URBAN SMS Soil Management Strategy

Guide Municipal Soil Management

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February, 2012

CENTRAL EUROPE
COOPERATING FOR SUCCESS.

EUROPEAN UNION
EUROPEAN REGIONAL
DEVELOPMENT FUND

URBAN SMS WP3 Action 4

Guide Municipal Soil Management

February 2012

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1 INTRODUCTION

Aim of this guidance is to explain the URBAN SMS soil management concept as core of the urban soil management strategy, how it can be designed, which parts it should consist of and what should be considered for implementation of such a concept.

This report describes the situation regarding soil in legislation and spatial planning across Central Europe, derives the needs for soil protection and defines goals and strategies of urban soil management which should be followed and implemented by several tools. The URBAN SMS tools for soil evaluation, soil management and awareness raising are briefly described and an overview of further existing management tools is provided. Guidance for application and monitoring of an urban soil management concept are given.

This guidance can be used for starting the process of better integrating soil issues into urban planning. It shows a way how this process can be followed step by step although some steps often overlap or may even run in parallel as the implementation of different tools. In locations where soil management tools are already discussed or implemented this guidance provides a proposal how these measures may be amended by other elements and put into a comprehensive concept for soil management. For municipalities advanced in soil management some new ideas and choices for effective tools are likely to be found in this document. As it is a compact guidance it can give only an overview of relevant legislation, planning systems and procedures as well as different types of tools. For more detailed information on these elements of the soil management concept a lot of specific URBAN SMS reports are available at the project website.

Municipal authorities responsible for urban planning decisions are regarded as the main target group. In particular in case of changes in the urban development plan soil evaluation and management tools are of big help towards sustainable land use. Furthermore spatial planners working as consulters may also profit from this guidance for their daily life. Also experts working on soil protection in communes can get ideas for new visions and plans how soil consumption can be mitigated in an effective way. Regional authorities responsible for spatial planning programmes may take up the general idea of a soil management concept as part of their programmes that should be implemented.

2 URBAN SOIL MANAGEMENT

2.1 CHALLENGES FOR SOIL USE

Soil offers a lot of functions relevant to society, such as food and fiber production, provision of living space for humans and other organisms, water filtering and storage, inactivation of contaminants as well as provision of raw material. According to the type and quality of soil these functions can be provided to a certain degree. These potentials are required by several land uses such as agriculture, forestry, industry, trade, infrastructure or buildings for settlement. In particular in urban areas there exists a high demand to use these potentials which creates competition among the current and potential land users often resulting in soil consumption for building purposes.

Land take of agricultural, forest and other semi-natural and natural land for urban area and infrastructure use increased between 1990 and 2000 by 5.7 % across Europe, but with unequal distribution. This trend accelerated during 2000–2006 — annual land take increased from 0.57 % for 1990–2000 to 0.61 % for 2000–2006 (EEA, 2010a). It is expected that by 2020 urban areas will increase their share in European land stock by approximately 1 % (EEA, 2007), although large differences exist between Member States and regions, with the proportion of the sealed surface ranging from 0.3 % to 10 % (European Commission, 2010).

Mainly agricultural land is converted into building land. An assessment of the Corine land cover 2006 database shows that around 4 % of agricultural or other non-developed land is built on. Comparison of Corine land cover data for 1990 and 2000 shows an estimated loss of 970,000 ha of agricultural land for 20 EU Member States in this ten year period due to urbanisation. The rate of change is not the same across all countries (EEA, 2010a). These trends continue in the period 2000–2006 as shown in the SOER 2010 land use assessment (EEA, 2010b). Decreases in total agricultural land use were projected for 2000–2020 in all development scenarios of the EEA PRELUDE study (EEA, 2007) and a recent review of land use outlook studies for the EEA (RIKS, 2010).

The loss of soil by soil sealing has impact on soil functions such as agricultural production. The annual impact of soil losses, due to urbanisation, on the production capability of agriculture in the EU 25 has been estimated to be equivalent to the loss of more than 4.4 million of tonnes of wheat (Gardi et al., 2009).

It is important which quality soils have that are converted into built-up areas. An assessment using satellite images showed that between 1990/92 and 2006/2007 in four of seven central European cities high quality soils have been preferentially taken for urbanization. In two their consumption was proportional to their share in total area, only in one city high quality soils were efficiently protected which, at least partly, might be the effect of the existing fee payment system. Considering the available areas of low and medium quality soils there is no obvious conflict between soil protection goals and demand for land related to economic development of these cities (Siebielec et al., 2010).

As soil is a limited resource often not all the demands of the land users can be met, especially in urban areas with high population density. But in order to steer the use of urban soils in a sustainable way a proper management of soil resources is needed. Soil management systems that efficiently protect the best soils should be introduced in cities. A multidisciplinary approach is necessary for better understanding of the soil role in urban environment in order to ensure its optimum use (De Kimpe & Morel, 2000) and provide the functions needed, like water filtering

and storage, space for fauna and flora, provision of recreation areas, production of wine or vegetables and deposit of dust and materials.

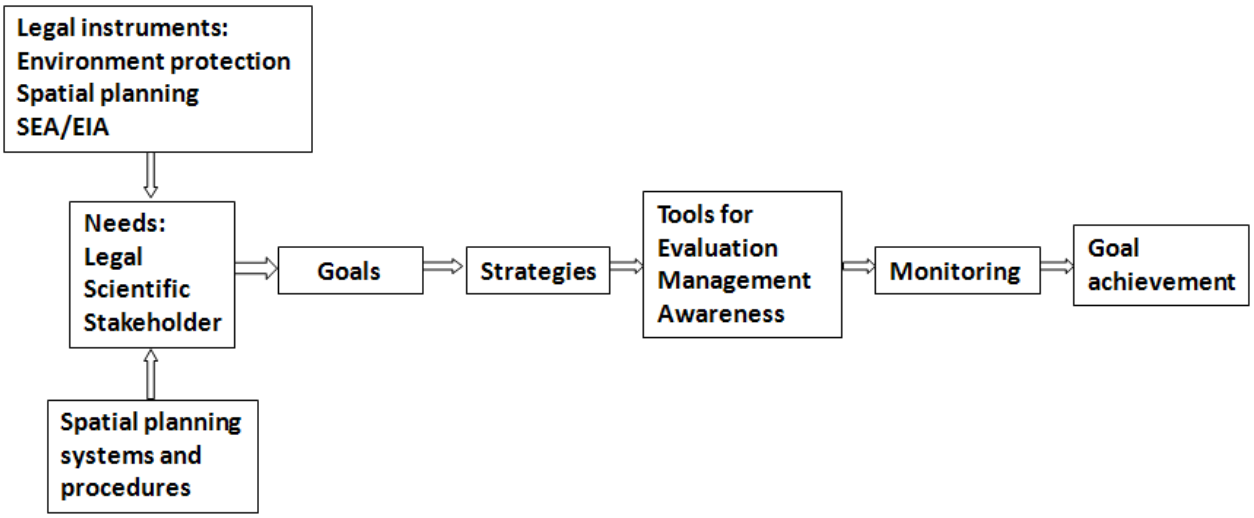
2.2 URBAN SOIL MANAGEMENT CONCEPT

Commonly soil is owned by someone who is managing it according to his needs and given legislation. In urban spatial planning procedures the use of soil within the urban borders is dedicated to certain types of land use. An intended change of land use has to be approved by an urban planning authority. These decisions should be taken only after careful evaluation of the potential consequences of such changes. Each single decision should be in line with the spatial development concept at local and regional level and relevant legislation. Such a concept has to consider not only socio-economic aspects, but also environmental aspects. Evaluation tools to assess environmental effects of land use changes should be applied. Management tools like instruments and measures such as regulations and incentives should be developed and implemented to regulate the use of soils in a sustainable way. All these actions are parts of urban soil management which should be coordinated in a concept.

First of all the goals to be achieved have to be defined, such as level of reduction of soil consumption in relation to urban development needs and soil potential. Involvement of stakeholders (land owners, investors, land planners, public authorities) at the early stage is an important prerequisite for successful implementation of urban soil management. Beside stakeholder needs soil management has to consider national and regional legislation, in particular regarding spatial planning. Suitable strategies based on state-of-the-art knowledge have to be selected according to the defined goals. For the assessment of soil status and scenario analysis suitable tools, like those developed within the project URBAN SMS, should be applied at the spatial plan development stage. Building site specific databases are a necessary condition for proper soil management. Best practice examples of soil management tools from other regions should be checked for their transferability to the local conditions and applied. Monitoring of the implementation of tools is crucial to evaluate the effectiveness of the instruments and measures which affect the achievement of the goals. The general soil management concept is shown in Figure 1.1.

In general a proper urban soil management can save available soil resources for future generations. So it will serve long-term plans of spatial development. In particular in urban areas with a low degree of open land it is crucial to implement an urban soil management concept. At local level a good opportunity for its implementation is the revision of the spatial development concept and the zoning plan. Recommendations for implementation of a soil management concept should be included in regional development programs.

Figure 1.1: Structure of soil management concept



3 SOIL IN LEGISLATION AND PLANNING

As a first step in the soil management concept policy instruments, laws and guidelines containing regulations considering the use of the soil and its functions were screened, analysed and collected in a standardised way. The standardised collection served as basis for a SWOT analysis (analysis of Strengths, Weaknesses, Opportunities and Threats) of the instruments. The key question for the SWOT analysis was the contribution of the instrument to best practice of soil protection (see URBAN SMS Product No. 2).

Five international (EU) instruments, 81 national laws and guidelines and 48 instruments on regional and local level were screened. The instruments were classified according to their influence on the different threats of soil, as compaction, sealing, pollution, loss of organic matter and erosion (see URBAN SMS Product No. 1).

As there is one focus on the integration of soil in planning systems another task was to collect and describe **planning systems and procedures** in the respective partner-country.

At least **best practice examples** how soil could be integrated in sectoral or planning instruments were collected and described to show different possibilities how to deal with this issue.

3.1 EXISTING SECTORAL LEGISLATION AND INSTRUMENTS

3.1.1 Soil protection acts

Soil protection acts include very detailed measures for all types of impact (mainly pollution, loss of organic matter, erosion). Still most of them – 12 instruments were analyzed – are either not applied often (e.g. the Austrian Soil Enhancement Plan or the Rehabilitation Instrument for Polluted Sites in the Piemonte region) or the implementation is not obligatory (e.g. the Protocol Soil conservation of the Alpine Convention in Italy). Some of them are just not monitored or in an insufficient way.

3.1.2 Nature protection, water and forest acts

12 acts on nature protection water and forest were analyzed. These do not directly focus on protection of soil. Protecting soil is a side-effect of the protection of natural resources as e.g. water, biodiversity, etc. In contrast to the spatial planning and building legislation these instruments mainly concentrate on areas outside settlements.

3.1.3 Acts for agricultural land

There exist various legislations in order to regulate the use of agricultural land. Mostly these regulations focus on soil quality and soil pollution which are often combined with the definition of threshold for relevant pollutants as well as on erosion. Moreover, these acts can foresee measures as such as crop rotation, limitation of fertilizers or planting of shrubs or windbreakers in order to protect soil in agricultural areas.

3.1.4 SEA/EIA

In the assessment of plans and programs through a Strategic Environmental Assessment (SEA) as well as in the assessment of large scale projects through an Environmental Impact Assessment (EIA) the impact on various soil functions has to be checked systematically. These assessments enable the administrations conducting EIAs resp. SEAs to counter-check potential impact on soil.
However, usually, soil is not the core issue of a SEA or an EIA. Furthermore, quantitative thresholds according to land consumption or soil sealing are missing, whereas e.g. exact and even European wide similar thresholds concerning air or water quality exist.

3.1.5 Subsidies/Penalties

Subsidies for special agricultural management as well as for housing have direct guiding effects for the land use and therefore its consequences on soil protection. Subsidies can be easily adapted to different goals.
However, especially subsidies for agriculture only last as long as there is money flow to the farmers. If the system of subsidies changes, the farmers can easily and quite fast adopt their land use to less suitable according to soil protection goals.

3.2 PLANNING SYSTEMS AND PROCEDURES

The transnational comparison of the spatial planning systems in operation on the respective territories of consortium partners (URBAN SMS Product No. 4) shows that there are both similarities and differences in structure, organisation, instruments and procedures. Differences depend to a large extent on size of territory, general administrative structure, planning traditions and planning cultures. It must be noted that the heterogeneity in these prerequisites also causes a remarkable inconsistency in the terminology used to denote instruments and procedures. This accounts for a major difficulty in conducting cross-country comparisons of urban planning systems. For instance, what is called a "plan" in one country may be called a "programme" in another country or vice versa, with the name of an instrument often giving little indications of its content and function.

3.2.1 Vertical planning structures

In most of the territories (countries, regions, or cities) analysed, hierarchically organised planning systems composed of **multi-level vertical structures** are in place. With regard to the way competencies for implementation of planning instruments are distributed among the different levels of territorial organisation, systems with one level, two levels, and three levels exist. In addition, there are also countries with a certain - albeit usually limited - role of the national state level in spatial planning.

In Germany (Baden-Württemberg), Austria (Vienna, Salzburg), Italy (Piemonte, Lombardia) and the Czech Republic (City of Prague), basically a **three-tiered system** is in place. This implies that obligatory urban planning instruments and procedures exist on federal state level (corresponding with region level in Italy), regional level (corresponding with province level in Italy and NUTS 3 level in the Czech Republic), and local (municipality / city) level. It is worth noting

that there are larger similarities between the two German-speaking federal countries Austria and Germany than towards Italy or the Czech Republic, whose planning systems are characterised by some particularities. Slovenia (City of Celje), the Slovak Republic (Bratislava) and Poland (Pulawy) currently each have a basically **two-tiered system**, with obligatory planning instruments in Slovenia being in force on the national and the municipality level only, but not on the regional level, whereas the Slovak Republic and Poland has binding instruments on the regional and municipality level (and, in addition, a non-binding spatial development concept on national level).

National level

The role of the national state in spatial planning differs between countries. In Germany, the Czech Republic and Slovenia, the national state has certain legal (framework) competencies for spatial planning and fulfils strategic coordination functions. In comparison between these countries, the national role appears to be most distinct in Slovenia, where both a strategic policy and an implementation document exist on national level. By contrast, the role of the national state is less important in Austria and Poland, although spatial development policy documents for the entire state territory exist (strictly non-binding in Austria). In Slovakia there is a national strategic document (Concept of territorial development), however the role of urban planners should be more considered.

Municipality level

On the municipality level, in most countries two or more mandatory instruments and related procedures are applied, often divided into a **Land Use or Zoning Plan** (or equivalents), which allocates defined land use functions and classes to each (urban) land parcel, and a **Building Regulation or Structural Development Plan** (or equivalents), which regulates the structural development on building land. In addition, in a number of countries such as Germany, Austria, Slovenia, Slovakia and Poland also a strategic planning instrument framing long-term spatial development objectives for the municipality is in place on local level, although in some cases it has non-binding character and acts as some kind of internal guideline for municipal authorities. The mostly multiple tiers of instruments and procedures on municipality level to some extent reflect the strong role municipalities have in many of the territorial systems.

In many of the countries investigated, municipalities own a relatively high degree of planning autonomy, with the **municipal authorities and the municipal council** being the prime planning authorities and adoption bodies. However, the internal logic of spatial planning systems and the need for vertical consistency of spatial planning instruments obviously demand that there is a **supervisory authority** on higher-ranking planning levels that is in charge of reviewing, checking and granting consent to local acts of planning.

Spatial planning legislation

In all countries, the legal basis for spatial planning instruments and their implementation procedures is usually provided by spatial planning (territorial planning) laws, including subordinate legislation and regulations. However, by far not all planning instruments are **obligatory** and **binding** in their effect. In a number of countries, also non-mandatory instruments with often non-binding character exist. For example, in the German-speaking countries, it is common to differentiate between binding "plans" or "programmes" and non-binding "concepts" in this context.

3.2.2 Planning procedures

Generally speaking, spatial plans and development concepts on **strategic level** (i. e. national, federal state, regional level, in some cases also local level) tend to be comprehensive by covering the entire territory, i. e. they usually deliver objectives, statements and planning determinations for all categories of land use, including non-urban land. By contrast, binding spatial plans on **municipality level** tend to focus on the settlement area, i. e. on (potential) urban land. A particular case is the existence of a not legally but administrative binding, parallel system of planning for implementing the aims of nature protection and landscape conservation. It covers settled and non settled area as well as zones for development. Selected contents can become legally binding when entering the Preparatory Land Use Plan or a Local Development Plan.

Naturally, most spatial planning documents in all countries are composed of both **text parts** and **maps**. However, the main contents of strategic planning documents is in written form; maps are very often provided, but only in coarse scales far above parcel scale. Apart from the strategic instruments on municipal level, both the Land Use Plan (Zoning Plan, or equivalent) and the Building Regulation Plan (Structural Development Plan, or equivalent) on local planning level need to be in parcel-sharp scale (or even finer).

The **planning cycles** of most instruments, regardless of the country, usually foresee planning intervals of 10 to 20 years. Often, the revision cycles are not fixed legally, but rather it is demanded to revise a plan if required by occurrence of land use changes or if existing framework conditions for spatial development have changed substantially.

The principle of **public participation** in the set-up of urban planning documents tends to be the rule in all countries and is mostly regulated as an integral part of planning processes in planning regulations. Nevertheless, the exact procedure and the degree of intensity of participation vary strongly between instruments, planning levels, and planning systems.

3.2.3 Soil conservation in spatial plans

Strategic level
With a view to soil conservation and soil management, it is important that a main function of strategic planning documents, in particular on supra-local level, lays in the **delineation of urban land** (settlement areas; developed land, and land to be developed) **against non-urban land** (open land, green space: undeveloped land, including land to be left undeveloped). Thus, strategic spatial plans, in principle, have high potential of limiting soil loss caused by settlement growth. Moreover, strategic plans usually allow assignment of a range of functional categories to certain areas that can be applied to favour conservation of soils, including high quality soils. Some examples for these functional categories include priority areas for agriculture, areas protected under nature conservation legislation, priority green areas, etc.

Local level
In comparison, urban planning documents on local level focus on the rational use of **land within settlement areas** (including future growth zones). Thus, their main potential of contributing to soil protection appears to be in the wise, careful and economic use of soils on building land, e. g. by measured densification of built-up structures, conservation of green spaces with undisturbed

soil, controlling the percentage of unsealed surface in relation to sealed surface and the steering of soil consumption on soils with an inferior performance regarding the natural soil functions.

Needs
Especially in the face of the usually multi-level structure of planning systems, the issue of **vertical coordination** of planning levels and **internal coherence** of planning instruments and procedures gathers importance. The more tiers a planning system comprises and the more instruments exist on one tier, the more urgent the need for vertical coordination gets. Otherwise, even the most sustainable and soil conservation-friendly strategic objectives risk failure if it comes to practical implementation "on the ground", i.e. on the lower-ranking planning levels. This touches upon the issue of **effectiveness** of urban planning. If the potential of spatial planning to positively contribute to soil conservation and sustainable soil management is to be put into practice, the effectiveness of planning instruments and procedures should be improved. There certainly is a need for integrating soil issues stronger into planning procedures, but there also is a need to make the planning systems in their existing shape and content more effective in general.

3.3 INTERESTING BEST PRACTICE INSTRUMENTS

Generally the analysed instruments are either adequate for building land or for agricultural land or for green land or protected areas. The one and only best practice instrument does not exist.
Among the analyzed instruments various best practice instruments can be named. However, the project focuses on some instruments that contain unconventional elements for soil protection respectively soil management and therefore could be of special interest for other countries.

3.3.1 Soil Enhancement Plan (Upper Austria)

The Soil Protection Act of Upper Austria foresees the implementation of Soil Enhancement Plans. The public authority is entitled to ask the land user to deliver a plan containing soil enhancement measures, if the thresholds of soil measurements are exceeded, any other negative impact on soil is identified such as erosion or compaction or enhancement of soil quality seems necessary. The land users plan shall include measures for soil enhancement and soil sanitation within a determined period. In addition to that a soil protection consultation centre was established. Persons concerned are informed before their interference. Within the information less harming solutions for planned interventions are elaborated. Up to now such activities were undertaken to counteract erosion problems.

3.3.2 Guideline for the assessment of soils according to their performance (Federal Land of Baden-Württemberg, Germany)

The guideline for the assessment of soils according to their performance provides methods by which soil functions have to be assessed. 5 soil functions are considered:

- “Natural soil fertility”
- “Habitat for natural vegetation”
- ”Regulation of water balancing”
- “Filter and buffer for pollutants” and

- "Archive of natural and cultural history"

The application of the guideline fulfils the requirements concerning evaluation and assessment of soils according to the building and nature legislation. By the clear and comprehensive assessment of the performance, high-quality soils can be identified and taken into account in the planning processes. This allows steering soil consumption on less valuable soils, if planning alternatives are available.
The soil valuation is a prerequisite for quantitative assessment of the impact of encroachments and therefore a prerequisite for the determination of compensation requirement. This is determined in the guideline "The environmental compartment soil in the compensation regulation".

3.3.3 Guidelines for provincial assessment on compatibility of municipal planning tools with the Provincial Land Coordination Plan (Italy)

The "guidelines for provincial assessment on compatibility of municipal planning tools with the Provincial Land Coordination Plan" are internal guidelines for technicians of the Provincial Administration helping them to evaluate municipal master plans and to check conformity to the Provincial Land Coordination Plan (PLCP). The instrument itself completes the already existing PLCP and compensates the lack of conformity to the regional planning level. It is a temporary instrument and shall be replaced once the Provincial Administration has updated the PLCP in conformity with Regional Law.
It provides reference and objective values for various aspects that are relevant for soil management such as reuse of built soil, permeability of urban soil, availability of green areas with trees, environmental connectivity, etc.. This gives municipalities clear indications on their development of conversion strategies.

3.3.4 Building Regulation of the Municipality of Milan (Italy)

The updated version of the Building Regulation of the Municipality of Milan includes objectives of soil protection. It comprehends among its objectives explicitly preservation of permeability of soils and chemical and physical quality. It is the ultimate instrument to define which intervention can be permitted and which is not acceptable. Recently the authority started inserting articles into the regulation about energy efficiency to also rule incentives and taxes.

3.3.5 Decree of determined amount of payment and specification of payment for agricultural land consumption (Slovak Republic, similar regulation exists also in Poland but refers to rural areas)

This relatively new "decree of determined amount of payment and specification of payment for agricultural land consumption" contains the quite innovative and strict regulation of payment for agricultural land consumption. The instrument is applied for in case agricultural land will be taken for non-agricultural purposes i.e. buildings, industrial, traffic, mining etc. Payment is obligatory for agricultural soil consumption (permanent or temporary) according to soil quality classes (first 4 classes from 9). The more fertile the soil to be used the higher is the payment:

- 1st class: 15 EUR/m^2
- 2nd class: 12 EUR/m^2

- 3rd class: 9 EUR/m^2
- 4th class: 6 EUR/m^2

Responsible are the land offices acting under the Ministry for Land Management of Slovak Republic.

A similar regulation exists in Poland. Each transformation of agricultural soils of classes I-III (of total 6) into non-agricultural use must be approved by the Ministry of Agriculture if the area exceeds 0.5 ha. The fees are approximately: 10, 9.5, 8 and 6.5 EUR/m^2 for classes I, II, IIIa and IIIb, respectively. The collected fees fully supply the Fund of Land Protection that is spent for land protection, recultivation and improving soil quality (e.g. liming). The regulation is not applied for urban zones. Additionally, the law on agricultural and forest land protection specifies that who causes degradation of land agricultural function must recover this function on own expense.

4 NEEDS FOR SOIL PROTECTION

Urban soil management has to consider the needs for soil protection in urban areas. There are different types of needs which are of relevance:

- **Legal needs:** These needs derive from the legislation situation as result from the SWOT analyses carried out (URBAN SMS Product No. 2).
- **Scientific and practical needs:** From the perspective of environmental protection specific needs for better integration of soil protection in planning procedures exist (URBAN SMS Product No. 3).
- **Needs by stakeholders:** Stakeholders from the planning sector have specific needs for better integration of soil in urban planning procedures (URBAN SMS Product No. 6).

4.1 LEGAL NEEDS

4.1.1 Requirements for soil protection

As all activities of the public administration have to be legally justified effective soil protection needs to be based on **legally binding goals** covering the different functions of soil (habitat function, filtering, buffering, storing functions and production function) as well as the different potential impacts (compaction, sealing, pollution, loss of organic matter, erosion). Concrete definitions of the objectives in sense of terms – such as sparingly, carefully and economically – would be helpful in many cases. Such a bundle of overall goals as e.g. set up in the Alpine Convention Protocol Soil Conservation is required for soil management by the public authorities.

The goals should be linked to thresholds that should be reached. These thresholds should take into account especially soil sealing and pollution. Furthermore the definition of different soil quality classes could contribute to a more differentiated treatment of soil and the protection of very valuable soil.

From the view of soil protection it is important to enhance the **inclusion of soil protecting measures in the planning procedures**. Thereby, the following issues are to be considered:

- The assessment of the impact of developments on soil should be assessed already in an **early planning stadium** in order to avoid any developments with serious negative effects on soil. The SEA could be one instrument to check the impact of planning decisions on soil. Thereby, standards for how to evaluate the impact on soil according to the different potential impacts (compaction, sealing, pollution, loss of organic matter, erosion) should be introduced to secure a certain quality of the assessment.
- The EIA assesses the impact of **large scale projects** (on soil). Technical standards and threshold concerning the impact on soil would improve the weight of chapter “soil” in an EIS compared to other chapters with already existing thresholds (e.g. noise or air).
- **Smaller projects** that do not require an EIA should be assessed regarding their impact on soil. Counterchecking soil protection objectives and measures in building permissions following clear technical assessment standards would facilitate this.

Beside the requirements in the planning procedures **stricter monitoring procedures** would increase the knowledge of the condition of soil and enable counter-measures, if goals are not reached or thresholds are exceeded. Especially after the implementation of permitted interventions the public authority shall monitor if the undertaken interventions differ from the permitted ones. In case of interventions that were not covered by the permission the authority has to decree rehabilitation measures or even penalties.

In any case of soil pollution or if actual developments does not correspond with the permissions the **polluter-pays-principle** should be used: The person that is responsible for the damage of soil should also pay for measures concerning its recovery.

4.1.2 Recommendations for soil management

Taking into account the high complexity of the different soil functions (habitat function, filtering, buffering, storing functions and production function) as well as the different potential impacts (compaction, sealing, pollution, loss of organic matter, erosion) and the variety of existing instruments it becomes rather clear that there is not the one and only instrument for soil protection and soil management. A bundle of different measures is needed to meet all the different threats to soil and the different requirements to manage them in a way to protect the valuable functions of soil.
Based on the contribution of the experiences with the different approaches in the different regions of the project partners, the following combination of instruments seems to be useful:

1. **A comprehensive list of clearly defined legally binding goals for soil protection covering all aspects:**
   Common goals for all relevant regulations concerning the impact on and the protection of soil could help to develop a common understanding of soil protection throughout all different sector related regulations. The goals should cover all types of potential impacts on soil such as compaction, sealing, pollution, loss of organic matter and erosion. The Soil Conservation Protocol of the Alpine Convention could be seen as a best practice example concerning the list of goals. Terms such as sparingly, carefully and economically etc. have to be clearly defined.

2. **Regulations on land consumption and sealing:**
   Land consumption and sealing threatens most of the soil functions. Various approaches can contribute to reduce land consumption:
   - Spatial planning regulations should focus on the development of compact settlements
   - Building decrees can limit the percentage of sealed surfaces of building land in order to guarantee the minimum of soil functions needed (e.g. water infiltration, cooling function, green space). This effect has to be assessed after finalization of the development.
   - Housing subsidies can be used to support the sparely use of land through higher subsidies for more densely buildings and support of renovation
   - Taxes on the use of agricultural land differentiated according to the quality of soil could guide the use of land to the less valuable areas

3. **Soil protection of non-urban land:**
   The use of non-urban land for agriculture or e.g. waste disposal can influence the quality of soil. Thus, regulations are needed to keep the quality of soil and to protect it against pollutants. This could be done by various approaches:
   - Thresholds on soil pollution e.g. concerning the use of fertilizers or pesticides or application of organic waste

- Subsidies for a soil-friendly agriculture (e.g. reduction of compaction and erosion) using the existing system of subsidies for agricultural production
- Definition of standards for good agricultural practice towards sustainable agriculture

4. **Standards for impact assessments (SEA, EIA, land use permissions) to reduce the impact on soil when land use is changed:**
   During the procedure of impact assessments the effect of plans, projects and other land use changes on soil are assessed. In order to improve their quality standards, regulations on how the impact on soil has to be assessed best combined with thresholds could improve the effectiveness of these impact assessments.

5. **Effective Monitoring:**
   The use of thresholds to protect soil has to be combined with an efficient monitoring system. Only if it is possible to monitor the quality of soil, any instrument linked with thresholds can be used efficiently.

6. **Acceptance and awareness**
   What is considered as important in our society is dependent on the existing appreciation. Thus, the necessity of soil management and soil protection has to be in the focus of the relevant decision makers as well as of the relevant stakeholders. The awareness of the soil value by the politicians that enact the laws is a key factor of the success of soil management measures.

4.2 SCIENTIFIC & PRACTICAL NEEDS

From the perspective of environmental protection and concerned municipalities, specific needs for integration of soil protection in planning procedures from a scientific as well as practical point of view were collected. These needs give an overview and were grouped into four types of needs which can be characterised as follows:

4.2.1 General needs

Looking at the general needs it can be stated that planners and stakeholders need to be aware of the importance, quality and quantity of soil for urban planning processes. This provides at a later stage a higher acceptance of the environmentally good soil. All decisions need to be based on existing soil data as much as possible, but monitoring of soil serves the necessity to know about future soil conditions. An evaluation can validate these monitoring assumptions and therefore indicators for the impacts on soil quality in urban development can be developed and applied in future planning decisions.

4.2.2 Conservation needs

The conservation needs highlight possibilities to protect good quality soil and specific functions of soil. This can be achieved via diverse sectors like agriculture, water or nature conservation giving the priority to protect these areas and thus avoid soil consumption. On the one hand, the quality of urban citizen's life (e.g. ecosystem and recreation functions via protected and green areas, reduction of wind erosion and improved air quality) and the supply of agricultural products from short distances can be improved and assured. On the other hand soil can be protected and secured in a long-term perspective. Also within urban areas, areas for play grounds, green fields and water retention need to be conserved. If subsurface construction has ceased, there is the need to set it back to the original state of soil.

4.2.3 Evaluation needs

As evaluation needs environmental quality, assessment and delineation are seen as very important. Also the loss of soil, including the sealing rate and potential for alternative uses of brownfields need to be evaluated. Based on this evaluation and the estimated demand of compensation, which is seen as an important evaluation need, potential areas of urban development and growth shall be identified, especially areas of low soil quality. In order to fulfil such needs it is important for municipalities to build databases characterizing urban space. As not only the soil itself is affected by change of land uses also the impacts on other environmental compartments is recommended to be assessed. The quantification of impacts of soil quality on local climate, air and water means a transdisciplinary approach, looking at interactions between several environmental matters.

4.2.4 Action needs

The proposed action needs should be based on the previous needs. Through the consideration of these conservation and evaluation needs in zoning plans the available area for construction can be defined and priority can be given to unsplit, low soil quality areas. Also looking at the economic and social costs related to works impacting soil is needed. Finally the expansion of a city shall, as already stated in the evaluation needs, depend on the suitability and quality of soil.

4.2.5 Conclusions

For the fulfilment of these needs several proposals for implementation were given. Beside legislative framework conditions the development of computer tools are regarded as helpful for practical implementation. Regarding the proposed needs tools for the evaluation of quality and functions of soil under different land use and impacts on other environmental compartments will be helpful. Also tools to assess the loss of soil resources, in particular by soil sealing, seem to be necessary. Furthermore for collecting and compiling of soil data from different sources tools should be developed. Such tools should be made accessible via internet. These tools are provided by this project (see chapter 6).

4.3 STAKEHOLDER NEEDS

Stakeholders of the planning sector were asked what their needs for integration of soil in urban planning processes are. Following needs were identified:

- **Better basic data:** Soil data are available in a different quality (differs on the one hand from federal state to federal state, on the other hand from region to region in some federal state). There should be a national wide standard, amongst other to have a basis for a national wide comparison.
- **Better information and awareness raising are needed**
    - About the soil quality and the special soil aspects in different scales of municipal urban planning level (e.g. landscape plan, local green structure plan and green design plan)
    - More information about potential areas for inner urban development projects and strategies for redevelopment, Stuttgart for example has a Sustainable Management of Building Areas Stuttgart (NBS) (Landeshauptstadt Stuttgart, 2003) with a database of all existing potential building sites in the city like brownfields, underused land, land conversion and new development areas
    - For implementation of the spatial planning instruments there is the need of more soil awareness of the different stakeholder: decision maker, communities, land owner, etc.
    - The information about the complexity of soil and soil functions should be better comprehensible for all groups (politicians, planner,...) as decision makers need a simple form of information
- **Implementation of instruments is needed:** There are enough planning instruments considering soil, but there is a lack of implementation. Further effort has to be done into the implementation of the spatial planning instruments. Decision makers have to be motivated to implement a soil management system.
- Protection is given, but the **development of stimulating strategies is needed:** The instruments of the past already consider the protection of soil. Focus should be laid on strategies which stimulate the protection of soil and open areas in appropriate parts of the urban areas.
- **Urban soil conservation guidelines and limitation of maximum soil loss are needed:** Two types of urban development exist: dense urban structure and open space with soil protected areas or sprawled structures. In order to avoid urban sprawl guidelines defining percentage for density in the region/state on yearly level could be established with prior precise calculation of percentage of all soil types and its quality and definition of maximum targeted loss in next 10 (30) years and then divided per year.
- **Regular monitoring and evaluation are needed:** Better monitoring system or evaluation of open space and soil consumption in the city as a basis for further strategic decisions of the politicians is needed (for example as part of a status report). Indicators of sustainability and related thresholds should be defined.
- **Financial incentives should be incorporated:** Methods for consideration of economical value of soils including soil quality should be developed and implemented as drivers for sustainable soil use. External costs of change of land use should be integrated in the calculations of soil values.

5 GOALS AND STRATEGIES

5.1 GOALS

The general goal in relation to URBAN SMS is the sustainable use of soil in urban areas considering soil quantity as well as soil quality in terms of providing different soil functions. Based on this overall goal the following two goals have been defined which should be achieved in order to meet the overall goal.

5.1.1 Reduction of soil consumption rate & soil sealing

One of the key issues is that in many urban areas only small areas of open soil are left to fulfil necessary soil functions like biomass production, water filtration and retention, gas exchange or recreational space for humans and living space for animals and plants. Urban and peri-urban areas in Central Europe face a progressive increase in soil consumption and sealed surfaces due to their sprawl. This is often a non-reversible process that leads to further loss of these natural soil functions. A sustainable use of soils has to consider a reduction of the soil consumption rate and density of sealed areas, in particular in peri-urban areas.
At national level there exist goals for sustainable soil consumption rate, like in Austria and Germany. In Austria the goal was to reduce the daily soil consumption by building and transport areas until 2010 down to one tenth of the value in 2002 (BMLFUW, 2002) which was clearly not achieved as the reduction was only one half (Umweltbundesamt, 2010). In Germany the goal is to reduce the soil consumption rate by settlements, trade and transport from 120 ha/day in 2002 to 30 ha/day until 2020. Between 2004 and 2007 the average soil consumption rate was 113 ha/day. The reduction in building areas since 2002 was nearly compensated by more recreation areas (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, 2009).
In distinct areas with very few open soils even an increase of exposed soil surfaces in urban settlements is needed in order to get the necessary environmental and social benefit from it. Ideally this open soil areas should be allocated in a way that green corridors or a green net structure can be built up. For the benefit of life quality the areas should be accessible by inhabitants in reasonable distances.

5.1.2 Sustainable use of soil considering soil quality in terms of soil functions

Soil is a three-dimensional effective, almost non-renewable system, so it is necessary to regard this environmental compartment in a quantitative and qualitative way. Otherwise misconduct can cause long-term consequences. The soil quality affects the ability of soil to fulfil several natural soil functions (Federal Ministry for Environment, Nature Protection and Nuclear Safety, 1998):

- basis for life and habitat for people, animals, plants and soil organisms,
- part of natural systems, especially by means of its water and nutrient cycles and
- medium of decomposition, balance and restoration due to its filtering, buffering and substance-converting properties.

Additionally soil functions as an archive of natural and cultural history.

These functions are endangered by various human activities like industry, deposition of raw material, settlement, transport, waste disposal and other economic and public uses. These uses cause physical or chemical influences like erosion, compaction, contamination, loss of soil organic matter and modification of soil profiles, what finally can lead to land abandonment.

The protection of soil means the preservation of its natural functions in their entirety. Therefore the use of the soil should consider the actual fulfilment of the natural soil functions and maintain these soil functions for future use as much as possible. The land use should be in accordance with the soil potential based on the natural soil functions. The goal must be to preserve particularly soils with a high performance regarding their most important functions for human being and for the ecosystem and to steer the unavoidable land consumption on degraded soils or soils with a low natural performance.

5.2 STRATEGIES

Eight strategies have been identified as helpful to achieve the soil management goals. In particular they should help to achieve the overall goal that soil protection is sufficiently considered in municipal spatial planning in order to steer and reduce soil consumption. Each strategy is briefly described in the following section.

5.2.1 Applying sustainable soil management in spatial and urban planning on all levels

Spatial and urban planning has the chance to consider the subject of soil protection at an early stage of planning. Therefore it is necessary that soil is a matter not only at the stage of construction planning, but also in the general development plans. At this planning level preventive orientation of the land use can still be ensured.

Firstly, decision makers must be convinced that soil is an important environmental compartment for a municipality. Decision processes are mainly located in the municipality council. Understandable methods and feasible proposals for the consideration of soil in urban planning must be - step by step - presented to the members of the council. It is also important to involve the relevant administrative bodies, like environment and planning department at an early stage. At the end of this process, there should be a binding decision of the municipality council, in which way soil should be considered in urban planning. The planners are then encouraged to apply a soil evaluation system. But if they are not convinced of the usefulness of the system and if this is very complex to apply, the system will not fit in planning processes and the acceptance will be very low.

Sustainable soil management should be a common practice in all relevant processes leading to soil consumption. The assessment of effects of these processes on soil consumption should be based on economic, social, and ecological balance. All planning processes leading to soil consumption should be evaluated and alternatives with lower soil consumption should be presented. Awareness of decision makers of the need for reduced soil consumption has to be raised. An integrated monitoring of available soil resources allows controlling the effectiveness of soil management.

5.2.2 Improving legislation in terms of soil protection as well as proposing a unified legislation approach in Central Europe

Urban planning makes with its detailed plans the basis for development projects to become real. In the process of preparation, due to the fact soil protection is a young discipline with less important role and protection measures even within other environmental compartments, not enough attention to soil protection is being paid. The main reason for that lies in wide range of soil functions not recognised by planners, decision makers and on the other hand in not yet

developed convincing tools for evaluation of loss of all soil functions when a new area is being sealed. With preparation of a validation system for soil functions in terms of different soil quality which would be widely accepted by all involved groups within urban planning procedures a first step for better soil evaluation would be established. In the next phase this validation system should be incorporated into the regional or national rules concerning the detailed content and methods of spatial plans and into urban planning procedures. Also improved, standardised SEA/EIA requirements regarding soil protection in terms of quality and quantity can help to minimize the loss of natural soil functions and the area of open soils, in particular of good quality.

The idea is to propose a unified approach how soils should be protected and considered in spatial planning. At the European level a Soil Thematic Strategy (COM(2006)231 final) that focus on conservation and restoration of soil functions with the aim to protect soils and its sustainable use was adopted. According to this strategy soil protection has to be considered more in other policies like regional development. As it is done in the Soil Conservation Protocol of the Alpine Convention more concrete requirements should be laid down also for Central Europe. For example, not only the reduction of soil consumption, but also the consideration of the different quality of soils in terms of soil functions which are intended to be consumed should be obligatory. As a new policy document at this level is very difficult to be achieved meanwhile the approach should be implemented in national or regional legislation of the respective countries.

5.2.3 Raising awareness of soil as a natural resource

Soil is endangered as a natural resource mainly in all highly developed and highly populated countries. Raising awareness of soil as a natural resource is therefore highly needed. This process has many different forms which depend on the specificity of the respective country and its legislative and historic approach to the soil as a natural resource.
One of the most important means in the respect of public awareness is mass media. They can enormously influence public opinion in both directions, either positively or negatively. They should be therefore permanently supplied with relevant information on actions taken.
Public should be informed more about the disastrous effects of flooding and landslides and its relationship with soil sealing. All the production and environmental functions of the soil should be emphasised.
Very important aspect is a proper education of specialists in soil protection and land use planning. This education process should start already at the low levels of education even during the basic education. It is also important to organize nature trails which will include soil profile description and showing the environmental functions of the soil.
As a very good mean of awareness increasing could be considered issuing of soil related publications. In this respect the Soil Atlas of Europe can serve as a good example.
The agricultural soils should be better defined in the legislative documents of EU member states. Soil rating must be considered as a substantive factor in respective decision-making.
Organization of specialized workshops for officers and decision-makers responsible for land use planning would raise awareness on role of soil.

5.2.4 Establishing regional co-operation in soil management

Each municipality depends on income by taxes paid by companies and inhabitants located in their territory. Therefore a lot of competition exists between municipalities concerning settlement of companies and inhabitants which demand space for spatial development. Urban sprawl is

taking place and needs coordination in order to minimize it and conserve sufficient soil resources for future use. Cooperation among neighbouring municipalities of a region can improve compatibility of the spatial development plans and help to avoid duplication of location of similar types of companies and infrastructure (e.g. schools, water treatment plants, dumpsites) in direct neighbourhood. It would help to minimize soil consumption and to optimize opportunities for use of soils. Soil of different quality can be dedicated more easily for different purposes depending on their requirements. The establishment of such a co-operation can be established by setting up a written agreement accompanied with a common fund for financing settlement projects with mutual benefits for the municipalities.

5.2.5 Involvement of stakeholders/decision makers at the early stage of management

This strategy represents a crucial issue for the acceptance of soil in a new urban soil management strategy by land owners, decision makers, urban architects and urban planners. Easy understandable information about the role of soils and their numerous functions in urbanized areas influence the decision process in site use at primary stage of urban plans. This strategy may enhance awareness about soil as limited natural resource which comprises an inevitable part of the urban ecosystem. Stakeholders may learn that enormous soil consumption causes losses of soil functions resulting in higher risk of flooding, change of local microclimate, finally in worse healthy status of urban population and costs for restoration. High acceptance of soil protection in urbanized areas at early stage can lead to more sustainable solutions. Stakeholders have high influence on the soil use and for this reason it is necessary to involve them at the early stage of management strategy in order to ensure the benefit for urban society and environment and to avoid high economical cost for soil restoration.

5.2.6 Improving management of degraded urban areas

Management methods have to be developed to provide municipalities and stakeholders with practical tools to manage degraded urban areas. These methods can be very diverse, ranging from economical measures to ensure recovery of soil functions by regulating taxes over land trade (to reduce discrepancies between agricultural land and building land) up to strict technical rules such as obliging for certain maintenance of unpaved surfaces in the reclamation process to ensure increasing soil surfaces within cities. Methods focussing on the reclamation of degraded urban areas will improve inner urban development and reduce soil consumption in cities.

5.2.7 Introducing compensation measures and validation of soil functions as market instrument

Every initiator of encroachments in soils, which cause measurable damages to the soil functions, should be committed to compensate the loss of soil functions by restoration or enhancement of these functions. Thereby it is essential that the compensation measures lead to a measurable improvement of the soil functions. If there are no or not enough possibilities to put measures into practice, unavoidable encroachments should be compensated by a payment. The amount of the compensation payment should correlate with the costs of the theoretically necessary measures to restore or improve the lost soil functions or at least to be correlated with the quality class of the lost or degraded soil. The legal and organizational mechanisms are needed to ensure that the collected payments are invested in measures or policies, which help to minimize soil

consumption by urban sprawl as e.g. the strengthening of inner urban development or to improve soil function performance.

Expected effects of the strategy:

- It is possible to restore soil functions in the area of interest by compensation of encroachments at least to a certain amount.
- The description of the loss of soils and their performance and the commitment to search for compensation measures and also the finding that a fully compensation is often not possible, may help to raise awareness of the value of soils.
- The efforts to find measures and to put them into practice or, if measures are not possible, a compensation payment may help to minimize soil consumption Comment: already mentioned above
- As the amount of measures or payments depends not only on area but also on soil quality, a steering effect of soil consumption (on soils with a low performance) could be achieved.

The commitment to compensate encroachment in soils regarding the soil functions and their performance could help to minimize and to steer soil consumption and to raise the awareness for soils and their value. But it must be kept in mind, that suitable areas for compensation measures are often not available, neither in sufficient quantities nor regarding the improvement potential. In consequence adequate compensation cannot be achieved, irrespective of the available measures. In fact, the loss of good to very good soils leads almost unavoidably to a deficit which is not compensable because a multiple of the claimed area is needed but often not available in practice.

On the other hand even if there are sufficient areas with improvable soils, any conflict with the main strategies of soil protection must be avoided. In general, unavoidable encroachments should be specifically directed towards lower-quality soils which are generally found within urban areas in disused settlements or industrial land. Furthermore it is not reasonable to return large areas of built-up land through expensive seal removal or decontamination to the natural circulation within the framework of compensation and in parallel - because of the increasing lack of suitable opportunities within the inner urban area - using natural and functional soils for settlement development.

These aspects are indispensable in connection with compensation measures to guarantee a reasonable application.

One of the most effective levers to steer real estate developers and builders towards the re-use of brownfields instead of virgin or agricultural soils are incentives or taxes. Tax exemption of investments in derelict sites must become common praxis in all European cities, the corresponding resources being recovered on taxes on new settlements on greenland (usually better fulfilment of soil functions than derelict land). In principle, costs borne by investors to reclaim a contaminated site (while not already obliged by the “polluter pays” principle) should be discounted from “urbanization fees” (taxes paid to the municipality to provide roads, pipelines, parks, schools...). The soil index based on evaluation of functions of built or open land should be the basis for the calculation of taxes or incentives, together with the assessment of usability of uniform or scattered land parcels by humans or by the ecosystem itself. In this way monetary levers could be quantified from land parcels’ values calculated with soil evaluation tools. This could let public authorities award with proper economic help investors avoiding quality soil consumption and/or recovering quality on brownfields.

5.2.8 Increasing inner urban development

One of the most promising solutions to minimize soil consumption by urban sprawl is a consistent inner urban development. But the reasons to prefer inner urban development are not only to safeguard the soils and their functions. There are also other important reasons and preconditions in favour for inner urban development.
Compared to other world regions, Europe faces rapid demographic change: declining population growth and increased population ageing in many European countries. Demographic ageing is inevitable and means for the future increasing costs to maintain infrastructure if there is no concentration of the “under roof” area. And issues like medical care or shopping facilities nearby will become more and more important for a population that is getting older.

Due to these conditions the strengthening of inner urban development is needed within a designated inner city area. In common, it can be assumed, that in many communities areas like building gaps, suboptimal used areas or restored brownfield sites could be utilized.
Basic prerequisite to activate the inner urban potential of construction areas is the evaluation and the documentation of these areas in a building gap cadastral. Based on this cadastral the municipalities should implement a building gap management in urban planning. Important tasks for the municipalities would be e.g. to offer a building gap marketplace and to negotiate with the owners of building gaps or not adequate used areas. A good example for an effective building gap management is the so-called “Sustainable Management of Building Areas (NBS), implemented by the city of Stuttgart (Landeshauptstadt Stuttgart, 2003).

5.3 RELATIONSHIP BETWEEN GOALS AND STRATEGIES

The strategies described above contribute either directly or indirectly to both goals. For each goal it can be shown which strategies are most relevant to achieve the goal. Considering regional or local priorities the focus should be laid on establishment of the most relevant strategies.

5.3.1 Reduction of soil consumption rate & soil sealing

Direct contribution

The application of sustainable soil management based on appraisal of the key role soils exert in the urban ecosystem (e.g. in the carbon sequestration, water and nutrients balance, etc.) would certainly help the reduction of soil consumption in cities. The reduction of soil consumption rate and soil sealing in cities can be mainly obtained by a direct involvement of policy makers, regulators and planners. This can be done through a process of improvement of the legislation by embedding soil protection and in particular the reduction of soil consumption and soil sealing into urban planning. Quantifying sealing rates in different projects may become a target to collect the current status of sealing rate in an area. If this is the basis for any planning action then the comparison of different projects can be done. Good practice or legal need will therefore embed soil protection into urban planning.

The agreement for saving unsealed areas outside the city built-up areas and green corridors should be made in a regional dimension, then additional factors that can help achieving a reduction in soil consumption rates can come from the establishment of regional cooperation in soil management (e.g. exchange of best practices and guidelines) and in the validation of soil

functions as a market instrument (e.g. un-sealing of soil as compensation measure in redevelopment activities). Saved money is a motivation for alternative approaches.

The goal of the reduction of soil consumption and sealing could also derive from policies aimed at increasing the inner development of cities and leaving vast areas of soils exposed and devoted to parks and open spaces in other city areas. To minimise the non-avoidable losses, the urban land use must be steered strategically on areas of soils with lower quality which are found mainly in the inner city. In fact, an increasing in the inner development leads to the prioritised use of brownfields and former used areas. This will satisfy city requirements of land use and transformation of greenfields in to building land will be prevented.

Indirect contribution

Awareness raising of the role of soil as a key and fragile natural resource will also contribute to the goal of a reduction in its consumption and sealing. In fact, sealing process strongly affects soil functions, sometimes in an irreversible way. Some key functions (such as air and water exchange, nutrients cycling, plants growth) are in fact strongly affected or removed by the process of soil sealing.

The reduction in soil sealing could also derive from a unified legislation approach that would rule the maximum allowed intensity of sealing in EU cities. The development and adoption of management methods for degraded urban lands (e.g. by obliging for certain maintenance of unpaved surfaces in the reclamation process) can also lead to an overall reduction of soil consumption. In fact, in the same way increasing of inner development contributes the goal directly, methods for management of degraded urban land can help reaching the goal indirectly, leading to a higher land-use of brownfields areas, therefore reducing the pressure on un-degraded soils. Often it is necessary to remediate such areas before usage is possible. One part of such a management method should be a cadastre for degraded areas as potential building development areas.
A reduction of soil sealing could also benefit from the inclusion of soil compensation as a market instrument by giving exposed surfaces an intrinsic economic value.

5.3.2 Sustainable use of soil considering soil quality in terms of soil functions

Direct contribution

As the land use type is mainly defined by land use planning and the use of soil can be influenced by spatial planning programmes a promising strategy is to embed soil protection more into urban planning by adapting existing legislation or even introduce new regulations which have been proven to be successful elsewhere and are compatible with the regional/local spatial planning system. With the current legal bases it is possible to assess soil contaminations and other forms of soil degradation. But the assessment of the natural functions of soil in a quantitative and qualitative way has not been legally established until now. So it is difficult to measure loss of soil in case of encroachment. The idea for a proposal for unified legislation approach in Central Europe is quite difficult to achieve as it can be seen from the discussion of the EU Soil Framework Directive. The EU Thematic Strategy on Soil Protection already exists and defines some general, non-binding objectives for sustainable soil use.

As economics usually play a crucial role in decision making of land planning the validation of soil functions as a market instrument (taxes) is a promising approach to increase the value of soil functions and therefore the conservation of them. In case of trade with land this strategy may

help to reduce the big differences in market prices of various land use types, in particular between building land and agricultural land. This economic approach could also be one of the management methods for degraded urban areas. These management methods have to consider recovery of soil functions, the costs in relation to the local needs and advantages as well as the future use of the soil in order to serve the goal of sustainable use of soil.

Indirect contribution

Awareness raising of soil as a natural resource will help to better understand the importance of soil for society and consequently for land use planning. With easy understandable information about the role of soils and their functions land owners, but also decision makers can be influenced to decide about soil use in a more sustainable way. They have to understand that soil consumption causes losses of soil functions which can be measured in deficits of soil quality and also in indirect costs and building measures, caused by deficit of certain amount of specific soil quality. These losses can cause higher risk of flooding, contribute to the change of local microclimate and create higher dependence on non-local (non-state) supply with food.
The decision makers must be convinced of the possibility to define realistic goals via restricting the loss of soil quality. Further the stakeholders have to realize that basing on combined approaches of soil quality (= functions) and quantity (= soil-surface areas) in practice is needed to reach the goal.

Establishing regional cooperation in soil management would help to move towards more sustainable use of soils as not all local needs have to be fulfilled in each municipality itself. For example certain land uses (e.g. industry, trade, and infrastructure) can be located only in one municipality and be used by the others and all partners of the regional cooperation share the costs. There may be possibilities for synergy effects such as joint industrial zones and infrastructure.

The involvement of stakeholders and decision makers at the early stage is crucial for acceptance of a new urban soil management strategy. The acceptance and the consequent implementation of such a soil management strategy will promote the sustainable use of soils considering soil functions. Finally introducing soil compensation as a market instrument will contribute to use the most suitable soils according to their soil functions fulfilment for the needed land uses. But the contribution of this strategy to the goal depends on the criteria that will be considered in the market instrument.

6 URBAN SMS TOOLS

In order to implement the strategies in practice tools are necessary. These tools should be clearly defined and purpose driven. They must rely on already available or easy to acquire soil, land and related data. Tools must be applicable, and flexible in different environments. The development of soil evaluation and management tools is directed by several important issues. The data quality and quantity, data definition and spatial resolution may vary significantly between cities, regions and countries. Additionally, the legal differences and requirements are present among different countries or regions. Applicability of tools and consequently the design of tools at least depend on structure, size and organization of local communities or cities. The tools must consider the common soil protection goals but should be designed in a flexible way allowing modifications related to data availability and legal issues.

Based on these conditions several evaluation and management tools have been developed within the project URBAN SMS which are briefly described in the following subchapters. More detailed descriptions are given in the respective reports regarding the tools (URBAN SMS Products No. 11 & 12).

The evaluation tools cover guidance for the evaluation of soil within the environmental assessment of plans and projects as well as software for the evaluation of soil quality and quantity as basic information for planning procedures. Regarding the management tools guidance on how to introduce and apply compensation measures (URBAN SMS Product No. 16) as well as brownfield redevelopment (URBAN SMS Product No. 19) can be used as a market tool. The awareness raising package (URBAN SMS Product No. 16-28) which provides a collection of facts and arguments for sustainable urban soil management contains tools to improve the awareness on the need to consider soils better in urban planning. The documentation of the application of these tools in pilot areas provided as a case study book (URBAN SMS Product No. 29) will be a helpful tool for application of soil management in future urban planning.

6.1 GUIDANCE FOR SOIL IN SEA AND EIA

Soil and its interactions with other subject of protection should be assessed and considered in environmental assessment, both in SEA and EIA. The function of soils being an interface between geo-sphere, biosphere and hydrosphere further compounds this, as they cannot be easily compartmentalised. Soils also play an important part in biodiversity conservation. So it is vitally important that soil aspects are included as an integral part of the environmental assessment process. Not only because changes to soils can have subsequent effects on other parts of ecosystems, such as vegetation composition and watercourses, but also because of the intrinsic value of soil as limited and living resource in its own right. Hence soil evaluation is an essential element of the Environmental Assessment process and any significant impacts on soils should be included in an Environmental Statement.

This guidance (URBAN SMS Product No. 7) provides practical proposals on how soil should be considered in SEA or EIA processes. The key messages and outcomes in this guidance are based on partner consultations. Examples used within the guidance are drawn from a broad range of partner countries types of projects, plans and programmes; mostly those that most typically consider the effects on soil (e.g. agriculture, town and land planning).

Quality soils like agricultural land were intended for urban development and other uses already in earlier planning decisions and before guidelines were developed. The focus of these recommendations is placed on upcoming planning processes and decisions.

Superior planning

Laws and decisions refer to general effects on environmental media, among them soil is specifically quoted, but not defined. Especially soil protection is often not defined in detail, so in practice only sealing and soil consumption are considered, thus not taking into account soil functions and their performance. The impact on soil protection is limited to EIA projects requiring an authorisation and the project area is usually fixed.

Superior planning (level of policies and plans or programmes – SEA) needs to be steered on low quality soils. Soils with a very high and high quality regarding soil functions have to be protected. Soil consumption needs to be steered and land consumption minimised by inner urban development. Deficits in compensation measures may be supported by economical instruments like e.g. appropriate payments per m^2. Impact assessment on soil functions is urgently needed and will be very helpful.

Communication

The main gaps regarding soil protection are not in the legal foundations. Due to organizational difficulties demands of soil conservation authorities and their acceptance in the decision making process are not sufficiently integrated into plans, programmes (SEA) and projects (EIA). Besides that soil is only mentioned as one of the 12 subjects of protection which have to be dealt with.

There are semantic differences for soil related terms used by spatial planners and soil experts; spatial planners consider soil in general as land consumption, whereas soil experts consider the qualitative and quantitative loss of soil.

Therefore a Common strategy between city planners and soil experts in the regional authority and the exchange between experts is a necessity. This can be achieved by implementing a platform for experts on soil and spatial planning via teaming up theses two separate fields for planning purposes.

Only communication within administrative units at an early stage in both processes is seen as nucleus to ensure adequate consideration of comprising soil protection.

Clear soil related approach and strategy

The sparingly, carefully and economically handling of soil is an indefinite legal term and in practice the effectiveness of these requirements is low. Also qualitative goals for a sustainable soil use are not described in detail. Further compensation measures on the legal basis usually compensate other environmental compartments and not primary soil.

A preventive and integrated approach about direct and indirect environmental impacts, especially for soil and subsoil is needed in urban and suburban environments. SEA and EIA measures should follow these approaches. Comprehensive strategies on how sustainable soil conditions should be achieved have to be specified.

For example the BOKS - Soil Protection Concept of Stuttgart - ensures this by controlling the point loss in the "soil contingent" by two consumption approaches (Landeshauptstadt Stuttgart, 2006):

- First approach “inner urban development” concentrates on brownfield redevelopment. Sustainable Management of Building Areas Stuttgart (NBS) supports the main strategy and goals by providing settlement areas for reuse and aggregation (Landeshauptstadt Stuttgart, 2003);
- Second approach "degressive rationing" aims at a yearly minimization of the soil consumption until the planning activities will be completely covered by inner urban development.

The assessment based on BOKS is used and accepted. With BOKS the affected soils can be determined by a "soil indication" according to their quantity (= area size) and quality (= soil function). The change can be evaluated. This "soil indication" is supported by the "Planning Map - Soil Quality“, which covers the entire Stuttgart city area. This figure indicates the soil quality as the sum of the soil functions to be protected specified by the Federal Soil Protection Act of 1998. Also anthropogenic influences as pollution, cultivation and sealing are considered. As a result the quality of soils is characterized by 6 levels (0 to 5). "Soil Index Points" are calculated in BOKS by the dimension of a planning area and the respective soil quality levels given in the planning map. This area-specific value will be reduced with every further demand on the soil in relation to the regional quality loss (= loss of soil functions) (Wolff, G. & Schweiker, M., 2008).

Consequently clear goals and aims for soil quality and sustainability need to be formulated (e.g. (national) sustainability strategy) and indicators (e.g. certain sealing rate), as assessment criterion, have to be developed. Additional the appropriate measures, which are obligatory, need to be implemented for each individual programme, plan and project.

Especially brownfields and contaminated sites need to be identified, rehabilitated or redeveloped. Sufficient open space and green space areas need to be protected, preserved, restored, and upgraded. Soil conservation and improved quality of life for urban citizen would be a positive side effect.

Improving guidance

Hardly any guidance focuses solely on soil and soil protection in the URBAN SMS partner countries. The few existing ones are legally not binding. In the majority of the partner countries guidance, only soil sealing and overall land/soil consumption are mentioned. Soil functions are referred to marginally. In many partner countries, no special regulations, limit values (except e.g. soil contamination with heavy metals) or other legislation exist, which would give more detailed instructions and state indicators how soil quantity in connection with quality should be evaluated. Only a few national guidelines are developed and only two of them in all partner countries focus solely on soil (“Assessment of soils according to their performance” and “The environmental compartment Soil in the compensation regulation” of Baden-Württemberg, Germany). If guidance is available on the regional or local level, it is often fragmented. Often the effects on soil are only considered in terms of potential impact due to pollution. Compaction and soil sealing or soil functions are not considered.

The more concrete soil focused and detailed a guidance is (a legal basis would be best), especially guidance for recultivation of soil and monitoring, the better. Improvement is necessary. Soil and the related effects due to plans and programmes need to be assessed in more detail based on soil focused guidelines on different levels.

No regulations concerning soil go beyond the EU SEA Directive or the UNECE SEA protocol. There is no precise soil protection objective mentioned and no references to soil related regulations or polices are given. The legal fundamentals are often universal and bylaws regarding soil are still missing. Approaches for soil protection and soil assessments are mentioned only in general and are delegated to e.g. regional development plans for specific approaches.

Approaches for soil protection and assessment need to be clarified in detail and have to be integrated in legal requirements.

Basics for evaluation

Despite of many demands in different planning levels and instruments the requirements are not substantial enough regarding soil inventory and sustainable handling of soil. There is still a lack of measurement methods and monitoring.

Therefore basic ground work, basic and frontier research, data collection, inventories and sufficient monitoring as well as evaluation of monitoring results is needed to improve evaluation schemes and method of indicator development. Additional a data platform (e.g. databases or maps) for all useful soil data is necessary to gain sufficient knowledge of inter alia soil quality and describe the current state of soil. Impact assessment matrices in which the effects on soil, namely on soil quality are mentioned can be an adequate support tool.

6.2 SOIL MANAGER SUITE

Soil management that should become integral part of the urban and peri-urban space management is in general carried out by city administration staffed by default by non soil experts. Thus, the lack of soil-related knowledge is generally present in local communities' administrations. This gap can be partly mitigated by introduction of computer tools with embedded soil knowledge and expert predefined methods and arguments. The introduction and successful use of soil management and evaluation tools can direct soil management and consequently largely improve soil protection. The computer tools (web applications and standalone single user desktop tools) should be equipped with guidelines and manuals which comprehend not only technical step-by-step description of functionalities but also guidance and interpretation of tool outcomes that are in line with the soil protection and management goals.
Development and introduction of convincing and easy to use tools combined with assisting guidelines represent an important tool towards sustainable use of soil in urban areas.

Regarding the size and structure of local communities and cities two major types of computer tools are needed. Larger communities, typically big cities with several departments including IT department, in general favour multi-user IT environment based on servers, common data collection and database management, well defined data flow and routines, sharing and exchanging common information including IT security issues. In such IT environment soil management tools can be embedded using two different approaches. An internet based GIS web application with dedicated soil management tools suits municipalities which would like to avoid financing expensive software (GIS software licenses) and hardware. In municipalities where commercial GIS software is already in daily use the introduction of purpose-driven and software tailored soil management tools would represent the adequate solution. In both cases

the soil management should be driven by well defined and easy to use software application which comprehends the set of clearly defined and single task focused tools. Tools must be easy to understand and simple to use. They should be carefully designed in a way to assist end-user to successfully carry out procedures during daily work and not become just an additional burden.

Guidelines for such computer tools describe how to use software, the evaluation method and the workflow (URBAN SMS Product No. 12). Guidelines must be comprehensive, understandable and easy to use having two main sections. The first part is usual technical guidance on the software tool or method which should clearly describe the work procedure, individual work steps, intermediate result and the final outcome. The second part should clearly describe the purpose of soil evaluation and the final soil management goals. This section must direct the end-user to correctly interpret the results of the tools in line with the soil protection goals and help to avoid misinterpretation.

The set of tools provided will allow a sustainable management of soil resources in urban areas. These soil evaluation tools embed the soil expert's knowledge, but can be used also by non-experts. The Urban SMS Manager Suite (URBAN SMS Product No. 11) consists of

a) Desktop Urban SMS Tools – a computer based interpretation application of non-spatial soil-related information, and
b) Web Urban SMS System – a GIS based portal that is used for interpretation, analysis, visualisation and modelling of soil and soil related data.

The Soil manager suite consists of evaluation tools which are related to following issues:

- Soil quality evaluation (assessment of the quality of soil resource),
- Soil quality management (improvement of urban environment and citizen's health protection)
- Mitigation of soil sealing (rational and soil protection oriented planning),
- Soil in urban environment (assessing specific urban soil functions) and
- Spatial planning and urban development (sensible and balanced planning).

The eight evaluation tools are

- Ecosystem Soil Quality tool – to assess the environmental value of soils;
- Agricultural Soil Quality tool – to preserve best agricultural soils;
- Soil Contamination tool – to steer the planning decisions towards lower impact of soil pollution;
- Loss of Soil Resource tool – to assist the planning decisions and to protect quality soils;
- Sealing Rate tool – to evaluate the importance of urban green areas;
- Water Drainage tool – to estimate the soils infiltration rate and potential water logging;
- Connectivity tool – to evaluate the suitability of the land parcel to complete larger green soil patterns or planned parks/green corridors;
- Proximity tool – to evaluate added value for resident population of additional high quality soil in their vicinity.

All tools were designed in the most flexible way possible, allowing each tool to be adjusted according to the local data availability, interpretation rules, national legislation, soil resource quality and various threshold values specific for a region or country.

The evaluation tools should help to identify the potentials of soils to fulfill different soil functions in urban areas. This knowledge helps to achieve the overall goal to consider soil protection sufficiently in municipal spatial planning in order to steer the use of soil according to its potentials and reduce soil consumption.

After application of the evaluation tools more knowledge about the quality of the resource soil is available. The spatial extension and distribution of the soils of an urban area with maximal five different quality classes for each function evaluated by the tools is known. Based on this knowledge urban planning can be oriented towards best use and conservation of the soil according to its quality.

Before and during the application of the evaluation tools several steps have to be carried out. The experiences from application in the pilot areas helped to draft further guidance regarding the following issues:

- Data needs
- Data preparation for software
- Interpretation of results
- Opportunities and limitations of tool application
- Recommendations for application

Further details of the tools of the Soil Manager Suite (purpose, outputs, detailed description, data requirements) are given in a separate report (URBAN SMS Report No. 11).

Based on stakeholders proposals several ideas for further development of the evaluation tools which are outside the scope of the project are

- Combination of evaluation results towards sustainability values related to land consumption (e.g. like BOKS system)
- Consideration of economic value by e.g. weighting results with market price of land
- Consideration of demographic density of urban areas by e.g. weighting results with number of inhabitants by area
- Consideration of external costs by estimation of costs of loss of soil functions (e.g. no cleaning of water) or costs for compensation measures
- Consideration of spatial allocation of areas of certain quality within urban area in relation to land management needs

6.3 GUIDANCE ON HOW TO INTRODUCE AND APPLY COMPENSATION MEASURES

Loss of soil or its transformation in urbanization process is practically irreversible. Thus it is not possible to compensate loss of soil functions in the particular spot. However some practices leading to mitigation of soil loss consequences considering city or district as a whole are feasible. When the soils are lost by sealing or degraded within urbanization process - the compensation activities are necessary to sustain performance of soil functions in the given area at the certain level (above threshold value). That level should allow avoidance of environmental risks and ensure life quality of population as a whole in all possible dimensions: social, environmental and economic.

There are various compensation definitions present in Central Europe cities. The following compensation measure definition is proposed: actions taken or instruments introduced in order to compensate/counterbalance soil loss or degradation during urbanization and to sustain/restore overall soils capacity to fulfil their functions in the given area.

Review done within project (URBAN SMS Product No. 15) indicates that compensation of soil function loss varies among Central Europe cities both in terms of legal regulations, assessment and practice. In some locations the compensation is ambiguous element of soil protection framework whereas in other locations (e.g. Baden-Württemberg, Germany) it comprises well defined assessment procedures and set of compensation alternatives. There is a broad frame of compensation policies in the partner cities. Many of existing instruments are of voluntary character. There are two main groups of measures:

1) direct measures including e.g. reuse of top soil excavated for reclamation of degraded land elsewhere or establishment of green areas, and
2) indirect measures, e.g. collecting fees for soil consumption that are used for environmental purposes.

Application of compensation measures might serve as a particular type of strategy of soil management. It would be a strategy for sustaining soil function performance in a certain area, rather than protection of soils against loss. Determination of compensation needs might utilize several terms such as initial state, post state and target state. The situation before the disturbance (initial state) and the found or expected adverse influence on soil function when implementing an urban investment (post state) would have to be evaluated. The difference between the two states would correspond to the investment-dependent soil loss which might be equal to required intervention or compensation (to achieve target state).

This tool described in URBAN SMS Product No. 16 focuses on measures with quite universal character that can be used in urban environment to improve or sustain soil functions. The handbook would help to select the proper method of compensation when the problem is defined. The report characterizes soil properties important for soil quality and soil functions, describes widely available soil treatments and other measures than can be applied in any area in order to enhance soil functions and presents relationships between the treatments and soil functions.

Landscape aesthetics is generally improved by measures restoring the soil returned to use after removal of sealing or metal removal and recultivation. Green roofs or grass coverage of physical structures also definitely improve landscape exterior. Health provision function of land is improved mostly by remediation of soil contamination since the residents are less exposed to contaminants. Soil liming reduces contaminant content in urban dusts. Removal of landfills may in some cases reduce exposure of human population to harmful agents.
The function of soils as habitat for natural vegetation is improved by re-irrigation of wetlands. Production function is improved by many measures that increase soil fertility (topsoiling, liming, erosion prevention, decompaction) or recover the soil.
All soil recovery treatments, restoring soil profile, are beneficial for biodiversity of soil and landscape. Liming impact on biodiversity is questionable; the effect will be dependent on site characteristics. Liming with high lime rates may alter plant succession.
There is a wide range of measures improving water retention function of soil: the measures include topsoiling, erosion prevention, decompaction, afforestation and soil recovery treatments such as recultivation and removal of sealing or landfill.
Buffer and filter function of soil is substantially improved by remediation treatments of contaminated soils as well as treatments improving soil sorption capacity (liming, topsoiling, humus application) or regulating water circulation (decompaction).
Air quality might be adjusted by measures reducing presence of contaminants and soil particles in air (contaminants removal or stabilization, erosion reduction). Green coverage of roofs and other surfaces improves air quality through enlargement of plant surface of dust adsorption. It might be improved also by growing creeping plants.

Measures increasing water storage capacity of land would be helpful in mitigation of temperature extremes in summer period. These measures would include, in some extent, green covers of roofs and other surfaces.

6.4 GUIDANCE ON BROWNFIELD REDEVELOPMENT

Tools dedicated to identifying, decontaminating and redeveloping abandoned sites are one of the most often applied management tools (see subchapter 7.7). The guidance on brownfield redevelopment (URBAN SMS Product No. 19) is based on the following definition (Ferber et al., 2006):
"Brownfields - sites that have been affected by the former uses of the site and surrounding land; are derelict and underused; may have real or perceived contamination problems; are mainly in developed urban areas; and require intervention to bring them back to beneficial use".

EU policy is to promote regeneration of derelict and underused sites and to limit urban development on valuable greenfield sites. However, currently there are no specific brownfield regulations in place at the EU level. The report gives an overview of national and regional regulations, strategies, guidelines and funding opportunities regarding brownfields.

Furthermore the scale of the problem in the partner cities, activities that caused the brownfields and information on available databases or inventories of brownfield sites are provided. Problems related to the brownfields like environmental, social and economic problems are reported. Lack of spatial information including size, type of brownfields, infrastructure, and contamination is one of major bottlenecks for more often utilization of brownfield areas. Problems related to the brownfields like environmental, social and economic problems are reported. The type and scale of the problem is crucial for feasibility of brownfield regeneration. Information on realized transformation of brownfield sites into new activities or land uses are only scarcely available.

Based on the most important barriers for transforming the brownfields into beneficial use (e.g. legal, financial, public acceptance, etc) proposals for brownfield redevelopment are given in this guidance.

6.5 RECOMMENDATIONS FOR SUCCESSFUL STAKEHOLDER PARTICIPATION

Stakeholder engagement becomes a major element of strategic planning and formulation of policies. Participation of stakeholders at planning stage is of vital importance for balanced soil management since the stakeholders know local specificity of environmental and socio-economic needs. The advantage of early involvement of stakeholders is mutual understanding of soil management goals, early identification of constraints between environmental safety and economic growth, income needs or political expectations. Shared agreement on soil management provides higher level of its acceptance by residents and investors while sharing information and points of view leads to creative proposals.

The recommendations have a form of guidelines for implementation of stakeholders' opinions in urban soil protection strategies and reaching balance between environment protection goals and city economic development (URBAN SMS Product No. 25). The recommendations define groups of stakeholders to be engaged in soil management strategies. These groups should include urban planners, decision-makers, architects, land owners, environmental engineers, NGOs,

residents. The approached group of stakeholders must be representative to ensure balanced impact of different groups of interest.

Methodology of stakeholder engagement through interactive workshops is provided. During the workshops the principles for soil protection are presented based on range of soil functions within environmental and socioeconomic dimensions. The methodology enables collection of stakeholder opinions on importance of soil functions in a semi-quantitative format. The importance assessment considers specific local conditions and provides clear information on what are the goals for sustainable development of a city. The stakeholders are invited to assess potential long-term impacts of different soil protection scenarios. This interaction is a specific but valuable type of impact assessment defining consequences of current and alternative scenarios for environment and socio-economic development of the city. Finally the stakeholders help do define the thresholds for soil consumption and loss of soil functions.
The stakeholder's engagement results in establishment of a stakeholder network to be used at different stages of consultations on soil management strategies and implemented protection tools.

6.6 AWARENESS RAISING PACKAGE

Raising awareness of decision-makers and other stakeholders on the role of soils for environmental safety and life quality in urban areas is a precondition for more effective soil protection. It is a milestone for acceptance of soil protection issues in spatial planning.

Beside direct dialogue with stakeholders during meetings an "awareness raising package" was developed (URBAN SMS Product No. 16-28). It is a collection of products to be used for external communication with stakeholders. The package will contain two groups of informative materials:

- Awareness raising information on role of soils for urban environment and life quality and possible consequences of current land management with very limited soil protection
- Information on available measures and techniques to assess and improve the soil management or soil functions.

The first group of materials contains leaflets explaining shortly and illustrating the role of soils for creating quality of live in urban areas. Emphasis is given to such soil functions as retention, buffering and filtering, production or provision of biodiversity.

The information documenting limited efficiency of current soil protection regulations in Central Europe countries is provided in descriptive and graphical form. The data were based on detailed analysis of land use change and soil consumption trends in case study urban areas. This message combined with forecasted land use changes by spatial modeling will inform the stakeholders on consequences of "no-change" soil protection scenario.

Outputs of stakeholder-inclusive impact assessment of soil protection scenarios are shown in order to prove that continuation of current regulations would lead to substantial loss of environmental soil functions and that better soil protection does not limit economic growth of cities.

The package encourages to regeneration of brownfields and their transformation into sites appropriate for construction as alternative to valuable soils. Impact of soil consumption on local climate is described and visualized e.g. as appearance of temperature extremes in densely

sealed city districts. The package contains also the awareness raising movie presenting soil functions and consequences of their loss.

The second group of materials includes summary of information potentially useful in land management and spatial planning, such as list of measures enhancing soil function performance or remediating contaminated soils that are in detail described in “Handbook for measures enhancing soil function performance and compensating the soil loss during urbanization process” (URBAN SMS Product No. 16). The list of indicators useful in assessment of scenarios of current status of environment will be provided along with the thresholds for certain soil functions, when possible.

6.7 PILOT ACTION CASE STUDY BOOK

Within the project URBAN SMS proposed tools were tested in several pilot areas. After the testing process the partners were asked for comments by a questionnaire. The experiences made are summarized in a report (URBAN SMS Product No. 30). A case study book (URBAN SMS Product No. 29) provides an insight in how the tools have been applied in the pilot areas, which advantages could be gathered and what are the limitations of the tools. Furthermore recommendations for the application of this URBAN SMS tools in other locations are given. Hence the case study book can be used as a tool, in particular for awareness raising and for implementation of soil management tools into planning practice and will serve stakeholders, developers and municipal staff.

The case study book gathered experiences gained by all partners involved in the work package aiming on testing of the project in pilot areas. It includes following items:

- Description of pilot areas, its size and location, the current situation and the possible and envisaged development of these areas
- Mind map, which will give in a concise form all the data sources, data handling and scheme of decisions
- List of tools that have been applied for solution of problems connected with development of pilot area under study
- Data sets needed for the use of Soil Manager Suite software application
- Application of Guide Municipal Soil Management, especially of the SEA/EIA guidance
- Comparison of results gained by application of Guide Municipal Soil Management and Soil Manager Suite
- Summary of experiences of all the above mentioned steps, including evaluation of each step and a clear statement what does work and what does not work.

The case study book also includes generalized experiences gained on all pilot areas and recommendations for possible use of the results of the project.

7 EXISTING SOIL MANAGEMENT TOOLS

7.1 INTRODUCTION AND OVERVIEW

A soil management tool is an instrument or measure to manage or protect soil in a qualitative or quantitative way within an urban planning procedure. Beside the URBAN SMS tools a lot of other soil management tools are developed in Central Europe. In total **47 soil management tools** that are applied either in, or in coordination and conjunction with, urban (spatial) planning procedures have been collected by the project partners. Consequently not all existing tools in Central Europe have been analyzed. However, this collection comprises a huge amount of tools that may be applied in other countries with some modifications or may function as starting point for the development of other tools.

Table 5.1: List of collected soil management tools

Soil data for planning processes	Austria
Legal regulation for soil reconstruction over subsurface constructions	
Unsplit Areas	
Consideration of soil in SEA	
Priority areas for agriculture in regional planning	
Priority green areas in regional planning	
Delimitation of settlement areas in regional planning	
Contractual spatial planning	
Re-dimensioning of building land reserves in local spatial planning	
Regulations on forest clearances in the National Forest Act	
Soil conservation maps	
Soil as subject of protection in EIA	
Property-related taxes	
Protection and conservation of high quality agricultural land	Czech Republic
Protection of green areas within the city and its surroundings and prior usage of abandoned areas	
Regulation of urban sprawl into open land	
Stuttgart Soil Protection Concept (BOKS)	Germany
Sustainable Management of Building Areas Stuttgart (NBS)	
Priority areas for agriculture, soil and green areas in regional planning	
Building Act § 202 preservation of topsoil	
Building Act § 1a priority of inner urban development	
Environmental Plan Baden-Württemberg	
Soil as subject of protection in SEA/EIA	
Soil quality maps (natural functions) Baden-Württemberg	
Cadastral of contaminated sites with risk assessment (Baden-Württemberg) Eco Account Ordinance (Baden-Württemberg)	
Guideline: Assessment of soils according to their performance (Baden-Württemberg)	
Guideline: Soil in the compensation regulation (Baden-Württemberg)	
Priority areas for agriculture	Italy
Technical norms and building regulations	
Brownfield redevelopment	
Provincial Address Plan for Forests (annex to Provincial Land Coordination Plan in Lombardia)	

Provincial Plan for Quarries (annex to Provincial Land Coordination Plan in Lombardia)	
Excerpt from Regional Land Plan on reclamation of contaminated areas (Lombardia)	
Establishment and management of parks and nature reserves (Piemonte)	
Soil map of the Region Piemonte	
Limitation of conversion of agricultural and forest soils to other purposes	Poland
Risk limitation in contaminated areas	
Protection of soils from degradation	
Protection of soils with high quality	Slovakia
Reduction areas for soil consumption (soil sealing)	
Identification and revitalisation of brownfields	
Appropriate location of industrial plants and industrial parks	
Appropriate location of cemeteries and burial grounds	
Protection of soils with high quality	Slovenia
Protection of areas ensuring high living standards of urban population (residential and recreation areas, playgrounds, schoolyards)	
Reduction of new soil consumption by internal urban development	
Identification and revitalisation of brownfields	

The identified tools cover a remarkably broad spectrum of **intervention types**, including legislation, implementing regulations, plans on national, regional and local level, impact and risk assessment, knowledge instruments, taxation and penalties. Tools either belong to **spatial planning** or to a number of **other regulatory or planning sectors** (such as agriculture, environmental protection, or nature conservation). In a considerable number of cases the compiled soil management tools combine two or more different types of instruments (e.g. legislation and regional spatial plans) and / or represent overlaps between spatial planning and other sectors (e.g. agricultural legislation implemented in local spatial plans). This frequent category of interventions may be classified as cross-type and inter- / cross-sectoral soil management tools.

Due to the above mentioned overlaps between characteristics (such as intervention types, planning sectors, soil threats covered etc.) that were applied in the present transnational analysis, many soil management tools figure under two or more categories. This explains why the sum of "matches" per analytical category is usually higher than the number of particular tools described.

7.2 SOIL THREATS COVERED

With regard to soil threats addressed by the collected management tools, **soil consumption** and **soil sealing** are the adverse impacts on soils that are by far most often covered [39], followed by **soil contamination** [14]. However, there is sufficient evidence from the available information that in particular most spatial planning instruments (spatial plans regardless of planning level) mainly have a potential to limit soil loss due to settlement growth in a quantitative way and hardly ever consider qualitative soil attributes. Instruments focused on **redevelopment of contaminated brownfields** are considered to contribute to reducing the impacts of both sealing and contamination at the same time, which makes brownfield redevelopment in urban areas appear a highly effective tool to soil management. A limited number of instruments [8-10 is considered to address also **other soil threats** (compaction, erosion, loss of organic matter).

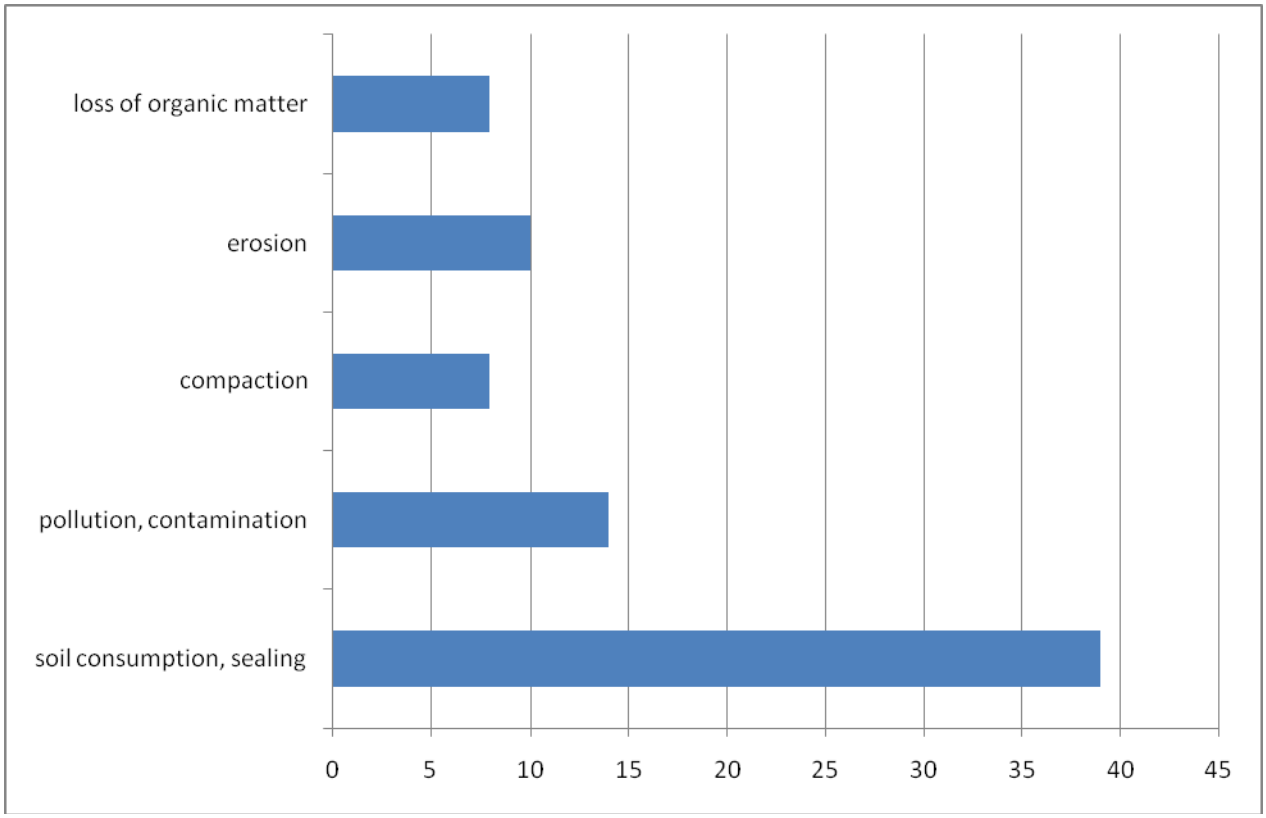


Figure 5.1: Tools – soil threats covered (multiple answers permitted).

7.3 INTERVENTION TYPE

Most tools gathered are "**spatial plans on local level** "(including the Building Regulation Plan) [15] and "**sectoral legislation implemented by spatial planning"** [13]. These two groups of tools are closely followed by spatial planning legislation and knowledge and monitoring [12], spatial planning on the regional level and sectoral legislation. Less often mentioned are "natural resource management plans" and taxation and penalties [4 matches each]. Also, two particularities were named: **contractual spatial planning** in Germany (Sustainable Brownfield Management Stuttgart) and in some of the Austrian federal states, which combines local zoning practice with contracts under private law [2], and the **Stuttgart Soil Conservation Concept** [1], which can be rated a best practice example (cf. below) because it widely integrates soil conservation with urban planning in an operational way on city scale.

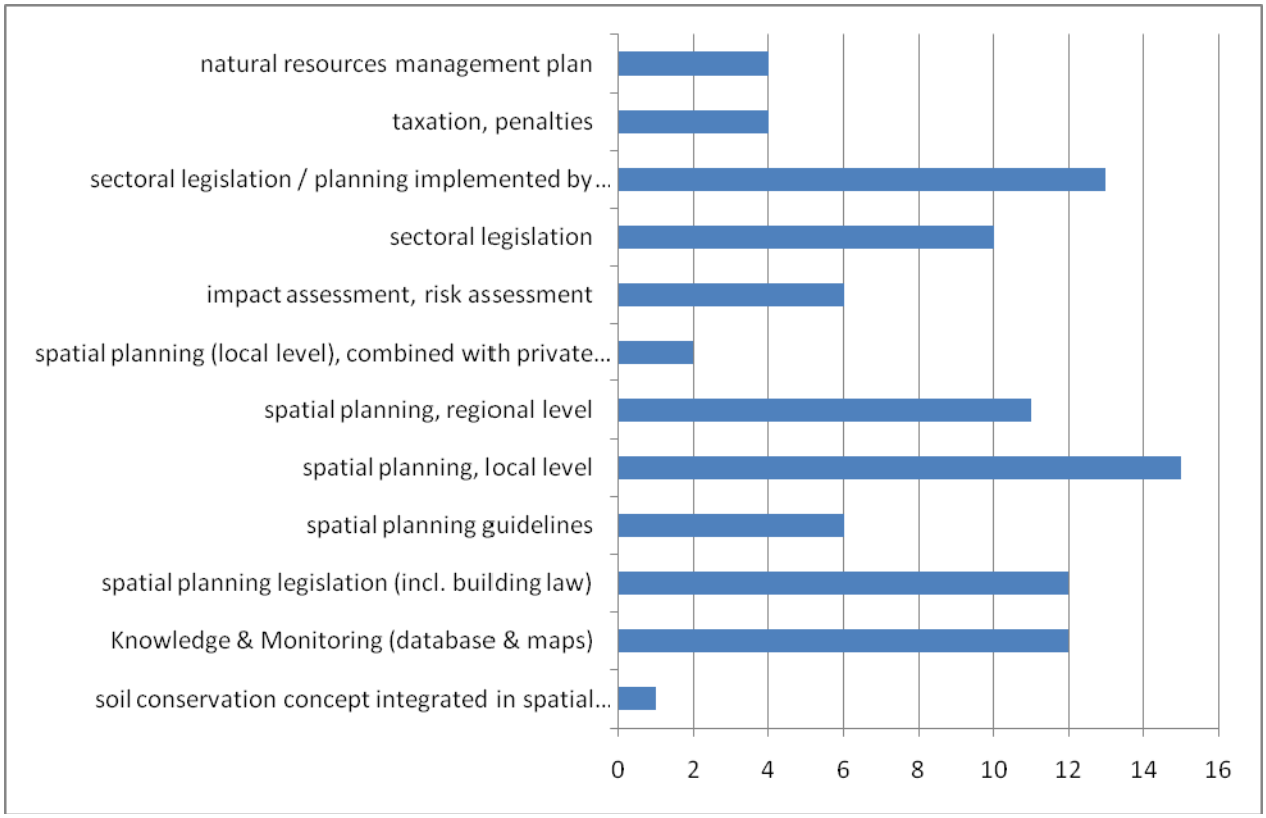


Figure 5.2: Tools - allocation to intervention type (multiple answers permitted).

7.4 SECTOR REFERENCE

A considerable part of all tools is not rooted mainly in spatial planning, but rather in **sectoral planning domains** and / or in predominantly **sectoral legislation**. Among the sectoral instruments identified, the majority are **agricultural** [9] or strictly or partly - **environmental** (including soil contamination and soil conservation) **instruments**, followed with decreasing frequency by the forest and nature conservation sectors. However, a large portion of these sectoral instruments is to some extent implemented by, or coordinated with, spatial planning. Nevertheless, there remain a limited number of purely sectoral instruments that do appear to have a **lack of horizontal coordination with spatial planning** instruments.

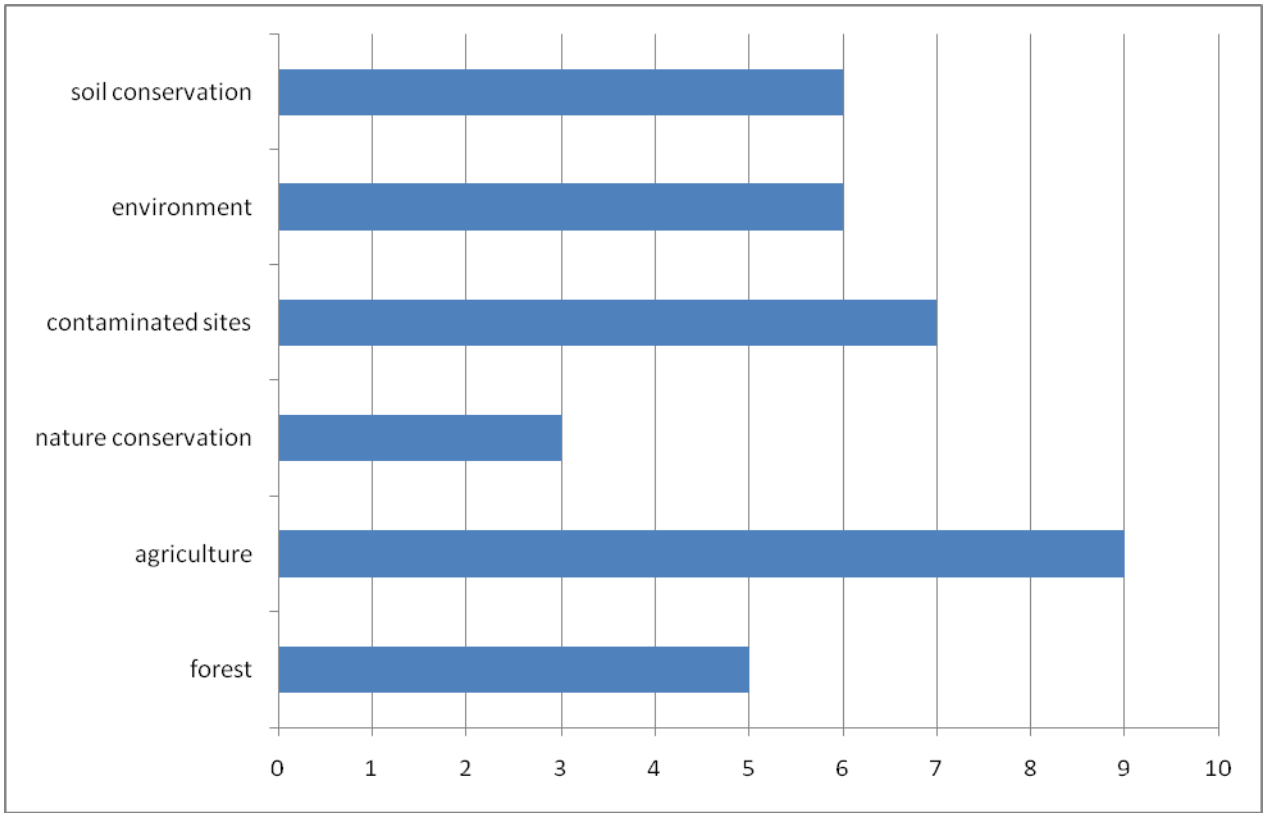


Figure 5.3: Tools – sectoral reference (multiple answers permitted).

7.5 SPATIAL PLANNING PROCEDURES

A very crucial issue is the role of soil management tools within urban planning procedures and (legal) instruments of urban planning. The gathered information strongly indicates that established **spatial planning instruments on local (municipal) level** are currently the most important procedures to deliver soil conservation and sustainable soil management. The vast majority of tools [28 matches] are applied in or closely coordinated with Local Spatial (Urban) Development Concepts, Local Land Use Plans (Zoning Plans), and Local Building Regulation Plans (either in one, two or all of these instruments).

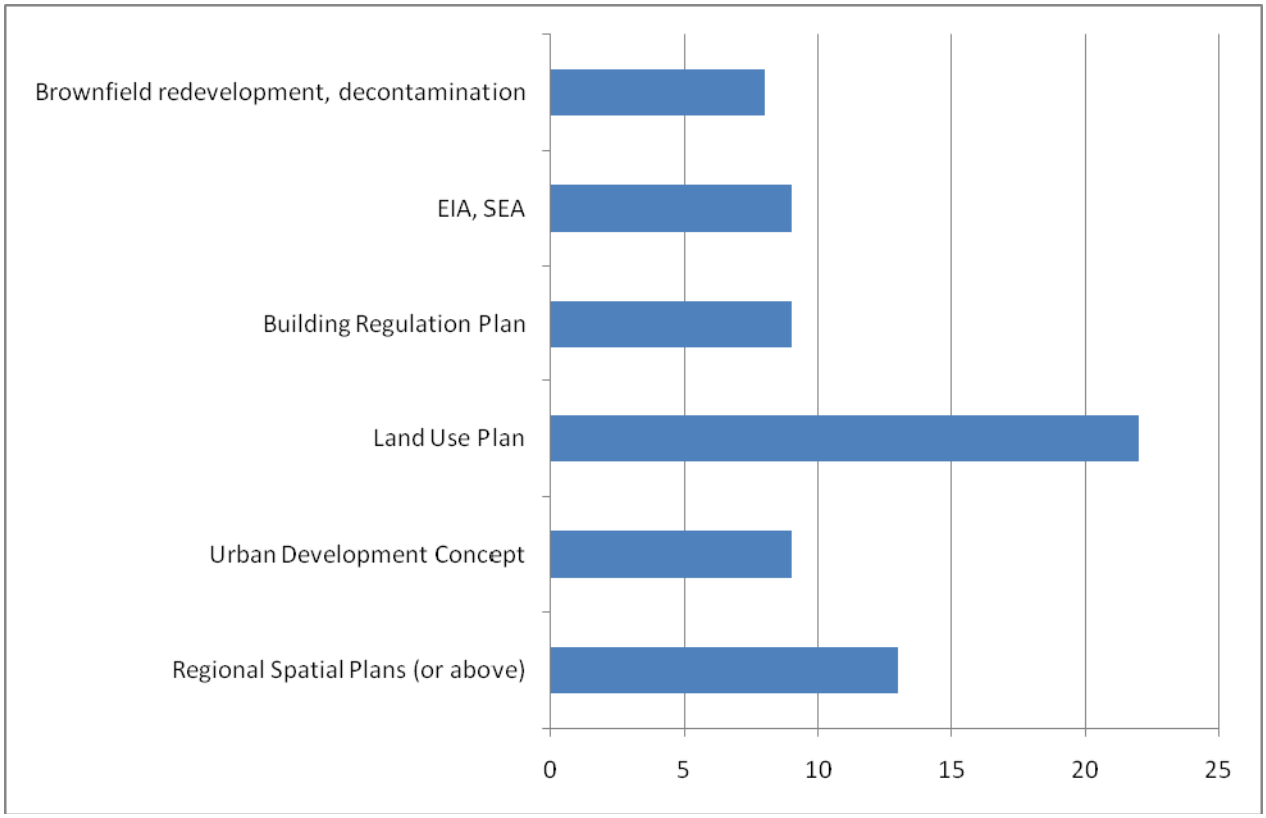


Figure 5.4: Tools – planning procedures (multiple answers permitted).

The comparative analysis suggests that among the local instruments the **Local Land Use Plan** appears to be the most vital implementation procedure for soil management tools [22]. However, also **Regional Spatial Plans** (including plans on higher-ranking level) are in many cases [13] suitable for implementing soil management tools. Quite often tools focus on identification, decontamination and redevelopment of **brownfields**; these brownfield-centered tools are usually carried out in close relation to local urban planning procedures. The lowest number of tools is suitable to be applied within EIA and / or SEA.

7.6 LAND (USE) CATEGORIES

Most of the analysed tools have a potentially positive influence on soil management mainly on one (a few) particular category(ies) of land use, i. e. they are *either* adequate for **building land** *or* for **non-urban land**, such as agricultural land, forest land, and protected areas. Corresponding to the high share of spatial planning instruments in all identified soil management tools, the largest number of tools [23] influences soil conservation on building land (settlement areas, urban land), including future settlement growth zones. This portion is followed by instruments relating solely or partly to **agricultural land** [14], **brownfields** [10], and **forest land** [10]. Again, instruments that focus on identification, remediation and redevelopment of brownfield sites are considered to reduce urban sprawl elsewhere at the same time. Comparatively few instruments relate to **mineral resource extraction sites** and to **protected areas** under nature conservation legislation.

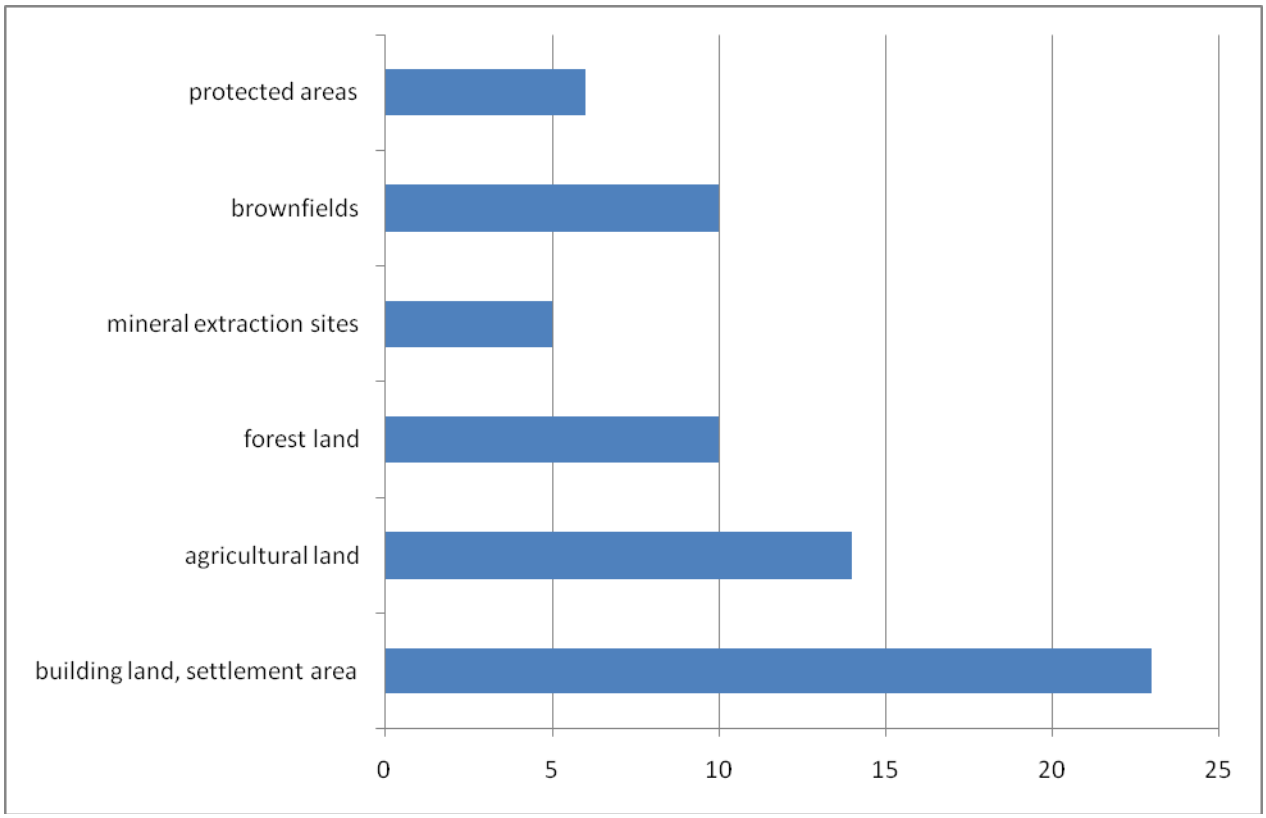


Figure 5.5: Tools – land use categories (multiple answers permitted).

7.7 MOST APPLIED TOOLS

The following particular soil management tools were most often named in similar form by consortium partners and are therefore regarded as highly relevant for urban areas in Central Europe:

- **Delineation and preservation of high quality soils:**
  Tools target at preservation of high quality soils, in particular such of agricultural land, were identified by partners of all countries. The implementation procedures and their relationship towards spatial planning can differ quite strongly between countries. In some countries, the practice is to designate priority areas for agriculture in Regional Spatial Plans in order to prevent them from being built up. However, there are also examples where integration into spatial planning procedures is poorly or not at all developed.
- **Rehabilitation and redevelopment of brownfields:**
  Tools dedicated to identifying, decontaminating and redeveloping abandoned sites were also identified by eight partners from six different countries. As mentioned above, implementation may often, but must not necessarily be closely coordinated with Local Spatial Planning.
- **Protection of open and green spaces in urban areas:**
  Tools focused on preserving, restoring or upgrading existing unsealed spaces in urban areas (such as greenery in residential areas, recreation areas, parks, playgrounds etc.) exist in five of the partner territories. Here, soil conservation occurs more or less as a side effect of tools to improve the quality of life for citizens in an urban environment. But also such indirect tools contribute to soil protection. Control of achieved effects on soils should be implemented.
- **Soil databases and soil maps:**
  Although explicitly mentioned only by three partners, implicitly information and monitoring instruments such as soil databases and maps are a prerequisite for many of the identified tools and thus highly important. Sufficient knowledge of soil qualities is also a major basis for the Stuttgart Soil Protection Concept. Hence continuation, improvement or establishment of such sources of soil information should be forced, in particular on local and regional level.

7.8 GOOD PRACTICE EXAMPLE – STUTTGART SOIL PROTECTION CONCEPT (BOKS)

The Stuttgart Soil Protection Concept (BOKS – Bodenschutzkonzept Stuttgart) enables the documentation of potential and actual soil losses with the help of a planning map for soil quality. BOKS is a logical and methodically simple concept with clearly defined objectives in order to raise acceptance and awareness. This is one of the main reasons why the soil protection concept BOKS became part of the regular planning process in the City of Stuttgart since March 2006.

The consumption of soil in the city that is tolerated for the transition into building land is defined in BOKS as a so-called "soil contingent". It consists of a starting amount of "soil index points" that decreases proportionally to every soil use connected with a loss of soil quality. The current score of the "soil contingent" indicates the loss of quality and the acceptable consumption in

accordance to the objective defined, respectively. This ensures sufficient potential of action for a limited period of time.

In Stuttgart, the “soil contingent” was calculated in correspondence to clear qualitative terms with the aid of "soil indication". The "soil indication" was supported by the "Planning Map - Soil Quality“ which covers the entire Stuttgart city area. This figure indicates the soil quality as the sum of the soil functions to be protected specified by the Federal Soil Protection Act of 1998. Also anthropogenic influences as pollution and cultivation or sealing are considered. As a result the quality of soils is characterized by 6 levels (0 to 5).

The guiding principle in Stuttgart was to preserve the quantity and quality status of soils with very high quality and high quality. On the other hand, it means that the consumption of medium and low quality soils is valued less substantial.

According to these objectives, a starting amount of 1.000 "soil index points" (March 2006) resulted for the Stuttgart "soil contingent". This corresponds to approx. 12 % of the entire supply in the Stuttgart city area. The exhaustion of this amount of "soil index points" is being tolerated in the long term. However, the prerequisite for a persistent sustainability is a strategy combining economic restrictions with a certain scope of action for successful urban planning.

Beside the concentration on brownfield redevelopment (Landeshauptstadt Stuttgart, 2003) the “decreasing rationing” of the “soil index points” – each year one index point less should be used as in the previous year starting from 30 points in 2006 - aims at a yearly minimization of the soil consumption until the planning activities will be completely covered by inner urban development. A systematic monitoring every 2 to 5 years helps to assess, if the target-oriented rationing works. If not, appropriate countermeasures can be established quickly (Wolff & Schweiker, 2008).

The Stuttgart Soil Protection Concept is considered as a good practice example for soil conservation in urban planning because, *inter alia*:

- explicitly considers soil quality aspects;
- combines a distinct qualitative approach to soil management with the quantitative approach of limiting overall soil loss;
- is based on a sound, tested and transparent methodology, which fosters political acceptance;
- is closely related to urban planning instruments and procedures;
- soil conservation can be ensured in a flexible way without delimiting urban planners by restrictive regulations;
- favours application of inner urban development and brownfield redevelopment strategies;
- increases awareness of quality and availability of urban soil resources.

7.9 STAKEHOLDER EXPERIENCE

After having collected the different tools, stakeholders of the planning sector were asked to add tools and communicate their experience with soil consideration in planning procedures.
The feedbacks of the stakeholder interviews affirmed – more or less - the descriptions of the different **planning procedures** and both the vertical and the horizontal planning structures in the different countries.

Whereas clear regulative are given by the vertical structure (e.g. local plans have to contain regional demands) the coordination of the horizontal structures (coordination between different sectors) should be improved.

- One Austrian stakeholder reported an initiative to improve this coordination: The federal state faces the problem of a very high share of transport areas (e.g. parking areas). Therefore they initiated a platform of the spatial planning and transport sector to coordinate common instruments and measurements, inter alia to avoid soil sealing.

As **additional tools** stakeholder mentioned:

- Analysis plan and management concept for sealed areas (sectoral plan "Bodenversiegelung in Stuttgart" scale 1:10,000) as an informal planning instrument. This instrument has no legally binding function but is an instrument to raise awareness.
- "Contract within Regions (Regionsvertrag)": one Austrian federal state experiences on a new instrument, a contract between communities of a region. This contract should regulate the cornerstones of regional development such as green space planning.
- "Policy of Promoting Soil Conserving Building Land Development": One Austrian federal state promotes communities to develop instruments or strategies to avoid soil sealing (e.g. master plans).

Experience:

There are different experiences with the collected tools.

One main problem is the high pressure of building stakeholders have to face nearby the city. Some stakeholder complained that there would be enough instruments, but there is no good implementation of these instruments (e.g. due to the building pressure).

8 IMPLEMENTATION OF SOIL MANAGEMENT

In previous chapters the urban soil management concept and its components are described. Many examples of components, like legislative instruments, planning systems and procedures as well as management tools applied in the partner countries are analysed. Additional the tools developed within URBAN SMS are described which comprise tools for evaluation and management of soil as well as tools for awareness raising. More detailed information on these tools is available in several URBAN SMS Products (see chapter 10).

Depending on the local goals and defined strategies for urban soil management a selection of available tools should be applied in the urban area of concern. Before the application can take place a lot of **functional, strategic and practical criteria** have to be considered. According to Wolff (2009) six basic criteria which base on each other are important for the conceptual realisation of effective strategies for soil protection in urban areas:

Criteria 1: Planning map of soil quality
To evaluate soils and their usage suitable functional maps are required. Their development does not necessarily require a scientific soil mapping. According to the experiences rather an image of the soil capacity in ecosystems is needed (natural soil functions like natural fertility, balancing of cycle processes, filter and buffer). This image of soil quality can be derived by determination of single soil functions (for example natural fertility).

Criteria 2: Methods and indicators
The use of the soil quality map for planning purposes needs methods to measure and to prognosticate as well as to balance the use and the revitalisation (including actions of compensation) of soil in a quantitative as well as in a qualitative way. On this basis indicators can be derived by which negative as well as positive impacts on soil can be documented and monitored.

Criteria 3: Objectives of soil protection
Promising soil protection objectives must follow sustainable approaches. As a consequence the local soil resources must be largely maintained on the contemporary level. Thereby economic treatment of soil does not imply a general interdiction of use. That means certain soil losses are tolerable unless they are significant compared to the existing soil capacity under consideration of soil quality.

Criteria 4: Soil management strategies
The strategies have to show how to obtain the objectives. The consequent inner urban development and the directing of inevitable use on soils of lower quality are examples. A soil management strategy is a kind of an operation guideline. It determines how to manage the economic treatment of soil in practice and in which direction the planning should be oriented to.

Criteria 5: Soil awareness and acceptance
Important is the transition from theory to practice. To reach an appropriate decision planners and decision makers must be aware of the consequences of soil impacts. The awareness of the functional roles of soils as well as of the consequences of soil use provides the required acceptance to reasonable soil protection strategies and concepts. Empirically acceptance can be established if a soil protection concept and its objectives do not predetermine decisions.

Criteria 6: Will and decision for implementation

If a general acceptance of a soil management concept and its strategies exists only the will and a binding decision for implementation are needed. Thus the competent authorities have to declare the implementation as well as the application of the soil management concept. This includes also the requirement of a monitoring for controlling the application. Methods and objectives as well as strategies have to be obligatory for all stakeholders.

First of all the idea of implementation of a soil management concept has to be discussed with relevant stakeholders, in particular at the political level. Arguments for the usefulness of such a concept are provided in chapter 1 and other URBAN SMS documents like the final brochure. Ways how the communication with stakeholders can work efficiently are given in the Awareness raising package. Crucial for implementation into practice is to achieve agreement in the authorities that take the planning decisions like municipality councils.

To implement a soil management concept in an urban area the **following steps are recommended** to be carried out:

1. Analysis of actual situation and problems of soil consumption
2. Consideration of existing urban planning system and procedures
3. Definition of needs and goals for urban development and soil protection
4. Selection of most promising strategies for urban soil management
5. Collection of data and application of relevant evaluation tools
6. Definition of threshold for accepted land consumption considering soil quality and current land use, in particular agricultural land
7. Selection and application of suitable soil management tools
8. Introduction of activities on awareness raising
9. Monitoring of implementation of soil management tools
10. Evaluation of goal achievement

The implementation of a soil management concept should be recommended in regional development programs, e.g. in case new or adaptations of existing local development concepts will be developed. The consideration of soil quality in terms of soil functions will help to adjust or design spatial planning programs and procedures towards sustainable soil use keeping enough potential for further urban development and sustainable quality of life for the citizens.

The URBAN SMS strategies and tools were applied to some extent in pilot areas. An overview which strategies and tools were applied in the pilot areas is given in the final brochure. More detailed information about the application in pilot areas is provided in the experience report and the case study book.

Following **practical conclusions** derived from the experiences gained during the **application of URBAN SMS tools** in the pilot areas can be helpful for implementation of a soil management concept:

The **soil evaluation tool** was regarded useful for the assessment of the situation on soil quality and to what extent the soil functions would be lost in the urban development process. It depends much on the available IT environment how difficult it is to implement the software and which IT knowledge is needed. The guidance document for installation of the software is very helpful. The hardware requirements for the installation of the software are rather low. Limitations in the performance of the tool can appear with a huge amount of data, e.g. in case of bigger areas (about 300 km²) with high resolution data. A translation of the evaluation tool in other languages may be favourable as the current English version may cause some difficulties in handling of the tool by local users in the partner countries.

For the preparation of the input data of the soil evaluation tool a **template for data classification** was developed which proved to be adequately transparent and understandable. Concerning soil contamination the national classification scheme was used as it exists in all partner countries. For the classification of the other soil parameters different approaches were used: national threshold values, expert estimation, national legislative definition of agricultural soil quality, guidelines for appropriate fertilization, results of soil mapping and soil survey evaluation methodology. This is mainly driven by the different historical development of classifications schemes for various soil parameters in the partner countries.

The **guidance for soil in strategic environmental assessment and environmental impact assessment (SEA/EIA)** is generally considered as a good contribution to better soil protection. Elements of the guidance have been used successfully as encouragement for soil protection in some pilot areas and are seen as a basis with high potential to improve soil assessment in spatial planning. The application of this document will make the process how to consider soil in environmental assessment procedures more transparent and understandable. The main problem in application of this document was found in the fact that in all involved countries the national legislation should be followed which is not uniform. During the application it was realized the necessity to obtain many data and therefore it is a time consuming procedure. For easy implementation of the guidance in the future checklists for SEA and EIA are provided as requested after testing of the guidance document.

The **report about compensation measures** providing a good overview of useful measures with concrete examples and detailed description as well as an assessment of single methods related to soil functions was seen as a good basis for practical implementation. In general soil compensation measures have to be regarded as last management option in dealing with soil sealing in urban planning.

The **report on brownfield redevelopment** giving information on regulations, strategies and guidelines as well as incentives and funding opportunities in Central Europe is a source of proposals how to deal with brownfields in urban development. Experiences show that often specific local problems have to be solved and due to different national legislation in each country direct implementation of the proposals is often not possible.

As awareness of the value of soils is a crucial in urban planning decision makers of different environmental bodies, stakeholders, developers were involved at an early stage of the application of the soil management concept. Needs of soil protection from the qualitative as well as quantitative point of view were discussed. The application of the **awareness raising package** leads to the concentrated efforts for further development of soil information useful in a proper soil management. It was shown that all tools were able to raise the awareness for soil protection. However, it was admitted by decision makers that other aspects as economical, infrastructural and social represent higher priority in the process of urban development. Protection of soils as an environmental body, soil functions as ecological value and the greenery as esthetical value in urban areas is usually not upfront in the order of importance. But in case of consequent implementing of a soil management concept (see criteria 6 above) the most negative impact on soil in urban areas – that is the sealing of soil – can be diminished and controlled (Wolff, 2009).

9 MONITORING OF SOIL MANAGEMENT

After the decision to implement an urban soil management concept it is needed to monitor the progress of implementation and to evaluate the effects of the application. The monitoring results enable to adjust the process and steer the soil management according to the goals. The following **steps** should be organised **for a successful monitoring** enabling the assessment of the goal achievement:

- Set up a procedure of monitoring (organisation, responsibilities, resources)
- Identification of success indicators, e.g. ratio of new inhabitants vs land consumption related to soil quality or index points like in BOKS (see chapter 5.8 and below)
- Definition of indicator classes
- Definition of acceptable thresholds for the indicator values
- Design template for reporting of monitoring results
- Roadmap for implementation of monitoring (frequency and date of reporting)

As **good example** how to organise a monitoring of application of an urban soil management concept is the monitoring of BOKS (Bodenschutzkonzept Stuttgart). In Stuttgart the city administration is assessing the consumption of “soil index points” by transition into building land in the city area. The better the quality of the soil, the higher is the amount of index points for one hectare of land. For this indicator the classes 0 to 6 were defined. In the council of Stuttgart it was decided that each year one soil index point less should be used as in the previous year starting from 30 points in 2006. The aim behind this decreasing approach is to conserve soil available for development of the settlement area in the long-run. With a linear approach the soil contingent fixed with 1000 points would be consumed in 33 years (Landeshauptstadt Stuttgart, 2006).

Every two years the city administration is providing their assessment about the soil consumption in the reporting period to the city council. For each new built-up land the following parameters are reported in a template:

- Name of area
- Date of building plan
- Location in inner or outer part of the city
- Size of the area
- Percentage of area with soil quality ≥4
- Loss in terms of index points
- Actual total amount of index points

The use of high quality soils causes a massive loss of soil index points and thus a strong depletion of the “soil contingent”. As these soils are usually occurring in the outer parts of the city new buildings in these areas cause a relatively high loss of index points compared to buildings in the inner parts of the city. By comparison of the actual total amount of index points with the calculated target value for a distinct year the monitoring shows quickly if the situation is in line with decreasing approach. If the actual amount is above the target value the magnitude of new planned built-up areas has to be decreased in the next years and countermeasures are required to meet the decreasing approach. Furthermore the monitoring results give information about the effects of planning decisions in the past and about the freedom of action in urban planning in the future. The experiences of the implementation of BOKS give as well reason to question some well-established approaches as they create new strategic ideas under consideration of the bigger picture that are sometimes opposed to the common local views (Wolff, 2011).

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[1] Collection of (policy) instruments influencing the use and protection of soil from the partners of the project URBAN SMS (EN)

[2] SWOT Analysis – Analysis of Strengths, Weaknesses, Opportunities and Threats of (Policy) Instruments Regarding the Protection of Soil from the Partners of the Project URBAN SMS (EN)

[3] Identification of scientific and practical needs for consideration of soil issues in planning processes (EN)

[4] Existing Soil Management Approaches within Urban Planning Processes (EN)

[6] Soil Management Approaches in Urban Planning Procedures – Summary of stakeholder consultation (EN)

[7] Guidance for Soil in Strategic Environmental Assessment and Environmental Impact Assessment (SEA/EIA Guidance) (EN)

[11] Soil Manager Suite (EN)

[12] Soil Manager Suite Handbooks (EN)
(12a) Software installation manual Web application URBAN SMS suite (EN)
(12b) Tools and data description manual Web application URBAN SMS suite (EN)
(12c) Web admin user manual Web application URBAN SMS suite (EN)
(12d) Web user manual Web application URBAN SMS suite (EN)

[15] Review of Existing Soil Compensation Measures (EN)

[16] Handbook for Measures Enhancing Soil Function Performance and Compensating Soil Loss During the Urbanization Process (EN)

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URBAN SMS Soil Management Strategy

This paper belongs to the following section of URBAN SMS work plan:
WP3 Soil management concept / 3.4 municipal soil management / 3.4.2 guide municipal soil management

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CENTRAL EUROPE
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EUROPEAN UNION
EUROPEAN REGIONAL DEVELOPMENT FUND

This project is implemented through the CENTRAL EUROPE Programme co-financed by the ERDF.