CURRENT STATE AND FUTURE PROSPECTS OF REMEDIAL SOIL PROTECTION

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- Background paper - [1]

1 Introduction

The legal basis for soil protection in the Federal Republic of Germany is:

- The Act on Protection against Harmful Changes to Soil and on Rehabilitation of Contaminated Sites (Federal Soil Protection Act) (Bundes-Bodenschutzgesetz - BBodSchG) of 1998 [1]
- The Federal Soil Protection and Contaminated Sites Ordinance (BBodSchV) of 1999 [2].

In Germany, the Federal Government has legislative competence in the field of soil protection. The *Länder* (German federal states), in turn, are responsible for enforcement of the BBodSchG and the BBodSchV; they may also issue supplementary procedural regulations.

According to Article 1 BBodschG, the purpose of the Act is *inter alia* to **protect and restore the functions of the soil on a permanent sustainable basis. These actions shall include prevention of harmful soil changes as well as rehabilitating soil, contaminated sites and waters contaminated by such sites in such a way that any contamination remains permanently below the hazard threshold.** Whilst prevention aims to protect and preserve soil functions on a long-term basis, the object of remediation is mainly to avert concrete hazards in a spatial, temporal and manageable causative context.

"Remedial soil protection" encompasses a tiered procedure in which a suspicion is verified successively and with least-possible effort and in which the circumstances of the individual case at hand are taken into account in deciding whether or not a need for remediation exists. It comprises the systematic stages of identifying, investigating and assessing suspect sites and sites suspected of being contaminated with a view to their hazard potential, determining whether remediation is necessary, remediating identified harmful soil changes and contaminated sites, and carrying out, where necessary, aftercare measures following final inspection of the remedial measure.

2 Basis and measures of remedial soil protection

Article 2 (2) no. 1 of BBodSchG states that the soil performs natural functions

a) as a basis for life and a habitat for people, animals, plants and soil organisms,
b) as part of natural systems, especially by means of its water and nutrient cycles,
c) as a medium for decomposition, balance and restoration as a result of its filtering, buffering and substance-converting properties, and especially groundwater protection.

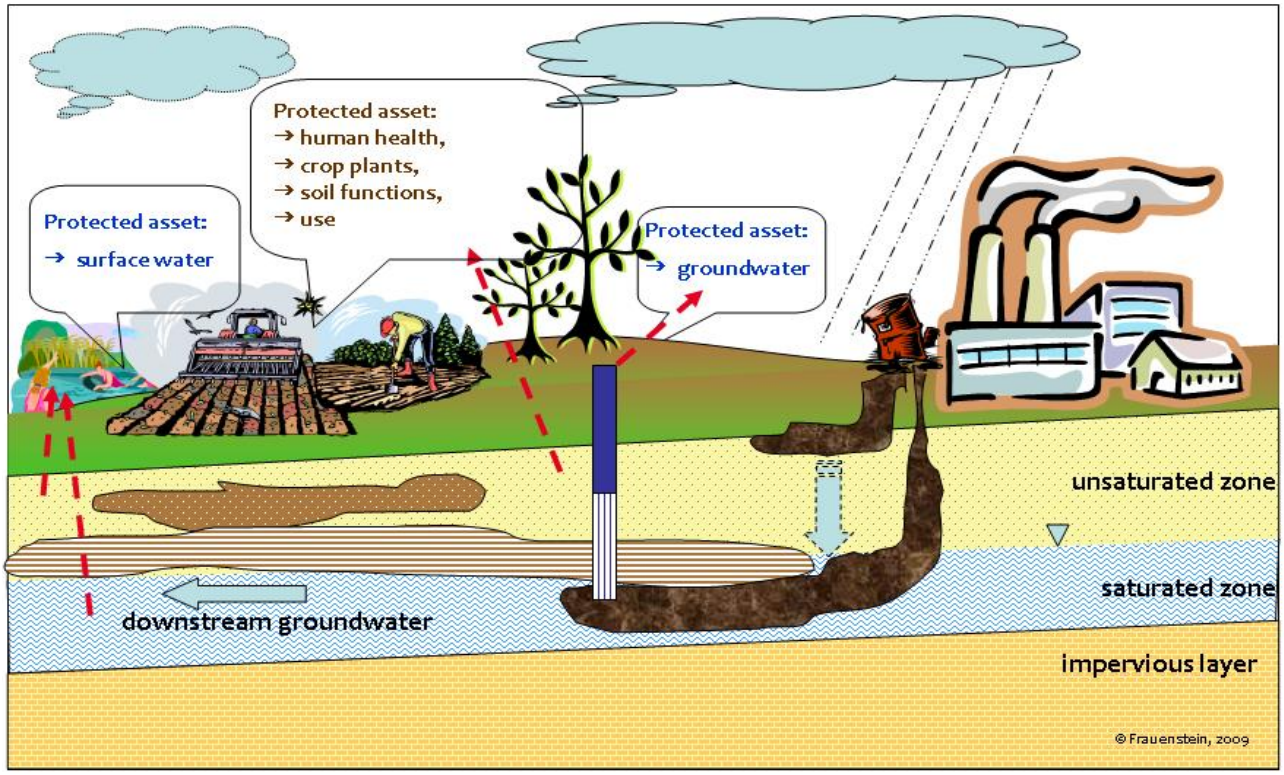
Pollutant and other impacts such as erosion, compaction, loss of organic material, salinisation, contamination, etc., may adversely affect these natural soil functions to such a degree as to result in harmful soil changes (as defined in Article 2 (3) BBodSchG).

Pollutant inputs into the soil may lead to impairment of natural soil functions or to hazards or damage to other protected assets as a result of accumulation, retardation, transport, reaction or degradation processes. They may originate from point, area or diffuse sources and give rise to harmful soil changes or contaminated sites (as defined in Article 3 (5) BBodSchG).

Contaminated sites within the meaning of BBodSchG are former waste disposal sites and former industrial sites that cause harmful soil changes or other hazards for individuals or the general public. This includes, for example, sites at which in the past waste has been treated, stored or landfilled (former waste disposal sites) or environmentally hazardous substances have been handled (former industrial sites).

In Germany, contaminated sites are dealt with by applying a tiered scheme which has proved to be robust and reliable in enforcement. Using this methodology, the suspicion of site contamination in terms of the existence, concentration and behaviour of hazardous substances and their effects on relevant transfer routes, protected assets and receptors is successively verified on the basis of available information and targeted investigations. It is usually not until the final risk assessment that the competent authority decides whether a site is contaminated and must be cleaned up. The investigation and assessment steps on the way to that decision are

[1] Editorial deadline: August 2009



sequenced so as to enable the authority to decide at each stage about necessary further steps on the basis of the information available at the time. As the number of investigation steps increases, so do the specific costs incurred and the reliability of the conclusions drawn. This methodology is no dogma, but enables the competent authority to consider a suspicion as having been ruled out on the basis of the available information, to close knowledge gaps through further investigations or to initiate immediate measures to avert hazards.

Key determinants for the potential hazards caused by pollutant inputs are the type and quantity of the pollutants, their dispersal / opportunities to disperse via relevant transfer pathways, and their potential effect on relevant protected assets/receptors.

Determining the hazard potential / extent of damage is the object of an exploratory investigation and, if necessary, a detailed investigation as defined in Article 2 nos. 3 and 4 BBodSchV. Pollutant inputs do not per se justify the need for hazard prevention; rather, this requires a risk assessment to be performed:

For a final risk assessment, the relevant circumstances (in terms of damage, site, protected asset and use) of the individual case need to be considered and evaluated.

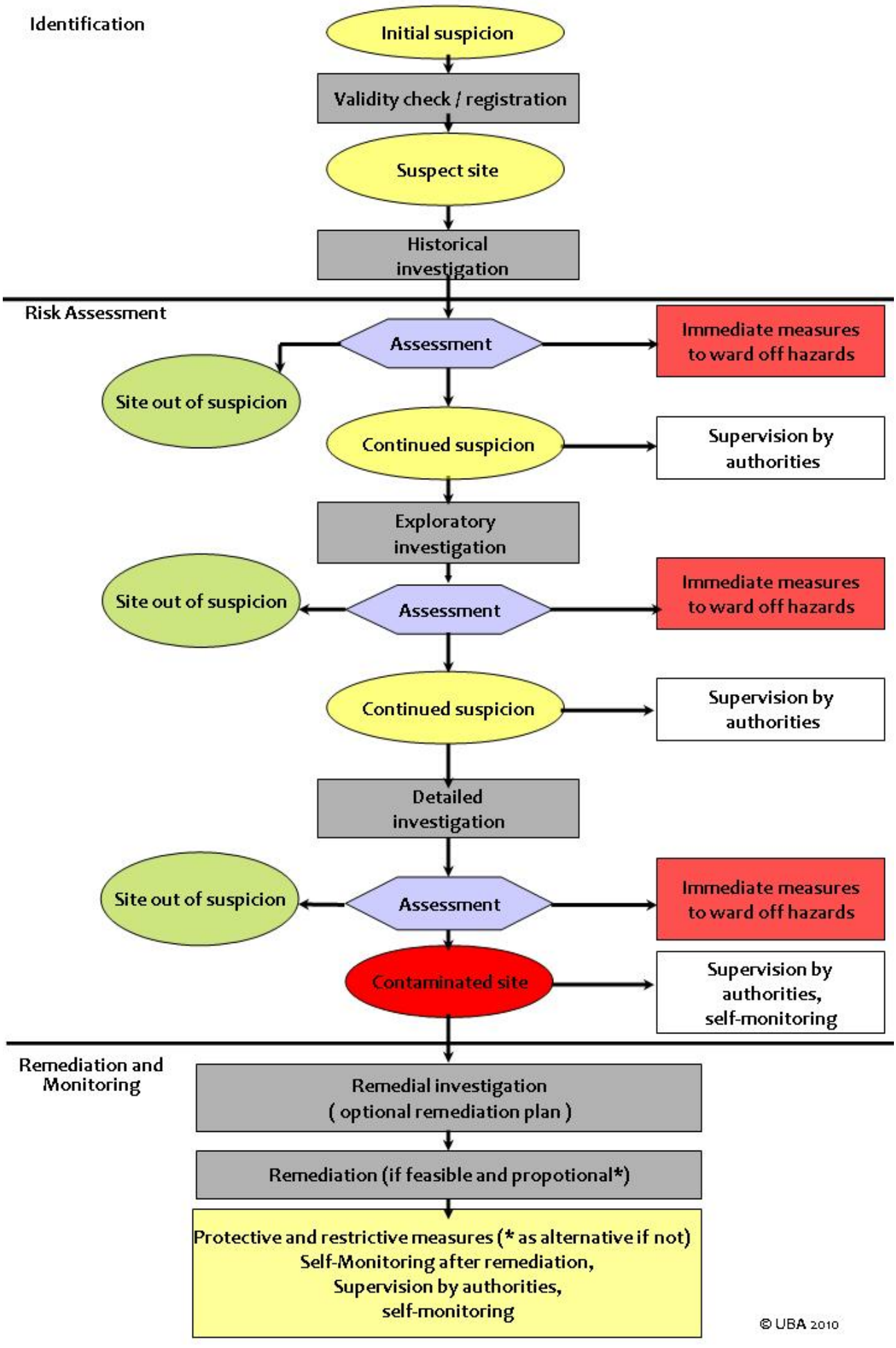
Protected assets:

- human health
- water resources and quality,
- air quality
- soil with natural functions
- nature and landscape

The obligations in relation to hazard prevention are set out in Article 4 BBodSchG :

The soil and contaminated sites, and any water pollution caused by harmful soil changes or contaminated sites, shall be remediated in such a manner that no hazards, considerable disadvantages or considerable nuisances for individuals or the general public occur in the long term.

Depending on the pedological, hydrogeological and hydraulic conditions at the site, its present and future use (as permitted under planning law), the properties of the pollutants, the relevant transfer / effect pathways and the protected assets affected, different options and different


Identification
Initial suspicion
Validity check / registration
Suspect site
Historical investigation
Risk Assessment
Assessment
Immediate measures to ward off hazards
Site out of suspicion
Continued suspicion
Supervision by authorities
Exploratory investigation
Site out of suspicion
Assessment
Immediate measures to ward off hazards
Continued suspicion
Supervision by authorities
Detailed investigation
Site out of suspicion
Assessment
Immediate measures to ward off hazards
Contaminated site
Supervision by authorities, self-monitoring
Remediation and Monitoring
Remedial investigation (optional remediation plan)
Remediation (if feasible and propotional*)
Protective and restrictive measures (* as alternative if not)
Self-Monitoring after remediation,
Supervision by authorities,
self-monitoring
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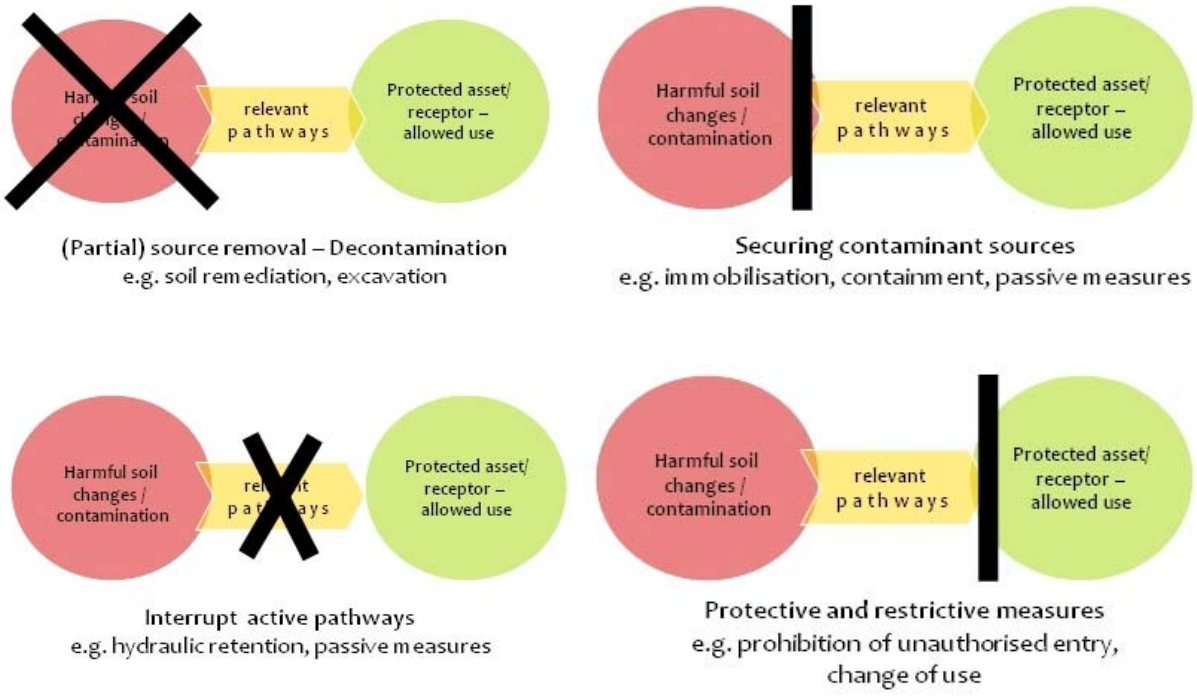

possible measures or combination of measures may usually be considered for hazard prevention.

The remediation investigation regulated by Annex 3 to BBodSchV is a comparative review of suitable measures (e.g. remediation methods and strategies). In this review, the principle of proportionality must be observed: The measures stipulated by the competent authority, and their consequences for the party obligated to carry them out, must be in reasonable proportion to the hazard to be prevented. This means that preference must be given to that measure / combination of measures which while being equally effective represents the "milder means" (i.e. is necessary) and which exhibits an adequate cost-benefit ratio.

According to Article 2 (7) BBodSchG, possible measures for long-term hazard prevention (remediation) include not only decontamination measures, in which pollutants are removed or reduced, but also containment measures, which prevent or reduce spreading of pollutants in a lasting way.

Aftercare measures will be necessary whenever any remaining pollution potential demands that the effectiveness and functioning of remediation structures and facilities be maintained for the long term and effect pathways be monitored.

If suitable remedial measures are disproportionate, protective or restrictive measures may be applied. However, for sites which became contaminated after the date the BBodSchG entered into force, i.e. 1 March 1999, only decontamination is allowed.

The costs and time necessary to achieve the remediation objectives defined (and for any necessary aftercare) may vary considerably, depending on what combinations of measures can be used.

Since the hazard prevention obligation pursuant to Article 4 (3) BBodSchG is based on the precautionary principle, coverage of the remediation costs is a key question and often presents a key hurdle for the implementation of necessary measures, as it is not always possible to identify a party obligated to carry out remediation and call that party to task.

3 The system of values under the BBodSchG und BBodSchV

The principle enshrined in the BBodSchG for remedial soil protection is hazard prevention. In the BBodSchV, the material standards for hazard assessment are further specified in the form of trigger values and action values for certain pathways and pollutants.

Trigger values are concentrations that, if exceeded, require an investigation to be undertaken

on a case-by-case basis, taking into account the relevant land use. Concentrations below the trigger value rule out any suspicion of a hazard for the pollutant concerned, i.e. the suspicion of harmful soil changes is deemed unfounded and no further investigations are necessary. If concentrations are above the trigger value, then this gives cause to suspect that harmful soil changes exist or that the site is contaminated and requires further assessment steps to clarify and evaluate the suspicion.

Action values are concentrations that, if exceeded, shall normally be deemed to indicate the presence of a harmful soil change or site contamination, taking the relevant soil use into account, and the need to initiate measures.

Annex 2 to BBodSchV contains use-related trigger values for pollutants for assessment of the soil - human health, soil - groundwater and soil - plant pathways as well as actions values for pollutants for assessment of the soil - human health and soil - plant pathways.

The following criteria in particular are relevant for the derivation of trigger and action values for the soil - human health pathway:

- Substance properties that influence spreading of substances and, possibly, their availability for uptake,
- Soil properties that affect substance compounds and their behaviour in the environment;
- Human behaviour patterns (play, work, gardening, etc.) together with different age-specific exposure durations at the places where these activities usually take place,
- Different routes of uptake (through gastrointestinal tract when ingesting food or drinking water or via inhalation of dust), and
- The quality and number of the available data (statistical data, epidemiological findings).

The BBodSchV does not contain any action values for the soil - human health pathway - other than those for dioxins / furans - because the technical bases and methods are still lacking that would be needed to express a given action value as the amount of a soil pollutant that would be available for human resorption. Measurement of the portion that is available for resorption, of the total amount of a given pollutant in the soil, is considered to be an important methodological prerequisite for introduction of action values.

The methods and standards used to derive the trigger and action values listed in Annex 2 have been published in the Federal Law Gazette (Bundesanzeiger) No. 161a of 28 August 1999 as well as in *"Berechnung von Prüfwerten zur Bewertung von Altlasten"* (Calculation of trigger values for the assessment of contaminated sites) (ERICH SCHMIDT VERLAG, Berlin, 1999). Article 4 (5) BBodSchV provides that these methods and standards must be taken into account when deriving trigger or action values for additional pollutants.

In order to be able to respond more quickly to the urgent need of enforcement authorities for binding trigger values, the legislation should be changed to allow values to be periodically updated, derived and authorised also outside the instrument of an amendment to the Ordinance.

Due to the complexity of the circumstances of each individual case (such as geological and hydrogeological site characteristics, specific nature of the damage, relevance of the protected assets affected by specific uses), no thresholds have been legally prescribed for determining the need for remediation, nor have remediation target values been defined. Instead, the competent authorities were accorded a considerable degree of discretion, which has proved its worth in enforcement.

4 Interfaces with other areas of legislation und issues

The BBodSchG applies to harmful soil changes and contaminated sites as far as the provisions of other areas of legislation as listed in Article 3 BBodSchG do not regulate impacts on soil. These other areas of legislation concern recycling / waste, hazardous goods, fertilisers / plant protection / genetic engineering, agriculture and forestry, construction of transport infrastructure, planning law / land use planning, mining and pollution control. As a result, there is a need to integrate soil-related requirements into various areas of legislation in order to gradually achieve compatibility between the systems of values applied in waste, water and soil legislation.

Since remedial soil protection in the German legal system is geared to preventing hazards, the provisions of the BBodSchG alone cannot ensure that remediated sites also meet the demands of regional planners and urban developers for any subsequent use or the specific requirements of the site and property market. Therefore, in efforts to reintegrate contaminated sites into the

real estate market (site redevelopment)[2], particular attention must be paid to the conditions and legal regimes of building and planning law and the particularities of programmes to promote regional economic development.

Based on a model decree of ARGE BAU[3] on policy regarding sites with soil pollution, particularly contaminated sites, in land use planning and in building permission procedures, recommendations have been issued in some Länder that address the interfaces with planning law and land use planning.

Site redevelopment can make a significant contribution to achieving the 30 ha/d land-take target set in the German sustainability strategy[4], but in practice it has also established itself as a driver for remedial soil protection. One example to illustrate this is the new building of the Federal Environment Agency in Dessau-Rosslau, where site redevelopment not only helped to overcome the negative image of this former derelict industrial site in the "Gas Quarter" in Dessau but also allowed more remediation to be carried out than what is usually done and what is required for hazard prevention under soil protection legislation.

In the opinion of the Federal Environment Agency, hazard prevention in remedial soil protection means that ecological concessions need to be made in terms of restorable soil quality. Sustained protection of soil quality can only be achieved by the means provided by preventive soil protection. The requirements for protection of the medium "soil" must therefore be effectively integrated, at the precautionary level, into affected legislative fields (particularly land use planning, agriculture and forestry, and nature conservation). Only in this way can the high costs of remedial soil protection be noticeably reduced in the medium and long term.

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[2] Site redevelopment *(Flächenrecycling)* means the use-related reintegration into economic and natural cycles of properties which have lost their previous function and use - such as decommissioned industrial and commercial sites, military sites, traffic areas and the like - by means of planning and economic policy measures (definition by technical committee of the Ingenieurtechnischer Verband für Altlastenmanagement und Flachenrecycling e.V. (ITVA)[3])

[3] Working group of the ministers or senators of the 16 Länder responsible for urban development, building and housing (Conference of German Federal and Länder Building Ministers)

[4] In 2002 the German Federal Government adopted the national sustainable development strategy "Perspectives for Germany". One of its quantitative targets is to reduce land-take from what is currently about 104 hectares per day to 30 hectares per day by 2020. [4]

[5] In 2004, the Joint Water Commission of the Länder (Länderarbeitsgemeinschaft Wasser, LAWA) derived so-called marginal thresholds (Geringfügigkeitsschwellenwerte, GFS) for 71 individual substances and summative parameters. The marginal threshold defines the boundary between an insignificant change in chemical groundwater quality and harmful contamination.

5 Past development and current status of remedial soil protection

5.1 Legal basis and enforcement in Germany

Enforcement of the legal provisions on remedial soil protection is the responsibility of the *Länder*. They must define the specific requirements.

Numerous manuals, guidelines and other materials exist in the *Länder*, providing assessment criteria for the authorities responsible for soil protection and concrete guidance for experts and investigating bodies.

Due to historical developments before the BBodSchG and BBodSchV entered into force, the way registers are kept and contaminated sites dealt with varies between the *Länder*, although the methodologies are based on the same technical principles. There are also differences in the way contaminated sites are financed and in how those sites are dealt with for which the party obligated to carry out remediation cannot be ascertained and/or called to task.

Due to advances in science and technology and the experience gained in enforcement, the secondary legislation needs to be updated. The German Federal Environment Ministry has detailed necessary adjustments and updates in a key issues paper on amendment of the BBodSchV:

- Fundamental revision of Annex 1 to BBodSchV (Requirements concerning sampling, methods of analysis and quality assurance during the investigations):
  - Update all references to standards and establish investigation methods for new priority pollutants,
  - Update the methods for estimating substance inputs to groundwater from suspect sites and sites suspected of being contaminated),
  - Determination of the equivalence of analytical methods in laboratory practice and dealing with measurement uncertainty in enforcement;
- Data collection for, and updating and supplementing the trigger and action values listed in Annex 2 to BBodSchV;
- Harmonising the trigger values for evaluation of the soil - groundwater pathway with the LAWA[5] marginal thresholds, and formulation of implementing rules;
- Taking natural attenuation into consideration when deciding on remedial, protective and restrictive measures;

- Comparable procedures for prevention of obvious harmful soil changes in case of accidents and imminent danger.

Exchange of information between the Federal Government and the *Länder* takes place via the bodies of the Joint Soil Protection Commission of the Federal Government and the *Länder* (LABO). Specific technical problems are dealt with in temporary ad-hoc working groups, in which the Federal Environment Agency participates.

The Federal Environment advocates, also from the viewpoint of quality assurance, the development and application of nationally uniform approaches to remedial soil protection. The development of detailed requirements and assessment tools takes place in the Joint Soil Protection Commission of the Länder (LABO) and its committees and working groups, in standardisation bodies (DIN, CEN, ISO), in associations (ITVA, BVA) and through R+D projects. The Federal Environment Agency supports these activities and contributes to them through the secretariats of the Expert Council on Soil Investigations (FBU) and the Federal Environment Agency Soil Protection Commission (KBU).

5.2 Current status of contaminated sites treatment and research in Germany

Although Germany has undertaken large efforts since the mid-1980s to clean up contaminated sites and nearly all sites in Germany have been registered, the registers of the *Länder* still contain around 304,000 (as at 08/2009) sites suspected of being contaminated. A final hazard assessment was performed for some 25 % of suspect sites, and for about 10 % of these sites remedial measures have been initiated or already been completed. In our experience, however, only about 10-15 % of suspect sites actually require remediation.

In addition, there are about 29,000 sites currently or formerly used for military purposes by the German Armed Forces or visiting forces and federally owned sites in civil use. These sites, which do not fall within the responsibility of the *Länder*, have been registered and subjected to an initial assessment. They include 13,970 sites which have been investigated with the aim of performing a hazard assessment. For 1,643 federally owned sites, remediation plans have already been drawn up or remediation carried out. The latter figures refer not only to site contamination, but also to harmful soil changes and resulting groundwater pollution.

The Federal Republic of Germany has invested considerably in research to support the work on contaminated sites. Over € 300 million have been spent so far within the sphere of the Federal Ministry for Education and Research (BMBF) alone, when adding the contributions of third parties. As a result, the scientific and technical basis for remediating harmful soil changes and contaminated sites has improved considerably in Germany. A network of competent engineering providers and an appropriate remediation infrastructure have made the "contaminated sites problem" largely manageable, from a strictly technical point of view. This does not preclude, however, that a remediation method might not be commercially available in a given case or that the acceptance of innovative technological or management concepts may continue to pose a problem in enforcement.

When choosing remedial measures, the interactions between them, and their environmental impacts are increasingly taken into account using life-cycle analysis. In this context, greater consideration is also given to social and economic aspects of remediation and site redevelopment. Another focus of interest for the parties involved in remediation is to increase the effectiveness of soil and groundwater remediation through development of complex remediation strategies and innovative methods while consistently applying BATNEEC[6] criteria.

Accordingly, BMBF funding priorities and joint research projects address the priority need for research to advance the state of the art in science and technology through the interplay of innovation and sustainability; for example:

- KORA - Controlled natural retention and degradation of pollutants in the remediation of contaminated groundwater and soil [5],
- RUBIN - Use of permeable reactive barriers for contaminated sites remediation, [6]
- REFINA - Reduction of land-take and sustainable land management [7],
- SAFIRA II - Concepts for revitalising contaminated soil and groundwater at megasites [8],
- TASK - Centre of Competence for Soil, Water and Site Revitalisation [9].

Especially when damage is large-scale and complex (as is the case with waste dumps at former lignite mining sites or with traditional large industrial sites of e.g. the chemical industry), conventional measures will not normally allow

[6] Best Available Techniques Not Entailing Excessive Cost[3]

the damage to be remediated or hazards to be prevented within a foreseeable period and by proportionate means. In such cases, the definition of appropriate remediation objectives and of optimal configurations of source and plume remediation measures presents a particular challenge. In the opinion of the Federal Environment Agency, this also requires new management concepts that are based on a fundamental technical consensus (e.g. to accept innovative remedial approaches) in enforcement.

5.3 National remediation programmes

With German unification, ownership of contaminated sites on the territory of the former GDR (East Germany), and thus the responsibility for their remediation, passed either to the new *Länder* or to the Federal Republic of Germany. In December 1992, the Federal Government / Treuhandanstalt (THA)[7] and the Länder Berlin, Brandenburg, Mecklenburg-Western Pomerania, Saxony, Saxony-Anhalt and Thuringia entered into an administrative agreement on the financing of remediation at contaminated industrial sites administered by the THA, with the aim of promoting investment at these sites and safeguarding and creating jobs.

The agreement regulates proportionate funding of measures by the Federal Government and the *Länder*, with the prerequisite that the competent *Land* authorities exempt investors from the liability and costs for any environmental damage caused prior to 1 July 1990, in accordance with the Environmental Framework Act and the Obstacles Removal Act. Exemption granted, the demands enforced on the *Länder* are split 60 (Federal Government) to 40 *(Länder)*. A cost ratio of 75 (Federal Government) to 25 *(Länder)* was set for so-called large-scale ecological projects. These costs are reduced by the amount borne by the buyer of a THA-administered company. Over € 3 billion have been spent to date on 21 large-scale projects.

Remediation of lignite mining sites is another task which the Federal Government and the *Länder* have been fulfilling jointly since 1992 on the basis of continued administrative agreements, with investment of over € 8 billion so far. The 4th Federal Government/*Länder* administrative agreement on the financing of lignite mining remediation entered into force on 1 January 2008 and has a duration of 5 years, securing continued financing of lignite mining remediation in the period 2008-2012 with a volume of over € 1 billion. Specific measures for remediation of lignite mining sites are funded by the Federal Government and the *Länder* at a ratio of 3 to 1, whereas funding of supplementary measures aimed at preventing hazards resulting from the rise of the groundwater table is shared equally between the Federal Government and the *Länder*. Another mining remediation programme is remediation of the former Wismut uranium mining sites, which is due to be completed by 2015. In its case, the Federal Government has sole financial responsibility with an estimated budget of € 6.2 billion.

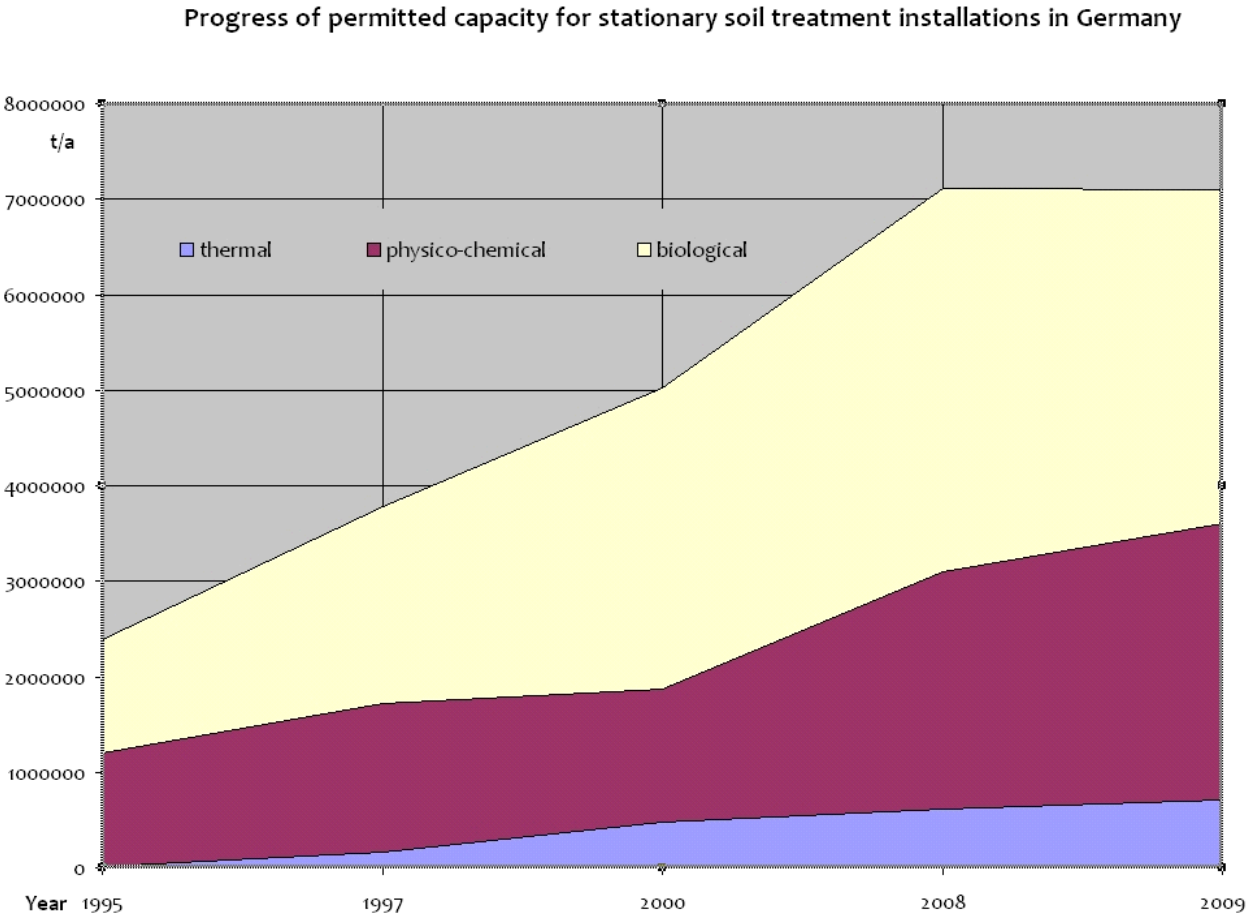
About € 400 million were allocated to the contaminated sites programme of the German Armed Forces in the period 1991 to 2008.

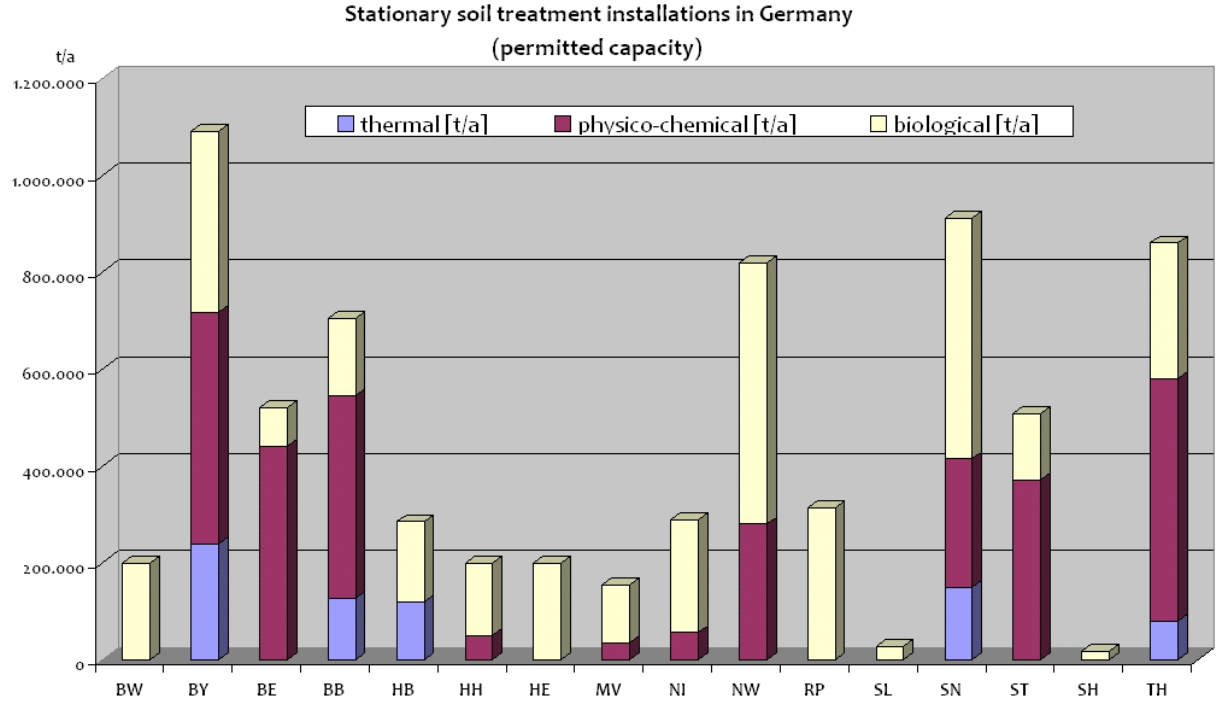
5.4 Remediation infrastructure

The market for soil remediation services in Germany is constantly changing. In the 1990s the aim was to develop and make available a functioning remediation infrastructure. Later, the "hunt for soil" began. Operators of soil treatment plants "struggled" to obtain sufficient quantities of soil to ensure the long-term economic viability of their plants. This was counteracted above all by scientific-methodological advances in hazard assessment and corresponding adaptations of the remediation concepts, which aimed to progressively reduce the proportion of soil to be treated. In addition, stationary soil treatment plants started to see competition from mobile and semi-mobile plants, which - optimised specific to each project - were often the economically more attractive alternative. Also, remediation concepts increasingly included separate requirements for sub-areas, which tended to create a need for modular remediation systems. Overall, the Federal Republic of Germany has a sufficient remediation infrastructure. An authorised plant capacity of over 7,000,000 t/a today is proof of a steady capacity increase since 1995 and appears to provide sufficient resources to additionally treat soil-like materials such as street cleaning waste or material from other countries. In 2009, 8 thermal, 23 chemical-physical and 62 biological soil treatment

[7] The **Treuhandanstalt** (THA, also called "Treuhand" for short) was a federal public-law agency in Germany established at the time the GDR (former East Germany) was in its final phase. Its task was to privatise the GDR's state-owned companies according to the principles of a market economy or, where this was not possible, to decommission them, and "to safeguard the companies' efficiency and competitiveness" (Article 8 of the Treuhand Act).

plants were in stationary operation in Germany [9]. In addition, there are a number of authorised pre-treatment plants and intermediate storage facilities.





* BW-Baden-Württemberg, BY-Bavaria, BE-Berlin, BB-Brandenburg, HB-Bremen, HH-Hamburg, HE-Hesse, MV-Mecklenburg-Western Pomerania, NI-Lower Saxony, NW-Northrhine-Westphalia, RP-Rhineland-Palatinate, SL-Saarland, SN-Saxony, ST-Saxony-Anhalt, SH-Schleswig-Holstein, TH-Thuringia

6 European Union

Soil protection is an integral part of media-related environmental protection and needs to be adequately regulated at both European and national level. While Germany had established modern soil protection legislation as early as 1999, today interest focuses on current activities of the European Commission towards the adoption of a European soil framework directive.

While soil protection has numerous interfaces with other international environmental issues, such as greater competition for fertile soil as a result of climate change, increased cultivation of energy crops, growing demand for food, landtake, a relevant additional aspect in the context of European policy is that differences in environmental protection requirements between Member States distort competition within their common market. This can only be eliminated through EC framework legislation which requires Member States to adhere to uniform environmental standards.

On 22 September 2006 the European Commission presented its Thematic Strategy for Soil Protection, an impact analysis and a proposal for a soil framework directive (SFD) [10].

Criticisms from Germany, particularly the Länder, address the following points: overall, an "overregulation", insufficient consideration of the principle of subsidiarity, lacking freedom of Member States to regulate risks to soil, and high costs. In two decisions, the *Bundesrat* (Federal Council) expressed its opposition to the SFD. At the EU Ministerial Council meeting of 20 December 2007, the German Government together with four other Member States (UK, NL, A, F) voted against the adoption of a political commitment. This general position of Germany against an SFD continues to hold and was reaffirmed at the EU Environment Council meeting on 15 March 2010. The Joint Soil Protection Commission of the Federal Government and the Länder (LABO) has also repeatedly underlined its opposition to the SFD.

The Federal Environment Agency advocates the SFD from a technical perspective, but does see potential for improvement. Of particular importance are clear outline procedures as well as substantive requirements for a uniform level of soil protection, taking into account land use on a European scale, without excessive obligations for reporting to the European Commission.

The Federal Environment Agency supports the setting of minimum standards for soil that are binding on all Member States, for reasons of environmental and resource protection. This holds especially for remedial soil protection, as the qualitative divergences between "old" and "new" Member States are grave in this area. In the opinion of the German Council of Environmental Advisors (SRU)[8], adoption of the SFD would open up a new field of environmental policy action and provide significant impetus to the national legislation (SRU 2008). Knowledge transfer and transnational research cooperation could help significantly to approximate existing divergences in the level of protection and to solve similar problems more efficiently.

According to the European Environment Agency (EEA), there are at least 1.8 million suspect sites in Europe[9][11].

A European soil framework directive would promote solving the important environmental problem of contaminated sites and politically upgrade efforts to this end, and it could ensure that existing experience with the management of contaminated sites is utilised throughout the EU. Soil quality from a preventive or remedial point of view should be measured according to uniform standards in both Germany and Europe and should not mirror the level of economic development of any particular Member State.

The Federal Environment Agency therefore advocates the introduction and development of a European soil framework directive, with the following conditions:

- Consistent integration with relevant fields of legislation for integrated soil protection (IPPC Directive[10][12]- SFD - Environmental Liability Directive [13]) to streamline enforcement: This would, for example, provide the opportunity in future to combine the Pollutants Release and Transfer Register (PRTR) emissions register and the contaminated sites register in a compatible way via appropriate interfaces. The data and information that exists on in-service installations could then be efficiently transferred to the contaminated sites register at the time they are decommissioned, which would effectively reduce duplicative data keeping, which is still common today,

[8] The German Council of Environmental Advisors (Sachverständigenrat für Umweltfragen, SRU) is a body giving scientific advice to the German Federal Government. Its mandate is to describe the environmental situation and environmental policy in the Federal Republic of Germany and its development trends and to identify undesirable developments in environmental policy and possibilities for avoiding or eliminating them.

[9] As at 2007 (incomplete data base)

[10] Directive concerning integrated pollution prevention and control

and secure site- and installation-specific information without any losses;

- Consistent implementation of the principle of compartmental environmental protection in combination with the establishment of harmonised substantive requirements (trigger values, threshold values, action values...);
- A tiered evaluation methodology adequate to the risk, based on a coherent review of available information, in particular historical, sectoral and substance-related information, prior to any sampling and analysis;
- A sound, case-specific exploration of hazards (identification of relevant contaminant sources, description and evaluation of relevant pathways including effects of environmentally harmful substances on affected protected assets and assessment as to whether this gives rise to concrete hazards) as a basis for the decision on the need for remediation (decision-making discretion);
- Specification of remediation measures and objectives in the course of a discretionary selection process, taking the principle of proportionality into account (suitability, necessity, reasonableness);
- Implementation of use-related and proportionate remedial measures in keeping with regional planning and land use planning needs ("fit for use" as a defined element of contaminated site/derelict site strategy);
- (Gradual) introduction of a soil quality report, to be prepared for a site when there is change of ownership, as an effective means for securing information and reducing the administrative workload in the investigation of suspect sites in the course of substitute performance;
- Adoption of an EU strategy for the management of contaminated sites which must be complemented by national action programmes.

7 Future fields of action in remedial soil protection

Based on the above, the Federal Environment Agency sees the following short- and medium-term tasks and measures in remedial soil protection:

- Contributing to economically and ecologically acceptable solutions to the contaminated sites problem:
  - Develop off-site hazard assessment methods (investigation, modelling, forecasting, monitoring, indicators),
  - work out innovative remediation strategies (see section 5.2) (with a special focus on megasites),
  - further develop criteria and strategies for remediating groundwater degradation due to contaminated sites,
  - review and supplement the trigger and action values of Annex 2 to BBodSchV,
  - improve assessment of the soil - groundwater pathway: Harmonisation of values and concepts (marginal thresholds - trigger values for leachate, assessment concepts under BBodSchV, the Federal Water Act (WHG), landfill legislation, for utilisation of mineral waste),
  - give adequate consideration to natural attenuation, particularly in the context of remediation (translate the results of the KORA funding priority of the Federal Ministry of Education and Research into enforceable requirements),
  - introduce financial and insurance elements in order to ensure that necessary remediation is carried out when a party so obligated does not exist or cannot be called to task,
  - achieve a reversal of the burden of proof in case of suspected contamination through introduction of a soil quality report/site certificate , so that the disturber can be immediately called to task,
  - define requirements for remedial soil protection for installations covered by the IPPC Directive (soil-protection-compliant operation, decommissioning);
- Promoting subsequent use of remediated sites (site redevelopment) as a contribution to reducing land-take from currently 104 hectares/day to 30 hectares/day:
  - Promote the establishment of derelict/contaminated site registers,
  - develop municipal and inter-municipal approaches for the management of contaminated and derelict sites (e.g. indicators),
  - identify coordination and communication deficits in administration and develop general or project-related structural improvements,
  - identify approaches under soil protection and planning law to promoting site redevelopment and present formulas for action (e.g. remediation planning pursuant to Articles 13 and 14 of BBodSchG),
  - accelerate the unsealing of sealed ground;

- Creating the basis for minimising diffuse substance inputs:
  - Qualify and quantify inputs from diffuse sources and diffuse-input scenarios,
  - Create a sound data base and develop harmonised assessment methods for inputs to soil and groundwater from diffuse sources.

8 Links, References and further information

[1] http://www.bmu.de/files/pdfs/allgemein/application/pdf/soilprotectionact.pdf

[2] http://www.bmu.de/files/pdfs/allgemein/application/pdf/bbodschv_uk.pdf

[3] http://www.itv-altlasten.de/

[4] http://www.bundesregierung.de/Webs/Breg/nachhaltigkeit/DE/Startseite/Startseite.html

[5] http://www.natural-attenuation.de/content.php?lang=en

[6] http://www.rubin-online.de/english/introduction/index.html

[7] http://www.refina-info.de/en/

[8] http://www.ufz.de/index.php?de=13244

[9] http://www.ufz.de/index.php?en=17107

[10] http://eur-lex.europa.eu/smartapi/cgi/sga_doc?smartapi!celexplus!prod!DocNumber&lg=en&type_doc=COMfinal&an_doc=2006&nu_doc=231

[11] http://www.eea.europa.eu/data-and-maps/figures/overview-of-progress-in-the-management-of-contaminated-sites-in-europe

[12] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32008L0001:EN:NOT

[13] http://eur-lex.europa.eu/smartapi/cgi/sga_doc?smartapi!celexplus!prod!DocNumber&lg=en&type_doc=Directive&an_doc=2004&nu_doc=35

Further information:

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety: http://www.bmu.de

Federal Environment Agency: http://www.umweltbundesamt.de/

Environmental Information of German Authorities: http://www.portalu.de

EUGRIS - Portal for Soil and Water Management in Europe: http://www.eugris.info/

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