7. An overview of effects of available and new management strategies on environmental impact. For example the change from low to high inputs systems of organic manure may result in higher nitrate losses to the groundwater.

8. The economic impact (both form farmers and governments) of changing regulations on the allowed content of unwanted substances. For example reducing the amount of cadmium in P-fertiliser will result in higher prices for fertiliser. What are economic consequences for this?

9. Organic matter decline can be compensated by organic fertilisers, like animal manure, sewage sludge or compost. How do these potential sources for soil organic matter compare to the real natural input (decomposition of the local vegetation)and what are the long-term consequences for the soil and the surrounding ecosystem?. How is the life support system and biodiversity affected by current "high input- high output" agriculture?

10. Establish long-term field scale experimental sites across the EU where EOM is used at controlled rates that approximate to GAP. The sites should span the breadth of climatic and soil types found in the EU. The sites can be a resource to experimenters wanting to research the long-term effects of EOM.

Specific recommendations for manure and slurry

1. Digestibility of diets of animals and more efficient use of Cu and Zn in the diet, according to the real needs of animals

2. Regarding management, plant nutrition and soil protection:

   - Mineralization kinetics of organic matter and organic N
   - Availability to crops and leaching to groundwater of N, P at field scales
   - Characterization of organic matter (easily degradable or stable fractions)
   - Effects of organic matter on soil (increase of microflora, stabilisation of soil structure…)
   - Development of models and software predicting the mineralization and availability of nutrients
   - Development of models predicting and quantifying the effects of organic matter on soil

3. Regarding the prevention of soil pollution and the protection of soil ecosystems:

   - Effect on soil ecosystems of N and P accumulation
   - Speciation of trace elements and links with bioavailability
   - Extraction, analysis, transfers and impacts of veterinary drugs
   - Characterization and behaviour of pathogens in manures and slurry

4. Regarding the socio economical aspects

   - How to change the regional distribution of animal production in EU?
   - How to de-concentrate animal breeding in EU countries?
   - How to incite such changes?
   - What will be the socio-economical and technical impacts of such changes?

Specific recommendations for EOM

The regular use of EOM on Agricultural land imposes 2 main challenges to be covered:

1. optimisation of OM and nutrient supply (=soil improvement)

2. diminishing potential adverse effects due to load with accompanying contaminants.

A lot of applied research has been conducted for a number of materials such as animal manure, sewage sludge and, recently since 10 to 15 years also for compost.
Especially for compost from source separated organic waste long-term impacts on the soil-plant-groundwater system (agro-ecosystem) are still missing and do not reflect all typical ranges of soil, climate and land management conditions. Therefore in order improve GAP (good agricultural practice) for the organic fertilisation systems specific networks should be established covering the use of exogenous organic matter (EOM, such as compost and sludge). Existing mid and long-term field trials must be integrated in order to profit from the already existing data pool. Harmonisation of *what* is being measured and *with which methods* is needed as well as completion with missing soil, management and climate variations. Parameters identified as effective indicators for soil quality and function can easily be integrated in such a co-operative research/monitoring network.

Key parameters related to soil contamination would be:

1. Various forms of *nitrogen* (nitrogen pools)

2. the *emission of greenhouse gasses (N_2O)*

3. the impact of spreading EOMs on *phosphorus-fractions* and their mobilisation potentials

4. The long-term effects of increasing the *sorption or fixation capacity for heavy metals* in soil by humified organic matter and dynamics are not fully understood in the view of precaution.

5. Accumulation, decay and solubility of *persistent organic pollutants* (POPs).

6. Potential hygienic problems resulting from the use of "*fresh compost*"

7. Impacts of the one-time use of higher amounts of composts (100 to 400 t/ha) in *land reclamation*.

8. The above mentioned effects (point 1 to 9) of *digestate* as compared to compost.

General Introduction

Soil is a central medium with connections to air and waters. For soil protection technical criteria have to be developed. A distinction is to be made between

- The prevention policies considering the need to **control and reduce** the amount of **future additional input** of pollutants into soil, and
- The management of **existing contamination** in order to deal with damages, hazards and threads to public health and the environment.

Precaution must be taken to avoid the occurrence of harmful soil changes. Cause for concern about the occurrence of harmful soil changes is given when adverse impacts on soil functions due to spatial, long-term or complex impacts of use or action can be expected.

The goal of the task group Diffuse Inputs was to assess the importance of various diffuse inputs to soils in Europe and to formulate policy recommendations to reduce these (if necessary). Monitoring may give meaningful results for the assessment of diffuse inputs and recommendations for monitoring approaches were made accordingly. The interaction of diffuse inputs with the soil and water system and the uses and functions of this system has many unknowns. This has led to the formulation of a number of research recommendations. Monitoring and research recommendations are given in the executive summary and will not be elaborated further in the main text. These recommendations have already been used as input for the working groups on Monitoring and on Research.

General systematic of diffuse inputs

The task group has addressed many subjects in their discussion. The following inputs to soil have been considered as diffuse inputs by the task group:

1. Wet and dry atmospheric deposition as well as dust which cannot be traced back to a specific point source (vehicle exhausts, fine contaminant containing dust transported over long distances, immissions from industrial and domestic incineration combustion)
2. Agricultural, horticultural, silvicultural activities
   a. mineral fertilisers
   b. exogenous organic matter = (EOM)

i. animal manure including digestate after anaerobic digestion of manure with and without agricultural biomass crops. Under consideration of the different keeping systems we distinguish

- pig manure (breeding and fattening)
- cattle manure (breeding, fattening, diary)
- poultry manure (egg production, fattening etc)
- turkey manure
- horse manure

ii. external organic fertilisers and soil improvers

- sewage sludge
- other sludges of different origins,
- biowaste and green waste compost,
- digestate from anaerobic digestion of organic waste or other industrial wastes
- mineral by-products such as stone dust etc.

c. mineral soil improvers

iii. lime
iv. other

d. pesticides

v. herbicides
vi. fungicides
vii. pesticides against parasites etc…..

3. Others (not specifically addressed)

a. Excavated soils, dredged sediments and manufactured (artificial) soils
b. Corrosion of construction materials
c. Streets/railroads/abrasion
d. Construction material
e. Construction waste
f. Mineral waste (slags from steel industries; fly ashes)

Further we set the following differentiation:

- diffuse inputs stemming from intentional additions (e.g. copper as fungicide in vineyards or Cu and Zn as feed supplements in pig fattening)
- diffuse inputs as a result of external agricultural or non-agricultural activities (atmospheric deposition, contaminants in sewage sludge or composts).

In separate annexes contributions from various task group members are included on the contribution of these sources to soils. They reflect the position of the authors or stakeholders represented which in some cases may be different from that of other group members. These annexes were circulated to the group for comment but there was insufficient time for discussions and revisions needed to ensure that the Essays were a consensus group view. Authors and titles are mentioned in the preface. The annexes deal with the following subjects: atmospheric deposition, fertilizers, lime, pesticides, manure, sludge, compost. Numbers given therein may also vary from other (e.g. national) statistics.

Specific implications of diffuse inputs and their impact on soils

In the following paragraphs a list of various diffuse inputs is given as well as an assessment of their impact on soils. For each individual class of diffuse inputs, an evaluation of impact and ways to reduce inputs is feasible, but when comparing different diffuse inputs, a clear evaluation is a lot more complicated to achieve due to various reasons:

1. Certain diffuse inputs are partly due to deliberate actions (in contrast to inputs from local point sources, which can in principle be avoided completely). Examples of this include inputs by products or waste materials applied on soils, like fertiliser, compost, sludge etc. It is important to note that waste derived materials which are applied to agricultural soils under the control of a waste management regime must be capable of delivering some form of benefit. It is not acceptable to use the agricultural recycling route as a disposal option. All these products and waste materials have their merits and are added to the soil intentionally to serve a purpose (soil fertility, structure). But they also contain a number of "unwanted" contaminating substances. The very nature of waste derived soil amendments will always mean that a balance has to be achieved so that there is a net benefit from the application of the materials to land without significant or unsustainable disadvantage occurring. The fact that these unwanted substances are added to the soil is unavoidable as long as the products or waste materials have to be applied on the soil in order to use the land as intended. We can only improve the quality of the products or wastes applied to the soil or optimise the application rates. Unless we decide to give the soil another function which does not require the application of products or waste materials.

2. The contribution of different diffuse sources is difficult to separate from each other. Especially since local data (inputs) are often lacking and average input levels are calculated from regional or even national data. This hinders a clear evaluation of the necessity of measures.

3. The impact of diffuse sources is still unclear for some substances or the evidence that inputs result in unwanted side-effects is corroborated by evidence that there are no such side-effects (e.g. the sludge discussion, input of cadmium by fertiliser etc.).

4. In addition to this, trends in soil quality due to long-term diffuse inputs are hard to quantify, partly because monitoring networks are not suitable (or designed) to evaluate changes in soil quality over time, or changes over time are simply too small to be detected. Also incorrect mass balance (input - output) approaches hamper a clear evaluation of long-term effects.

5. Inputs by diffuse sources are sometimes hard to control in case of transboundary import or export. Especially in combination with the issues raised under point 2 (contribution of different sources) and 3 (impact) measures to reduce inputs are not easy to impose on national authorities.

6. Since diffuse inputs are partly a result of intentional actions (fertilisation, maintenance of organic matter in soils), inputs are unavoidable but a clear framework to assess whether or not the merits outweigh the disadvantages is still lacking. For example maintenance of organic matter by compost or sludge has clear advantages in relation to the important functions of organic matter in soils, but the net positive effect considering the input of certain contaminants is hard to establish.

7. Differences in national policies with respect to the use and benefits of certain products (esp. sludge and compost) vary widely across Europe and range from common practice (use of sludge to maintain organic matter) to a complete ban on the use of sludge.

8. An important difference between local and diffuse inputs is the scale at which effects occur. Local point sources often are characterised by more or less clear boundaries (area of factories) and the relation between the source area and the affected area is (usually) clear. For diffuse inputs, the relation between area of production and impact can be very different. This is clear for atmospheric deposition but also plays a role for the production of certain organic soil amendments like animal manure or compost. These substances are not necessarily used within the region of production.

In the case of soil protection the "object" of concern is the soil and its functions in the landscape. An agreement on the perception of soil functions is therefore a crucial precondition for any further consideration of protective strategies. When assessing the relevance of input of pollutants three processes must be addressed:

1. physico-chemical or bio-accumulation on the basis of site and management specific input-output balances (e.g. metals/potential toxic elements, persistant organic pollutants/POPs with long half life time)

2. stronger or less sorption/fixation to soil organic and inorganic constituents and thus bioavailability of contaminants

3. biodegradation (e.g. organic pollutants and xenobiotica underlying microbiological decay, e.g. LAS or nonylphenol derivates)

The latter does not effect the accumulation itself, but might lead to a differentiated distribution within more or less extractable/leachable/elutable/bioavailable fractions. Analytical methods using stronger or weaker digestion agents seek to reflect the sorption strength or solubility of elements.

As indicated above soil contaminants might be adventitious ingredients of materials, which are necessary for plant nutrition or soil improvement (e.g. copper in pig manure as a consequence of having been added as mineral supplement in the pig diet) or applied for crop protection and are also deposited on soil (e.g. copper in Bordeaux mixture). Copper is an example of a substance that on the one hand is an essential nutrient (and deficient in some European soils), but that in excess can adversely affect soil microbiology and the growth of higher plants.

In addition also essential plant nutrients such as nitrogen, phosphorus or sulphur can be considered as diffuse contaminants according to the definition given here. A clear distinction has to be made, however, for beneficial (essential!) functions of these elements and potential effects related to these substances in compartments other than those where the essentiality is needed (e.g. ground and surface waters). If added to an extent that impairs the sorption capacity by mobilisation, nutrients can be released from the soil system. Once released from the soil system, elements like N and P are considered contaminants as well and are included in this document. The same is true for essential elements like Cu and Zn.

Thus an unwanted (adverse) impact is caused by unbalanced nutrient supply. A significant surplus of readily available nitrogen increases the potential of plant diseases (e.g. mildew in cereals or other pests) or gaseous N emissions to the air (N_2O and NH_3).

Diffuse inputs in relation to the DPSIR framework

In contrast to local sources, the working group on diffuse sources mainly focussed on the rural areas and inputs that affect rural areas. This does not mean that this is the only area where diffuse inputs affect soil quality. Also in urban areas inputs from atmosphere will affect soil quality, for example in parks and gardens. Also the (local) use of soil amendments and pesticides to maintain urban 'green' areas clearly has an impact on the quality of soil. However, the large diversity between these affected areas, ranging from small gardens to large parks, and the widely varying approaches to maintain those hampers a clear evaluation as can be done for rural areas as a whole. This means that diffuse inputs are largely discussed in relation to soil quality in arable soils (including grassland) and natural areas (affected by atmospheric deposition only). The diffuse inputs can be placed in the DPSIR framework as described below.

Driving Forces

Major driving forces that steer the magnitude of diffuse inputs are:

Agricultural production

Inputs of compost, sludge, lime and fertiliser are essential (not necessarily in all countries) to maintain soil fertility and crop production and as such certain inputs are unavoidable. This mainly concerns inputs by compost, sludge, lime, fertiliser and pesticides. A large part of these inputs are deliberate inputs as stated before. Without these inputs, production rates will decrease and in the end may lead to a situation where the EU can no longer produce enough food for its own population.

Production of waste from society (households)

The production of waste (e.g. compost from organic household waste, waste from food processing facilities, leather waste and sludge from urban wastewater treatment plants) is in many cases not a traditional prerequisite for agricultural production and as such is a separate 'driving force': we need to re-use the resulting materials (either apply them to soil directly, burn them or substances like metals is hard to quantify even though background levels of many metals (as well as phosphate) in soils have increased over time in agricultural soils. As stated before, quantitative modelling tools that are able to assign the increase to one or more specific sources are still 'under construction'. This is partly due to the fact that in order to achieve a clear picture of the contribution of each source to the current state of the soil, both concentrations (of substances in various inputs) as well as fluxes (in terms of loading- and output-rates per hectare) are needed.

turn them into quality controlled and marketable soil improvement products, etc.) since disposal in landfills is the less preferred option in policies on waste management.

Industrial activities

Modern society (in Europe) demands the production of consumer goods and as such production of goods and services (including emission from traffic). These activities lead to the input of pollutants by atmospheric deposition. Here also the maintenance of harbours and canals should be mentioned. Application of contaminated dredged sediments on land bordering canals can be considered here as well, but not as much as diffuse input but as an example of problem shifting from water to land.

Pressures

The pressures resulting from the driving forces are inputs of many substances ranging from heavy metals (manure, leather, sludge, compost, fertiliser, atmospheric deposition), nutrients (manure, fertiliser, atmospheric deposition), organic micro pollutants (atmospheric deposition), pesticides, pathogens (sludge, manure, fresh compost), veterinary and human medical substances (manure and sludge). The resulting pressures not only occur in the soils receiving the products but also in bordering ground- and surface waters. This touches an important issue since inputs of, for example, nutrients or metals in surface waters cannot easily be assigned to one or more (diffuse) input. In certain cases the link between diffuse inputs (e.g. N and P inputs from manure) and the resulting increase in the concentration in ground- and surface waters is rather clear, but for other substances (metals in surface waters) the relation between action and pressure is far less clear.

State

Inputs of nutrients, pesticides, metals, pathogens and organic micro-pollutants have resulted in an increase of these substances both in soils and ground- and surface waters. However, the magnitude of the impact as measured by changes in the concentration is not always clear. For mobile substances like nitrate, the increase in the upper groundwater in low-lying areas in Germany, the Netherlands, Belgium and France is obvious. On the other hand, a clear quantitative relationship between levels of inputs and concentrations in groundwater is still difficult to achieve.

Also the impact of soil amendments as well as atmospheric deposition on the level of less mobile

Impact

In agricultural and natural areas, a considerable part of all inputs can be considered diffuse. Only in the vicinity of heavy industry (like the Katowice area in Poland) a clear link with point sources can be established. So, the importance of diffuse inputs in a large part of Europe is considerable, but in many cases poorly quantified other than on a large-scale level (often the national level). The impact on the other hand does have a direct effect on the local scale. Major impacts are:

1. Increase in the soil content of generally immobile substances like phosphate, metals and certain

persistent pesticides (usually banned by now). This affects the local soil ecosystem (below and above ground ecosystem) as well as crop quality, in particular in case of mobilisation of contaminants (e.g. lowered pH);
2. Increase in the upper groundwater and local surface water for mobile substances like nitrate and pesticides (rapid run-off to surface waters in cracking clay soils for example);
3. Direct impact on surface waters in case of pesticide application;
4. Long-term supply of less mobile substances like phosphate, cadmium, lead and mercury from soil to ground- and surface waters.

In order to assess whether or not these changes in soil quality will lead to unacceptable effects, we need to be able to evaluate the risks resulting from inputs and accumulation in an atmosphere - soil - water system. As of now, most regulatory frameworks focus on one of these systems (either atmosphere, soil or water) without taking into account the link between the environmental compartments.

This makes that a clear assessment of the impact of diffuse sources is difficult. Even within one compartment, regulatory frameworks only focus on a limited number of quality aspects. For example, the use of manure is regulated on the basis of the N and P content and the maximum amount that can be applied. This does not consider the amount of Cu and Zn in the manure and it is likely that supply rates of both elements in soils treated with manure will exceed crop removal rates and might in the long run exceed levels at which soil quality is safeguarded with respect to heavy metals.

In general however, different impacts of diffuse inputs throughout Europe are clear:

1. Nitrate levels in ground- and surface waters have increased in low-lying areas with intensive animal husbandry.

2. Copper levels in soils have increased in areas with intensive animal husbandry and high manure application rates as well as in vineyards (as a result of traditional copper-based fungicide). Leaching of metals like Cu and Zn has resulted in elevated background levels in shallow surface waters draining from acid sandy soils as well as peat soils.

3. . Although the use and application rates of pesticides have decreased due to advances in the formulation and application rates of many pesticides, concentrations in surface waters in some situations still exceed ecotoxicological thresholds. The pseudo-zero (0.1 ppm) limit for drinking water can be exceeded in ground- and surface- water as well.

4. Cadmium levels in food (esp. wheat) have increased and have reached food safety limits in areas with elevated atmospheric deposition.

5. Inputs of N and S from atmospheric deposition have resulted in large-scale soil acidification and release of base cations. Although emissions have decreased as well, the process of soil acidification is still a serious problem, especially in many natural areas.

To assess the impact of diffuse sources in a risk based approach it is therefore necessary to define:

1. *The target compartments* of the environment that need protection. Here several targets can be considered like ecosystem related targets (soil biodiversity, ecosystem stability, specific target organism). These can be both soil (terrestrial) ecosystems but also aquatic ecosystems when considering the link between soil and water. Other targets that need protection include groundwater quality, crop quality, human health (direct exposure by ingestion of soil or dust). This also requires knowledge of the pathways connecting different target compartment like soil to groundwater and surface waters.

2. *Relevant protection criteria*. For certain compartments (e.g. crops) this is rather straightforward since existing food quality criteria can be used as maximum acceptable limits. For ecosystem protection on the other hand, concepts are still being developed. Also for assessment of soil quality in relation to contaminants new concepts are currently being developed like incorporation of the bioavailability concept.

3. *The acceptable impact* of unavoidable diffuse inputs. This requires a careful evaluation of various risk assessment approaches. During the working group sessions different approaches have been discussed among which the stand-still principle (no further accumulation), and various variants of the risk based approaches. The degree to which accumulation, leaching or uptake are accepted strongly depends on available data and interpretation of these data and no consensus was obtained as to whether certain products lead to effects at all. Contrasting evidence as to whether or not inputs lead to accumulation or effects leads to a considerable division between stakeholders.

Quality of ground- and surface waters

Contamination of groundwater which is one of the major impacts of diffuse inputs to soils has to be precluded by an appropriate precautionary strategy. The decision on the admissibleness of measures therefore depends on awareness of when contamination of groundwater occurs, and is thus precluded when water coming into contact with groundwater that is only negligibly contaminated. This is indicated by the insignificance threshold, and where contamination falls short of this threshold the requirements of the amended Drinking Water Directive are met and no relevant eco-toxicological effects occur. The result, from the point of view of groundwater protection, is that with the recycling of wastes or the use of products insignificance thresholds have to be observed

- at the latest, in leachates before it comes into contact with groundwater, and

- in groundwater that is in direct contact with the material (contact groundwater).

In order to guarantee the precaution in groundwater protection required under WFD, with fills and deposits as well as with the use of construction products that – such as concrete – are emplaced at an unforeseeable proximity to groundwater, insignificance thresholds have

to be adhered to not only immediately before leachate passes into groundwater, but already in the unsaturated zone at the lower edge of the fill or in the area of contact of the construction product. This way, concentrations are achieved at the point of transition to groundwater that are sufficiently below the insignificance threshold to satisfy the required precaution.

These demands of groundwater protection must be realised through appropriate demands on materials and requirements concerning the method of emplacement. Substance concentrations in leachates and contact groundwater are influenced, on the one hand, by the release behaviour of the material, which can be determined through appropriate investigation of the material. Where, on the other hand, negligible contaminant loads are released from materials, in addition to compliance with insignificance thresholds, hydro-geological conditions can also be considered as well as the importance of the measure at its particular location from the water-management perspective. It has to be ensured, however, that retention and degradation processes – that reduce concentrations – in the course of the leaching path below emplaced wastes or products are permanently preserved, that accumulation of contaminants in the subsoil is prevented and that the soil's buffer capacity with respect to contaminants is also not exhausted in the long term.

Adherence to the precautionary strategy can prevent a noticeable increase in contaminants in the affected aquifer as a result of recycling measures and the use of products. Insignificance thresholds do not therefore represent a quality goal for groundwater.

Response

For controlling diffuse contamination, upstream and down stream measures may apply respectively. When specific sources can be identified as it is the case for local or point sources, outputs can be reduced by setting emission limits in combination with effective emission controls (e.g. Air Framework Directive). Where minimisation at the source is apparently exhausted diffuse inputs can be regulated by

- definition or exclusion of source materials
- products directives or ordinances setting concentration limits, (Sludge Directive, Biowaste Directive, Eco-Farming Directive),
- management based regulations in limiting quantities to be applied to land (Nitrates Directive, Sludge Directive, Biowaste Directive).

In many cases a combination of both is chosen in existing national and EU measures.

But before addressing the different concepts for controlling specific inputs we need to consider the soil as a receptor. Consequently the question has to be answered: can we achieve a definition of soil quality or soil reference parameters and critical threshold values in order to guarantee soil functions?

Therefore we insert some principle considerations on the definition of soil threshold values for contaminants:

Agronomic uses and largely uncontaminated areas

Contaminants that accumulate might not have adverse effect until their active concentration exceeds a (critical) threshold value. Contaminants might also be substances that when render the soil, may constitute a contaminating source for other media, for example a substance that is deposited on soil and then transferred to water.

This leads to the necessity of soil reference, guide or threshold values which enable us to judge whether a potential charge with pollutants might cause a risk or not:

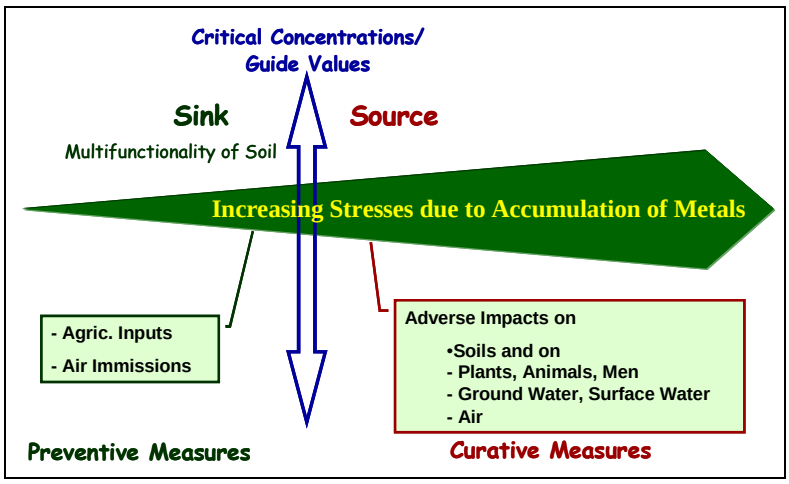

Fig. 1. The critical concentration decides whether the soil serves as sink or source of potential pollutants (Gupta, 1999)

The *critical concentration* marks the threshold from where, when exceeded the soil pass from a *sink* into a potential source of *'risk compounds'* to a receptor. This critical concentration must be based on experimental and field experience derived from eco-toxicological effects over defined pathways. With this static value still nothing is said, if the released contaminant would have a toxicological relevance for the final receptor media or entity concerned.

The final definition of a guide value for the multifunctional (predominantly agronomic) use of soil depends very much on the traditional perception of the *value of soil* as such and the qualitative and quantitative assessment of soil functions. This can then lead to a more or less precautionary approach (introducing a wider or smaller safety buffer).

As an *example* Table 1 shows the precautionary threshold values for soils of the German Soil Protection Ordinance. They are set independently from the soil use.

Table 1. Precautionary soil values of heavy metals for soils of the German Soil Protection Ordinance (BBodSchV, 1999) as compared to the EU Sludge Directive (86/278/EEC)

		Cd	Cr	Cu	Hg	Ni	Pb	Zn
German Soil Protection Ordinance								
"SAND"		0.4	30	20	0.1	15	40	60
"LOAM/SILT"	mg kg^{-1} d.m.	1.0	60	40	0.5	50	70	150
"CLAY"		1.5	100	60	1.0	70	100	200
soils with naturally increased and large-area settlement-related increased background contents		safe, as far as the release of pollutants or additional inputs pursuant to § 9 paragraphs 2 and 3 of this Ordinance do not give reason to expect any adverse impacts on the soil functions						
EU Sludge Directive (86/278/EEC)								
6<pH<7	mg kg^{-1}d.m.	1 – 3	-	50 – 140	1 – 1.5	30 – 75	50 – 300	150 – 300
EU Sludge Directive (proposal 3rd draft)								
5≤pH<6	mg kg^{-1}d.m.	0.5	30	20	0.1	15	70	60
6≤pH<7	mg kg^{-1}d.m.	1	60	50	0.5	50	70	150
pH≥7	mg kg^{-1}d.m.	1.5	100	100	1	70	100	200

Table 2. Precautionary soil threshold values of organic pollutants for soils (German Soil Protection Ordinance, BBodSchV, 1999)

		PCB (6)	Benzo(a)pyrene	PAH (16)
SOM > 8%	mg kg^{-1}d.m.	0.1	1	10
SOM ≤ 8%		0.05	0.3	3

Soil precautionary values within the meaning of the Federal Soil Protection Act are understood to mean soil values which, when being exceeded, give rise to assume the (possible) arising of a soil change with possible adverse affects to the environment.

Guidance for application of table 1a "Precautionary values for heavy metals":

1. *With regard to Cd, Ni and Zn it is evident that the precautionary values of the category "loam" apply to soils of the category "clay" with pH < 6,0 (pH limit value); the precautionary values of the category "sand" apply to soils of the category "loam" with pH < 6,0. This is also true for Pb using, however, a pH limit value of 5,0.*
2. *Soils consisting of claystone and marl stone / loess, loess loams and till / sand (pleistocene or alluvial)*

For derivation of precautionary values the following technical requirements apply:

1. Data on the accumulation and **effect of pollutants** in soils provide the basis for establishing precautionary values. Reference is made first of all to the variety of data given in literature on ecotoxicological effect thresholds (habitat, buffer, degradation and sink function for substance caused effects). If possible, the effect of soil pollutants on other targets to be protected (e.g. food plants including phytotoxic effects, groundwater and human health) is to be evaluated in addition. The effect thresholds determined shall be checked against soil background values in order to pay regard to the soil as **integral part of the ecosystem**.
2. The sensibility of soils shall be taken into consideration by **classification of the soil texture** (clay, loam, sand) and by using the pH value. Soils with significantly increased background contents shall be evaluated separately. Classification of a given soil into the categories introduced for precautionary values shall be enforceable.
3. Precautionary values shall be given as **total contents** for characterization of the long-term ecological relevance of a substance including its potentially mobilizable fraction. In order to particularly consider the soil function as "soil ability to filter, buffer and degrade substances, in particular, for the protection of groundwater" additional data give in mg/l leachate might be used to assess predicted leachate contents (not within the scope of this report).

In EU Member States soil limit values for heavy metals have been established predominantly within the framework of regulations for the application of sewage sludge on agricultural land. (see table 1 and comparison in the Annex of the document "Inputs from exogenous organic matter – compost")

In order to assess whether an element concentration may become "critical" can only be judged if the following processes are understood

- Sorption and mobilisation dynamics under the relevant site and soil specific conditions

- critical charges with respect to the transfer rates and doses-(no)effect concentrations (e.g. PNEC) of the receptor concerned (e.g. soil biota, plant and transfer to plant organs, percolation and further potential of pathway soil-sediment-groundwater etc.)

- critical balances related to potential N_2O emissions

- critical N balances inducing unbalanced luxury N consumption resulting in increased susceptibility for parasites and plant diseases

It has to be pointed out that critical thresholds might not be the same for all soil types, climatic and land use conditions. But key factors influencing this process might be identified together with conceptual approaches for establishment of sustainable management of potential diffuse sources.

Another crucial factor are the analytical methods, providing the empirical baseline for further estimations or models derived thereof. In direct measuring elements or compounds either 'totals' or certain extractable pools, the result is always an approximation of the reality. The correct interpretation very much depends on the knowledge about the coincidence of 'concentration' and effects. This is a major factor for an efficient monitoring programme.

Soils with naturally increased and large-area settlement-related increased background concentrations

The category "soils with specifically increased background values", can be defined on the basis of regionally representative background values supported by a supplementary list of precautionary values or by the individual Member countries within the frame of the enforcement of soil regulations. The proportion of these soils considering the whole territory of the EC is not clear in the moment. Soils generally belonging to this category are as follows:

- soils with geogenic increased contents of e.g. magmatites, metamorphites (e.g. granite, gneiss) as well as of sandstone and limestone

- soils with predominately anthropogenic increased contents (due to the settlement structure)

- soils in marshes and flood areas

Principle option to reduce or control inputs

The options for the management of the Agro-Ecosystem are limited and vary with specific sources concerned.

As said before it has to be distinguished between external pressures and those which originate in the agricultural actions and measures itself (see Fig. 2)

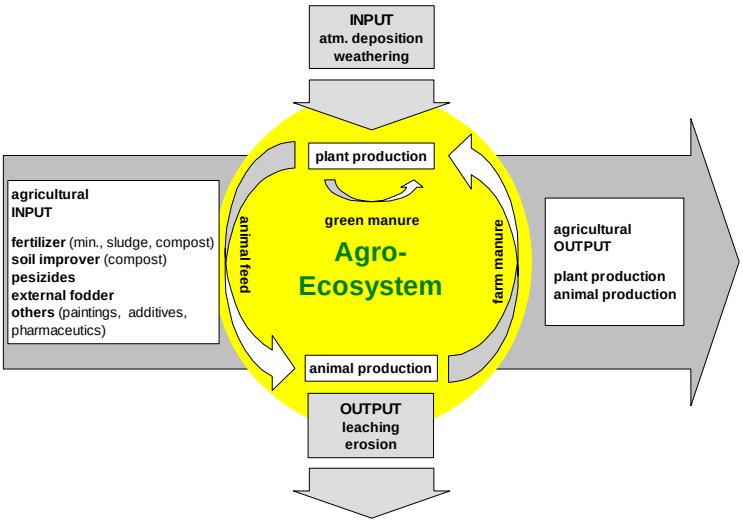

Fig. 2. Input and output pathways for contaminants into and out of the Agro-Ecosystem (from Wilcke & Döhler, 1997)

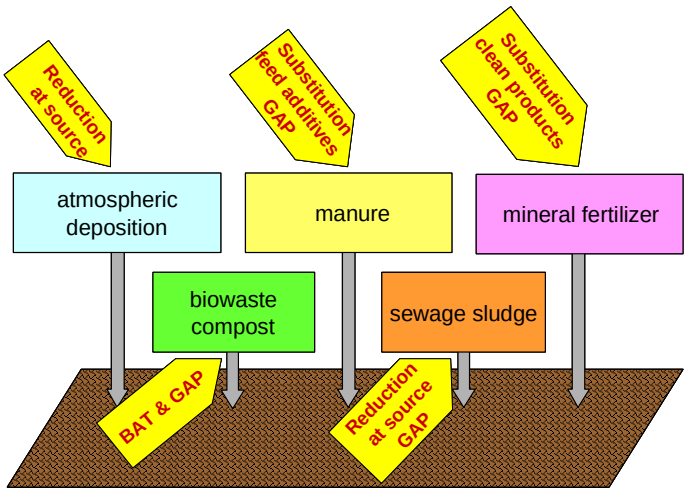

Fig. 3. Options to minimise inputs to agricultural land with the examples of atmospheric deposition and fertilisers (BAT…best available technology such as source separation in organic waste recycling; GAP … good agricultural practice for fertilisation)

Figure 4 gives an exemplary overview of the available options for reducing, minimising or controlling the introduction of contaminants in agricultural soils.

A reduction in the risk of diffuse inputs into arable and natural systems is desirable considering the pressures and effects (impacts) listed previously. One should also realize that once the soil is adversely affected it is very hard to restore it in a healthy condition. The big technical problems and the large financial burden of contaminated land are well established in countries that started to remediate their soil problems from the past. The large scale of the diffuse inputs to soil may in the end lead to large areas of affected soils, which will be even harder to restore because of the large size. So the primary aim of the response to diffuse inputs is to reduce the pressures in time before significant impacts start to occur.

Limitation of substance inputs into soil generally requires consideration of all input pathways, of the different substance properties (e.g. persistence, degradability, mobility) and partly also of different soil properties determining the behaviour of substances in soil. In addition, it has to be taken into account to which extent these are controlled or uncontrolled inputs and which possibilities for technical limitation measures do thus result.
From the viewpoint of soil protection there are various technical options for limitation of substance inputs possible. In line with precautionary soil protection, it is necessary to develop a graduated action concept for the limitation of pollutant discharges that takes into account the type and behaviour of pollutants and provides for some flexibility in the various action options to limit pollutant discharges. The aim of this limitation is to protect soil, particularly with regard to its natural soil functions[3].
Diffuse inputs, in contrast to local inputs, especially those in relation to agricultural activities are often a direct consequence of actions necessary to maintain soil functions or plant performance. Fertilisers or soil amendments such as rock phosphate, compost, sludge or animal manure which are applied to maintain the soil organic matter and nutrient status entail the addition of contaminants to the soil.

In a first approach two basic concepts can be distinguished:

1.) Risk based assessment such as the No Observable Adverse Effect Levels (NOAEL) concept

2.) Mass balance or No Net Accumulation in relation to the concentration of contaminants in the soil (NNA; precautionary approach)

There are two options for a *no accumulation* scenario

i. imitation of **PTE/POP concentration** in applied fertilisers and soil amendments at the soil background level *("same to same"or "similar to similar")*

ii. imitation of **PTE/POP load** at the level of tolerable exports from soil via harvested crops, leaching or erosion *("import = export")*

Between those two polarities manifold hybrid systems and indicators such as the assessment of *predicted environmental concentration* (PEC) in comparison with the *predicted no effect concentration* (PNEC) are discussed.

What is commonly agreed is that any concept should provide long-term safe food and feeding stuff production, the protection of the water resources and the biodiversity in the soils.

The debate on how far precaution must involve the soil itself and its basic functions (transformation, buffer, filter, biodiversity, genetic heritage and as a result productivity) is still going on and is mirrored by the different approaches.

A strategy that simply aims for a reduction of inputs following a no net accumulation scenario (*input = estimated output*) might, result in a decline of SOM or

[3] cf. § 2 BBodSchG

nutrient status in the soil below a desirable level according to GAP and sustainable productivity objectives.

On the other hand, a pure risk based approach could result in accumulation (up to a specified level) but this might not be acceptable by neither sustainability nor political means.

Further description of the two types of responses to avoid adverse effects related to diffuse inputs:

1. *Control of inputs and risks*

Risks related to inputs can be reduced in a number of ways:

- Controlling the introduction of chemicals (including pesticides) on the market.

This is prevention at the source in its ultimate form. Chemicals that are not introduced cannot contaminate and those which are banned will gradually disappear by biodegradation and dilution. Although some contaminants like heavy metals and POP's may persist for a very long time. In view of soil protection there should be a feedback loop from diffuse contamination and agricultural practice to the approval policies for chemicals and pesticides and emission control for air and surface waters. These EU regulations should not allow a new substance on the market that cannot be sustainably used in practice or cannot be controlled to prevent it from entering the large-scale diffuse pollution pathways (deposition and sedimentation). A stronger emphasis on persistence of chemical substances and pesticides in soil may be necessary in view of soil protection. The EU regulations on chemical substances and on pesticides should solve that problem Further discussions about this issue should take place during the revision of Directive 91/414/EEC and/or in the Thematic Strategy on pesticides.

- Setting more stringent emission controls for air and water.

Because atmospheric deposition is still a major pathway for soil contamination and water pollution is still leading to accumulation of contaminants in sediments, improving the control of emissions to air and water will put less pressure on soil and sediments.

- Setting quality criteria for products applied in agriculture (may also be applied to certain waste streams)

We should improve the ratio of benefits to environmental burden of products used on soils. If a product like compost is applied to improve the organic matter content of soils it should contain minimal amounts of "unwanted" substances, Elements that do not have a biological function (like cadmium) and POP's are always unwanted, whereas essential elements and nutrients may be unwanted if the compost is used primarily for its contribution to soil organic matter. If the soil was also deficient for essential elements and nutrients, the same substances may be labelled "wanted or beneficial" in the compost. The amount of substances in the product that are always "unwanted" should be "As Low As Reasonably Achievable"(ALARA). This means that for certain products (like P-fertilisers) containing various amounts of cadmium, technological (partly equal to economical) boundary conditions may put a limitation as to how far a reduction is feasible. It is also important that the chemical composition of the product is specified, to allow the land user who is responsible for maintaining the quality of his soil, in line with Good Agricultural Practice, to make an informed choice whether substances like nutrients and essential elements may be unwanted or beneficial in his case, or whether the cadmium in fertiliser may become a problem in his case.

- Adjusting the application rate of the product on the land to avoid accumulation of contaminating substances

By regulating the amount of a product to be applied based on average (or worst case) composition data (e.g. limitations on the amount of sludge or compost that can be applied), one may avoid accumulation of contaminating substances in soils. The minimum application rates of products needed to result in a beneficial effect for soils will depend on the specific use of the soil, soil type and climatic conditions. The same holds for maximum application rates in view of adverse effects. Whereas quality of products, especially if they are marketed, should be regulated at EU level, the best spatial scale for regulation of application rates is regional or national. However, not all inputs are controlled by a regulatory framework. The cadmium input to soil from P fertiliser usage is largely uncontrolled. To maintain the agreed application rates according to climatic regions, type of soils and usage of soil, compost or manure could be exchanged between regions with the condition of chemical monitoring of this substances and the knowledge by the users of advantages and disadvantages of that action.

2. *Minimization of effects* in case of unavoidable inputs.

In certain cases inputs leading to impacts cannot be avoided. Nutrients and pesticides are required to achieve the desired production rate. Of course alternative ways of production can be implemented like biological [organic] farming where less than optimal production rates are accepted or integrated farming where natural controls and manmade inputs are integrated for optimal production. It is also important to consider whether impacts that seem economically unavoidable at present may become avoidable in future due to technological innovation and whether the impacts really lead to irreversible loss of soil quality. We need to use an ecologically realistic time scale to evaluate this. To give an example: On more or less natural soils (no significant contamination) it may take 20 years to change agricultural land into a natural woodland by natural succession of vegetation. This period could be used to allow for natural attenuation of the accumulated inputs from agriculture as long as they do not delay the natural succession. It will be obvious that a lot of knowledge about ecology of soils is needed before these ideas can be put into practice.

The choice of the most appropriate response

The choice of an appropriate response in relation to minimization of diffuse inputs is crucially dependent on information to build such decisions on. Considering the large range in (sometimes contrasting) evidence on whether or not inputs of products like sludge, compost, fertiliser lead to long-term accumulation and the considerable debate on what is considered an acceptable level, it was decided that at present it is beyond the reach of the Task group Diffuse Inputs to decide which inputs have to be reduced.

For some of the diffuse inputs the contribution to the loading of the soil-water system is large. If huge amounts of animal manure are applied (the same is true for compost or sludge) the metal input levels will always exceed current estimates of the output levels, but the content depends on both the kind of animals producing the animal manure and the content of heavy metals in the feed etc. The question then is whether this is acceptable (time frame to reach unacceptable levels?) or can be avoided (choice of products?). Especially the discussion on what the acceptable time frame is within which critical limits will be exceeded is crucial.

Various options exist ranging from:

1. No further accumulation at all (including protection of groundwater, which could mean a further reduction of inputs)
2. Accumulation to a certain critical level (below the effect level) within a pre-specified time frame
3. Accumulation up to the predefined effect level.

It should be noted that in this report the term accumulation is used to describe a more or less continuous and gradual increase in concentration of contaminants in soil, as a result of a continuous input from agriculture, atmospheric deposition or (in the case of sediments) surface water. The steady increase in heavy metals and POP observed in soils at Rothamsted experiment station (UK) are clear examples of this and many experts feel that this is an adverse effect even if there are no current risks. Risk levels may be reached in future and the trends are hard to reverse. On the other hand an increase in concentration of a contaminating substance in soil as a single event should be judged differently. Applying a large amount of EOM (compost, manure, sludge) to repair a depleted soil will rise the level of heavy metals and POP's but as long as the functions of the soil are not adversely affected this single increase should not be labelled as adverse effect or as "accumulation". One should realise that natural soils with higher amounts or organic matter also contain more heavy metals than poor sandy soils. Adding EOM to a sandy soil to improve its agricultural quality or to promote plant growth (avoiding erosion) may be considered as a change in soil type rather than "accumulation of contaminants". There are of course many situations between the addition of contaminants in a single event and the continuous rise due to continuous inputs. The distinction between accumulation and a series of single inputs will be hard to make in general.

The options for policy decisions as described above can depend on (among others) the economic interest of the agricultural system (high value cash crops, food security, land values) or the natural value of the surrounding (vulnerable ecosystems). We also have to consider that contaminated land also brings economic problems for the future as the market may be less willing to accept products from contaminated land. As of now such an integrated evaluation system of the soil-water-sediment system does not exist but appears to be a prerequisite to achieve an acceptable decision on reduction of inputs.

To build this integrated evaluation system many policy questions have to be discussed. Important elements in this discussion are:

- Is accumulation of substances in soil as such an adverse effect or only if there is some risk in view of uses and functions of the soil?
- Is the risk to be related to current practice in the current land use, should it anticipate future changes in current practice, should it anticipate to planned future land uses or to any conceivable land use given the natural constitution of the soil? This question may be related to the classical policy objective in soil protection (see for instance the European Soil Charter of the Council of Europe from 1972[4] , revised in 2003), the protection of multifuntionality of soils. Soils can have many functions and the user of the land should conserve the functions for future users. The number of functions that a soil can have should not be reduced by human activities, in order to keep all options for actual and future landuse open.
- If accumulation of substances is an adverse effect as such, does that imply that any change in soil composition is to be avoided? Or only for unnatural substances or only if changes are orders of magnitude faster than natural changes that occur in soils?
- Human civilisations have had their influence on development of soil. Some of these "changed" soils are now considered very valuable because they support unique flora and fauna. Therefore we must allow our society to use and change soil to suit it's needs without compromising the needs of future generations. Soils do have a filter function, which keeps our groundwater pure. Soils have also been the repository for organic wastes in agricultural societies (manure, crop residues, etc.) but should we continue to use this cleaning capacity to process organic wastes from our urbanised society? Or should we only use waste recycled in quality controlled products like for instance compost if there is a need to keep our soils in good shape?

These questions cannot be answered by science alone because they depend on political choices as well. To get more clarity in these debates we need to work out different scenario's (which scientists can do based on knowledge and realistic assumptions) for different political choices.

A policy-oriented approach for the reduction of diffuse inputs

Soil protection concerning so-called diffuse inputs has been discussed up till now from the perspective of the state and impacts on soils. It does not matter for the soil if the contamination comes from the air, the sewage sludge or other sources. The choice of appropriate policy responses based on this integrated problem perception has led to divergent opinions. However in discussing responses another, more solution oriented, perspective may become important. If soil protection means that the users of the land have responsibilities to keep the soil resources in a healthy state for the future, it does matter where the contamination comes from, because it indicates the parties that should be addressed to reduce the inputs. In the case of farming practices (for practical purposes including silviculture and horticulture) the input of substances is partly under control by the user of the

[4] Council of Europe. European Soil Charter, Ref:B(72) 63, Strasbourg 1972.

land (the farmer). Partly, because he controls the amount of manure and fertilisers (chemical and organic) applied to the land, and to some extent by the content in the feed to the animals producing manure and by choosing chemical fertilizers with a low content of Cadmium.

Inputs from atmospheric deposition and sedimentation cannot be controlled by the individual user of the land. They are the results of air and water pollution which is still going on and reflect the shortcomings of our society in reducing emissions from the large number of sources that contribute to the diffuse pollution. Environmental policies for air and water have already been quite successful in reducing emissions. Further progress in emission reduction is likely to be slow. There are many sources involved and some of these sources are really difficult to reduce. We may for instance further reduce emissions from individual cars but the overall effect is nullified by the increase in traffic intensity.

From the user perspective it seems logical to separate the discussion about input and output of substances to the soil system by agriculture from the discussion about input and output of substances driven by natural (hydrological) cycles. This leads to a conceptual model that describes the physical soil and water system and its inputs and outputs as a system consisting of two systems. The first one is the soil (without agriculture) where atmospheric deposition is the input and the leaching flux to groundwater (and runoff to surface water) is the output. The second one is the agricultural system, which is superimposed on the first one. Inputs to the agricultural systems are fertilizers, lime, manure, composts, sludges, pesticides, etc. and the output is uptake by crop plants, ingestion by animals, and biodegradation (pesticides). At present both systems are out of balance for many substances in some cases, and it is the duty of those who are in control (of course stimulated by appropriate policy instruments) to bring their system into an acceptable balance.
This means for agriculture that leakage of contaminants from the system to groundwater and to air has to be As Low As Reasonably Achievable (ALARA). The output via biodegradation and via crop plants can be exploited, of course without compromising food safety. It also means that we recognize that we cannot restrict applications of compost or fertilizers because the input of unwanted substances from atmospheric deposition is too high. We cannot ask a farmer to compensate for the pollution coming from other sources. There are some situations where normal agriculture has become impossible because the contaminated soil generate crops that are not allowed on the market for food safety reasons. This is however a short-term issue, clearly based on an assessment of actual risks, while the efforts to make agriculture more eco-efficient by bringing it's inputs and outputs into balance is a long-term goal.

For the large (natural) system the input by atmospheric deposition should be balanced by the flux to groundwater, without compromising the quality of water resources. Although the long-term goal looks simple it will be very difficult to address the many polluters responsible and to specify the targets for reductions of emissions. In this area it is of utmost importance to use risk assessment (e.g. critical loads concept) to establish the priorities and to have the possibility to design large scale (e.g. riverbasin) management plans based on scientifically sound scenarios.

Conclusions and policy recommendations

The **main conclusions** from the task group are:

1] Given the complexity of the diffuse input problem a strategic approach is needed that gives some indication how to consider the different inputs and their relations and how to pave the way to sustainable land use and soil conservation as a resource for future generations. European Parliament stressed the importance of preventing the accumulation of hazardous substances in soils, but the task group could not agree on the basic principles to turn this EP statement into a policy.

2] Preventing accumulation of harmful substances by balancing inputs and outputs was considered a too simple "arithmetic" approach by some. According to them it is not the accumulation of the substance as such but the accumulation of risk for human health or ecosystems that should be the key issue. You have to choose whether a soil or a field has to be fertile for agricultural production or it has to remain/become in a low nutrient status which promotes oligotrophic plants but where sustainable agricultural production is impossible. Therefore it is necessary to have a different approach in different situations. Others found that focussing on (short-term) risk and current land uses is not preventive enough, in particular in relation to the Water Framework Directive. Risk assessments must be sufficiently knowledge-based and detailed to take into account future land uses and potential impacts in the long term in order not to be in conflict with sustainability. We should not want to endow future generations with risky soils and limit their freedom of choice to use the land differently.

3] In view of the lack of consensus for a strategic approach, the group decided to use a bottom up approach, because they felt that was the most practical when discussing inputs of contaminants in agriculture. Materials like composts, lime, manures, fertilizers, pesticides and sludges can be assessed according to agronomic value, the impurities and potential pollutants can be identified, the pathways of exposure can be tracked and the risks for soil functions, water resources, plants, animals and man can be assessed. Should the benefit to society of using organic wastes on land be weighed in this balance? This discussion automatically led to the question whether we should protect the multifunctionality[5] of soils together with applying the precautionary principle, or whether we should make a differentiation between different types of land uses according to their sensitivity for pollution. Some favoured the long-term goal of preserving soil as a multifunctional resource for future generations, others favoured the more short-term risk based point of view related to the current use of the land.

4] The weighing of agricultural benefits versus environmental impacts of each product proved also to be a controversial issue. This weighing is dependent on several political value judgements. Moreover the merger of the discussion about the sludge and biowaste from a waste management point of view with the discussion about soil protection did not contribute to the consensus in the group. One option is to define treated (e.g. composted) waste materials as product which is put on the EU market to be used for the improvement of nutrient

[5] The classical policy objective in soil protection.The user of the land should conserve the functions for future users, in order to keep the options for actual and future landuse open

status or organic matter content of soils. This strategy is applied in a number of Member States for composted biowaste (Austria, Italy, The Netherlands etc.). Another option as known from the Sewage Sludge Directive and national regulations is the strategy of waste recycling with the possibility to follow and control the recycling path until the application on a specific plot. In both cases agriculture must not be urged to serve as principle receptor of certain waste streams, but a distinct and comprehensive material and quality definition of waste derived soil amendments must ensure an environmentally sound beneficial use. In addition it has to be noted that, by definition, if a material is a waste does only depend on the fact, if someone wants to discard a material. On the first hand this is no matter of quality definition.[6]

The answers to these questions seem to require some general policy guidance. The more so because the added value of intervention at the EU level in regulations concerning waste, especially sewage sludge seems to be based on different arguments than for regulations concerning soil. Sewage sludge is produced locally and should be dealt with close to the source (it is not an example of transboundary pollution). Generally sludge is not exported as a recycled product to other countries (though it is sometimes transported over long distances), and whether sludge is burnt, landfilled or applied as organic fertilizer does not affect the performance of the internal market in EU or the balance of competition between Member States.

However, organic waste recycling to the benefits of the environment must go hand in hand with the needs of agriculture and more specifically the demands of soil protection.

General policy recommendations

A general policy framework should be developed to address diffuse soil contamination resulting from atmospheric deposition, water pollution in the case of sediments, from agriculture and other activities like reclamation, landscaping and building activities. This policy has to achieve the following:

A] Specification of (ultimate) long-term goals and (proximate) short-term goals.

The long-term goal is related to sustainable land use and protection of natural resources. Balancing diffuse inputs with acceptable outputs of the soil and groundwater system in order to prevent a decline of soil functions seems to be the most appropriate long-term goal, whereas short-term goals can be based on the current risks of the contamination as related to land uses and functions and the bioavailability of the contaminants. Moderate surplus of diffuse inputs could be acceptable if the long-term goal is not endangered. The interaction between short-term and long-term goals need a thorough consideration, especially in relation to land use changes and cross-cutting issues like sustainable agriculture, mid-term beneficial aspects of certain soil management practices and climate change.

Therefore function related soil quality definitions and investigations on critical concentrations of (potential) contaminants are an important pre-requisite and reference for addressing GAP related to land management.

B] Specification of the responsibilities of the users of the land.

The user of the land should be addressed while taking into account that the user cannot be held responsible for all diffuse inputs. In the light of a "Good agricultural practice" a farmer should have the duty to be as eco-efficient as possible by minimising the flux of contaminating substances like heavy metals and organic pollutants coming from agricultural inputs and the flux of unused nutrients to groundwater and air. Suppliers and manufactures of products that are used on land and may impact on soil also have responsibilities to support the farmer in proper use of these products (quality assurance, guidelines for application).

Abatement of air and water pollution contributing to non-agricultural diffuse inputs is a task for society as a whole. The long-term goal is to achieve a balance between inputs and outputs to groundwater into balance without compromising the quality of soil and water resources for future uses and functions taking into account the requirements of the water framework directive.

C] Ensure a linkage between soil protection policies and other related policy areas

Policy areas of relevance are policies approving chemical substances (including pesticides) for the market, policies concerning the quality of products applied on soils (fertiliser, compost) that may contain "unwanted" contaminating substances, policies for Good agricultural practices and policies concerning the use of organic waste on soil. Soil protection aspects should be taken into account, or enhanced where necessary, to ensure that there are no long- or short-terms threats.

There should be a more direct feedback loop from diffuse contamination and agricultural practice to the approval policies for chemicals and pesticides that sustainable use in agricultural practice and prevention from entering the large-scale diffuse pollution pathways (deposition and sedimentation) can be improved. A stronger emphasis on persistence of chemical substances and pesticides in soil may be necessary in view of soil protection. The EU regulations on chemical substances and on pesticides should solve that problem. Further discussion about this issue for pesticides should take place in the Thematic strategy on pesticides and the current revision of 91/414/EEC Regulation on pesticides.

Concerning waste the policy should specify whether recycled waste can be used as a product or if it should be recycled in the framework of waste regulations.

If an application regime under waste regulations controls is chosen possibilities of a proper use of products are limited. Therefore for products high level of quality assurance, product declaration and quality requirements must be applied together with more and more emphasising GAP.

[6] Example: Austria produces ca. 2 Mio tons of high quality excavated soil as waste. From e legal standpoint it is a waste. On qualitative level this soil should be reused in line with a environmentally sound material flow. At the end the question has to be solved based on proper quality definition.

Specific recommendations for manure and slurries

1] In the long term, sustainable land use planning could encourage a better distribution of animal breeding and production in EU countries. One possibility to reduce unwanted inputs to soils would be to adapt the husbandry density (livestock unit per hectare) according to the environmental sensitivity of each area.

- 2] In the short and medium term, we should substitute manures and slurries for mineral fertilizer according to the needs of crops (good agricultural practices) in intensive breeding regions.
- Develop treatments like biogas production that, on the one hand, improves the fertilization capacities of manures and slurries and, on the other hand, makes it easier to store and to handle. Appropriate land use planning policies are needed to ensure its development.
- Compost manures and slurries, which increases the percentage of stable organic matter in these materials and sanitises the manure but loses nitrogen. The benefits have to be compared with negative impacts like emissions of ammonia to the air which needs more research work.
- Decrease (if feasible) the amount of Zinc and Copper in the feeding of animals to a necessary level taking animal welfare implications into consideration as well as increasing the digestibility of diets to limit excretion in excess of N and P in the faeces after evaluation of potential benefits.

Specific recommendations for sludges

1] It would be desirable to refine the current EU sludge directive to achieve a holistic approach to all organic resources that are applied to all types of land in order to have soil protection based, harmonized requirements for all of them.

2] It would be desirable to improve the definition of treatment and preferably to move to the protocol that has been adopted by the food industry and that is progressively being required of farmers, i.e. Hazard Analysis and Critical Control Point (Codex, 1997; Evans, 2003). HACCP is equally applicable to chemical as well as to microbiological hazards.

Specific recommendations for compost

1] A positive list of high quality source materials for composting and anaerobic digestion intended for the processing of organic soil amendments would be essential to guarantee high quality compost. This should include source separated household waste and green waste as well as organic industrial waste (e.g. from food industries).

2] In order to bridge the gap between targets for the reduction of biodegradable municipal waste to landfill and a sustainable use of the biodegradable waste fraction incentives for the recycling of source separated biowaste are essential. Member States are encouraged to explore the best solution for implementation considering local conditions.

Questions concerning prevention of soil contamination from diffuse inputs to soil

The following questions were posed to the Advisory Forum. The received answers are given beneath.

1. Does the AF agree that a common policy framework is needed that gives some indication how to weigh the different diffuse inputs and their relations and how to evaluate the risks resulting from inputs and accumulation in an atmosphere-soil-water system?

Austria	Yes, but a reference to the Technical Guidance Document on Risk Assessment (1996, 2003) should be given. This could help to define the assessment factor for risk assessment. Combined effects of substances should be taken into account. On a local level it is not so much a question of weighing but rather of evaluating the impact of defined sources. Further, effective and efficient measures preferably at the source for minimising the inputs of diffuse sources should be assessed.
Belgium	Yes
Eurofer	Yes
Euro-metaux	There is a significant body of evidence showing that, for many pollutants, diffuse sources on a regional or continental scale are often much more significant than point sources. An EU policy framework to weight the various diffuse inputs and their relations is therefore a potentially relevant recommendation if based on risk concepts. The evaluation of the risks resulting from the inputs should clearly recognise the fundamental differences between man-made chemicals and naturally occurring substances for which different concepts and assessment techniques would be required.
Sweden	A common framework should be very useful, but it can be in the form of guiding principles and not necessarily legally binding. Such a document might help resolving some of the controversy considering supply of: a) atmospheric deposition vs ground-based sources, b) essential vs non-essential substances, c) man-made vs naturally occurring substances and d) decomposable vs persistent substances, e) different land use, eg. land reclamation, agricultural soils and soils in natural or semi-natural environments.
UEPC	Yes

2. Does the AF regard accumulation of substances in soil as such an adverse effect or only if there is sufficient scientific evidence about the risk in view of uses and functions of the soil?

Austria	In general terms the input as such cannot be addressed as negative, e.g. the input of clean organic fertilisers with defined quality or even plant nutrients if applied according to CAP. On the other hand accumulation of substances in soil bearing a potential risk of causing negative effects (impacts) to the soil-water system and the food chain have to be considered more critically. If there is scientific evidence about the risk in view of uses and functions of the soil, the risk assessment approach can be used for setting measures. Input of contaminants into soil is caused by industrial activities, diffusion and concentration processes. Sound scientific based models for the evaluation of soil change (including potential impact on ground water and the food chain) should be applied in order to secure the defined soil functions in the long-term scale. The principle must be to use the benefits from soil management systems (e.g. addition of EOM) as much as possible whilst minimising inputs at the same time. In order to evaluate a potential, slow, long-term accumulation in soils in a sustainable way this has to be done against critical soil threshold values, which guarantee no decrease of soil functions. Therefore accumulation as such is no ecological criterion. It must be seen in the context of the benefits of a specific action. If as a side effect of a certain soil management an input of pollutants occurs, the long-term soil changes may not endanger precautionary soil quality objectives.
Belgium	Yes, accumulation as such should be regarded as an adverse effect. This is the only way to protect soil quality in a sustainable way on the long term. Input should be balanced by output, provided that this "no-accumulation" principle does not cause subsequent accumulation in other compartments such as water or living organisms.
Eurofer	EUROFER supports the second alternative that is taking the risk-based approach into account

Euro-Metaux	The question of accumulation in soil needs careful consideration, since the way in which it is interpreted and assessed will be different for man-made chemicals and naturally occurring substances such as metals. The natural biological cycling of certain metals in soil (plant uptake, organic material/crop decomposition, etc., may be very significant compared to the anthropogenic input. It is therefore essential for metals to recognise the different functions and uses of soil, since the contribution of this natural bio-cycling may differ significantly for different soil uses. Accumulation of substances in soil as such is not "per se" an adverse effect. There should be sufficient scientific evidence about the risk in view of the uses and functions of the soil. Accumulation can also have positive effects. For example, accumulation of nutrients in certain areas deficient in those nutrients will have positive effects.
Sweden	Yes, in principle a long-term accumulation of harmful substances is an adverse effect. However, the type of substance must also be considered; agricultural soils must e.g. contain sufficient nutrient concentrations to be cultivated, but having reached this level a balance should be aimed at. Regulations of non-essential substances should be based on risk analyses. Man-made persistent substances should be prevented from reaching the environment, and for these substances any significant accumulation should be considered harmful. The same principle should hold for the metals Hg, Pb and Cd.
UEPC	Evidence is needed

3. Does the AF agree that prevention of soil contamination should protect the multifunctionality of soils together with applying the precautionary principle, or whether prevention should be different for different types of land uses according to their sensitivity for pollution?

Austria	Austria prefers that prevention of soil contamination should protect the multifunctionality of soils together with applying the precautionary principle. Therefore, what is needed is a clear definition of the term 'MULTIFUNCTIONALITY' with reference to the interrelation of soil quality parameters and soil functions. In general terms it could be phrased in this way: *"Functions of a given soil use must not be diminished by soil management measures"*. In addition it has to be considered that land use can change rapidly inducing the change of levels of prevention (e.g. thresholds). Well-specified requirements including certain restrictions for the use can be defined for non-food areas (e.g. landfill reclamation layers, noise barriers, old mining areas; other land reclamation or forest and silviculture). Also quality requirements have to apply. Precondition must always be the acknowledgement of the beneficial effects of an soil amendment with respect to soil quality and function
Belgium	Prevention should protect the multifunctionality of soils to make sure to protect soils in a sustainable way on the long term and to safeguard that future generations have the same freedom of land use as we have today.
Eurofer	EUROFER supports the second alternative, taking into account the IPPC Directive which requires among others the application of the BATs.
Euro-metaux	The availability of soil is a scarce property that has a high intrinsic value for all the pillars of sustainable development, namely economic, social development and natural capital. Restricting the policy solely to the natural capital would therefore not properly value the other pillars of sustainable development. Secondly, experience in Flanders, for example, has shown that some *very vulnerable end uses* such as children's playgrounds, require a higher level of protection than what would be applied under a multifunctional approach. To use the strictest protection target as a reference (= multi-functionality) would therefore lead to extreme costs both for prevention and rehabilitation, which would not be in balance with the desire to improve the general status of good soil quality. Furthermore, the *recognition of use-related protection targets and policy setting* allows brownfield development to be promoted, which has high intrinsic value for society and nature. The potential and incentive for brownfield development would decrease significantly if a strict multifunctional soil policy were to be applied. A proper balance between the recognition of different land uses and their sensitivity for pollution on the one hand and the precautionary principle in relation to prevention are therefore recommended. The Soil Thematic Strategy is part of the Commission's objective of Sustainable development. To answer properly the question on "multifunctionality versus prevention linked to types of land uses and soil function", one needs to have necessary information regarding the environmental AND socio economic aspects of each goal.

Sweden	Protecting multifunctionality and using the precautionary principle should be the main strategy, applied within reasonable limits. The supply of non-essential substances should be assessed and regulated on the basis of risk assessments and accumulation for the soil itself and their indirect effect on water, air, ecosystems and humans. The most limiting receptor should determine which and how strong protection measures should be taken. The risk analysis must contain safety margins. In some cases it may be justified to differentiate between risks regarding agricultural soils and land reclamation such as landfill covers
UEPC	Categorisation according to land uses seems sense as a first step so that protective measures can be more efficiently and effectively targeted.

4. Does the AF support the view that it is not acceptable to use the agricultural recycling route as a disposal option?

Austria	Yes. Nowadays nobody would ask to convert agricultural land into a dumping site. Based on the mandate this question is no matter for further discussion. Application of external organic (waste) materials should be done only if improvement (e.g. fertilisation) of the agricultural soils is needed. Consequently the quality of materials to be applied should be optimised. Quality definition and quality management in product design and application is a precondition for any environmentally sound recycling of waste derived materials on land.
Belgium	No, the agricultural recycling route may be useful, as use of some wastes may be beneficial (e.g. compost) when they are properly applied taking into account the needs of the soil. Thus, using the "agricultural recycling route" has to be controlled by putting boundary conditions such as: the use of the waste has to be useful for the soil, the use complies with the "no accumulation" principle, etc. We remind that from a SOM management point of view, adequate measures (catch crop/green manure, management of crop residues, conservation tillage/no-tillage) should be applied first; addition of EOM can only be considered in second order.
Sweden	We support the view that recycling of waste in agriculture and forestry should only be done if the waste replaces other soil improvers or fertilizers and if it does not cause any increased negative environmental effects or risk for human health. The use of waste or waste products with a benefit/risk-ratio as high or higher that the product it replaces should be encouraged.
UEPC	Keep the option open, even if it is clearly identified as not normally acceptable.

5. Discussions in many countries have shown that being safe is not sufficient for the acceptability to the public and stakeholders of the spreading of organic wastes such as sewage sludge on agricultural land. Waste on soil does not match very well with soil protection. Does the advisory forum agree that waste management policies should consider public perception and marketing issues more seriously?

Austria	This question may lead to a wrong perception of the problem. If a material is regarded as waste, does only depend on the fact, if someone wants to discard a material or substance. This is no matter of the quality of the material. *Example: Austria produces ca. 2 Mio tons of high quality excavated soil. From the legal point of view it is waste. On qualitative level this soil should be reused in line with a environmentally sound material flow. At the end the question has to be solved based on proper quality definition.* If a strategy including obligatory QM tools and safeguarding of the final product has been acknowledged as 'safe' and beneficial to the soil system (soil functions) by the scientific community, policy should follow its advise and encourage measures to create a positive perception and awareness amongst all involved parties and the public and should promote information on appropriate land management and its effects. In case this influence of public perception is underestimated, farmers may have to suffer economic disadvantages due to lower revenues.
Belgium	Policy has to take into account all stakeholders, public is just one stakeholder; communication is relevant to inform stakeholders in a correct way and marketing issues are important to gain acceptability; those aspects thus have to be taken into account in waste management policies, but public perception should not be the only force driving policy.
Eurometaux	Yes. This is however a communication issue. Sewage sludge has a lot of positive attributes and can be a very good soil improver. These aspects should be highlighted much more.
Sweden	The main rule is that management policies should be based on scientifically based risk assessments. The public perception depends on the amount and type of information available, and not least how the issue is discussed in media.
UEPC	Yes, it seems inevitable. However, gathering reliable evidence, interpreting it responsibly and using it to educate the public can provide a way forward

6. Does the AF agree on the added value of intervention at the EU level in regulations concerning exogenous organic (waste) material applied to soil?

Austria	Europe wide incentives, encouragements and drivers for creation of clean source materials and products would be welcome in order to support national strategies towards a quality linked biowaste management market distortion. If it turned out that a "Compost Directive" is needed, it would be important for Austria that only minimum quality requirements are laid down in such a directive, and it would be essential for Austria to have the possibility on national level to ask for higher quality requirements that are appropriate to local soil demands.
Belgium	Yes, at least to avoid uncontrolled cross-border waste streams.
Sweden	Yes, an added value is food safety since we have an extensive trade of foodstuffs between MS in the EU. There should be a possibility to impose stricter limit values and regulate further substances in national legislation
UEPC	EU level regulation should be applicable only to large scale, high risk cases, especially where there is the potential for cross border contamination, if poor quality products are used

7. Does the AF agree that quality of products used on soils, especially if they are marketed, should be regulated at EU level, whereas the best spatial scale for regulation of application rates is regional or national?

Austria	See arguments to question 6. The system should be: minimum quality requirements on EU level – specific implementation with the possibility of even more stringent quality requirements on MS level.
Belgium	Yes, but also co-ordination at EU level seems beneficial for exchange of expertise on regulation of application
Eurofer	Yes
Eurometaux	It makes sense to take EU action on product uses on soils, since products are traded widely and openly within the EU Community. In this particular case, however, the question arises as to whether existing legislation (fertiliser legislation, etc.) or legislation under development (such as REACH) would not already sufficiently cover this concern. REACH in particular will impose the requirement to assess the environmental properties of substances and preparations included in products and focus attention on their impact on soil. We therefore recommend to begin with an in-depth assessment of existing legislation relevant to this subject before going on to consider the need for new policy or regulatory initiatives.
Sweden	The quality, and possibly also the use, of marketed products should be regulated at EU level. For waste there should be a possibility for MS to impose stricter regulations with reference to differences in e.g soil types and climate.
UEPC	EU level regulation should be applicable only to large scale, high risk cases, especially where there is the potential for cross border contamination, if poor quality products are used.

8. Does the AF agree that the primary aim of the response to diffuse inputs is to reduce the pressures in time before significant impacts start to occur?

Austria	Yes, in accordance with the EU document on pollution prevention for chemical substances. Therefore the critical point is the definition of soil quality, critical threshold levels or precautionary soil thresholds. This is an essential orientation. The strategy must not lead to a filling up scenario up to levels where significant impacts start to occur. On the other hand a No Net Accumulation concept would lead to arbitrary load limitations, which might hinder the use also of quality assured materials. As a result efforts of further quality improvements in recycling processes would not be considered any more (such as quality management in organic waste management).
Belgium	Yes, this is strictly in line with the precautionary principle.
Eurometaux	The Sustainable Development principle would indeed require a proper protection level in the long term, ensuring that the next generation has at least equal potentials to the present generation. This does NOT mean, however, that accumulation is an adverse effect.The application of this principle to soil protection should include trend analysis, as well as the considerations of longer-term scales within the risk analysis. A significant body of methodological experience exists in this respect, in programmes such as the Existing Substances Directive and the Biocides Directive.
Sweden	Yes
UEPC	Yes

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CONTAMINATION AND LAND MANAGEMENT

Task Group 4 on
WORKING TOGETHER TOWARDS A RISK BASED LAND MANAGEMENT

Victor Dries

1. Executive summary and recommendations

The **task group Contaminated Land Management** focuses on a risk based and sustainable management of land that has already been contaminated (= "historical pollution"). This accounts for diffuse contamination as well as for contamination coming from point sources. It also covers what has been termed recently as "proximity pollution", wide-spread diffuse pollution originating from a single industrial source, outside the property boundaries of the industry.

The **main results** of the discussions in the task group are:

1. The following definitions are proposed:

a. A *"potentially contaminated site"* is :"site where an activity is or has been operated that may have caused soil contamination".

b. *"Land"* represents a geographical area (could be a single site, or it could be a region such as a municipality or larger area). However, it also includes the physical components of this spatial area, such as soil and groundwater beneath the surface of the land.

c. *"Site"*: A particular area of land, usually related to a specific area of ownership or activity.

d. *"Contaminated land"*: a geographical area with confirmed presence of "dangerous substances" caused by man in such a level that they may pose a significant risk to a receptor in such a way that action is needed to manage the risks. The risk is evaluated taking into account current and expected uses of the land."

e. *"Contaminated site"*: a site with confirmed presence of "dangerous substances" caused by man in such a level that they may pose a significant risk to a receptor in such a way that action is needed to manage the risks. The risk is evaluated on a site-specific base taking into account current and expected uses of the site.

2. The management of contaminated land must follow the concept of Risk Based Land Management (as studied in the Clarinet-report) applied on a case by case approach. When a problem of new soil contamination is found immediate action is required.

3. Every MS should work out an action plan for contaminated land management.

4. Today, an EU-wide inventory has little relevance, because many Member States (MS) have a different understanding of what "contaminated site" means, and because the way and speed of building up inventories throughout the MS differ greatly. That being said however, every MS (or county or region) needs information on potentially contaminated sites to be able to plan necessary management actions. This information can be grouped in an inventory. As decision for action can take into account other factors than contamination, it should be up to MS to fill it in depending its own needs. EU-wide guidelines on how to build up an inventory of potentially contaminated sites as well as contaminated sites can be useful to exchange good practice in particular for MS not having such inventories.

5. Several Member States have carried out national action plans. Key principles and recommendations concerning such action plans are the following:

a. A strategic approach at national level is very useful in particular to define priorities for action based on the risks and the impacts of the contaminated sites.

b. An approach requiring a strong harmonisation of such plans at EU level is not appropriate. In particular MS should have the freedom to decide whether the inventory or the plan should be carried out at national or regional level. MS should also decide the type of inventory necessary to cover their territory (in particular a number of MS have already developed such tools).

a. An information exchange on strategic approach between MS would be highly beneficial and should be developed to define best practices; the already established EU Common Forum may serve as a useful starting point here.

6. Information on soil contamination is often owned by private parties (e.g. land owner or operator); aggregated information should be made publicly available, at least when contamination has been proven. MSs should be able to decide that they want all information on possible soil contamination to be made publicly available.

7. Application of the "polluter pays"-principle is not always possible for historical contamination, as the polluter may not be liable for historical contamination, may not be able to pay for remediation or does not exist any more. The recent Directive on environmental liability deals differently with soil damage versus water and biodiversity damage. The liability directive might have been an opportunity to protect/restore soil and land to the same standards as water and biodiversity.

8. The Proposal of the Commission for a Directive on Groundwater gives no solution for large zones of contaminated groundwater (for instance compliance with certain limit values is required in all points of the water body regardless the technical and economical difficulties to manage historical contamination). The Proposal should be amended to ensure an appropriate management of historical contaminated sites In particular, the preventive and limit clause in the Water Framework Directive (WFD) may hinder remediation activities and should be clarified.

9. A need exists for a better harmonisation of risk assessment concepts. Much research has been carried out on the issue, and within the Caracas project an effort has been made to bring together all information within MS, but little has been done to really co-ordinate the concepts. Some scientific elements relevant to risk assessment should be harmonized (e.g. stepwise and scientifically coherent decisional procedure, tox/ecotox/chem. contaminant properties) while others should be optionally selected from jointly developed "toolboxes"(e.g. sampling/analytical procedures, fate&transport models), in order to allow for site-specific and regional variabilities. MSs should be encouraged to harmonize their acceptable human health risk level e.g. excess lifetime tolerable cancer risk because differences are hard to explain to the public. .

10. The "Best Available Technology" (BAT)-principle is relevant to make sure that best technologies are being used for soil remediation, while taking into account also secondary effects and costs of a technology. Guidance documents on proven technology may be helpful, while a strict list is likely to stifle innovation and development of new technologies. Implementing "BAT" should more be about procedures to come to site specific BAT rather than a strict list of what technology should be used for what type of contaminant. Examples of guidance documents already exist in several MSs, while also Clarinet- and NATO/CCMS Pilot Study reports provide useful information. When EU-funds include soil remediation in certain projects (like in funds for regional development, Interreg, Life, etc.) building in the necessity to use site specific BAT could trigger technology development and knowledge dissemination.

11. Some MSs have got mechanisms to co-finance the remediation by the present owner of contaminated sites where responsible parties have failed. Some EC-funding mechanisms (such as Interreg or European Fund for Regional Development) may fund soil remediation; they are limited though to certain regions. Yet, the application of the "state aid" regulation on soil remediation is not always very clear and should be amended.

12. The rights of an owner can interfere with "public interest", where e.g. soil contamination poses a threat to human health, groundwater quality, ecosystems, etc.. The rights of an owner should be of minor importance to the public interest. Anyhow, an owner is an interested party in the soil quality, so he should take part in the decision making process of a remediation plan. To make the market "work" on remediation, the responsibility for the remediation could be put with the owner of the land, as this will make a remediation most effective; this can be "softened" with co-financing when the owner is not the liable party. Financial guarantees could also be required to ensure that industrial operators have the necessary funds to rehabilitate their sites when the activities cease.

13. Generally, greenfield development is too easy, thus hindering brownfield redevelopment.

14. A report on land status is desirable when a "risk activity" has been carried out on a piece of land to inform a potential buyer about the risks. One might even think of creating a "financial guarantee" at the moment of transfer to avoid constructions in which a liable party "sells" the badly contaminated land to an insolvent third party. Such a land status report should also be required in case of land use change toward a more sensitive use.

1.1. Monitoring Recommendations

The objectives of monitoring are multiple:

- To gather data on the quality of soil
- To identify where action is needed
- To assess the efficiency of the actions undertaken and of the effectiveness of policy in place

There is a strong need for tiered monitoring: at national or regional level a monitoring strategy is desirable to know where action is required, at EU-level it may be interesting to aggregate the collected data -level to give an idea about the effectiveness of the policy in place.

The monitoring objectives are also linked to the discussion under "definition"; following that item, "aggregated parameters" might be:

- Number of potentially contaminated sites
- Number of sites that have been investigated
- Number of sites where action is needed
- Estimated amount of money needed to undertake action
- Number of sites where action has been undertaken
- Amount of money spent in action

Other interesting parameters (giving a broader view) might be:

- Technologies used for remediation: this parameter gives an idea about the "sustainability" of remediation concept and may serve as a driver to initiate use of new technologies in other MS.
- Surface of brownfields known and dealt with: those parameters may serve as a signal for site remediation as driver for sustainable land use

A guideline should describe what a potentially contaminated site is (for instance with reference to "risk activities").

On the other hand, some sites may have such a serious impact on other relevant fields (so called mega-sites), that reporting at EU-level on specific parameters for this site could be interesting. A definition of a megasite could be: "site where pollution is so bad that is has EU dimension (meaning that the site is relevant for existing EU-policy). Examples may be sites where the quality of a (ground or surface) water body is endangered, where foodsafety is endangered or a site that has a big social impact. A report on such a site could comprise parameters such as the location, kind of hazard (what EU dimension is "close") and the management concept for the site.

The main principles on monitoring could be in a directive, details on the monitoring scheme and on the reporting should be in a technical guideline.

1.2. Research Recommendations

- There is a strong need for harmonised analysis and sampling procedures. If not enough political agreement can be found to achieve this in a short term, effort should be put in attaining common performance standards such as accuracy and precision of the processes. Sampling and analysing have to be oriented as much as possible to the objective of the monitoring: whether one is interested in concentrations or in possible effects may have a strong influence on the kind of analyses that have to be carried out. There is a strong wish for risk-oriented sampling/analyses to get a better understanding of the possible effects of a contamination, rather than getting an idea about concentrations of a certain substance, without any notion of possible risks and without any notion of the potential effect of a cocktail of hazardous substances.

- Focus research on giving better estimations of transfer of contaminants to possible receptors via the different transfer routes.

- Sustainability of remediation concepts: most remediation concepts have an environmental impact themselves: emissions of volatile compounds, traffic, energy consumption, while on the other hand some concepts require long-term (sometimes even eternal) management. Most often, information about those environmental impacts and impact of this long term care is very scarce.

- Easy-entry decision support tools for BAT: a lot of research has been carried out already on remediation techniques, but the information is not easily accessible for the end-users. There is a strong need for a good instrument for information exchange on remediation technologies. Such an instrument should be created at an EU-wide level. The EUGRIS project develops an internet based source of information for contaminated land managers who want to use EU state of the art approaches. Such projects are useful but have the disadvantage that they stop at a certain moment.

1.3. Policy Recommendations

- As a starting point for individual monitoring at risk activities, it is interesting to start with a soil quality monitoring duty for operators who already have an existing monitoring and reporting duty, such as IPPC. An amendment to the directive should be made to specifically reference soil monitoring activities in the duties for operators. To make sure that the activities with higher risks for soil contamination are covered, an investigation should be carried to define the main contaminating activities that are not yet covered by the IPPC-list.

- It seems necessary to clarify “satisfactory state” in IPPC, as interpretations differ at the moment throughout MSs.

- Contaminated land policy comprises both soil and groundwater contamination. We need an integrated approach to soil and water.

- Water-soil interaction is very important for dealing with sediment problems. Sediments should be included in soil strategy.

- Create an incentive to the harmonisation process for risk assessment.

- Promote the use of the RBLM concept to manage historically contaminated sites in an efficient and sustainable way.

- Soil should be protected at the same level as other environmental compartments in the coming Directive on environmental damage.

- The text of the “state aid” regulation should be amended or at least clarified to reduce uncertainties about possible public incentives, which for instance aim to bring brownfield sites/regions back into the economic cycle, to solve urgent problems which pose a high risk, etc.

- Create a legal basis for the public availability of aggregated data on soil quality on contaminated sites.

- Create incentives for the redevelopment of brownfield areas; this implies often creating extra protection against greenfield development.

Draft report of the task group

1.4. Preamble

Contaminated land management addresses mainly problems from the past. The lessons we learned from this should lead to a strong policy for prevention of new contamination within the general framework of soil protection which addresses all threats to soil. Therefore EU policy should promote that every Member State formulates a preventive soil policy aiming at:

- A sound and good functional soil that:
  - poses no harm to any use by human beings, plants and animals,
  - can function without restriction in natural cycles,
  - does not contaminate other parts of the environment.
- Prevent irreversible impacts to the soil by the users of the land
- Prevent unacceptable health risks from (historically) contaminated land

1.5. Contaminated Land Management: what are we talking about?

The Task group Contaminated Land Management focuses on a risk based and sustainable management of land that has already been contaminated (= “historical contamination”). This accounts for diffuse contamination as well as for contamination coming from point sources. It also covers what has been termed recently as “proximity pollution” wide spread diffuse contamination originating from a single industrial source, outside the property boundaries of the industry. From a technical point of view it is not very useful to make these distinctions although, dependent on the national laws there may be legal differences between the different types of pollution.

1.6. Definitions

Looking at the problem of soil contamination, several interpretations can be given to the word “contaminated site”; different MS use different definitions based on the different threats perceived in the different countries and based on policy options chosen (such as a multifunctional versus risk based approach). A definition may also depend on what it is used for. On the one hand, there is a need for identification and registration of “contaminated sites” while on the other hand, there is a need to have a common basis to know when and where action is needed on the basis of the current or expected use of the site.

1.6.1. Proposal of definitions

We propose a set of definitions in this text for two reasons:

- To know whether or not a site is contaminated, a soil and groundwater investigation is necessary. As it is not feasible to investigate all land within the EU in a limited amount of time with a limited amount of money, attention should be given primarily to those

locations that have a high potential for contamination. Thus a definition of "potentially contaminated site" is desirable.

- The mandate given to the group is to discuss a number of items relevant for "contaminated land management"; yet this mandate is given within a "soil strategy" and several MS have a policy dealing with "contaminated sites". "Contaminated Land Management" integrates the "contam. site" (point source) issue in a broader (spatial) concept which links long-term solutions with land-use (spatial planning) considerations. Thus a link between those issues should be made.

A "potentially contaminated site" is :"site where an activity is or has been operated that may have caused soil contamination".

"Land" represents a geographical area (could be a single site, or it could be a region such as a municipality or larger area). However, it also includes the physical components of this spatial area, such as **soil** and **groundwater** beneath the surface of the land *(see figure 1.1).*

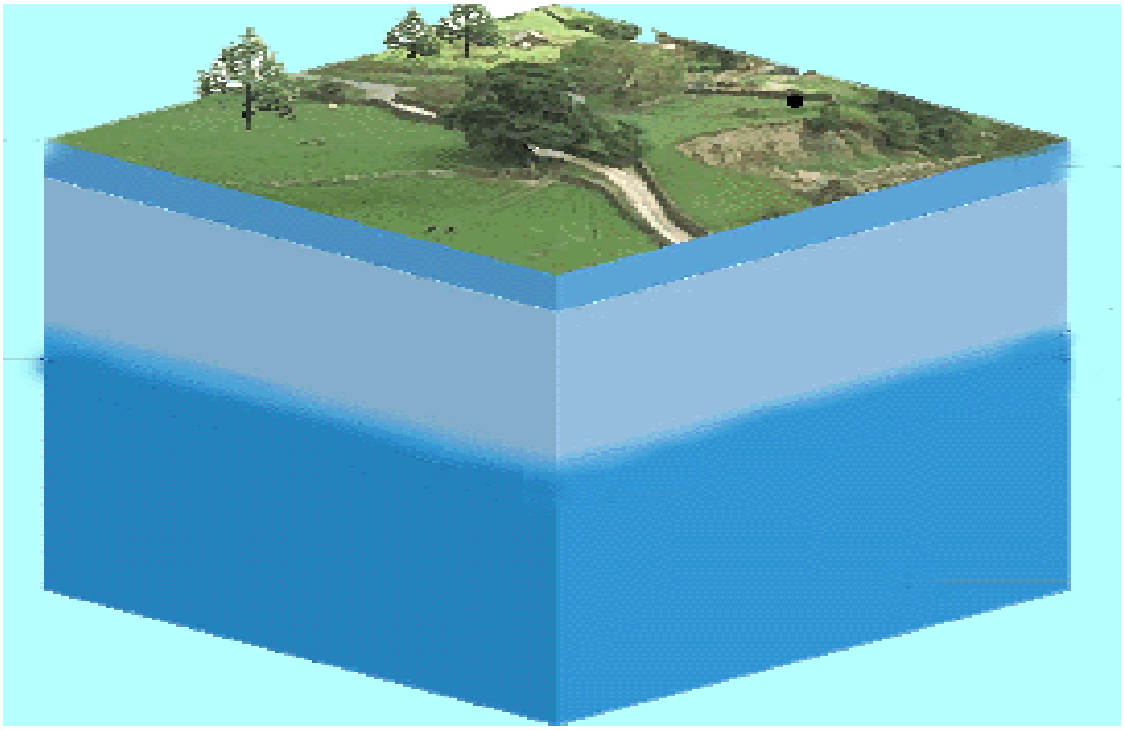


*Figure 1.1: "**Land"** as a three dimensional spatial area*[1]

"Site": A particular area of land, usually related to a specific area of ownership or activity.

"Contaminated land": a geographical area with confirmed presence of "dangerous substances" caused by man in such a level that they may pose a risk to a receptor in such a way that action is needed to manage the risks. The risk is evaluated taking into account current and expected uses of the land."

"Contaminated site": a site with confirmed presence of "dangerous substances" caused by man in such a level that they may pose a risk to a receptor in such a way that action is needed to manage the risks. The risk is evaluated on a site-specific base taking into account current and expected uses of the site.

"Risk" describes the combination of the probability and the effects of contamination (e.g. adverse environmental effects on human health, on ecosystems, or on water resources). If an adverse effect has occurred, the consequences are often described as **damage.**

"Management": is a set of activities involving decisions about assessment, remediation, land-use restrictions, monitoring, spatial planning, aftercare and other issues. In the context of risk based land management, it is a much broader activity than 'choosing a remediation technique'. It includes all the aspects of developing and implementing a sustainable approach.

1.6.2. Explanatory note

The interpretation whether a site is regarded as "contaminated" or not, is linked to the current and expected use of the site. This also implies that if spatial

[1] from UK Groundwater Forum "*Groundwater: Our hidden asset*", published by the British Geological Survey

planning determines a land use shift toward a more sensitive use for the site, risk assessment is necessary. If risk assessment indicates that unacceptable risks are expected under more sensitive use, the site is defined as contaminated. There is no concensus on the definition of contaminated site aspect, but a majority of the group supports the proposed text. Another vision is to introduce a definition that starts from a multifunctional point of view. Two possible definitions arise from this point of view:

1. a site with confirmed presence of "dangerous substances" caused by man in such a level that they may pose a risk to a receptor in such a way that action is needed to manage the risks. The risk is evaluated taking into account all possible present or future uses of the land.

2. a site with confirmed presence of "dangerous substances" caused by man in a level that is significantly higher than natural background concentrations.

Advantages of definition (1) above the present proposal: a shift in land use does not imply that a site that was regarded as "not contaminated" before the shift is regarded as "contaminated" afterwards, while the same concentrations of contaminants are present in the soil.

Disadvantage of definition (1): even though the contamination does not pose any risks and needs no management taking into account present and future land-use, it is regarded as "contaminated". This already has proved today that it may put a stigma on a site, scaring possible investors and thus hindering economical developments. This in return pushes investors even more to "greenfields" (sites that have not been used so far for building or industry); those actions can be considered at a certain moment as inappropriate land use.

Advantages of definition (2): it gives a very clear signal that man has had an impact on the natural concentrations of substances in soil. It is the utmost translation of the precautionary principle: we call the site contaminated as we want to protect all natural processes and biota in soil; we take into account that we don't understand yet all processes and ecological risks.

Disadvantages of definition (2): it is not always easy to make a clear distinction of what is a natural background concentration and what is not, however detailed (but rather expensive) investigation methods can solve this problem. The question is whether this cost is worth the raised knowledge level or not (even "classical" soil investigations are regarded as too expensive by most site owners). Next to this, the same disadvantage as with def. 1 occurs, while in this case the contaminant levels are even far lower, thus "stigmatising" even more land. When the criterion "significantly higher than natural background" is applied, every site that has been used by man for a few years (be it for industry or for living or for agriculture) may be regarded as "contaminated". Under this definition a huge portion of Europe would have to be called "contaminated", if criteria for significance are very strict (Note that in NL ca 80% of the soil area is still considered as "not contaminated" given our definition of significantly higher). Whereas definition 2 represents the ideal world it will in reality lead to stagnation and non-intervention as remediation expenses will be considered too high. A clear example of this is the legislation in The Netherlands which had to step away from multifunctionality as it proved to be inefficient in getting rid of historically contaminated soil.

1.7. The difficulties to set up an inventory of contaminated sites and assess common methodologies already in practice

Several member states have an inventory of contaminated sites. Such an inventory is in fact a databank of sites where evidence has shown that the site is contaminated. This inventory can be kept at a local, regional or national level.

1.7.1. Analysis of "common" methodologies present today (in the light of the definitions proposed):

- not all MS have contaminated land registers; this may be due to national or regional circumstances (e.g. contaminated land management is under local authority and information is not centralised at national/regional level) or due to the fact that the MS has not yet got a regulation dealing specifically with contaminated land management.

- registers of contaminated land are usually focused on contaminated sites rather than on diffuse sources

- "common" methodology to gather information to indicate that a site is contaminated for those MS which have a registers implemented:

1.) identify potentially contaminated sites:

the identification of contaminated sites is mainly based on information about historical risk activities; maps, historical archives, local knowledge, industrial permits and license records may give administrative information, surveys of surface and groundwater quality and site visits may give indications that a site in a specific region may be contaminated; some MS carry out a prioritization in this stage according to relative (or simplified) risk assessment procedures to select sites where a preliminary soil investigation is required first.

2.) preliminary soil investigation:

based on existing information, a site is examined for the presence of suspected contaminants or waste, screening values for soil and groundwater quality are often used as a first "trigger for further evaluation" to limit the amount of sites that need a more detailed site-specific investigation.

3.) site-specific investigation/risk assessment:

taking into account present and/or intended use of the site and its effects on the environment (e.g. soil/groundwater), this investigation leads to the conclusion whether action is required to manage any risks present.

4) possible results:

- delete the site from the inventory of contaminated sites→ the site is safe for its present or known future use and poses no threat to the environment

- the site stays in the inventory of contaminated sites → need for remediation (this may be based on prioritisation); type of land use may tolerate a certain level of contamination → recording needed as a land use planning control → avoid more sensitive land

use in the future (without performing a new risk assessment)

- even though the investigation shows that the site should not be regarded as contaminated, it is very relevant to keep the information available in a register. By doing this, a future buyer of land or the local authority may be warned about the presence of the contaminants when they are thinking about a more sensitive site use; also the information is present when the owner wants to carry out an excavation (in preparing a construction) and knows he may excavate soil that can not just be used freely to level a piece of land.

- The information present in the (national/regional) inventory is used to report progress in the respective MS (see current Monitoring discussion!) and predict resource requirements

- Note: quality control is needed on soil investigations.

1.7.2. Advantages of an inventory (at national/regional level):

- it is useful as a management instrument for efficient development of priorities of action (resources are always limited, so it is useful to have an overview of the locations where some kind of action is required, so an evaluation of priorities can be made, for instance based on a risk assessment)

- it facilitates insight in information on (potentially) contaminated sites for land use planning control measures (e.g. allowing only certain uses, e.g. if long-term remediation measures have been chosen or when eternal after care is required e.g. with landfills)

- it helps to ensure consistent quality across all sites in a national/regional framework

- it can be used merely to give interested parties insight in whether a certain piece of land is contaminated or not; e.g. it gives potential buyers of land information about the risk they run when they would want to build houses on the land.

- without registers, problem sites may not be discovered untill they create a major problem (e.g. inproper development will increase remediation costs substantially)
- it helps in localising abandoned sites and to initiate remediation action on sites where the commercial pressure and interest for exploitation is low

1.7.3. Problems encounterend to create a good EU-wide inventory of contaminated sites

- lack of common definitions among MS

- lack of real data – data on total number of sites are depending partly on estimations

- different level of solving/tackling the problem in the various countries; different legal backgrounds, different public perception of the problem; different industrial history, different waste management history, etc

- different approaches to solve the problem (e.g. remediation targets according to land use vs. groundwater quality)

- geological/hydrological background; there is a big soil diversity throughout Europe

- different legal requirements

- non homogeneous interest/capability throughout MS in providing data to international bodies

- sometimes MS have no centralised (national) registers, but regional ones (which are not comparable even at national level)

- often there is no information on environmental impacts available, rather on management issues (most national inventories are targeted to support administration of contaminated sites).

1.7.4. Problems encountered to create a good inventory at regional/national level

- often the information on potentially contaminated sites is only available at a local level and is hard to access (as a major part of the information dates from before the IT era – quite a few potentially contaminating activities have been operated in the 19th century- and is only available via a search by hand in the archives of the local authorities

- often the information on the quality of the soil at a site is owned by an owner or operator of the site and is not sent to the government

- the cost of having an inventory may be pretty big as most often the authorities only have the information they have paid for

- if you have an inventory of potentially contaminated sites, there is a danger of blight of land value for those sites indicated as potentially contaminated (see also needed DK amendment of CL-law mid-90 for private house owners); therefore it is an important discussion what information (with what degree of certainty should be available public it may be a problem to make non-experts understand what the results stands for and not to overestimate the impact of the information that is most often very limited at the stage of a preliminary investigation

An idea was that problem of cost of information could be met by the directive on the publicity of environmental information. The problem will not be solved by this directive, as it deals with information owned by the government only.

1.7.5. Option to overcome this problem

The Flemish government had been dealing with the contaminated land issue for about 10 years under the waste legislation when they decided they needed specific soil legislation. They also had encountered the problem of a limited accessibility of old information with local authorities and of property of information. Above that, budgetary restraints were very strict at the time the legislation came in force, so the government could spend very little money on the inventory. On the other hand, they had been faced with many problems at sites that had

been contaminated by operators that had left the site, where subsequent owners were made liable for damage to third parties resulting from the soil contamination.

To solve those problems, the Flemish legislation introduced an duty of investigation on owners of potentially contaminated sites and on operators of risk activities. The regulation states that for a number of risk activities, the operator must carry out a periodical soil investigation (depending on the risk, every 5, 10 or 20 years; the fist investigation had to be carried out respectively before end 1999, 2001, 2003). When a risky activity is closed, the operator also has to carry out a soil investigation. On the other hand, a soil investigation needs to be carried out at the transfer of a potentially contaminated site, so that the buyer has an idea about what the soil quality is. The owner of a piece of land has to check himself whether a site is potentially contaminated or not. If he "forgets" to carry out this site investigation though a risk activity had been carried out in the past, the buyer or the OVAM can demand the annulment of the transfer. As a notary has the duty to make sure that all legal requirements are met at a transfer, also he will check with the owner and with the local authorities whether anyone has information about a present or past risk activity. There is no central Flemish inventory on potentially contaminated sites.

The Flemish legislation also states that all soil investigations have to be sent to the OVAM.

This system has created a huge information flow to the OVAM. Every year, the OVAM receives more than 4000 preliminary soil investigations, and at the end of 2003 (less than 8 years after the legislation come into force), the OVAM had information on more than 22.500 sites, covering more than half of the total surface of all land which is dedicated for "industrial use" in the spatial plans. OVAM itself orders between 50 and 100 soil investigations a year, so the vast majority of the information present in the databank is being delivered by operators and site owners. All information is made publicly available. The cost of creating and maintaining the central databank system is being paid by every owner who wants to sell a piece of land, who has to deliver a soil certificate to the buyer indicating what information is present in the databank on that particular piece of land. Thus the net cost of the entire databank is being covered by the market players (and not by the government).

1.7.6. Policy Recommendations

Today, an EU-wide inventory of contaminated sites has little relevance, because many Member States have a different understanding of what "contaminated site" means, and because the way and speed of building up inventories throughout the MS differ greatly.

That being said however, every MS (or county or region) needs information on past and present risk activities, thus of potentially contaminated sites. This information can be listed in an "inventory". This list of potentially contaminated sites should be an "open list" as it should be amended when data become available.

The information on potentially contaminated sites is essential at MS-level (or at county or regional level, depending on who the competent authority is) to plan necessary management actions such as remediations or monitoring. As decision for action can take into account other factors than contamination, it should be up to MS to fill it in depending its own needs.

Some general EU-wide guidelines how to build up an inventory of potentially contaminated sites (e.g. linked to risk activities) could be useful.

As decision for action can take into account other factors than contamination, it should be up to MS to fill in relevant aspects of an inventory depending on its own needs. A legal obligation has to be created to dictate that Information generated during soil investigations becomes public information.

It could be a good start for national inventories to introduce a duty on soil information on operators of IPPC activities (taking into account that the list of IPPC activities should be extended with a number of activities with a high potential for soil contamination.

Aggregated data on contaminated land that have been evaluated by e.g. the competent authorities should be made publicly available, at least when the information shows that the site really is contaminated (and thus a risk is present that needs to be managed). MSs should be able to decide that they want all information on possible soil contamination to be made publicly available.

1.8. Recommendations for the Directive on soil monitoring

The monitoring of contaminated land should have the following objectives:

1. gather data on the quality of soil according to risk-based principles, i.e. land use fitness and protection of resources
2. identify where action is needed
3. assess the efficiency of the actions undertaken and of the effectiveness of policy in place.

There is a strong need for tiered monitoring: at national or regional/catchment level a monitoring strategy is desirable to know where action is required, at EU-level it may be interesting to aggregate the collected data -level to give an idea about the effectiveness of the policy in place. The monitoring objectives are also linked to the discussion under "definition"; following that item, "aggregated parameters" or "indicators" might be:

1. Number of potentially contaminated sites
2. Number of sites that have been investigated
3. Number of sites where action is needed
4. Estimated amount of money needed to undertake action
5. Number of sites where action has been undertaken
6. Amount of money spent in action

Other interesting parameters/indicators (giving a broader view) might be:

1. Technologies used for remediation: this parameter gives an idea about the "sustainability" of remediation concept and may serve as a driver to initiate use of new technologies in other Member States.

2. Surface of brownfields known and dealt with: those parameters/indicators may serve as a signal for site remediation as driver for sustainable land use

3. Some sites may have such a serious impact on other relevant fields (so called megasites or problem areas), that reporting at EU-level on specific parameters for this site could be interesting. A

definition of a megasite could be: "site where pollution is so bad that is has EU dimension (meaning that the site is relevant for existing EU-policy). Examples may be sites where the quality of a (ground or surface) water bodies is endangered, where food safety is endangered or a site that has a big social impact. A report on such a site could comprise parameters such as the location, kind of hazard (what EU dimension is "close") and the management concept for the site.

4. The main principles on monitoring could be in a directive, details on the monitoring scheme and on the reporting should be in a technical guideline.

Note: there is a strong need for harmonised analysis and sampling procedures. Sampling and analysing have to be oriented as well as possible to the objective of the monitoring: whether one is interested in concentrations or in possible effects may have a strong influence on the kind of analyses that have to be carried out. There is a strong wish for risk-oriented sampling/analyses, not only concentrations. We think this should not be included in the monitoring directive, as it is too detailed, but could be a point of attention in the communication.

A specific remark needs to be made concerning site-specific monitoring as a risk management tool. For some contaminations, monitoring the evolution of the contamination is an essential part of the remediation and risk management process (e.g. where natural attenuation, isolation or long term groundwater remediation is chosen as the most appropriate concept). This is a site-specific kind of "monitoring" that is not being dealt with in the discussion concerning the proposal for a monitoring directive.

1.8.1. Policy recommendation

As a starting point for individual monitoring at risk activities, the group thinks it is interesting to start with a soil quality monitoring duty for operators who already have an existing monitoring and reporting duty, such as IPPC. An amendment to the directive should be made to include specific soil monitoring activities in the duties for operators. To make sure that the activities with higher risks for soil contamination are covered, the IPPC-list should be amended to incorporate a number of contaminating activities.

1.8.2. Research recommendation

There is a strong need for harmonised analysis and sampling procedures. Sampling and analysing have to be oriented as well as possible to the objective of the monitoring: whether one is interested in concentrations or in possible effects may have a strong influence on the kind of analyses that have to be carried out. There is a strong wish for risk-oriented sampling/analyses to get a better understanding of the possible effects of a contamination, rather than getting an idea about concentrations of a certain substance, without any notion of possible risks and without any notion of the potential effect of a cocktail of hazardous substances. Much of this could be delivered through the Horizontal Project. References for pre-treatment and analysis of contaminated soil samples could be taken from available ISO guidelines.

1.9. The difference between historical and future pollution

Historical contamination is the contamination that has taken place in the past; future contamination is the contamination that does not exist at this moment, but may take place in the future (e.g. after some text with global principles is accepted, i.e. after a specific, to be agreed cut-off date). A site with "future contamination" is in fact a site where the preventive measures fail. If legislation already exists in a MS dealing with future pollution, this should not be annihilated by this strategy, e.g. a contamination that is regarded as "future" concerning this specific legislation should not be dealt with as "historical" due to this strategy.

The legal abilities to make "polluters liable" for the damage is in many MS limited in case of "historical contamination", often because of the lack of environmental protection legislation at the time of the polluting activities. The distinction between "historic" and "new" pollution is therefore often related to the date of the enforcement of a protection act. Even when legislation in a MS makes a "historical polluter" clearly liable, it is not often easy or even impossible to get money out of this party (e.g. because the polluter does not exist any more, has no money any more …).

From a technical viewpoint, problems from historical contamination are often more difficult to manage than contamination which might result from new activities, as the contamination has had more time to migrate to the groundwater or to neighbouring parcels.
Therefore, the legal and technical requirements for prevention of new contamination should be more stringent as an incentive to prevent future contamination and avoid that the already huge mass of historically contaminated sites will grow further.

Tackling historical contamination should be done using a "strategic approach" based on sites that have been identified & registered. We should not try to investigate everything first and wait for action until all potentially contaminated sites have been investigated. The strategy also comprises "data working" for instance to correct the list of risk activities when no problems show in certain sectors. Management of the contamination itself should be based on the RBLM-concept. Of course, sometimes a contamination poses such a high risk that some kind of interim measures are really needed.

When a problem of new soil contamination is found immediate action is required.

The principle in IPPC should be followed; if a problem is found, the site should be returned to "satisfactory state". "Action" should not be limited to "dig and dump" (eventually implying destruction of part of the installations), immediate action may also mean that the emission is stopped, and the contamination is monitored until more active remediation is possible in equilibrium with the industrial operation. Where RBLM is the suitable approach to manage historical contamination, the ALARA-principle should be the basis to deal with new contamination.

1.9.1. Policy recommendation

It seems necessary to clarify "satisfactory state" in IPPC, as interpretations differ at the moment throughout MS.

1.10. The Groundwater Directive

1.10.1. Integration of Soil & Water Policy

Environmental policies for water have moved to a management approach at a water system level which addresses the ecological quality of surface water and groundwater in river basins. The Water Framework Directive (WFD) will lead to regional water quality management and control of sources of pollution of groundwater and surface water.

In the implementation of the WFD the large European river basins are likely to be divided in smaller regional management units. CLARINET has addressed management issues at this level in relation to the RBLM framework.

As groundwater is intrinsically in the land and the land is a sink for many pollutants, contaminated land or soil (whether industrially contaminated or agriculturally contaminated) is an important source of water pollution. On the other hand, water pollution can be a significant source of land or soil pollution. This will be obvious in countries where sediments are considered as soils in aquatic ecosystems. But it applies in many other circumstances, ranging from the spread sediments over soil via flooding or by deposition of dredged materials to the transport of contamination by water movement within soils.

The interaction between soil and water is also important in environmental problems that are not caused by polluting substances. Overexploitation of the water cycle leads to soil problems such as desertification and salinisation. The close link between soil and water is well established in terms of soil science - soils are formed in close interaction with the water cycle and plant and animal life.

1.10.2. RBLM integrates Soil & Groundwater

The RBLM concept can equally be applied to land and the associated groundwater and surface water. It is essential to recognise the substantial obstacles to complete remediation of historical pollution in groundwater, both from a technical and an economic viewpoint. We have to address the clean up of historical groundwater pollution in a similar way to that being accepted throughout Europe for land and soil: i.e. a risk-based approach. RBLM when considered within the Water Framework Directive will help in setting a common framework for European groundwater remediation.

1.10.3. Further recommendations

Although amounts of contaminants have already been introduced to the underground, the *precautionary* and *preventive principles* can still be followed in contaminated land and water management to prevent further damage and to remedy the problems in an environmentally friendly way. Restoration and a progressive reduction of emissions and plumes of mobilised contaminants can lead to a re-establishment of a good ecological status of aquatic ecosystems or a good chemical status of groundwater.

This has important implications for the practical implementation of the Water Framework Directive:

- The development of strategies to prevent and control pollution of groundwater (*referring to WFD Art. 17*) should stress distinctions between 'old' and 'new' contamination. It would also be worth providing a clear picture of how to assess the overall quality of a groundwater body as a resource and how to assess the local impact of a specific activity or point source on groundwater.
- To handle the problem of contaminated land within River Basin Management Plans there is a demand for new strategies and a methodology for implementation. The concept of assessing trends at a local scale by determining the 'plume-status' (expanding, stable, shrinking) could serve as a starting point. Subsequently the principles for monitoring plumes and the procedure for data analyses should be brought together as a coherent instrument.
- Common groundwater standards can be one of the criteria to unify overall regional assessments. Taking this to the local level, and taking into account the diverse natural conditions throughout Europe, the need for specific solutions is clear. These specific solutions, including remediation targets for contaminated land, have both to refer and be adjusted to local demands.
- A single set of pan-European restoration targets for groundwater is not technically robust and would result in inappropriate standards being set. A risk-based approach should be adopted that would allow Member States to develop restoration objectives on a local scale. Objectives should be developed to protect specific receptors (surface waters, wetlands, humans ingesting water, etc.) in addition to the general objectives of groundwater resource protection, taking into account the local circumstances of each site and water body.

The present evolution in the draft text of the Groundwater Directive focuses solely on the mandate in the WFD. This means that there will be no global principle to manage large-scale contaminated groundwater problems in the Groundwater Directive which should be amended accordingly.

If a global management concept is desirable, it should be integrated in the Soil Strategy. The preventive and limit clause in the WFD may hinder efficient remediation techniques, such as re-infiltration of cleaned groundwater, in-situ bioremediation, MNA, etc).

1.10.4. Policy recommendation

Contaminated land policy comprises as well soil as groundwater contamination. So from an environmental point of view, soil and water interact too much to be managed separately. Successful implementation of the WFD has to involve land management.

Water-soil interaction is very eminent at sediment problems. Sediments are formed by particles that have been part of the soil but have migrated (e.g. because of erosion) into the surface water, and will become part of the soil again when they settle, at inundations, when clearing the bottom of a waterway. Sediments should be included in soil strategy (and should not be regarded as waste) without generating conflicts generated with WFD [2].

[2] According with WFD (article 16 (7)) the Commission shall submit proposals for quality standards applicable to the concentrations of the priority substances in surface water, **sediments** or biota. That would be taken into account if we propose to include sediments into soil strategy because quality levels on sediments can be defined under WFD.

1.11. Uniform criteria/principles for risk assessment

Risk assessment of contaminated sites is a major component of Risk Based Land Management: the management of contamination problems starts in fact from the assessment of related risks.

Risk assessment approaches are widely used over the EU: they have been thoroughly explored by the CARACAS, CLARINET and NICOLE networks. Results of the studies have shown that, even if the rationale is very similar, several differences exist among MSs in terms of approaches. The full reports on the CARACAS and CLARINET studies can be found at CIRCA: http://forum.europa.eu.int/Members/irc/env/soil/library?l=/contamination/contamination&vm=detailed&sb=Title

Reasons for some harmonization are the following:

- **Robustness and confidence.** More comparable approaches and outcomes of risk assessment will make the discipline stronger and more easily accepted as a tool for decision making, even though uncertainties, as in any scientific decision, will remain.

- **User friendliness.** Public authorities, local and central, would feel more comfortable if some guidelines on harmonized approaches at the EU level existed. Allowing for flexibility, of course, but guiding over flexible choices. Public authorities do not generally have the required skill and scientific expertise, especially at the local level, in order to be able to make all choices on their own.

- **Protection levels comparability.** Persistence of large differences in risk assessment outcomes may generate the opinion that large differences in environmental and health protection levels exist in different countries. Harmonization of risk "endpoints" (i.e. ADI, cancer risk levels and ecotox risk limits) would avoid this perception.

1.11.1. Field of application

In principle risk assessment could be applied everywhere. On one side, is can be used to decide whether action is required at a location. On the other hand, it is a useful way to assess the problem if a site is contaminated. It may generate information on the most relevant exposure pathways of a contamination and on the most relevant risks. This information is essential to work out a management plan for a site. For historical pollution site-specific risk based solutions are allowed that leave some pollution in the soil (e.g. by setting fit for use cleanup goals over background level and considering local conditions over semi-generic screening values*).*

1.11.2. The assessment and decisional procedure

Risk Assessment is generally applied in a tiered procedure according to 2 or 3 levels:

I. A generic level where site (soil) contamination is compared to generic risk-based screening/guideline/trigger values: decision can be taken on whether remediating to screening values (that become also cleanup targets) or moving to a next level. Depending on site-specific circumstances (e.g. small sites), a site can be defined as contaminated already at this level. This level does generally trigger further site investigations. If the contamination does not exceed screening values, no action is needed. Assumptions behind level I assessment are generic and conservative. Level I screening values can be multifunctional (i.e., derived for the most sensitive land use) or differentiated by land use categories depending on MS approaches.

II. A site specific level where soil contamination is compared to risk-based site specific values taking into account land use and site environmental features. Site can be defined as contaminated at this level. Site can be cleaned up to site-specific target values. This level should generally envisage the use of simple (analytical) fate and transport models. Assumptions behind level II assessment are site specific and (in most cases) less conservative than level I.

III. A site specific more detailed level of analysis might be used in complex situations.

Many countries have indeed 2 or 3 levels but screening values may have different roles in the assessment. They may be a useful instrument for level I evaluation, but should not be mandatory. Some countries use a system whereby evaluation (in the first phase) is not based on values, but on a simplified RA method that takes into account other parameters, such as potential impacts.

<u>Harmonisation need:</u>

The joint development of TOOLBOXES comprising models for level I, II and III analysis is strongly recommended. This would allow for MSs and local authorities to make their own and referenced choice.

1.11.3. Source- pathway-receptor

The assessment of the three elements source-pathway-receptor is essential to elaborate the site conceptual model and to assess exposure and risk related to soil contamination. Most of the following considerations apply to all levels of analysis and are mainly focused at the evaluation of risks to human health.

1.11.4. Source characterization

Hazard assessment implies contaminated soil source definition**.** Guidelines for soil sampling (minimum number of boreholes and patterns) are different and not always efficient. The soil sampling, sample pre-treatment and analytical criteria are different among MSs.

<u>Harmonisation needs:</u>

- Sampling, analytical and statistical/geostatistical procedures in order to characterise source extent and contamination level in terms of representative concentrations of contaminants could be included in a joint TOOLBOX allowing for guidelines over different choices.

Much work in this direction has already been done by ISO 190 'Soil quality' and this should be continued. In addition the new CEN TC 345 'Soil quality' should be encouraged in order to screen the ISO's and prepare recommendations for possible harmonization on the basis of ISO standards. There is no need to harmonise strict procedures prescribing minimum numbers of samples, etc. as this should be adapted to the site conditions. There is a desire to work out global quality objectives (rather than quantity objectives).

1.11.5. Exposure assessment

In order to assess receptor exposure to soil contamination, pathways (pollutant linkages) must be identified in the site conceptual model.

For non-direct routes of exposure to soil (i.e. inhalation of soil dust and vapours, vegetable ingestion, drinking of groundwater), fate and transport models are needed in order to predict spatial and temporal migration of contaminants from the soil source to the point of exposure. Models used by MSs in order to predict expected contaminant concentrations in air (indoor and outdoor), in vegetables and in groundwater, are often different.

Exposure assessment has to be integrated with a toxicity assessment in order to define the risks. For human health toxicity (dose-response) of contaminants, MSs refer to several databases available (WHO, USEPA, IARC, ATSDR and national reviews). Theoretical tolerable excess lifetime risk for genotoxic carcinogenic chemicals exist in may MSs; a range is used from 10^{-6} (Denmark) to 10^{-4} (The Netherlands) per single chemical, with the majority of countries preferring 10^{-5}. Criteria for setting tolerable excess lifetime risks for chemical mixtures apply in some MS, but are different.

Existing differences between MSs in the selection of databases cannot always be explained in a scientific way.

Receptor characterisation is closely linked to the actual or expected land use for the site and its surroundings. At present MSs consider different land use categories and some MSs include only one (multifunctional) land use at level I analysis. Receptors identified in each land use may be slightly different and may have different behaviours because of geographical and lifestyle variations.

Harmonisation needs:

A set of equations (if possible validated ones) for the different exposure pathways, with different levels of complexity

A set of data for some of the exposure and transfer parameters for most frequently encountered substances (that can be combined depending on the local conditions).

There is no support for any “European Risk Evaluation Model” seen as a black box using pre-determinated pathways and site conditions.

Physical and chemical parameters of contaminants governing fate and transport processes should be available in a common, harmonized database. When these parameters depend on site-specific features (e.g. pH) guidance should be given in order to assess correct values.

A common toxicological database on carcinogenic and non-carcinogenic effects of contaminants: acceptable/tolerable daily intakes (ADI/TDI) and Cancer Potency Factors/Slope Factors (CPF/SF). We advise to work out where possible common factors and harmonised tolerable excess lifetime risk for genotoxic carcinogenics. Probably consensus will be hard to reach because:

a) Health experts will refer to subsidiarity concerning human health agreed in EU

b) There is a huge "not invented here" syndrome. National politicians will only accept the views held by the national experts and the national experts (especially human toxicologists) want to keep this special position.

Estimates for bioavailability: Most MS take conservative assumptions in order to take care of bioavailability (i.e. effective toxicity) of soil-bound contaminants. Guidelines are needed in order to account for research results. This should be harmonized, but taking into account knowledge gaps.

Information should be exchanged between different MSs on fate and transport models of different levels of complexity, for level I, II and III analysis, used to predict contaminant partitioning among phases, emission and dispersion from soil to air and to groundwater, sorption, vegetable uptake and degradation. This information might be collected in a joint toolbox.

- Requirements for environmental parameters to be investigated or estimated in order to predict contaminant migration should be included in the toolbox together with the models. “Usual” ranges of the relevant parameters should be included in the toolbox..

- Consideration of effects from other contaminant non-soil sources is needed. It should be specified when chronic versus acute effects apply. Criteria for assessing effects of mixtures of chemicals are needed. These issues can be developed in the model/risk assessment toolbox(es).

- Information on exposure parameters should be exchanged. There is no need for harmonization of these parameters since they reflect geographical and lifestyle variations that should be left as such.

1.11.6. Ecological risk assessment

MSs are more and more considering ecological receptors in assessing risks related to contaminated sites. The largest experience is with the development of level I screening values (The Netherlands, Denmark, Germany) accounting for both human health and ecological risks.. Protection of ecological receptors is based on NOEC, LOEC, LC50 values obtained in laboratory tests. Site-specific ecotoxicological tests and indicators are used quite frequently but interpretation might be difficult as long as a model of ecosystem functioning and a decisional framework are missing.

Harmonisation needs:

- Relevant ecotoxicological databases should be harmonized
- A joint toolbox should be developed in order to provide guidance of the use of tests and indicators.

1.11.7. Risks to groundwater

Groundwater is very relevant receptor to be protected from soil contamination, as an ecological resource. Nevertheless criteria in use in order to protect groundwater often refer to drinking water standards. Other uses of groundwater are also envisaged as well as categories of aquifers according to their regional/local relevance and their use. Remediation objectives and compliance criteria vary among MSs and often also at a regional level. Quality objectives for groundwater must fit WFD requirements.

Harmonization needs:

- Common principles for 'point of compliance' criteria referring to point sources (new and historic).
- Common approaches and objectives for plume management at historic point sources.
- Development of a joint toolbox for the choice and guidance on fate and transport models.

1.11.8. Uncertainties

Parameters used in risk assessment, and particularly in exposure assessment, are often subject to large uncertainties because of spatial and temporal variability, because of lack of data and because of errors in observations.

Even though probabilistic approaches are sometimes proposed in order to account for uncertainties and variability, it is generally agreed that deterministic approaches are more practical and more easily understood by the non-scientific community.

Variability and uncertainties are then taken care by MSs according to worst case or reasonably worst case criteria that are applied in different ways. This is directly related to modelling and interpretation of results.

Information exchange needs:

- Experiences should be shared on the use of worst case and reasonable worst-case analysis among MSs.
- Experiences should be shared on the management of uncertainties and on perception of uncertainties from the general public (risk communication).

1.11.9. Harmonization advice

Available advice for harmonisation, regarding several of the elements discussed, may be provided by:

- ISO/TC 190 outcomes
- Results and follow-ups of CLARINET/RIVM comparison exercise on MS exposure models
- Results and follow-ups of NICOLE comparison exercise on risk assessment models.

1.11.10. Research recommendation

Focus research on giving better estimations of transfer of contaminants to possible receptors via the different transfer routes.

1.11.11. Policy recommendation

Create an incentive to move to a global basis for risk assessment.

1.12. Management of contaminated sites

1.12.1. Risk Based Land Management: global principles

To assist in the convergence of thinking and the development of solutions for the problems presented by contaminated land in Europe, we propose the concept of risk based land management (RBLM). This concept provides a framework for the management of contaminated land in structuring the decision-making process to achieve sustainable solutions. It allows for ***regional*** and ***site-specific solutions*** in policy and other decision-making across Europe.

The RBLM concept will assist policy makers and regulators, as well as other stakeholders, in making balanced and informed decisions to achieve sustainable management of land.

Risk Based Land Management is primarily a framework for the integration of two key decisions for remediation of contaminated land:

- **The time frame**: this requires an assessment of risks and priorities, but also the consideration of the longer term effects of particular choices
- **The choice of solution**: this requires an assessment of overall benefits, costs and environmental side 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. The decision making process needs to consider three main components:

- **fitness for use**
- **protection of the environment**
- **long-term care**

The first two describe the goals in relation to a safe use of the land, including prevention of harm and resource protection. The third allows for a more rigorous assessment of the way to achieve these goals in a sustainable way. The three components need to be in balance with each other to achieve an appropriate solution.

The ***aim of the RBLM*** concept is to achieve integration of approaches originating from different perspectives (e.g. spatial planning, environmental protection and engineering), based on the identification of common goals:

- Comparable levels of protection of health and the environment, taking into account local characteristics;
- Optimised use and development of technical and administrative solutions; and
- Sustainability - evaluating and optimising environmental, economic and social factors.

The concept applies at different scales – site, regional, national – and covers the whole cycle of risk assessment and risk management of contaminated land. It is driven by current and emerging scientific knowledge. It links to wider themes, in particular to soil protection, spatial planning, and water catchment management.

The concept also applies at a strategic level. However, it has practical application at a site specific level: the operational details of treatment, monitoring, aftercare and other risk management techniques (containment techniques for instance) can be assessed using the RBLM concept on a site-specific basis.

1.12.2. The COMPONENTS of RBLM

Fitness for use

This depends on reducing risks to human health and the environment as necessary to ensure the safe use or reuse of the land. It focuses on quality requirements of the land for uses and functions, and takes into account the timeframe of the particular use of the land – for example the assessment considers how long a receptor might be exposed to contamination.

Risks related to the use of the land should be "acceptable" for the people concerned. This acceptance might be obtained if the quality of the land meets certain minimum quality requirements. In some cases, obtaining acceptance might require additional quality requirements to create confidence and security. It is essential in determining the "total quality requirements" to know all the aspects of the site use. This will ensure that the requirements are appropriate. It is also necessary to consider the future activities and controls on the site to ensure that long term risks are also managed, and that the land will continue to be "fit for use" in the future.

Making certain choices about the management of the land can not only achieve the necessary quality requirements in relation to immediate fitness for use but also improve the quality of the land over time. For example, introducing additional gradual treatment would open up opportunities for land use changes, more biodiversity and less long-term care.

Protection of the environment

Protection of the environment is related to the wider effects, in contrast to those only related to the use of the site[3]. It has two objectives:

To prevent or reduce negative impact on the natural surroundings, including ecosystem health and biodiversity;

To conserve and, if possible, enhance the quality and quantity of resources (for example land, soil, water, or cultural heritage)

Accepted principles like the precautionary principle and the preventive principle apply to both these objectives.

Preventing or controlling the dispersion of contamination from a site to the surroundings may often achieve both objectives. For example, preventing further spreading of pollution by surface water and groundwater can be a component of overall risk reduction for contaminated land. Being able to achieve both objectives depends on the uses, functions and characteristics of both the land and the surrounding environment.

The requirement to achieve both fitness for use and protection of the environment means that solutions have to be chosen carefully. A solution that meets only the fitness for use requirements is probably not the best solution if it creates potential problems in surrounding areas. A solution that manages the dispersion risk may be different from the solution that manages risks to achieve "fitness for use".

[3] In the UK the term **suitable for use** combines the two concepts of fitness for use and protection of the environment (DETR Circular 2/2000; DoE news release 654/1994)

Solutions may in turn lead to the exploitation of other resources, such as energy reserves, or land capacity for disposal. Other environmental and spatial planning policies will aim to protect these resources and a balanced decision - or new solutions - will be needed where there is conflict between the objectives of risk reduction and conservation of resources.

The decision to conserve land or soil as a resource may lead to policies favouring redevelopment of brownfields **–** land previously used, for example by industry, which may be affected by contamination - over greenfields. This in turn may lead to increased pressure to develop new solutions to deal with the risks to health and the environment. It also shows the need for strategies to prevent sites from becoming brownfields.

Long-term care

If a solution leaves contamination in the soil, there is a need for long-term care. Monitoring and control may be necessary to ensure that the solution remains appropriate, that it continues to work and that any restrictions on future choices regarding the land use are enforced.

Solutions that are based on the current use only, or rely on specific restrictions on land use need additional documentary records. Taking into account the social and economic burden of long-term care and the risk of failure is essential in identifying sustainable solutions.

1.12.3. Policy recommendation

Create a formal basis for the use of the RBLM concept to deal with contaminated sites.

1.13. Cost-effectiveness of remediation of contaminated sites – the identification of best techniques for contaminated sites remediation;

The BAT-principle is relevant to make sure that best technologies are being used for soil remediation, while taking into account also secondary effects and costs of a technology be based on cost-effectiveness and cost-benefit analysis). The decision on what is BAT for remediation of a site will be site-specific – we cannot have "BAT for remediation" but an approach which is used to determine BAT on a site-specific basis.

1.13.1. Overview of selecting the "best" remediation technique

Selection of the best techniques for contaminated site remediation may be required:

- As the first step in risk management where risk assessment demonstrates that there are unacceptable risks associated with historical contamination to human health and the environment given the current or intended site use; or
- As a result of a breach of a regulatory requirement e.g. PPC permit has caused contamination of a site; or
- Where a landowner or other person decides to remediate a site voluntarily following a spill or leak.

The main stages to selecting the "best" remediation technique can be summarised as:

- Agree the remedial objectives to be achieved for the site;
- Identify feasible remediation options;
- Carry out a structured evaluation of feasible remediation options to identify "best" option;

- Where appropriate, combine options to produce a remediation strategy ("i.e. the "best" package of remediation techniques for the site);
- Based on the evaluation of remediation options, the remedial objective may have to be rediscussed.
- Monitor effectiveness of the remedial strategy
- Based on intermediate reports of this monitoring, remedial objectives or selected remediation concepts may have to be rediscussed.

The table in annex provides a summary of the stages, key decisions and actions to take to identify the "best" remediation techniques for a contaminated site. This could be used as a decision support tool for selecting the "best" remediation technique.

Annex x contains the suggested content for technology summary sheets which may provide useful information in the short-listing of options in selecting the "best" remediation technique (Stage 1).

Guidance documents on proven technology seem to be very relevant (when can it be used, under what conditions for what kind of contamination problems), while a strict list may be dangerous, as it is often limiting evolution and very difficult to work out because of the very large variety of contamination problems. Summary sheets on technology should be a living thing; a format has to exist to ameliorate sheets that may be created.. Information on demo-cases could be very helpful and interesting.

Much research has been carried out already on remediation technologies, but very little is being coordinated. Very little information on the state of the art is present at a EU-wide scale, while several member states have worked out guidance documents for the problems they face.

Two CLARINET reports and the NATO/CCMS Pilot Study can be useful background information for further work on this).

1.13.2. Research recommendations

Sustainability of remediation concepts: most remediation concepts have an environmental impact themselves: emissions of volatile compounds, traffic, energy consumption, while on the other hand some concepts imply long-term (sometimes even eternal) care. Most often, information about those environmental impacts and impact of this long term care is very scarce.

Easy-entry decision support tools for BAT: a lot of research has been carried out already on remediation concepts, but the information is not easily accessible for the end-users. There is a strong need for a good instrument for information dissemination.

1.13.3. Policy recommendation

When EU-funds are used for soil remediation (like in funds for regional development, Interreg, Life, …) building in the necessity to use site specific BAT could trigger technology development and knowledge dissemination.

1.14. The principles to set priorities to build up a national strategy for remedial actions

Every policy must start from data from investigations, making an inventory essential. Thus, also some kind of prioritisation for site investigation is necessary, as it is not feasible to investigate all sites at the same time, nor is it desirable to do nothing untill the inventory is complete (if an inventory ever can be complete, at all). Several Member States seem to have some system of prioritisation, but they tend to be different. A prioritisation system is desirable to have some idea to plan the remediations.

1.14.1. Current situations in Member States

Several Member States have out national action plans. A crucial point in the management of contaminated sites is to understand the existing situation with respect to the size of the problem and the options available. Inventories are therefore widely used by the Member States or by local or regional authorities (see also chapter on inventories).

1.14.2. Key principles and recommendations for national action plans

1. National actions plans are useful tools to address the issue of contaminated sites, but should not be mandatory. Some MS are dealing with the problem on contaminated sites where the market is "urged" to create its own priorities, rather than having a national action plan that is strictly followed. Other MS have gone a long way in delegating contaminated land management and priority setting to local or regional authorities. Yet, it seems desirable that every MS works out a policy to tackle the contaminated land problems.

2. Priority should be given to the investigation and management of sites which represent unacceptable risks for human health and the environment.

3. Concerning historically contaminated sites where industrial activities have ceased, inventories should be carried out. At this stage, it seems difficult to harmonise in all details at Community level the scope, objectives, priorities and timeframe of such inventories. The situation varies widely among the Member States..

4. Information on the implementation of the national action plans including inventories should be shared among the Member States. The Commission could carry out an analysis of such national plans to exchange good practices in particular in view of the accession of the candidate countries. Information exchange can also be organised via structures like Eugris. *It is important that any practice recommended to the accession countries is practicable and attainable in their individual circumstances.*

1.14.3. Recommendations

- Strategic approach at national level is very useful
- Don't fix a form of approach at EU-wide level, leave MS freedom whether the inventory itself is at national or regional level
- Strategic approach for the investigation at potentially contaminated sites is necessary
- Leave MS freedom to see what kind of inventory they want/need
- An information exchange on strategic approach between MS may be very interesting

A strategic approach may imply other factors than contamination (e.g. spatial planning, social or economical aspects, …).

1.15. Aspects related to liability

Quite often, the polluter is no longer present or has no money to pay for the remediation. On the other hand, quite often it is not so clear whether the polluter can be held liable for a soil contamination, especially if he had a permit to operate. Many contaminations can't be traced that easily to a certain mistake or "fault" during the operation; quite often the contamination has been going on bit by bit for many years or even decades because of leaking tanks, tubes or reactors; this reason for leaking was often an inadequate technology to prevent all leaking, or a lack of technology to do a proper check-up of underground storage tanks or tubes. Apart of that, sensitivity to soil contamination was quite different up to about 20 years ago: dumping of industrial waste at your proper site was quite often considered as "best practice", as it took care of all the rubbish and made the rest of the site look clean.

The recent Directive on environmental damage only takes into account "future contamination", and then even just this contamination which may have a serious impact on human health. One can wonder why soil damage is regarded completely differently from water and biodiversity. The liability directive might have been an opportunity to protect soil.

1.15.1. Policy recommendation

Soil should be protected at the same level as other environmental compartments in the coming Directive on environmental damage.

1.16. Assessment of existing and the development of new mechanisms to fund the remediation of "orphan" contaminated sites

We don't like the term "orphan" sites. As raised above, there are quite many sites that have been contaminated in the past where the pollutor has either gone, or cannot be held (partly or fully) liable for the contamination. The Netherlands, Austria and Sweden have got mechanisms (agreed by EC) to co-finance the remediation of such a site by the present owner. Another example of a funding construction is "SUBAT", where money is generated by the gasoline sector (and partly paid by the consumer) to solve the problems in a sector dominated by small companies who very often have too little money to afford a soil remediation.

Some EC-funding mechanisms (such as Interreg or European Fund for Regional Development) also have possibilities to fund soil remediations; they are limited though to certain regions.

On the other hand, most Member States have got a system where the government may carry out the soil remediation of a badly contaminated land where nobody can be held liable or where the liable party can not be found. In fact, such a system can be considered as a "hidden" form of state aid to other interested parties (like the owner of the land), as the government pays for the entire remediation.

In some MS, tax breaks are available for the developer of contaminated sites (not the polluter) and exemptions are in place for landfill tax where removal of pollution is required because harm is being caused or has the potential to be caused (not available if a government remediation notice is served). This seeks to encourage re-development of brownfield instead of greenfield.

A recent contact with Mr. Colson from DG Competition clarified quite a few of the uncertainties about the "State aid" principles. An analytical lecture of the text of article 38 of the "Community guidelines on State aid for environmental protection" (2001/C 37/03) was accompanied by the vision from DG Competition on the interpretation of this article. The main conclusions are:

- The title of the article is "*rehabilitation of polluted industrial site*s". This title implies that the article is dealing only with a site that is owned by an economical actor. A site that is owned by a government does not fall under the application of this directive. This also implies that when a government buys a piece of land, and carries out the remediation afterwards, this is not regarded as state aid. Yet, when the government wants to sell this piece of land again, it has to follow the principles from the "Commission Communication on State aid elements in sales of land and buildings by public authorities" (*Official Journal C 209 , 10/07/1997 p. 0003 – 0005)*. This communication states that any sale of land owned by a government should happen at market value. If this is not the case, this sale is regarded as state aid. In principle, the market value should not be set below primary costs during a period of at least three years after acquisition unless an independent valuer specifically identifies a general decline in market prices for land and buildings in the relevant market. The remediation cost paid by the government has to be regarded as part of the primary cost. This means that there may be a problem when the price the government paid for the acquisition added with the remediation cost is higher than the land value and when the government wants to sell the land again within 3 years after acquisition.

- The first paragraph states "*Interventions made by firms repairing environmental damage by rehabilitating polluted industrial sites may come within the scope of these guidelines*". This implies that not only co-financing of remediations paid by a firm on its soil, but also remediations carried out and paid by a government at a soil owned by a firm is regarded as "state aid".

- The second paragraph states "*Where the person responsible for the pollution is clearly identified, that person must finance the rehabilitation in accordance with the "polluter pays" principle, and no State aid may be given. By "person responsible for the pollution" is meant the person liable under the law applicable in each Member State, without prejudice to the adoption of Community rules in the matter.Where the person responsible for the pollution is not identified or cannot be made to bear the cost, the person responsible for the work may receive aid*." This implies that whether a government can give state aid or not, is merely dictated by the liability legislation in the MS itself.

- The last two paragraphs indicate "aid for the rehabilitation of polluted industrial sites may amount to up to 100 % of the eligible costs, plus 15 % of the cost of the work. The eligible costs are equal to the cost of the work less the increase in the value of the land. The total amount of aid may under no circumstances exceed the actual expenditure incurred by the firm." This implies that, in principle, the full expenditure for the remediation can be financed in an aid, taking into account the increase in the value of the land. When estimating the "value

of the land", also the liability issues have to be taken into account. This means that when the present owner of the land is not the "person responsible for the pollution" (meaning not liable under the law applicable in the MS), the land value for him is the same before and after remediation. As he was not liable, the value of the land before remediation was not lowered by a liability issue, so it is not raised by the remediation. On the other hand, when the owner of the land has acquired a limited liability from the real polluter in a land transfer, the value of the land is affected by this liability issue and a remediation would restore the value to market value. In this case, the increase of value of the land has to be deducted from the eligible cost.

1.16.1. Policy recommendation

The "state aid" regulation seems to offer quite a few possibilities of cofinancement for problematic contaminated sites. On the other hand, the text itself does not seem clear, and leads to uncertainties. It would be very interesting if the text could be amended or at least clarified to reduce uncertainties.

1.17. Relevant aspects of the right and duties of ownership of the land; possibilities to encourage participation of landowners

The rights of an owner can be summarised in the following principles: he possesses the land, he may use the land and its fruits, he manages the land. Those rights can interfere with "public interest", where e.g. a soil contamination is present at a land that poses a threat to human health, groundwater quality, ecosystems, etc. Here one should state that the rights of an owner are of minor importance to the public interest.

A land owner should anyhow allow data on contamination to be public, allow investigation or remediation to be undertaken. Anyhow, an owner is an interested party in the soil quality, so he should take part in the decision making process of a remediation plan.

What to do to stimulate the market? When no liable party can be found, owner may have responsibility for remediation. A remediation carried out by the owner of the land will most often be cheaper and more efficient than one carried out by a government, as he can take into account parameters that are relevant to his own operation when planning and designing the remediation process. Such a remediation duty has to be "softened" with co-financing mechanisms, as it is often not "fair" to put the remediation bill entirely with the owner.

Generally spoken, greenfields are too easily available; this is hindering brownfield redevelopment. Land planning should take this into account.

The Flemish system not only obliges an owner to carry out a soil investigation when he wants to transfer a potentially contaminated site, but also to sign a remediation engagement when the soil investigation proves that remediation is necessary. To guarantee this engagement, a financial guarantee is demanded. This engagement and financial guarantee can also be fulfilled by the party acquiring the land.

Advantages of this system:

- remediation is not driven by priorities set by the government, but by a market instrument (desire to sell land, to merge, …)
- money is generated in the process of the transfer, so the psychological barrier to spend money in a remediation is lower (parties see the benefit i.e. realisation of the land transfer)
- the system creates a barrier against fraudulent transfers
- without any obligation posed (and controller) by the government, 1500 remediation plans have been submitted since the Flemish decree came into force (and every year between 300 and 400 are submitted)

Disadvantage of the system:

This market driven instrument is not effective when the estimated remediation cost is far higher than the potential land value. Today such sites remain unused. Some government intervention is deemed necessary to solve those (but this is a limited minority of sites).

New French legislation introduces the principle of requiring a financial guarantee for the most polluting activities in order to ensure that the contaminated sites will be remediated when the activity is stopped.

Some advantages of such a system:

- Money for the remediation is available at the moment when a problem becomes visible and the operator refuses to undertake action (or has no financial means e.g. at bankruptcy).
- The duty of a financial guarantee can be linked to the duty to have a permit to operate, and the permit to operate can be refused or stopped when the operates refuses to pay

Some disadvantages of the system

- It may take a while to build up a guarantee that is high enough
- Money from the operator is blocked, even though n contamination has been caused yet.

1.18. "*Report on land status*" to be drawn by the landowner upon any transaction of land property and/or land use change

Property is most often sold with visible and invisible faults; soil contamination very often is invisible and may hinder severely the future use of land. On the other hand, an owner has a duty of information of the interested buyer (e.g. on limitations of land use such as public right of passage …). Both those elements seem to make a report on land status very desirable when a "risk activity" has been carried out on a piece of land. Such a report might contain information on the previous activities and on the soil quality (implying a soil investigation at the moment of transfer). One might even think of moving further than that, and create some kind of "financial guarantee" at the moment of transfer to make sure (before the transfer) that

a remediation which might be necessary is being paid for by the party who is concerned. In this way, constructions may be avoided in which a liable party "sells" the badly contaminated land to an insolvent third party (whom it controls fully or partly) which goes bankrupt at the moment the government tries to enforce the duty to remediate. As the liable party will have left and the new owner has no money at all, the government will be forced to carry out the remediation and will have very little chance to recover any money at all.

A "report on land status" should be required also in case of land use change toward more sensitive use, within the same property.

2. OVERVIEW OF THE ANSWERS TO THE QUESTIONS POSED ON CONTAMINATED LAND MANAGEMENT

The following questions were posed to the Advisory Forum. The received answers are summarised beneath.

1. Should we harmonise as many Risk Assessment aspects as possible, when differences can not be objectively motivated by geological, cultural… differences? Does the AF propose that acceptable human health risk levels (e.g. tolerable cancer risk levels) should be harmonised?

Response received from:	Answer:
Austria	Concerning "historical contamination", risk assessment is a fundamental element for the proposed concept of "Risk Based Land Management". The idea of harmonized approaches and criteria to establish a common European Framework is supported. However, natural and cultural conditions vary considerably throughout Europe and different RA approaches in MS reflect these circumstances. The appropriate level of possible EU harmonisation of risk assessment aspects need to be discussed in depth between MS to avoid developments which cannot be justified for focused site-specific solutions. Harmonisation of the scientific basis (toxicology/ecotox/chemic.) of RA approaches is supported. Aspects concerning acceptable health risk levels and especially tolerable cancer risk levels are policy questions and need decisions on a political level. Harmonization in this context is seen as a prerequisite that European citizens can rely upon a common level of safety and dignity. Risks to organisms in the ecosystem should also be taken into account, as adverse effects on those might weaken the overall ecosystem and imply adverse effects e.g. on water bodies.
Belgium	Yes, as well as e.g. food standards are harmonised, human health risks related to soil should be harmonised.
Common Forum on Contaminated Land in Europe	The appropriate level of possible EU harmonisation of risk assessment aspects need to be discussed in depth to avoid developments which cannot be justified for focused site-specific solutions in the MS. The work of the EU Concerted Actions CARACAS and CLARINET (multistakeholder networks funded by DG RES) should be taken into account. Harmonisation of the scientific basis of RA approaches (toxicology, ecotox, chemical databases) is supported. Aspects concerning acceptable health risk levels should be discussed on the political level.
Eurofer	EUROFER is recommending the harmonization of the Risk Assessment principles (both the risk to the human health and the risk to the environment) in order to have a common approach in the different MS. We believe the second sub question should be addressed to the SCALE consultative forum members where the right experts could express an authorized opinion.
Eurometaux	The harmonisation of *Risk Assessment concepts* would be recommendable for several reasons, including a common understanding of the required protection targets. Guidance on Risk Assessment concepts would, for example, include how to account for natural background natural or seasonal variability, monitoring data versus calculated estimations. Beyond that, however, it does not make sense to provide too detailed guidance on the specific RA methodology, since the latter will be determined by local aspects, such as the density of the population, cultural differences, etc.).
Sweden	Yes
UEPC	First phrase: Yes, this seems reasonable. Second phrase: Yes, if there are reliable pan-European data to enable this to be done. Alternatively taking account of national differences and preferences, several risk categories could be established with a view to merging them in future.

2. Does the AF agree that Risk Based Land Management is the relevant concept to manage historically contaminated land?

Response received from:	Answer:
Austria	Yes. Experiences at national level and EU-wide co-ordinated networking reveal that this approach is an effective way to manage historic contamination under the aspect of sustainability.
Belgium	Yes, as this allows to control the problem and the risks in an affordable and efficient way.
Common Forum on Contaminated Land in Europe	Yes. Experiences at national level and EU-wide coordinated networking between MS reveal that this approach is an effective way to manage historical contamination under the aspect of sustainability.
Eurofer	EUROFER fully supports this concept.
Eurometaux	*Risk-based land management* is the ONLY practical and relevant way to handle historically contaminated land and to ensure that progress can be made within a reasonable timeframe. National inventories of historically polluted soils have clearly indicated the high number and complexity of the issue, thereby underlining the need for a clear prioritisation of the order to tackle sites with historical pollution, as well as the need for Risk Assessments of the cases to be conducted in order to focus and determine proper Risk Management in a cost-efficient way.
Sweden	Yes
UEPC	Yes, provided procedures are put in place to enable the transfer of land for development. UEPC supports the use of Land Condition Reports as a way of declaring the condition of land that is transferred from one owner to another.

3. Does the AF agree that Member States that do not have a distinction between historical and new contamination so far, should provide for this?

Response received from:	Answer:
Austria	Definitely yes. Historic and new contamination need different management approaches. Risk based land management (based on the repair principle) is an effective tool to manage ”historical contamination” because of the legal, financial and technical problems involved. New contamination should be managed on the basis of the precautionary principle to remove the damage immediately and completely.. Therefore a distinction of new and old contamination is supported.
Belgium	Yes, as new contamination should be dealt with in line with the prevention principles, where as the problems of historical contamination are so big that they have to be tackled in an efficient way.
Common Forum on Contaminated Land in Europe	Historical and new contamination (= before/after preventive regulation) are addressed with different management approaches in most MS. Risk based land management is an effective tool to manage ”historical contamination” because of the legal, financial and technical problems involved. With regard to sustainability, “new contamination” should be removed immediatelly and completely.
Eurofer	EUROFER supports such a distinction and recommends that it should to be applied in each MS.
Eurometaux	There is an absolute need for a clear distinction to be made between New and Historical contamination, since the focus for risk management is based on a different concept for each of them: 1. *New contamination*: focus on the prevention of soil contamination 2. *Historical contamination*: focus on priority-based risk management
Sweden	Yes
UEPC	Yes, in order that the polluter pays principle can be enforced where possible. (The UK requires the polluter of the land, or the owner of the land where the polluter can not be found, to remediate that land where it is causing or has a significant possibility to cause harm to human health, ecological systems, animals, crops and buildings as defined)

4. Does the AF agree that soil quality data on contaminated sites should be made available to the responsible authorities (and thus to the public)?

Response received from:	Answer:
Austria	In the sense of an efficient management of a contaminated land programme, soil quality data should be made available to responsible authorities (e.g. environment, spatial planning). Public information on contaminated sites should be based on aggregated information and only in case of proven contamination in order to avoid uncertified blight of land value.
Belgium	Yes (but with caution to the public), as the fact that the site is contaminated implies that the contamination poses a risk, this information is of public interest
Common Forum on Contaminated Land in Europe	To enable an efficient management of a contaminated land programme, soil quality data should be made available to the responsible authorities (environment, spatial planning). Public information on contaminated sites should be based on aggregated information and only in case of proven contamination in order to avoid uncertified blight of land value.
Eurofer	EUROFER agrees for privately owned sites when there is a motivated request from the authorities: the soil quality data on contaminated sites should however never been made publicly available without their interpretation by authorized persons showing the risk these contaminations could pose for the environment.
Eurometaux	No reply
Sweden	Yes
UEPC	Yes, this seems inevitable.

5. Does the AF agree that soil and groundwater have to be regarded and managed in an integrated way at contaminated land?

Response received from:	Answer:
Austria	Yes. Soil, groundwater and sediments should be managed in an integrated way. The coordination of a future EU soil strategy with the WFD/GWD is supported (because contam. soils are a major source for ground-/water contamination).
Belgium	Yes, as soil often is the medium via which contamination moves to the groundwater; if you want to manage groundwater quality in an effective way, soil and groundwater quality have to be regarded and managed in an integrated way.
Common Forum on Contaminated Land in Europe	Yes. Soil, groundwater and sediments should be managed in an integrated way. The coordination of a future EU soil strategy with the WFD/GWD is supported (contam. soils are a major source for ground-/water contamination).
Eurofer	EUROFER agrees in particular when the risk based approach makes it necessary.
Eurometaux	*Soil and groundwater* are interlinked environmental compartments, and therefore need to be managed in an integrated way. To focus on a single compartment could result in inappropriate risk evaluation or risk management recommendations.
Sweden	Yes
UEPC	Yes, this makes sense.

3. Annexes

3.1. Relevant existing EU-legislations

According to Article 2 of **Directive 2003/4/EC of the European Parliament and of the Council 2003 on public access to environmental information and repealing Council Directive 90/313/EEC** "environmental information" means any information … on, inter alia, the state of the elements of the environment, such as air and atmosphere, water, **soil, land, landscape and natural sites including wetlands, coastal and marine areas**, biological diversity and its components, including genetically modified organisms, and the interaction among these elements. Francesca will go through this directive. Group will give info on what info should be included and what can be concluded.

According to **Commission Decision 2000/479/EC on the implementation of a European pollutant emission register (EPER)** according to Article 15 of Council Directive 96/61/EC concerning integrated pollution prevention and control (IPPC) Member States shall report to the Commission on emissions from all individual facilities with one or more activities as mentioned in Annex I to the IPPC Directive. The report must include the **emissions to air and water** for all pollutants for which the threshold values are exceeded; both pollutants and threshold values are specified in Annex A1.

3.2. Risk-Based Land Management – A Concept for the Sustainable Management of Contaminated land

Copied from the Clarinet report

3.2.1. Summary

The concept of Risk-based Land Management developed during the course of the CLARINET concerted action[4] to provide a framework for development of policy, research and practice in sustainable management of contaminated land. It focuses on legacy contamination and allows for regional and site-specific solutions in policy and other decision-making across Europe. It aims to integrate the decisions on *timeframe* and on *choice of solution* by considering three components *fitness for use*, *protection of the environment* and *long term care*. The RBLM concept will assist policy makers and regulators, as well as other stakeholders, in making balanced and informed decisions to achieve sustainable management of land. The RBLM concept and its relevance for sustainable management of European soil- and water resources is presented with the CLARINET report "Sustainable Management of Contaminated Land", which is available for download on the CLARINET website http://www.clarinet.at.

3.2.2. Introduction

Twenty or so years ago land contamination was usually perceived in terms of relatively rare incidents, with poorly known but possibly catastrophic consequences for human health and the environment. Several incidents attracted major media attention, e.g. Love Canal, New York State; Times Beach, Missouri; Lekkerkerk, the Netherlands. As a result politicians responded by seeking maximum risk control: pollution should be removed or contained completely. The Superfund programme in the USA, which was largely a response to Love Canal and a few other highly-publicised sites, initially focused on 'the worst 100 sites in the nation'. Even today, after almost 20 years and the expenditure of many billions of dollars, the number of US sites cleaned up under the Superfund programme amounts to only a few hundred.

Today land contamination is no longer perceived in terms of a few severe incidents, but rather as a widespread structural problem of varying intensity and significance. It is now widely recognised that drastic risk control, for example cleaning up all sites to background concentrations or to levels suitable for the most sensitive land use, is neither technically nor economically feasible. To give an example, in 1981 about 350 sites in the Netherlands were thought to be contaminated and possibly in need of remedial action. By 1995 the number had grown to 300,000 sites with an estimated cleanup cost of 13 billion EURO. Similar circumstances exist in most other industrialised countries. Consequently, although the need for policies to protect soil and groundwater is recognised, strategies for managing "historical" contaminated land – legacies from past industrial activities – have moved towards sustainable solutions based on fitness for use (Ferguson, 1999)

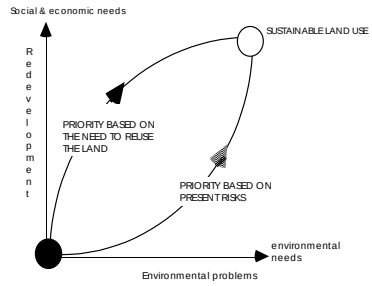
However, effective and responsible risk-based management approaches require substantial research efforts to provide a reliable scientific basis for sound decision making.

3.2.3. Policy approaches

Policies traditionally often view contaminated land problems from two main perspectives. The first is the perspective of protection - relating to the impact of contamination on human health and environmental quality. The other is the spatial planning perspective - managing the impact of contaminated land on the way land is used, for example regenerating industrial areas, or increasing agriculture use, or for creating a nature area.

These different perspectives influence the different legal regimes used in different countries: some countries use environmental legislation as the primary means of preventing impacts from land contamination on land use and the environment, others use spatial planning legislation.

The major trend in policy development is to address these two aspects simultaneously *(figure 1).* This is increasingly evident in the development of a more holistic approach to management of urban development. This in turn increasingly links to economic issues, such as changes to land values and use of the market to drive environmental improvements.



[4] CLARINET has been a concerted action on contaminated land funded under the European Commission 4th Framework Programme for Research and Technological Development, with all EU member states also supporting participation and funding specific projects and activities

Figure 1: Trend in policy development in European countries

Different drivers for solving contaminated land problems ultimately aim at restoring the capacity to reuse the land. Defining contaminated land problems as a general burden for society instead of a sectoral environmental or spatial planning problem will assist in finding sustainable solutions

Underlying all this is the wider perspective of sustainable development[5], in particular the need to consider the timing of any intervention and the future consequences of any particular solution in relation to environmental, economic, social and cultural dimensions.

The need for new solutions

The focus on developing integrated and sustainable approaches has resulted in a shift in attention from the assessment of problems to the formulation of solutions that will meet both the present and future needs of society.

The need to focus on solutions applies just as much on contaminated land. However, this is taking place against a backdrop of limited information about the full extent and significance of contaminated land, of changing attitudes and systems, and of concerns that decisions taken now should fit within a vision of a sustainable future. Current approaches focus on better-informed and sustainable solutions, which will manage the contamination effectively and restore the social, environmental and economic value of the land.

3.2.4. The concept of Risk Based Land Management

CLARINET considers that an intellectual framework for management of contaminated land would assist in structuring this decision-making process to achieve sustainable solutions. The concept of Risk Based Land Management (RBLM) aims to fulfil this role. It focuses on legacy contamination and allows for regional and site-specific solutions in policy and other decision-making across Europe.

Risk Based Land Management is primarily a framework for the integration of two key decisions for remediation of contaminated land:

The time frame: this requires an assessment of risks and priorities, but also the consideration of the longer term effects of particular choices

The choice of solution: this requires an assessment of overall benefits, costs and environmental side 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. The decision making process needs to consider three main components which form the core of the RBLM concept:

- fitness for use
- protection of the environment, and
- long-term care.

The first two describe the goals in relation to a safe use of the land, including prevention of harm and resource protection. The third allows for a more rigorous assessment of the way to achieve these goals in a sustainable way. The three components need to be in balance with each other to achieve an appropriate solution *(see figure 2)*.

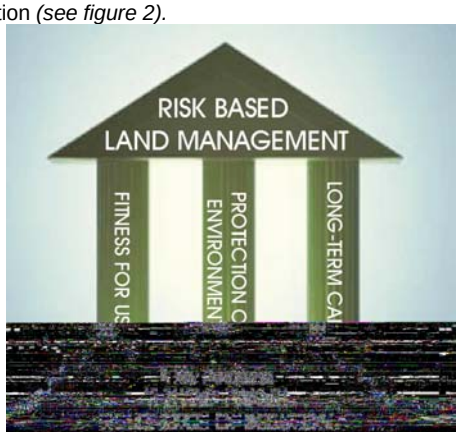


Figure 2: The architecture of RBLM

3.2.5. The aim of RBLM

The aim of the RBLM concept is to achieve the integration of approaches originating from different perspectives (for example spatial planning, environmental protection and engineering), based on the identification of common goals:

Comparable levels of protection of health and the environment, taking into account local characteristics;

Optimised use and development of technical and administrative solutions; and

Sustainability - evaluating and optimising environmental, economic and social factors

The concept applies at different scales – site, regional, national – and covers the whole cycle of risk assessment and risk management of contaminated land. It is driven by current and emerging scientific knowledge. It links to wider themes, in particular to soil protection, spatial planning, and water catchment management.

The concept also applies at a strategic level. However, it has practical application at a site specific level: the operational details of treatment, monitoring, aftercare and other risk management techniques (containment techniques for instance) can be assessed using the RBLM concept on a site-specific basis.

[5] This concept gained international governmental recognition at the United Nation's Earth Summit conference in Rio de Janeiro in 1992. Sustainable development has been defined as: "…. *Development that meets the needs of the present without compromising the ability of future generations to meet their own needs*" (Brundtland 1987).

3.2.6. The components of RBLM
Fitness for use

This depends on reducing risks to human health and the environment as necessary to ensure the safe use or reuse of the land. It focuses on quality requirements of the land for uses and functions, and takes into account the timeframe of the particular use of the land – for example the assessment considers how long a receptor might be exposed to contamination.

Risks related to the use of the land should be "acceptable" for the people concerned. This acceptance might be obtained if the quality of the land meets certain minimum quality requirements. In some cases, obtaining acceptance might require additional quality requirements to create confidence and security. It is essential in determining the "total quality requirements" to know all the aspects of the site use. This will ensure that the requirements are appropriate. It is also necessary to consider the future activities and controls on the site to ensure that long term risks are also managed, and that the land will continue to be "fit for use" in the future.

Making certain choices about the management of the land can not only achieve the necessary quality requirements in relation to immediate fitness for use but also improve the quality of the land over time. For example, introducing additional gradual treatment would open up opportunities for land use changes, more biodiversity and less long-term care.

Protection of the environment

Protection of the environment is related to the wider effects, in contrast to those only related to the use of the site6. It has two objectives:

To prevent or reduce negative impact on the natural surroundings, including ecosystem health and biodiversity;

To conserve and, if possible, enhance the quality and quantity of resources (for example land, soil, water, or cultural heritage)

Accepted principles like the *precautionary principle*[7] and the *preventive principle*[8] apply to both these objectives.

Preventing or controlling the dispersion of contamination from a site to the surroundings may often achieve both objectives. For example, preventing further spreading of pollution by surface water and groundwater can be a component of overall risk reduction for contaminated land. Being able to achieve both objectives depends on the uses, functions and characteristics of both the land and the surrounding environment.

The requirement to achieve both fitness for use and protection of the environment means that solutions have to be chosen carefully. A solution that meets only the fitness for use requirements is probably not the best solution if it creates potential problems in surrounding areas. A solution that manages the dispersion risk may be different from the solution that manages risks to achieve "fitness for use".

Solutions may in turn lead to the exploitation of other resources, such as energy reserves, or land capacity for disposal. Other environmental and spatial planning policies will aim to protect these resources and a balanced decision - or new solutions - will be needed where there is conflict between the objectives of risk reduction and conservation of resources.

The decision to conserve land or soil as a resource may lead to policies favouring redevelopment of brownfields – land previously used, for example by industry, which may be affected by contamination - over greenfields. This in turn may lead to increased pressure to develop new solutions to deal with the risks to health and the environment. It also shows the need for strategies to prevent sites from becoming brownfields.

Long-term care

If a solution leaves contamination in the soil, there is a need for long-term care. Monitoring and control may be necessary to ensure that the solution remains appropriate, that it continues to work and that any restrictions on future choices regarding the land use are enforced.

Solutions that are based on the current use only, or rely on specific restrictions on land use need additional documentary records. Taking into account the social and economic burden of long-term care and the risk of failure is essential in identifying sustainable solutions.

3.2.7. How RBLM can work in practice

The way in which the balance between the three components of RBLM is achieved will be different for different treatment approaches. Over the past fifteen years, developments in contaminated land policies and the emergence of a wide range of treatment approaches have broadened the repertoire of potential solutions for contaminated land problems. There can be other options rather than only 'dig and dump' or containment.
However, it is clear that there is no universally practical solution. Each solution has its advantages and disadvantages, which depend on a wide range of factors and requirements, such as:

- nature of the contamination
- physical characteristics of the land
- use of the land, either current or planned
- the environmental setting, in particular ecosystems and buildings
- the hydrogeological characteristics and impact on water resources,
- nature of impact on community
- local and regional practicalities

These factors and requirements vary from one situation to another, and as a result the practical availability and appropriateness of solutions needs to be determined on a site-specific basis. The overall balance of disadvantages

[6] In the UK the term **suitable for use** combines the two concepts of fitness for use and protection of the environment (DETR Circular 2/2000; DoE news release 654/1994)

[7] **Precautionary principle:** Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation (Rio Declaration, 1992)

[8] **Preventive principle** The state of the environment should not get worse as a result of pollution that can be avoided. Further pollution of already polluted areas should be avoided. The principle also implies that accumulation of persistent substances in the environment should be stopped (UN-DPCSD, 1995)

and benefits can then be determined for those options which are technically possible. RBLM provides a framework for determining this balance in practice.

The choice of any specific practical option, either at a strategic policy level or for a particular site, needs to take into account the extent to which the land meets any fitness for use criteria, achieves adequate protection of the environment or needs longer term care. This assessment is complex, and has already generated a demand for decision support tools, which may vary from straightforward information about the broad advantages and disadvantages of various options to formalised weighting systems.

On the basis of the underlying three components of risk based land management: *fitness for use, protection of the environment and long term care*, **the risk based land manager has to address the following issues in order to ensure a sustainable solution:**

- Risk reduction
- Land use related requirements
- Using natural capacities in the soil and water environment
- Costs
- Involving stakeholders
- Managing uncertainties
- Other management constraints and influences

These issues are discussed in more detail in the CLARINET report "Sustainable Management of Contaminated Land", which is available for download on the CLARINET website http://www.clarinet.at.

3.2.8. The way forward

To put the RBLM concept into practice, action therefore needs to take place on three main fronts:

- in continued research to improve the knowledge base and develop tools to support the emerging areas of European policy which are affected by contaminated land;
- in improving practice by the transfer of knowledge and information to a range of groups; and
- in integration of policy approaches.

The RBLM concept and its relevance for sustainable management of soil- and water resources are currently discussed at a European and - in some cases – national level. For example, the EU Common Forum (a platform between the European Commission and the national Environment ministries on contaminated land management) evaluates the presented CLARINET conclusions with regard to future EU regulations, such as the Water Framework Directive and possible "Daughter-Directive" on groundwater, the EU Soil Policy, the Environmental Liability Directive and the 6th RTD Framework Programme.

3.2.9. Future

Environmental priority setting for policymaking and regulation has often considered water and air before land. Land issues - such as contamination, land use, soil protection and waste disposal - are still considered in different compartments and, to some extent as a result, as a series of ad hoc problems. Technical solutions have often addressed a narrow perspective; in particular, the long-term value of the land as an environmental resource or the wider impacts of particular technologies have not been considered.

As experience has shown in other environmental fields, a narrow problem-oriented approach will not automatically lead to a sustainable use of environmental resources. The total environment, including soil and water, has to be managed in a sustainable way.

Better decisions about the solutions of contaminated land problems can be made if there is clear interaction and integration of the management of contaminated land, of land use planning, and of wider environmental protection controls, which of course must include waste management.

The Risk Based Land Management concept of the CLARINET concerted action is intended to be a step forward towards an integration of sustainable soil quality, protection of water and land use management in environmental policy.

CLARINET's vision is to see a change in social and political attitudes away from a negative perception of contaminated land towards that of positive shared action to conserve and enhance the soil and water resources.

3.2.10. References

CARACAS - Concerted Action on Risk Assessment for Contaminated Sites in Europe (1996-98): *http://www.caracas.at*

CLARINET – Contaminated Land Rehabilitation Network in Europe (1998-2001): *http://www.clarinet.at*

Ferguson C. (1999) Assessing Risks from Contaminated Sites: Policy and Practice in 16 European Countries; Land Contamination & Reclamation, 7 (2) pp. 33, EPP Publications. Available on http://www.caracas.at

Vegter J.J., Lowe J., Kasamas H. (2002) Sustainable Management of Contaminated Land: An Overview Austrian Federal Environment Agency 2002 on behalf of CLARINET. Available on *http://www.clarinet.at*

3.2.11. The work of CLARINET

CLARINET has been a concerted action on contaminated land funded under the European Commission 4th Framework Programme for Research and Technological Development. It developed as part of a wider history of emerging collaboration and international exchange on contaminated land. In particular it builds on the work of CARACAS (CARACAS - Concerted Action on Risk Assessment for Contaminated Sites in Europe (1996-98): *http://www.caracas.at*) and has links with other networks and organisations.

The overall aim of CLARINET has been to identify efficient ways to deal with contaminated land without compromising public health and water quality, business confidence in the benefits of land regeneration, or the sustainable use of land. As a focussed network, it has promoted partnership between the EC and member

states, between the 20 or more countries who send representatives and between many different stakeholders (including Government Ministries and Agencies, industry, and scientists). It is multidisciplinary and has aimed to be a catalyst between different perspectives. It has contributed to continuing research and technological development programmes both under the EC 5th Framework Programme and beyond, and at national level.

CLARINET has concentrated its work on a number of key areas of relevance to find solutions to contaminated land problems. Working groups have covered:

- Impact of contaminated land on water resources
- Brownfield redevelopment
- Human health
- Ecological health related to land uses and functions
- Remediation technologies and techniques
- Decision support
- Collaboration of R&D programmes in Europe.

All of these groups have produced specific outputs which are available on the CLARINET Website *http://www.clarinet.at*

3.3. Concept to come to BAT

Main stages of options appraisal	Key decisions at each stage	Actions / Factors to take into account
Identifying feasible remediation options (Stage 1)	1. What site specific remediation and other objectives should apply to options appraisal? 2. Is there sufficient data? 3. Which remediation options should be taken forward for more detailed consideration?	1. Establish the remedial objectives to be achieved. 2. Review the existing data to decide if there is sufficient information available to produce a list of potential remedial techniques. 3. Produce a shortlist of potential remedial techniques using the following factors (example technology summary sheet attached): • Is it effective in dealing with the substance and its properties? • Is it effective in dealing with the contamination for the location /media type as identified? • Is it effective and durable in dealing with the contamination using a preferred strategic approach (i.e. treating source, breaking the pathway and /or controlling the receptor)?
Carrying out a detailed evaluation of feasible remediation options to identify the 'best' option (Stage 2)	1. Which is the "best" remediation option? 2. Which options, if any can / need to be combined to produce a remediation strategy?	1. Evaluate in detail whether each short-listed option is likely to achieve the remedial objectives in the required time-scale and be practicably implementable given the circumstances of the site in question (Example technology summary sheet attached). 2. Identify if any if the short-listed options require a site specific treatability study to confirm likely effectiveness (Example technology summary sheet attached). 3. Establish the verification and long-term monitoring / management requirements for each short-listed option. 4. Consider whether any of the short-listed options could be combined with others to achieve a more efficient remediation scheme. 5. Assess the remedial techniques using a number of factors including: • Practicability – technical constraints, site constraints, time constraints, Regulatory constraints, • Adverse environmental impacts • Effectiveness – ability of remediation to achieve the objectives; • Durability – Extent to which the remediation will continue to be effective in achieving the objectives over time; • Reasonableness – consideration of the costs and benefits of remediation. In some cases, it may prove difficult to identify remedial options that will meet all the objectives, in which case, there may need to be a trade off between the criteria or objectives may need to be reviewed. In addition, if no remedial option can be identified (e.g. because the technology doesn't exist or it is not cost effective to do anything) it may be necessary to review the remedial objectives or implement monitoring of the situation. 6. Consider whether or not efficiency in time or resources could be achieved if a combination of actions into a strategy could be undertaken.
Where appropriate, combining options to produce a remediation strategy (Stage 3)	What combination of options will produce a remediation strategy that will meet all objectives and deal with the site as a whole?	Select either the "best" remediation technique or combination of techniques to remediate the site.

3.4. Suggested Content of Remedial Treatment Summary Sheets

1. **Classification of remedial treatment** e.g. containment system, biological processes, chemical processes, solidification / stabilisation, physical processes, thermal process, other.

2. **Basic process description**

3. **The effectiveness of the remedial treatment** e.g. what sort of contaminants it can be used to remediate, the chemical properties that should be considered for the contaminants, site conditions which can influence the effectiveness of the treatment, whether or not treatability studies will be required, timescales for effectiveness of the treatment.

4. **Durability of the remedial treatment** e.g. characteristics for long term performance.

5. **Practicability** e.g. practical constraints contaminants chemical properties, site conditions that influence effectiveness, Timescales to achieve effective remediation, wider environmental impacts of the remediation, regulatory requirements, practical operational advice on good practice management, technology track record, potential for integration with other remedial treatment actions.

6. **Costs** e.g. factors that influence relative cost of remediation.

7. **References and further information**

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